RESEARCH CENTER

FIELD

Activity Report 2014

Section Partnerships and Cooperations

Edition: 2015-06-01

ABS Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. Projets Exploratoires Pluridisciplinaires from CNRS/Inria/INSERM

Title: Novel approaches to characterizing flexible macromolecular systems in biology

Modeling Large Protein Assemblies with Toleranced Models
Type: Projet Exploratoire Pluri-disciplinaire (PEPS) CNRS / Inria / INSERM
Duration: one year
Coordinator: C. Robert (IBPC / CNRS)
Other partner(s): F. Cazals (Inria Sophia Antipolis Méditerranée)
Abstract: A central problem in structural biology consists of modeling the dynamics and thermodynamics of macro-molecular assemblies involving a large number of atoms (thousands to hundreds of thousands). This requires understanding the structure of the potential and free energy landscapes (PEL and FEL) of the system. A number of approaches have been developed from the physical perspective, in particular to sample the PEL of the systems scrutinized (molecular dynamics, Monte Carlo based methods). The goal of this project is orthogonal, since our aim is to enhance the processing of samplings generated by the aforementioned approaches. Our methods aim at analyzing and comparing sampled PEL and FEL, using novel methods from computational geometry, computational topology, and optimization. These methods should foster our understanding of the behavior of macro-molecular assemblies, and in the long run, they should also trigger the development of more efficient sampling algorithms.

6.2. International Initiatives

6.2.1. Participation In other International Programs

F. Cazals (Inria ABS), I. Emiris (Prof., Univ. of Athens) and S. Theodoridis (Prof., Univ. of Athens) collaborate in the scope of an Inria COLOR entitled *Discriminating and classifying in high-dimensional spaces*.

The scientific goal was to study methods and algorithms in high dimensional spaces, revolving around three problems: approximate nearest neighbors, polytope volume approximations, and classification - discrimination in high high-dimensional Spaces.

The long-term plan is to examine whether the work done so far can be combined with work by other European teams targeting a European research proposal. F. Cazals and I. Emiris participate in a FET-Open STREP proposal, entitled *Exploring the Geometry of Data*, including high-dimensional geometry, machine learning, and statisctical methods. More precisely, the collaborations proposed between the two groups bootstraps on the achievements of the COLOR, as they aim at exploring (i) incremental nearest neighbor methods in metric spaces, (ii) sampling methods for polytope volume approximation and high-dimensional space exploration, and (iii) applications in biophysics (protein docking and energy landscape exploration).

6.3. International Research Visitors

6.3.1. Visits of International Scientists

- Fasseli Coulibaly, Monash University, September 2014.

6.3.1.1. Internships

- R. Tetley, from the MSc program *Computational biology and biomedicine* from the Univ. of Nice, completed his MSc internship under the guidance of F. Cazals, on the topic *Bootstrap algorithms for structural alignments, with applications in structural virology*. Romain is now following-up as a PhD student.
- D. Shah, second year student from the IIT Bombay, completed a summer internship on the topic *Improving scoring functions for protein docking*.

ALF Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Capacités: Projet "Investissement d'Avenir", 1/11/14 to 31/01/2018

Participants: Damien Hardy, Isabelle Puaut.

The project objective is to develop a hardware and software platform based on manycore architectures, and to demonstrate the relevance of these manycore architectures (and more specifically the Kalray manycore) for several industrial applications. The Kalray MPPA manycore architecture is currently the only one able to meet the needs of embedded systems simultaneously requiring high performance, lower power consumption, and the ability to meet the requirements of critical systems (low latency I/O, deterministic processing times, and dependability). The project partners are Kalray (lead), Airbus, Open-Wide, Safran Sagem, IS2T, Real Time ar Work, Dassault Aviation, Eurocopter, MBDA, Supersonic Imagine, ProbaYes, IRIT, Onera, Verimag, Inria, Irisa, Tima and Armines.

8.1.2. Inria Project Lab: Multicore 2013-2016

Participants: Erven Rohou, Alain Ketterlin, Nabil Hallou.

The Inria Project Lab (formerly *Action d'Envergure*) started in 2013. It is entitled "Large scale multicore virtualization for performance scaling and portability". Partner project-teams include: ALF, ALGORILLE, CAMUS, REGAL, RUNTIME, as well as DALI. This project aims to build collaborative virtualization mechanisms that achieve essential tasks related to parallel execution and data management. We want to unify the analysis and transformation processes of programs and accompanying data into one unique virtual machine.

8.1.3. ADT IPBS 2013-2015

Participants: Sylvain Collange, Erven Rohou, André Seznec, Thibault Person.

As multi-core CPUs and parallel accelerators become pervasive, all execution platforms are now parallel. Research on architecture, compilers and systems now focuses on parallel platforms. New contributions need to be validated against parallel applications that are expected to be representative of current or future workloads. The research community relies today on a few benchmarks sets (SPLASH, PARSEC ...) Existing parallel benchmarks are scarce, and some of them have issues such as aging workloads or non-representative input sets. The IPBS initiative aims at leveraging the diversity of parallel applications developed within Inria to provide a set of benchmarks, named the Inria Parallel Benchmark Suite, to the research community.

8.1.4. ADT Padrone 2012–2014

Participants: Erven Rohou, Alain Ketterlin, Emmanuel Riou.

Computer science is driven by two major trends: on the one hand, the lifetime of applications is much larger than the lifetime of the hardware for which they are initially designed; on the other hand the diversity of computing hardware keeps increasing. The net result is that many applications are not optimized for their current executing environment. The objective of Padrone is to design and develop a platform for reoptimization of binary executables at run-time. There are many advantages: actual hardware is known, the whole application is visible (including libraries), profiling can be collected, and source code is not necessary (interesting in the case of proprietary applications).

8.1.5. ANR W-SEPT 2012-2015

Participants: Hanbing Li, Isabelle Puaut, Erven Rohou.

Critical embedded systems are generally composed of repetitive tasks that must meet drastic timing constraints, such as termination deadlines. Providing an upper bound of the worst-case execution time (WCET) of such tasks at design time is thus necessary to prove the correctness of the system. Static WCET estimation methods, although safe, may produce largely over-estimated values. The objective of the project is to produce tighter WCET estimates by discovering and transforming flow information at all levels of the software design process, from high level-design models (e.g. Scade, Simulink) down to binary code. The ANR W-SEPT project partners are Verimag Grenoble, IRIT Toulouse, Inria Rennes. A case study is provided by Continental Toulouse.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. DAL: ERC AdG 2010- 267175, 04-2011/03-2016

Type: IDEAS

Instrument: ERC Advanced Grant

Duration: April 2011 - March 2016

Coordinator: André Seznec

Inria contact: André Seznec

Abstract: In the DAL, Defying Amdahl's Law project, we envision that, around 2020, the processor chips will feature a few complex cores and many (may be 1000s) simpler, more silicon and power effective cores. In the DAL research project, we will explore the microarchitecture techniques that will be needed to enable high performance on such heterogeneous processor chips. Very high performance will be required on both sequential sections —legacy sequential codes, sequential sections of parallel applications— and critical threads on parallel applications —e.g. the main thread controlling the application. Our research will focus on enhancing single process performance. On the microarchitecture side, we will explore both a radically new approach, the sequential accelerator, and more conventional processor architectures. We will also study how to exploit heterogeneous multicore architectures to enhance sequential thread performance.
For more information, see http://www.irisa.fr/alf/dal.

8.2.1.2. HiPEAC3 NoE

Participants: Pierre Michaud, Erven Rohou, André Seznec.

P. Michaud, A. Seznec and E. Rohou are members of the European Network of Excellence HiPEAC3. HiPEAC3 addresses the design and implementation of high-performance commodity computing devices in the 10+ year horizon, covering both the processor design, the optimizing compiler infrastructure, and the evaluation of upcoming applications made possible by the increased computing power of future devices.

8.2.2. Collaborations in European Programs, except FP7 & H2020

8.2.2.1. COST Action TACLe - Timing Analysis on Code-Level (http://www.tacle.eu) 10-2012/09-2015

Participants: Damien Hardy, Isabelle Puaut.

Embedded systems increasingly permeate our daily lives. Many of those systems are business- or safety-critical, with strict timing requirements. Code-level timing analysis (used to analyze software running on some given hardware w.r.t. its timing properties) is an indispensable technique for ascertaining whether or not these requirements are met. However, recent developments in hardware, especially multi-core processors, and in software organization render analysis increasingly more difficult, thus challenging the evolution of timing analysis techniques.

New principles for building "timing-composable" embedded systems are needed in order to make timing analysis tractable in the future. This requires improved contacts within the timing analysis community, as well as with related communities dealing with other forms of analysis such as model-checking and type-inference, and with computer architectures and compilers. The goal of this COST Action is to gather these forces in order to develop industrial-strength code-level timing analysis techniques for future-generation embedded systems, through several working groups:

- WG1 Timing models for multi-cores and timing composability
- WG2 Tooling aspects
- WG3 Early-stage timing analysis
- WG4 Resources other than time

Isabelle Puaut is in the management committee of the COST Action TACLe - Timing Analysis on Code-Level (http://www.tacle.eu). She is responsible of Short Term Scientific Missions (STSM) within TACLe.

8.3. International Initiatives

8.3.1. Participation In International Programs

8.3.1.1. UFGM Chair (Brasil)

Program: Cátedras Francesas UFMG

Title: Compiler Support for emerging parallel architectures

Inria principal investigator: Sylvain Collange

International Partner (Institution - Laboratory - Researcher):

Universidade Federal de Minas Gerais (UFMG) - Computer Science Department - Fernando Pereira

Duration: Sep 2014 - Dec 2014

We propose . The project develop compilation techniques for code optimization to speedup applications that run in Graphics Processing Units (GPUs). The objective is to enable developers code high-performance programs in high-level languages, while taking maximum benefit from the hardware. In particular, we seek to alleviate control and memory divergence, which are important performance limiters specific to GPU architectures. For instance, the call fusion optimization factors out a common function call invoked from multiple independent conditional branches to enable the hardware to execute the function in SIMD mode regardless of branch divergence.

8.3.2. Informal collaborations

The ALF project-team has informal collaborations (visits, common publications) with University of Wisconsin at Madison (Pr Wood), University of Toronto (Pr Moshovos), University of Ghent (Dr Eyerman), University of Upsalla (Pr Hagersten), University of Cyprus (Pr Sazeides), the Egyptian-Japanese University of Science and Technology (Pr Ahmed El-Mahdy).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Dr Stijn Eyerman from University of Ghent has been visiting the ALF project-team in April-May 2014.
- Pr Erik Hagerstern from Uppsala University has been visiting the ALF project-team in September-December 2014
- Pr Fernando Magno Quintão Pereira, from the Federal University of Minas Gerais visited the ALF project for 1 week in January 2014.

8.4.2. Visits to International Teams

Sylvain Collange has been invited on a professor chair at Universidade Federal de Minas Gerais, Brasil (September-December 2014). The subject of the collaboration is "Compiler Support for emerging parallel architectures".

ALGORILLE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

Plate-form(E)^3 (2012-2015, 87k€) has been accepted in 2012 in the ANR SEED program. It deals with the design and implementation of a multi-scale computing and optimization platform for energetic efficiency in industrial environment. It gathers 7 partners either academic (LEMTA, Fédération Charles Hermite (including AlGorille), Mines Paris, INDEED) or industrial (IFPEN, EDF, IDEEL). We will contribute to the design and development of the platform. The engineer P. Kalitine has been recruited to work on this project from May 2014 to June 2015.

ANR SONGS (2012–2015, 1800k€) Martin Quinson is also the principal investigator of this project, funded by the ANR INFRA program. SONGS (Simulation Of Next Generation Systems) aims at increasing the target community of SimGrid to two new research domains, namely Clouds (restricted to the *Infrastructure as a Service* context) and High Performance Computing. We develop new models and interfaces to enable the use of SimGrid for generic and specialized researches in these domains.

As project leading team, we are involved in most parts of this project, which allows the improvement of our tool even further and sets it as the reference in its domain (see Section 6.2.1).

7.1.2. Inria financed projects and clusters

AEN Hemera (2010-2014, 2k€) aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid'5000 infrastructure, and at animating and enlarging the scientific community around the testbed. M. Quinson, L. Nussbaum and S. Genaud lead three working groups, respectively on *simulating large-scale facilities*, on *conducting large and complex experimentations on real platforms*, and on *designing scientific applications for scalability*.
Other partners: 20 research teams in France, see https://www.grid5000.fr/mediawiki/index.php/Hemera for details.

ADT Aladdin-G5K (2007-2014, 200k€ locally) aims at the construction of a scientific instrument for experiments on large-scale parallel and distributed systems, building on the Grid'5000 testbed (http://www.grid5000.fr/). It structures INRIA's leadership role (8 of the 9 Grid'5000 sites) concerning this platform. The technical team is now composed of 10 engineers, of which 2 are currently hosted in the AlGorille team. As a member of the executive committee, L. Nussbaum is in charge of following the work of the technical team, together with the Grid'5000 technical director.
Other partners: EPI DOLPHIN, GRAAL, MESCAL, MYRIADS, OASIS, REGAL, RESO, RUNTIME, IRIT (Toulouse), Université de Reims - Champagne Ardennes

ADT LAPLACE (2014-2016, AlGorille is major partner, 100k€) builds upon the foundations of the Grid'5000 testbed to reinforce and extend it towards new use cases and scientific challenges. Several directions are being explored: networks and Software Defined Networking, Big Data, HPC, and production computation needs. Already developed prototypes are also being consolidated, and the necessary improvements to user management and tracking are also being performed.

ADT Cosette (2013-2016, AlGorille is the only partner, 120k€), for *COherent SET of Tools for Experimentation* aims at developing or improving a tool suite for experimentation at large scale on testbeds such as Grid'5000. Specifically, we will work on (1) the development of Ruby-CUTE, a library gathering features useful when performing such experiments; (2) the porting of Kadeploy, Distem and XPFlow on top of Ruby-CUTE; (3) the release of XPFlow, developed in the context of Tomasz Buchert's PhD; (4) the improvement of the Distem emulator to address new scientific challenges in Cloud and HPC. E. Jeanvoine (SED) is delegated in the AlGorille team for the duration of this project.

INRIA Project Lab MultiCore (2013-) Supporting multicore processors in an efficient way is still a scientific challenge. This project introduces a novel approach based on virtualization and dynamicity, in order to mask hardware heterogeneity, and to let performance scale with the number and nature of cores. Our main partner within this project is the Camus team on the Strasbourg site. The move of J. Gustedt there, has strengthened the collaboration within this project.

ADT PLM (2014-2016, Martin Quinson is leading this project in collaboration with G. Oster from the Coast project-team, 100k€) This project is not directly in line with the goal of the AlGorille project-team, as its goal is to establish an experimental platform to study of the didactic of informatics, specifically centered on introductory programming courses.

The project builds upon a pedagogical programming exerciser developed for our own teaching, and improves this base in several ways. We want to provide more adapted feedback to the learners, and gather more data to better understand how beginners learn programming.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. FED4FIRE

Participant: Lucas Nussbaum.

Title: Federation for Future Internet Research and Experimentation

Type: ICT

Instrument: Integrated Project

Duration: October 2012 - September 2016

Coordinator: iMinds

Other partners: IT Innovation, UPMC, Fraunhofer, TUB, UEDIN, Inria, NICTA, ATOS, UTH, NTUA, UNIVBRIS, i2CAT, EUR, DANTE Limited, UC, NIA.

See also: http://www.fed4fire.eu

Abstract: The key outcome of Fed4FIRE will be an open federation solution supporting all stakeholders of FIRE. Fed4FIRE is bringing together key players in Europe in the field of experimentation facilities and tool development who play a major role in the European testbeds of the FIRE initiative projects.

Lucas Nussbaum started participating in the project in September 2013, mainly with an expert role.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

7.3.1.1. Internships

Ezequiel Torti Lopez

Subject: Parallel and Distributed Simulation of Large-Scale Distributed Applications

Date: from May 2014 until October 2014

Institution: Universidad National de Rosario (Argentina)

ALICE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Meshing and PDEs, Regional Council of Lorraine, 25 KEuros for initiating the cooperation between Xavier Antoine (Prof. in Math., Nancy who joined ALICE for a short-term 1 year period) and Bruno Lévy;

7.2. National Initiatives

7.2.1. ANR BECASIM (2013 – 2016)

890 K€. X. Antoine heads the second partner, which includes Bruno Lévy. Budget for Nancy: 170 K€ of which 100 K€ are for IECL (team CORIDA). This project is managed by Inria. Becasim is a thematic "Numerical Models" ANR project granted by the French Agence Nationale de la Recherche for years 2013-2016. The acronym Becasim is related to Bose-Einstein Condensates: Advanced SIMulation Deterministic and Stochastic Computational Models, HPC Implementation, Simulation of Experiments. The members of the ANR Project Becasim belong to 10 different laboratories.

7.2.2. ANR Bond (2013 – 2017)

X. Antoine is a member of the (“projet blanc”) ANR BOND (Boundaries, Numerics and Dispersion).

7.2.3. ANR TECSER (2014 – 2017)

X. Antoine is a member of ANR TECSER that stemmed from the ASTRID program (DGA). The consortium gathers Inria (S. Lantéri, Nice-Sophia, ÉPI CORIDA (X. Antoine) and HIEPACS), EADS, and Nuclétudes.

Total budget: 300 K€ of which 54 K€ are for CORIDA.

7.2.4. ANR Morpho (2010 – 2014

Dobrina Boltcheva and Bruno Lévy are involved in the ANR project Morpho. Morpho is aimed at designing new technologies for the measure and for the analysis of dynamic surface evolutions using visual data.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

7.3.1.1. SHAPEFORGE

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Objectif: NC

Duration: December 2012 - November 2017

Coordinator: Sylvain Lefebvre

Inria contact: Sylvain Lefebvre

Abstract: Project Shapeforge aims at developing new methods for creating objects from examples, with 3D printers. The main challenge with this project is combining approaches that are very different in nature: algorithms from computer graphics which are used to build forms and textures using examples are combined with digital optimization methods which make sure that the real object complies with the function it is assigned. Thus, to produce a Louis XV bench, on the basis of a Louis XV chair, you need to not only capture the appearance of the example but also formalize the characteristics of a bench as well as its mechanical properties to ensure that it is solid enough. You then need to find, from among all the shapes that can be produced from a single example, the one that best complies with the various criteria.

7.3.1.2. VORPALINE

Type: FP7

Defi: NC

Instrument: ERC Proof of Concept

Objectif: NC

Duration: July 2013 - June 2014

Coordinator: Bruno Lévy

Inria contact: Bruno Lévy

Abstract: The Vorpaline software takes a new approach to 3D mesh generation, based on the theory of numerical optimization. The optimal mesh generation algorithm developed in the frame of the European Research Council GOODSHAPE project globally and automatically optimizes the mesh elements with respect to geometric constraints (two patents) . The mathematical foundations of this algorithm, i.e. the minimization of a smooth energy function, result in practice in a faster algorithm, and - more importantly - in a higher flexibility. For instance, it will allow automatic generation of the aforementioned "hex-dominant" meshes. It is now proposed (since 2014) to the sponsors of the Gocad consortium, as an extension package of the Gocad software.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. PREPRINT3D

Title: Model Preparation for 3D Printing

International Partner (Institution - Laboratory - Researcher):

HKU (HONG KONG)

Duration: Delayed for administrative reasons

We seek to develop novel ways to prepare objects for 3D printing which better take into account limitations of the fabrication processes as well as real-world properties such as the mechanical strength of the printed object. This is especially important when targeting an audience which is not familiar with the intricacies of industrial design. We target complex, intricate shapes such as models of vegetation and highly detailed meshes, as well as models with thin walls such as architectural models. Our methods will modify the object geometry and topology while remaining as close as possible to its initial appearance.

7.4.2. Inria International Partners

7.4.2.1. Informal International Partners

- We have a long-term cooperation with the Gocad Consortium (Nancy school of Geology), with co-advised students. This resulted in some applications of our result to oil exploration, listed in the *numerical simulation* item above (Ph.D. theses of Arnaud Botella, Nicolas Cherpeau, Jeanne Pellerin);

- We cooperate since 2008 with Wenping Wang's group (Hong-Kong University), on centroidal Voronoi tesselation. The last results of this cooperation on *Sampling and Remeshing* are published in : [22] Siam J. on Scientific Computing and [30] (SIGGRAPH 2013)
- Cooperation with Pierre Poulin and Gilles-Philippe Paillé on volumetric distance minimization [26] (SGP 2009)
- Cooperation with Tsinghua University (Jean-Claude Paul was Professor there from 2004 to 2013).
- We started a research project with "Ateliers Cini", "Institut Jean Lamour" (IJL) and the "Ecole de Chirurgie de Nancy", to develop new 3D printers using novel types of materials developed by IJL. This project is funded by the "Region Lorraine" under the "Pacte Lorraine" program.

7.5. International Research Visitors

7.5.1. Visits to International Teams

7.5.1.1. Research stays abroad

Jérémie Dumas (PhD student) stayed in Hong Kong for 1 month as a visiting student (12-04-2014 to 10-05-2014). This visit was done in the context of the Equipe Associée PrePrint3D.

ALPAGE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. LabEx EFL (Empirical Foundations of Linguistics) (2011 – 2021)

Participants: Laurence Danlos, Benoît Sagot, Chloé Braud, Marie-Hélène Candito, Benoit Crabbé, Pierre Magistry, Djamé Seddah, Sarah Beniamine, Maximin Coavoux, Éric Villemonte de La Clergerie.

Linguistics and related disciplines addressing language have achieved much progress in the last two decades but improved interdisciplinary communication and interaction can significantly boost this positive trend. The LabEx (excellency cluster) EFL (Empirical Foundations of Linguistics), launched in 2011 and headed by Jacqueline Vaissière, opens new perspectives by adopting an integrative approach. It groups together some of the French leading research teams in theoretical and applied linguistics, in computational linguistics, and in psycholinguistics. Through collaborations with prestigious multidisciplinary institutions (CSLI, MIT, Max Planck Institute, SOAS...) the project aims at contributing to the creation of a Paris School of Linguistics, a novel and innovative interdisciplinary site where dialog among the language sciences can be fostered, with a special focus on empirical foundations and experimental methods and a valuable expertise on technology transfer and applications.

Alpage is a very active member of the LabEx EFL together with other linguistic teams we have been increasingly collaborating with: LLF (University Paris 7 & CNRS) for formal linguistics, LIPN (University Paris 13 & CNRS) for NLP, LPNCog (University Paris 5 & CNRS) LSCP (ENS, EHESS & CNRS) for psycholinguistics, MII (University Paris 4 & CNRS) for Iranian and Indian studies. Alpage resources and tools have already proven relevant for research at the junction of all these areas of linguistics, thus drawing a preview of what the LabEx is about: experimental linguistics (see Section 4.6). Moreover, the LabEx provides Alpage with opportunities for collaborating with new teams, e.g., on language resource development with descriptive linguists.

Benoît Sagot is the head one of the 7 autonomous scientific "strands" of the LabEx EFL, namely the strand 6 on "Language Resources". Marie-Hélène Candito and Benoit Crabbé are respectively deputy-head of strands 5 on "Computational semantic analysis" and 2 on "Experimental grammar from a cross-linguistic perspective". Several project members are in charge of research operations within these 3 strands.

8.1.2. ANR

8.1.2.1. ANR project ASFALDA (2012 – 2015)

Participants: Marie-Hélène Candito [principal investigator], Marianne Djemaa, Benoît Sagot, Éric Villemonte de La Clergerie, Laurence Danlos, Virginie Mouilleron, Vanessa Combet.

Alpage is principal investigator team for the ANR project ASFALDA, lead by Marie-Hélène Candito. The other partners are the Laboratoire d'Informatique Fondamentale de Marseille (LIF), the CEA-List, the MELODI team (IRIT, Toulouse), the Laboratoire de Linguistique Formelle (LLF, Paris Diderot) and the Ant'inno society.

The project aims to provide both a French corpus with semantic annotations and automatic tools for shallow semantic analysis, using machine learning techniques to train analyzers on this corpus. The target semantic annotations are structured following the FrameNet framework [57] and can be characterized roughly as an explicitation of "who does what when and where", that abstracts away from word order / syntactic variation, and to some of the lexical variation found in natural language.

The project relies on an existing standard for semantic annotation of predicates and roles (FrameNet), and on existing previous effort of linguistic annotation for French (the French Treebank). The original FrameNet project provides a structured set of prototypical situations, called frames, along with a semantic characterization of the participants of these situations (called *roles*). We propose to take advantage of this semantic database, which has proved largely portable across languages, to build a French FrameNet, meaning both a lexicon listing which French lexemes can express which frames, and an annotated corpus in which occurrences of frames and roles played by participants are made explicit. The addition of semantic annotations to the French Treebank, which already contains morphological and syntactic annotations, will boost its usefulness both for linguistic studies and for machine-learning-based Natural Language Processing applications for French, such as content semantic annotation, text mining or information extraction.

To cope with the intrinsic coverage difficulty of such a project, we adopt a hybrid strategy to obtain both exhaustive annotation for some specific selected concepts (commercial transaction, communication, causality, sentiment and emotion, time), and exhaustive annotation for some highly frequent verbs. Pre-annotation of roles will be tested, using linking information between deep grammatical functions and semantic roles.

The project is structured as follows:

- Task 1 concerns the delimitation of the focused FrameNet substructure, and its coherence verification, in order to make the resulting structure more easily usable for inference and for automatic enrichment (with compatibility with the original model);
- Task 2 concerns all the lexical aspects: which lexemes can express the selected frames, how they map to external resources, and how their semantic argument can be syntactically expressed, an information usable for automatic pre-annotation on the corpus;
- Task 3 is devoted to the manual annotation of corpus occurrences (we target 20000 annotated occurrences);
- In Task 4 we will design a semantic analyzer, able to automatically make explicit the semantic annotation (frames and roles) on new sentences, using machine learning on the annotated corpus;
- Task 5 consists in testing the integration of the semantic analysis in an industrial search engine, and to measure its usefulness in terms of user satisfaction.

The scientific key aspects of the project are:

- an emphasis on the diversity of ways to express the same frame, including expression (such as discourse connectors) that cross sentence boundaries;
- an emphasis on semi-supervised techniques for semantic analysis, to generalize over the available annotated data.

8.1.2.2. ANR project Polymnie (2012-2016)

Participants: Laurence Danlos, Éric Villemonte de La Clergerie, Julie Hunter.

Polymnie is an ANR research project headed by Sylvain Podogolla (Sémagramme, Inria Lorraine) with Melodi (INRIT, CNRS), Signes (LABRI, CNRS) and Alpage as partners. This project relies on the grammatical framework of Abstract Categorial Grammars (ACG). A feature of this formalism is to provide the same mathematical perspective both on the surface forms and on the more abstract forms the latter correspond to. ACG allows for the encoding of a large variety of grammatical formalisms, in particular Tree Adjoining grammars (TAG).

The role of Alpage in this project is to develop sentential or discursive grammars written in TAG and to participate in their conversion in ACG. Results were first achieved in 2014 concerning text generation: GTAG formalism created by Laurence Danlos in the 90's has been rewritten in ACG [25], [26], [27]. As regards discursive analysis, D-STAG formalism created by Laurence Danlos in the 00's is currently been rewritten in ACG and enhanced to cover attributions with some preliminary linguistic work on attributions [33].

8.1.3. Other national initiatives

8.1.3.1. "Investissements d'Avenir" project PACTE (2012 – 2015)

Participants: Benoît Sagot, Kata Gábor, Pierre Magistry.

PACTE (*Projet d'Amélioration de la Capture TExtuelle*) is an "Investissements d'Avenir" project sumbitted within the call "Technologies de numérisation et de valorisation des contenus culturels, scientifiques et éducatifs". It started in November 2012, although the associated fundings only arrived at Alpage in July 2013.

PACTE aims at improving the performance of textual capture processes (OCR, manual script recognition, manual capture, direct typing), using NLP tools relying on both statistical (n-gram-based, with scalability issues) and hybrid techniques (involving lexical knowledge and POS-tagging models). It addresses specifically the application domain of written heritage. The project takes place in a multilingual context, and therefore aims at developing as language-independant techniques as possible.

PACTE involves 3 companies (Numen, formerly Diadeis, main partner, as well as A2IA and Isako) as well as Alpage and the LIUM (University of Le Mans). It brings together business specialists, large-scale corpora, lexical resources, as well as the scientific and technical expertise required.

The results obtained at Alpage in 2014 within PACTE are described in 6.3

8.1.3.2. FUI project COMBI (2014-2016)

Participants: Laurence Danlos, Vanessa Combet, Jacques Steinlin.

COMBI is is an "FUI 16" project. It started in February 2014 for a two year duration. It groups 5 industrial partners (Temis, Isthma, Kwaga, Yseop and Qunb) and Alpage. Temis and Istma work on data mining from texts and big data. Kwaga works on the interpretation and inferences that can be drawn from the data retrieved in the analysis module. Alpage and Qunb work, under the supervision of Yseop, on the production of respectively texts and graphics describing the results of the interpretation module. Currently, COMBI aims at creating the full chain for a user case concerning the weekly activity of an on-line service.

Alpage works on text generation, with the adaptation of TextElaborator, a generation system developed in the 10's by WatchAssistance and based on G-TAG. Alpage also works on the opportunity to describe pieces of information by texts, graphics or both.

8.1.3.3. Consortium Corpus Écrits within the TGIR Huma-Num

Participants: Benoît Sagot, Djamé Seddah.

Huma-Num is a TGIR (Very Large Research Infrastructure) dedicated to digital humanities. Among Huma-Num initiatives are a dozen of consortia, which bring together most members of various research communities. Among them is the *Corpus Écrits* consortium, which is dedicated to all aspects related to written corpora, from NLP to corpus development, corpus specification, standardization, and others. All types of written corpora are covered (French, other languages, contemprorary language, medieval language, specialized text, non-standard text, etc.). The consortium Corpus Écrits is managed by the Institut de Linguistique Française, a CNRS federation of which Alpage is a member since June 2013, under the supervision of Franck Neveu.

Alpage is involved in various projects within this consortium, and especially in the development of corpora for CMC texts (blogs, forum posts, SMSs, textchat...) and shallow corpus annotation, especially with MElt.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

Program: **IC1207 COST**

Project acronym: PARSEME

Project title: PARSing and Multi-word Expressions

Duration: March 2013 - March 2017

Coordinator: Agata Savary

Other partners: interdisciplinary experts (linguists, computational linguists, computer scientists, psycholinguists, and industrials) from 30 countries

Abstract: The general aim of PARSEME is increasing and enhancing the ICT support of the European multilingual heritage. This aim is pursued via more detailed objectives: (1) to put multilingualism in focus of linguistic and technological studies; (2) to establish a long-lasting cross-lingual, cross-theoretical and cross-methodological research network in natural language processing (NLP); (3) to bridge the gap between linguistic precision and computational efficiency in NLP applications.

Program: **ISCH COST Action IS1312**

Project acronym: TextLink

Project title: Structuring Discourse in Multilingual Europe

Duration: April 2014 - April 2018

Coordinator: Liesbeth Degand

Other partners: experts in computational linguistics and discourse from 24 countries

France MC members: Laurence Danlos and Philippe Muller (IRIT)

Abstract: With partners from across Europe, TextLink will unify numerous but scattered linguistic resources on discourse structure. With its resources searchable by form and/or meaning and a source of valuable correspondences, TextLink will enhance the experience and performance of human translators, lexicographers, language technology and language learners alike.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

Alpage has active collaborations with several international teams. The most active in 2014 have been:

- collaboration with Columbia University (United States), in particular on discourse modeling (Laurence Danlos, with Owen Rambow) and on computational morphology (Benoît Sagot, with Owen Rambow)
- collaboration with the Emory University (USA) on broad coverage parsing of unlabeled and noisy Korean data set (Djamé Seddah, with Jinho D. Choi).
- collaboration with the Indiana University (United States) on parsing morphologically rich languages (Djamé Seddah, with Sandra Kubler)
- collaboration with the University of Ljubljana (Slovenia) on wordnet development (Benoît Sagot, with Darja Fišer)
- collaboration with the Uppsala University (Sweden) on statistical parsing (Marie-Hélène Candito and sDjamé Seddah, with Joakim Nivre)
- collaboration with the Weizmann Institute of Science (Israel) on parsing morphologically rich languages (Djamé Seddah, with Reut Tsarfaty)

8.4. International Research Visitors

8.4.1. Visits of International Scientists

James Pustejovsky from Brandeis University (Boston, USA) was invited Professor at Alpage in April 2014. His stay was funded by Inria, his travel by Alpage. He is specialist in computational semantics and the creator of the “Generative Lexicon”. During his stay in Paris, he gave two lectures with a large audience. The topic was on the computational model of events. The notion of event has long been central for both modeling the semantics of natural language as well as reasoning in goal-driven tasks in artificial intelligence. James outlined a unified theory of event structure. James has also been working with Alpage members. First on the French lexical resources developed at Alpage, namely Framenet (Marie Candito) and Verbenet (Laurence Danlos). Second on the role of attributions in discourse structure within the linguistic work made at Alpage for the ANR Polymnie (Laurence Danlos and Julie Hunter).

8.4.1.1. Internships

Kristina Gulordava is a visiting research student from the University of Geneva (LATL) supervised by Paola Merlo, visting ALPAGE from September 2014 to January 2015. Her Phd thesis is dedicated to the study of generic cross linguistic constraints across languages. Her goal is to investigate the connection between the quantitative aspects of word order variation across languages and the quantitative aspects of word order variation within a language. She explores to which extent a computational corpus-based analysis can provide new evidence not only for empirical, but also for theoretical linguistic research.

ALPINES Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. Medimax

ANR-MN (Modèles Numériques) October 2013 - September 2017

The main goal is the methodological and numerical development of a new robust inversion tool, associated with the numerical solution of the electromagnetic forward problem, including the benchmarking of different other existing approaches (Time Reverse Absorbing Condition, Method of Small-Volume Expansions, Level Set Method). This project involves the development of a general parallel open source simulation code, based on the high-level integrated development environment of FreeFEm++, for modeling an electromagnetic direct problem, the scattering of arbitrary electromagnetic waves in highly heterogeneous media, over a wide frequency range in the microwave domain. The first applications considered here will be medical applications: microwave tomographic images of brain stroke, brain injuries, from both synthetic and experimental data in collaboration with EMTensor GmbH, Vienna (Austria), an Electromagnetic Medical Imaging company.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. EXA2CT

Type: COOPERATION
Instrument: Specific Targeted Research Project
Objectif: NC
Duration: September 2013 - August 2016
Coordinator: Imec, Belgium
Partner: UA Belgium, USI Switzerland, Intel France, NAG England, UVSQ France, T-Systems SfR Germany, IT4Inovations Czech Republic.
Inria contact: Luc Giraud
Abstract: The goal of this project is to develop novel algorithms and programming models to tackle what will otherwise be a series of major obstacles to using a crucial component of many scientific codes at exascale, namely solvers and their constituents. The results of this work will be combined in running programs that demonstrate the application-targeted use of these algorithms and programming models in the form of proto-applications. The application targeting will be done by an analysis of a representative selection of scientific applications using solvers and/or the constituent parts that we target. The results of the project will be disseminated to the reference application owners through a scientific and industrial board (SIB), and board-partner specific code targeting activities, to help generate momentum behind our approach in the HPC community. The proto-applications will serve as a proof-of-concept, a benchmark for doing machine/software co-design, and as a basis for constructing future exascale full applications. In addition, the use of the SIB is a means to extract the commonalities of a range of HPC problems from different scientific domains and different industrial sectors to be able to concentrate on maximising the impact of the project by improving precisely those parts that are common across different simulation needs.
Alpines role: in charge of the Task "Preconditioners" in the working group focusing on numerical algorithms.

7.3. International Initiatives

7.3.1. Inria International Labs

Members of Alpines are part of the International Lab JLPC Etats-Unis.

7.3.2. Inria Associate Teams

7.3.2.1. COALA

Title: Communication Optimal Algoritms for Linear Algebra

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (ÉTATS-UNIS)

Duration: 2010 - 2015

See also: https://who.rocq.inria.fr/Laura.Grigori/COALA2010/coala.html

Our goal is to continue COALA associated team that focuses on the design and implementation of numerical algorithms for today's large supercomputers formed by thousands of multicore processors, possibly with accelerators. We focus on operations that are at the heart of many scientific applications as solving linear systems of equations or least squares problems. The algorithms belong to a new class referred to as communication avoiding that provably minimize communication, where communication means the data transferred between levels of memory hierarchy or between processors in a parallel computer. This research is motivated by studies showing that communication costs can already exceed arithmetic costs by orders of magnitude, and the gap is growing exponentially over time. An important aspect that we consider here is the validation of the algorithms in real applications through our collaborations. COALA is an Inria associate team that focuses on the design and implementation of numerical algorithms for today's large supercomputers formed by thousands of multicore processors, possibly with accelerators. We focus on operations that are at the heart of many scientific applications as solving linear systems of equations or least squares problems. The algorithms belong to a new class referred to as communication avoiding that provably minimize communication, where communication means the data transferred between levels of memory hierarchy or between processors in a parallel computer. This research is motivated by studies showing that communication costs can already exceed arithmetic costs by orders of magnitude, and the gap is growing exponentially over time. An important aspect that we consider here is the validation of the algorithms in real applications through our collaborations.

7.3.3. Inria International Partners

7.3.3.1. Informal International Partners

A collaboration focused on the theoretical and numerical analysis for the simulation of wave scattering by means of boundary integral formulation has been in place for several years between Xavier Claeys and the group of Ralf Hiptmair from the Seminar of Applied Mathematics at ETH Zürich.

7.3.4. Participation In other International Programs

Joint Laboratory for Petascale Computing, JLPC Etats-Unis. We take part in this joint effort, in the numerical libraries aspects of the joint laboratory. We collaborate and interact in particular with B. Gropp, UIUC, and J. Brown and M. Knepley, Argonne.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Visit of Jed Brown, Argonne National Laboratory, 1 week, June 2014, in the context of JLPC, Etats-Unis.

7.4.1.1. Internships

- Jean-Yves Pallaro, Master 2 student, University of Lille. Jean-Yves worked on LORASC preconditioner.

7.4.2. Visits to International Teams

7.4.2.1. Sabbatical programme

Grigori Laura

Date: Aug 2014 - Aug 2015

Institution: University of California Berkeley (USA)

7.4.2.2. Research stays abroad

- Xavier Claeys, Visit to SAM ETH Zürich for collaboration with Ralf Hitpmair, 3rd August - 16th August 2014.
- Sebastien Cayrols, Visit to UC Berkeley in the context of COALA associated team, December 2014 - April 2015.

AMIB Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

A. Denise is involved in the NSD-NGD ANR project 2010-2014. Y. Ponty was involved in the MAGNUM ANR project (BLAN program, 12/2010–12/2014).

6.1.2. PEPS

Ch. Froidevaux was responsible at LRI for the CNRS-INSERM-INRIA PEPS grant *Identification of metabolic capabilities of fungi by comparative genomic* involving IGM, Paris-Sud and UMR GV, CNRS.

6.1.3. FRM

Fondation pour la Recherche Medicale – *Analyse Bio-informatique pour la recherche en Biologie* program

- Approche comparatives haut-débit pour la modelisation de l'architecture 3D des ARN à partir de données experimentales
- 2015–2018
- Y. Ponty, A. Denise
- B. Sargueil (Paris V – Experimental partner), J. Waldispuhl

6.2. European Initiatives

6.2.1. Collaborations in European Programs, except FP7 & H2020

ANR International program

- Fast and efficient sampling of structures in RNA folding landscapes
- RNALands (ANR-14-CE34-0011)
- 01/10/2014-30/09/2018
- Y. Ponty, A. Denise, M. Regnier
- EPI BONSAI/INRIA Inria Lille - Nord Europe, Vienna University (Austria)

6.3. International Initiatives

- Capes Biologie systémique du cancer (051/2013) porté par Sandro José de Souza (Univ. Federal do Rio Grande do Norte, Brésil)
- Sabine Peres
- 2014-2018

6.3.1. Inria Associate Teams

6.3.1.1. ITSNAP

Title: Intelligent Techniques for Structure of Nucleic Acids and Proteins

International Partner (Institution - Laboratory - Researcher):

Stanford University (ÉTATS-UNIS)

Duration: 2009 - 2014

See also: http://pages.saclay.inria.fr/julie.bernauer/EA_ITSNAP/

The ITSNAP Associated Team project is dedicated to the computational study of RNA 3D structure and interactions. By developing new molecular hierarchical models for knowledge-based and machine learning techniques, we can provide new insights on the biologically important structural features of RNA and its dynamics. This knowledge of RNA molecules is key in understanding and predicting the function of current and future therapeutic targets.

6.3.2. Inria International Partners

6.3.2.1. Declared Inria International Partners

Title: CARNAGE: Combinatorics of Assembly and RNA in GEnomes

International Partner (Institution - Laboratory - Researcher):

State Research Institute of Genetics and Selection of Industrial Microorganisms (Russia (Russian Federation)) - Bioinformatics laboratory - V. Makeev and Mireille Régnier

Duration: 2012- 2014

See also: https://team.inria.fr/amib/carnage

CARNAGE addresses two main issues on genomic sequences, by combinatorial methods.

Fast development of high throughput technologies has generated a new challenge for computational biology. The recently appeared competing technologies each promise dramatic breakthroughs in both biology and medicine. At the same time the main bottlenecks in applications are the computational analysis of experimental data. The sheer amount of this data as well as the throughput of the experimental dataflow represent a serious challenge to hardware and especially software. We aim at bridging some gaps between the new "next generation"sequencing technologies, and the current state of the art in computational techniques for whole genome comparison. Our focus is on combinatorial analysis for NGS data assembly, interspecies chromosomal comparison, and definition of standard pipelines for routine large scale comparison.

This project also addresses combinatorics of RNA and the prediction of RNA structures, with their possible interactions.

6.3.2.2. Informal International Partners

Polytechnique/UPSud and McGill/U. Montréal

Program: CFQCU

Title: Réseau franco-québecois de recherche sur l'ARN

Inria principal investigator: Jean-Marc Steyaert

International Partner (Institution - Laboratory - Researcher):

Mc Gill and Université de Montréal (Canada)

Computer Science Department

Jérôme Waldispühl

Duration: 2012 - 2014

Résumé : The partners have developped complementary expertise on RNA : bioinformatics, combinatorics and algorithms. machine learning, physics and genomics. Methodologies will be developed that combine theoretical simulations and new (high throughput) experimental data. A common high level training at Master and PhD level is organized.

6.3.3. Participation In other International Programs

Henry van den Bedem and J. Bernauer presented their work at the Inria BIS 2014 Workshop in Paris https://project.inria.fr/inria-siliconvalley/workshops/bis2014/.

6.4. International Research Visitors

6.4.1. Visits of International Scientists

J. Holub

Subject: Word automata

Institution: Praha University (Czech Republic)

E. Furletova

Subject: word enumeration

Institution: Institute of Mathematical Problems in Biology (Russia)

6.4.1.1. Internships

Jan Lin Chan

Subject: Exceptional words in *Archae* genomes

Date: 01/06/2014 - 11/08/2014

Institution: NUS (Singapour)

Funding: INRIA

Supervision: M. Régnier

Damien Busatto-Gaston

Subject: de Bruijn graphs and assembly

Date: 01/06/2014 - 14/07/2014

Institution: ENS-Lyon (France)

Funding: INRIA

Supervision: M. Régnier

Robert Huang

Subject: Repeats in genomic sequences

Date: 01/06/2014 - 25/08/2014

Institution: Berkeley (USA)

Funding: ECOLE POLYTECHNIQUE

Supervision: M. Régnier

Hanlun Jiang

Subject : conformational dynamics of the RNA-induced silencing complex

Date: 01/06/2014 - 25/08/2014

Institution: HKUST (Hong-Kong)

Funding: MRE

Supervision: J. Bernauer

Stéphanie Kamgnia Wonkap

Subject : Extraction de motifs dans les graphes de workflows scientifiques

Date: 01/06/2014 - 30/06/2014

Institution: Univ. Rennes

Funding: INRIA

Supervision: Ch. Froidevaux and S. Cohen-Boulakia

6.4.2. Visits to International Teams

6.4.2.1. Sabbatical programme

Julie Bernauer

Date: Feb 2014 - Jul 2014

Institution: Stanford University (USA)

6.4.2.2. Research stays abroad

Sarah Cohen-Boulakia

Date: Apr 2014

Institution: University of Pennsylvania (USA)

Date: Dec 2014

Institution: Humboldt University of Berlin (Germany)

Yann Ponty

Date: Sep 2013 - Sep 2015

Institution: Simon Fraser University (Canada)

Sabine Peres

Date: Dec 2014

Institution: Friedrich-Schiller-University Jena (Germany)

Alice Heliou

Date: Feb-Apr 2014

Institution: King's College (UK)

Date: December 2014

Institution: Vavilov Institute of General Genetics (Russia)

Amélie Heliou

Date: Mar-May 2014

Institution: Stanford University (USA)

Antoine Soulé

Date: Half-time 2014

Institution: McGill University (Canada)

ANGE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Instabilities in Hydrodynamics (2011–2015)

Participant: Nicolas Seguin.

The Emergence project (Ville de Paris and FSMP) "Instabilities in Hydrodynamics" is related to theoretical, applied, and numerical mathematics for the study of hydrodynamical turbulence phenomena.

8.1.2. Plasticity of geophysical flows and seismic emissions (2013–2016)

Participant: Anne Mangeney.

This project is funded by Sorbonne Paris Cité (80.000 euros) and is a collaboration between IPGP and Univ. Paris 13.

8.1.3. LRC Manon (2010–2014 and 2014–2018)

Participants: Edwige Godlewski, Yohan Penel, Nicolas Seguin.

CEA and Laboratory Jacques-Louis Lions launched a collaboration in order to carry out studies about complex fluids (modelling, numerical simulations and optimisation), in particular about compressible two-phase flows. This includes the derivation of strategies for model coupling, for instance in the case of an asymptotic hierarchy of models. This collaboration was recently renewed for another 4-year partnership.

8.2. National Initiatives

8.2.1. ANR MIMOSA (2014–2017)

Participants: Nora Aïssiouene, Marie-Odile Bristeau, Anne Mangeney, Jacques Sainte-Marie.

Program: ANR Défi 1 "Gestion sobre des ressources et adaptation au changement climatique"

Project acronym: MIMOSA

Project title: Microseism MOdeling and Seismic Applications

Coordinator: Eleonore Stutzmann (IPGP)

Seismic noise is recorded by broadband seismometers in the absence of earthquakes. It is generated by the atmosphere-ocean system with different mechanisms in the different frequency bands. Even though some mechanisms have been known for decades, an integrated understanding of the noise in the broadband period band 1-300sec is still missing. Using novel theoretical, numerical and signal processing methods, this project will provide a unified understanding of the noise sources and quantitative models for broadband noise. Conversely, we will be able to interpret seismic noise in terms of ocean wave properties. This first analysis step will lead to the identification and characterization of source events, which we will use to improve noise tomography, and seismic monitoring.

8.2.2. ANR LANDQUAKES (2012–2016)

Program: ANR Blanc "Mathématiques et interactions"

Project acronym: LANDQUAKES

Project title: Modélisation des glissements de terrain et des ondes sismiques générées pour détecter et comprendre les instabilités gravitaires

Coordinator: Anne Mangeney

Within the ANR domain "Mathematics and Interfaces", this ANR project (between Univ. Paris-Est – LAMA, Univ. Denis Diderot Paris 7 – IPGP, Univ. Nantes – LPGN, Univ. Strasbourg EOST, 180.000 euros) deals with the mathematical and numerical modelling of landslides and generated seismic waves.

A. Mangeney is also involved in the CARIB ANR program (2014–2017) entitled “Comprendre les processus de construction et de destruction des volcans de l’Arc des Petites Antilles”.

8.2.3. GdR EGRIN (2013–2017)

Participants: Anne Mangeney, Jacques Sainte-Marie.

EGRIN stands for Gravity-driven flows and natural hazards. J. Sainte-Marie is the head of the scientific committee of this CNRS research group and A. Mangeney is a member of the committee. The scientific goals of this project are the modelling, analysis and simulation of complex fluids by means of reduced-complexity models in the framework of geophysical flows.

8.2.4. ADT Inlgae, Inria Project Lab “Algae in Silico”

Participants: Marie-Odile Bristeau, Raouf Hamouda, Jacques Sainte-Marie.

In the framework of the ADT Inlgae (2013–2014), we developed in collaboration with the BIOCORE Inria project-team a simulation tool for microalgae culture. It lead to the recruitment of R. Hamouda as a young engineer.

An Inria Project Lab “Algae in Silico” is planned in collaboration with BIOCORE. It concerns microalgae culture for biofuel production and the aim is to provide an integrated platform for numerical simulation “from genes to industrial processes”.

8.2.5. ANR project HJnet (2013–2015)

Participant: Edwige Godlewski.

This research project consists in studying Hamilton-Jacobi equations on networks, and more generally on heterogeneous structures. This theoretical problem has several potential applications, in particular to traffic flow theory.

8.2.6. Statistical Inference for Structure Health Monitoring (I4S)

Participant: Nicolas Seguin.

The I4S team results from a collaboration between Ifsttar and Inria. N. Seguin is funded by this team. His work consists in providing efficient numerical tools to take into account the impact of the flows around the structures. The most challenging part of this project concerns the off-shore wind turbines and the understanding of the ice formation on the structure.

8.2.7. Hydraulics for environment and sustainable development (HED^2)

The scienfitic group (GIS in French), which includes Inria, brings together scientists and engineers involved in hydraulics, risk management and sustainable development. ANGE belongs to this group. On the one hand, the team can be provided with experimental measurements (erosion, long waves, fluid structure interactions,...) thanks to this collaboration; on the other hand, the GIS can favor the transfer of numerical tools and scientific results.

8.3. European Initiatives

8.3.1. ERC Consolidator Grant (2013–2018)

Participant: Anne Mangeney.

The project SLIDEQUAKES about detection and understanding of landslides by observing and modelling gravitational flows and generated earthquakes has been funded by the European Research Council (2.000.000 euros).

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

The team has developed strong relations with researchers from Spanish universities, in particular with Carlos Pares (Malaga), Enrique Fernandez-Nieto and Tomas Chacon Rebollo (Sevilla). They have an expertise in complex flows, including variable density flows, erosion, non-hydrostatic effects, ...

ANTIQUE Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. AnaStaSec

Title: Static Analysis for Security Properties

Type: ANR générique 2014

Defi: Société de l'information et de la communication

Instrument: ANR grant

Duration: January 2015 - December 2018

Coordinator: Inria Paris-Rocquencourt (France)

Others partners: Airbus France (France), AMOSSYS (France), CEA LIST (France), Inria Rennes-Bretagne Atlantique (France), TrustInSoft (France)

Inria contact: Jérôme Feret

See also: http://www.di.ens.fr/ feret/anastasec/

Abstract: An emerging structure in our information processing-based society is the notion of trusted complex systems interacting via heterogeneous networks with an open, mostly untrusted world. This view characterises a wide variety of systems ranging from the information system of a company to the connected components of a private house, all of which have to be connected with the outside.

It is in particular the case for some aircraft-embedded computer systems, which communicate with the ground through untrusted communication media. Besides, the increasing demand for new capabilities, such as enhanced on-board connectivity, e.g. using mobile devices, together with the need for cost reduction, leads to more integrated and interconnected systems. For instance, modern aircrafts embed a large number of computer systems, from safety-critical cockpit avionics to passenger entertainment. Some systems meet both safety and security requirements. Despite thorough segregation of subsystems and networks, some shared communication resources raise the concern of possible intrusions.

Some techniques have been developed and still need to be investigated to ensure security and confidentiality properties of such systems. Moreover, most of them are model-based techniques operating only at architectural level and provide no guarantee on the actual implementations. However, most security incidents are due to attackers exploiting subtle implementation-level software vulnerabilities. Systems should therefore be analysed at software level as well (i.e. source or executable code), in order to provide formal assurance that security properties indeed hold for real systems.

Because of the size of such systems, and considering that they are evolving entities, the only economically viable alternative is to perform automatic analyses. Such analyses of security and confidentiality properties have never been achieved on large-scale systems where security properties interact with other software properties, and even the mapping between high-level models of the systems and the large software base implementing them has never been done and represents a great challenge. The goal of this project is to develop the new concepts and technologies necessary to meet such a challenge.

The project ANASTASECproject will allow for the formal verification of security properties of software-intensive embedded systems, using automatic static analysis techniques at different levels of representation: models, source and binary codes. Among expected outcomes of the project will be a set of prototype tools, able to deal with realistic large systems and the elaboration of industrial security evaluation processes, based on static analysis.

8.1.1.2. Verasco

Title: Formally-verified static analyzers and compilers

Type: ANR Ingénierie Numérique Sécurité 2011

Instrument: ANR grant

Duration: Septembre 2011 - September 2015

Coordinator: Inria (France)

Others partners: Airbus France (France), IRISA (France), Inria Saclay (France)

See also: http://www.systematic-paris-region.org/fr/projets/verasco

Abstract: The usefulness of verification tools in the development and certification of critical software is limited by the amount of trust one can have in their results. A first potential issue is *unsoundness* of a verification tool: if a verification tool fails (by mistake or by design) to account for all possible executions of the program under verification, it can conclude that the program is correct while it actually misbehaves when executed. A second, more insidious, issue is *miscompilation*: verification tools generally operate at the level of source code or executable model; a bug in the compilers and code generators that produce the executable code that actually runs can lead to a wrong executable being generated from a correct program.

The project VERASCOadvocates a mathematically-grounded solution to the issues of formal verifying compilers and verification tools. We set out to develop a generic static analyzer based on abstract interpretation for the C language, along with a number of advanced abstract domains and domain combination operators, and prove the soundness of this analyzer using the Coq proof assistant. Likewise, we will continue our work on the CompCert C formally-verified compiler, the first realistic C compiler that has been mechanically proved to be free of any miscompilation will be continued. Finally, the tool qualification issues that must be addressed before formally-verified tools can be used in the aircraft industry, will be investigated.

8.1.1.3. AstréeA

Title: Static Analysis of Embedded Asynchronous Real-Time Software

Type: ANR Ingénierie Numérique Sécurité 2011

Instrument: ANR grant

Duration: January 2012 - December 2015

Coordinator: Airbus France (France)

Others partners: École normale supérieure (France)

Inria contact: Antoine Miné

See also: http://www.astreea.ens.fr

Abstract: The focus of the ASTRÉEA project is on the development of static analysis by abstract interpretation to check the safety of large-scale asynchronous embedded software. During the THÉSÉE ANR project (2006–2010), we developed a concrete and abstract models of the ARINC 653 operating system and its scheduler, and a first analyzer prototype. The gist of the ASTRÉEA project is the continuation of this effort, following the recipe that made the success of ASTRÉE: an incremental refinement of the analyzer until reaching the zero false alarm goal. The refinement concerns: the abstraction of process interactions (relational and history-sensitive abstractions), the scheduler model (supporting more synchronisation primitives and taking priorities into account), the memory model (supporting volatile variables), and the abstraction of dynamical data-structures (linked lists). Patrick Cousot is the principal investigator for this project.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. MemCad

Type: IDEAS

Defi: Design Composite Memory Abstract Domains

Instrument: ERC Starting Grant

Objectif: Design Composite Memory Abstract Domains

Duration: October 2011 - September 2016

Coordinator: Inria (France)

Partner: None

Inria contact: Xavier Rival

Abstract: The MemCAD project aims at setting up a library of abstract domains in order to express and infer complex memory properties. It is based on the abstract interpretation frameworks, which allows to combine simple abstract domains into complex, composite abstract domains and static analyzers. While other families of abstract domains (such as numeric abstract domains) can be easily combined (making the design of very powerful static analyses for numeric intensive applications possible), current tools for the analysis of programs manipulating complex abstract domains usually rely on a monolithic design, which makes their design harder, and limits their efficiency. The purpose of the MemCAD project is to overcome this limitation.

Our proposal is based on the observation that the complex memory properties that need to be reasoned about should be decomposed in combinations of simpler properties. Therefore, in static analysis, a complex memory abstract domain could be designed by combining many simpler domains, specific to common memory usage patterns. The benefit of this approach is twofold: first it would make it possible to simplify drastically the design of complex abstract domains required to reason about complex softwares, hereby allowing certification of complex memory intensive softwares by automatic static analysis; second, it would enable to split down and better control the cost of the analyses, thus significantly helping scalability. As part of this project, we propose to build a static analysis framework for reasoning about memory properties, and put it to work on important classes of applications, including large softwares.

8.2.1.2. MBAT

Title: Combined Model-based Analysis & Testing of Embedded Systems

Type: Artemis Call 10

Instrument: FP7 project

Duration: November 2011 - October 2014

Coordinator: Daimler (Germany)

Others partners: 38 partners in Austria, Denmark, Estonia, France, Germany, Italy, Sweden, and United Kingdom

See also: https://artemis-ia.eu/project/29-mbat.html

Abstract: MBAT will mainly focus on providing a technology platform for effective and cost-reducing validation and verification of embedded systems, focusing primarily on transportation domain, but also to be used in further domains. The project involves thirty three European industrial (large companies and SMEs) and five academic partners. Radhia Cousot is the principal investigator for this project.

8.3. International Initiatives

8.3.1. Participation In other International Programs

8.3.1.1. EXEK

Title: EXEcutable Knowledge

Type: DARPA

Instrument: DARPA Program

Program: Big Mechanism

Duration: July 2014 - December 2017

Coordinator: Harvard Medical School (Boston, USA)

Partner: Inria Paris-Rocquencourt, École normale supérieure de Lyon Université Paris-Diderot,

Inria contact: Jérôme Feret

Abstract: Our overarching objective is Executable Knowledge: to make modeling and knowledge representation twin sides of biological reasoning. This requires the definition of a formal language with a clear operational semantics for representing proteins and their interaction capabilities in terms of agents and rules informed by, but not exposing, biochemical and biophysical detail. Yet, to achieve Executable Knowledge we need to go further:

- Bridge the gap between rich data and their formal representation as executable model elements. Specifically, we seek an intermediate, but already formal, knowledge representation (meta-language) to express granular data germane to interaction mechanisms; a protocol defining which and how data are to be expressed in that language; and a translation procedure from it into the executable format.
- Implement mathematically sound, fast, and scalable tools for analyzing and executing arbitrary collections of rules.
- Develop a theory of causality and attendant tools to extract and analyze the unfolding of causal lineages to observations in model simulations.

We drive these technical goals with the biological objective of assembling rule-based models germane to Wnt signaling in order to understand the role of combinatorial complexity in robustness and control.

8.3.2. Inria International Labs

Xavier Rival attended the LIAMA Open Day in July 2014, gave a talk on “Modular Construction of Shape-Numeric Analyzers” and participated to the associated Summer School, giving a one day introduction to Verification by Abstract Interpretation.

8.3.3. Inria International Partners

8.3.3.1. Informal International Partners

Research on abstract domains for memory states involves the group of Bor-Yuh Evan Chang (University of Colorado at Boulder, Colorado, USA).

Research on sensitivity is done in partnership with the group of Sukyoung Ryu (Assistant Professor at KAIST, Daejeon, Korea).

Research on numeric abstract domain is done in partnership with the groups of Ji Wang and Liqian Chen (National University of Defense Technology, Changsha, China) and of Deepak Kapur (University of New Mexico, USA).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Kwangkeun Yi (Professor at Seoul National University, Seoul, Korea) visited the group during two weeks in June-July 2014. Sukyoung Ryu (Assistant Professor at KAIST, Daejeon, Korea) visited the group during four weeks in July-August 2014.

8.4.2. Internships

Benjamin Audry accomplished a under the supervision of Jérôme Feret (while he was a student at “Collège du Parc”, Sucy en Brie, France).

Pretesh Agrawal accomplished a pre-doctoral internship undern the supervision of Jérôme Feret and Norman Ferns (while he was a fourth year undergraduate student at IIT Kanpur, India).

Émile Ferreux and Nessim Morsli accomplished under the supervision of Jérôme Feret (while they were L1 student of the FDV Bachelor program, Frontiers in Life Science, at University Paris-Descartes, France).

Huisong Li accomplished a pre-doctoral internship under the supervision of Xavier Rival (while she was a student at the Institute of Software, at the Chinese Academy of Sciences (Beijing, China).

Thibault Suzanne accomplished a Master internship under the supervision of Antoine Miné.

Abdelraouf Ouadjaout, a PhD student at CERIST Research Center (Alger), performed a one-month internship in the group under the supervision of Antoine Miné. The internship was funded by the Ministry of Higher Education and Scientific Research of Algeria.

AOSTE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CIM PACA Design Platform

Participants: Robert de Simone, Ameni Khecharem, Carlos Gomez Cardenas, Emilien Kofman.

This ambitious regional initiative is intended to foster collaborations between local PACA industry and academia partners on the topics of microelectronic design, though mutualization of equipments, resources and R&D concerns. We are active in the Design Platform (one of three platforms), of which Inria is a founding member. This provides opportunities for interactions with local companies, leading indirectly to more formal collaborations at times. Phase 3 of the CIM PACA programme should be launched in 2015, and was subject of extensive preparation at the end of 2014.

The ANR HOPE project 8.2.1.1 is conducted under the auspices of the CIM PACA Design Platform, which also hosts prototype and commercial software products contributed by project members (Synopsys, Docea Power, and Magillem, see 8.2.1.1). Similarly, the CLISTINE FUI project was labeled by the platform as microelectronic branch of the SCS competitiveness cluster.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. HOPE

Participants: Carlos Gomez Cardenas, Ameni Khecharem, Emilien Kofman, Robert de Simone.

The ANR HOPE project focuses on hierarchical aspects for the high-level modeling and early estimation of power management techniques, with potential synthesis in the end if feasible.
Although this project was officially started in November 2013, it was in part postponed due to the replacement of a major partner (Texas Instruments) by another one (Intel). Current partners are CNRS/UNS UMR LEAT, Intel, Synopsys, Docea Power, Magillem, and ourselves. A publication on multiview modeling (including performance, power, and temperature) was presented at FDL'2014, reflecting Ameni Khecharem ongoing PhD work.

8.2.1.2. GeMoC

Participants: Matias Vara Larsen, Julien Deantoni, Frédéric Mallet.

This project is admistratively handled by CNRS for our joint team, on the UMR I3S side. Partners are Inria (Triskell EPI), ENSTA-Bretagne, IRIT, Obeo, Thales TRT.
The project focuses on the modeling of heterogeneous systems using Models of Computation and Communication for embedded and real-time systems, described using generic means of MDE techniques (and in our case the MARTE profile, and most specifically its Time Model, which allows to specify precise timely constraints for operational semantic definition).

8.2.2. FUI

8.2.2.1. FUI P

Participants: Abderraouf Benyahia, Dumitru Potop Butucaru, Yves Sorel.

The goal of project P is to support the model-driven engineering of high-integrity embedded real-time systems by providing an open code generation framework able to verify the semantic consistency of systems described using safe subsets of heterogeneous modeling languages, then to generate optimized source code for multiple programming (Ada, C/C++) and synthesis (VHDL, SystemC) languages, and finally to support a multi-domain (avionics, space, and automotive) certification process by providing open qualification material. Modeling languages range from behavioural to architectural languages and present a synchronous and asynchronous semantics (Simulink/Matlab, Scicos, Xcos, SysML, MARTE, UML),
See also: http://www.open-do.org/projects/p/
Partners of the project are: industrial partners (Airbus, Astrium, Continental, Rockwell Collins, Safran, Thales), SMEs (AdaCore, Altair, Scilab Enterprise, STI), service companies (ACG, Aboard Engineering, Atos Origins) and research centers (CNRS, ENPC, Inria, ONERA).

8.2.2.2. FUI CLISTINE

Participants: Robert de Simone, Amin Oueslati, Emilien Kofman.

This project was started in Oct 2013, aprovides PhD funding for Amine Oueslati. Partners are SynergieCAD (coordinator), Avantis, Optis, and the two EPIs Aoste and Nachos. The goal is to study the feasibility of building a low-cost, low-power "supercomputer", reusing ideas from SoC design, but this time with out-of-chip network "on-board", and out-of-the-shelf processor elements organized as an array. The network itself should be time predictable and highly parallel (far more than PCI-e for instance). We started a thorough classification of parallel program types (konown as "Dwarfs" in teh literature), to provide benchmarks to evaluate the platform design options.

8.2.3. Investissements d'Avenir

8.2.3.1. DEPARTS

Participants: Liliana Cucu-Grosjean, Adriana Gogonel, Codé Lo, Cristian Maxim.

This project is funded by the BGLE Call (*Briques Logicielles pour le Logiciel Embarqué*) of the national support programme *Investissements d'Avenir*. Formally started on October 1st, 2012 with the kick-off meeting held on April, 2013 for administrative reasons. Research will target solutions for probabilistic component-based models, and a Ph.D. thesis should start at latest on September 2015. The goal is to unify in a common framework probabilistic scheduling techniques with compositional assume/guarantee contracts that have different levels of criticality.

8.2.3.2. CLARITY

Participants: Yann Bondue, Julien Deantoni, Robert de Simone, Marie Agnès Peraldi-Frati.

This project is funded by the LEOC Call (*Logiciel Embarqué et Objets Connectés*) of the national support programme *Investissements d'Avenir*. It was started in September 2014 , and a kick-of meeting was held on October 9th. Partners are: Thales (several divisions), Airbus, Areva, Altran, All4Tec, Artal, the Eclipse Fondation, Scilab Enterprises, CESAMES, U. Rennes, and Inria. The purpose of teh project is to develop and promote an open-source version of the ARCADIA Melody system design environment from Thales, renamed CAPPELLA for that purpose.

8.2.3.3. Capacites

Participants: Liliana Cucu-Grosjean, Dumitru Potop-Butucaru, Yves Sorel, Walid Talaboulma.

This project is funded by the LEOC Call (*Logiciel Embarqué et Objets Connectés*) of the national support programme *Investissements d'Avenir*. It has started on November 1st, 2014 with the kick-off meeting held on November, 12th 2014. The project cordinator is Kalray, and teh objective of the project is to stydy relevance of Kalray-style MPPA processor array for real-time computation in the avionic domain (with partners such as Airbus for instance).

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7 & H2020

8.3.1.1. ARTEMIS PRESTO

Participants: Frédéric Mallet, Arda Goknil, Julien Deantoni, Marie Agnès Peraldi Frati, Robert de Simone, Jean-Vivien Millo.

Type: ARTEMIS

Project title: PRESTO

Duration: April 2011 - March 2014

Coordinator: Miltech (Greece)

Others partners: TELETEL S.A. (Greece), THALES Communications (France), Rapita Systems Ltd. (United Kingdom), VTT (Finland), Softeam (France), THALES (Italy), MetaCase (Finland), Inria (France), University of LâAquila (Italy), MILTECH HELLAS S.A (Greece), PragmaDev (France), Prismtech (United Kingdom), Sarokal Solutions (Finland).

See also: http://www.cesarproject.eu/

Abstract: The PRESTO project aims at improving test-based embedded systems development and validation, while considering the constraints of industrial development processes. This project is based on the integration of test traces exploitation, along with platform models and design space exploration techniques. Such traces are obtained by execution of test patterns, during the software integration design phase, meant to validate system requirements. The expected result of the project is to establish functional and performance analysis and platform optimisation at early stage of the design development. The approach of PRESTO is to model the software/hardware allocation, by the use of modelling frameworks, such as the UML profile for model-driven development of Real Time and Embedded Systems (MARTE). The analysis tools, among them timing analysis including Worst Case Execution Time (WCET) analysis, scheduling analysis and possibly more abstract system-level timing analysis techniques will receive as inputs on the one hand information from the performance modelling of the HW/SW-platform, and on the other hand behavioural information of the software design from tests results of the integration test execution.

8.4. International Initiatives

8.4.1. Inria International Labs

8.4.1.1. HADES LIAMA project

This joint project is held in collaboration with ECNU Shanghai, together with the Scale Inria team, and extends in scope the Associated Team DAESD (see below). As part of this project Frédéric Mallet spends a sabbatical year at ECNU Shanghai, partly funded by an Inria delegation programme.
We attended a number of LIAMA meetings, both in France and in Beijing, most often in confcall form.

8.4.2. Inria Associate Teams

8.4.2.1. DAESD

Title: Distributed/Asynchronous and Embedded/synchronous Systems Development

Inria principal investigator: Robert de Simone (Aoste) / Eric Madelaine (Scale)

International Partner (Institution - Laboratory - Researcher):

East China Normal University (China) - SEI-Shone - Robert De Simone

Duration: 2012 - 2014

See also: https://team.inria.fr/DAESD/

The development of concurrent and parallel systems has traditionally been clearly split in two different families: distributed and asynchronous systems on one hand, now growing very fast with the recent progress of the Internet towards large scale services and clouds; embedded, reactive, or hybrid systems on the other hand, mostly of synchronous behaviour. The frontier between these families has attracted less attention, but recent trends, e.g. in industrial systems, in Cyber-Physical systems (CPS), or in the emerging Internet of Things, give a new importance to research combining them.
The aim of the DAESD associate team is to combine the expertise of the Oasis and Aoste teams at Inria, the SEI-Shone team at ECNU-Shanghai, and to build models, methods, and prototype software tools inheriting from synchronous and asynchronous models. We plan to address modelling formalisms and tools, for this combined model; to establish a method to analyze temporal and spatial consistency of embedded distributed real-time systems; to develop scheduling strategies for multiple tasks in embedded and distributed systems with mixed constraints.
A dedicated Summer School was organized this year in Shanghai (July 8-11), with participation of Julien Deantoni and Frédéric Mallet from Aoste.
DAESD is strongly linked with the LIAMA project HADES, that it supports.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Invited Professor

Qingguo XU

Date: July 2014 to June 2015

Institution: Shanghai University (China)

8.5.2. Visits to International Teams

8.5.2.1. Sabbatical programme

Mallet Frédéric

Date: Sep 2014 - Aug 2015

Institution: ECNU (China)

APICS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Contract Provence Alpes Côte d'Azur (PACA) Region - Inria, BDO

Contract (no. 2014-05764) funding the research grant of C. Papageorgakis, see Sections 6.1.1 , 7.3 .

8.2. National Initiatives

8.2.1. ANR

The ANR (Astrid) project COCORAM (Co-design et co-intégration de réseaux d'antennes actives multi-bandes pour systèmes de radionavigation par satellite) started January 2014. We are associated with three other teams from XLIM (Limoges University), respectively specialized in filters, antennas and amplifiers design. The core idea of the project is to work on the co-integration of various microwave devices in the context of GPS satellite systems in particular it provides us with an opportunity to work on matching problems (see Section 6.3.1).

8.2.2. ANR MagLune

The ANR project MagLune (Magnétisme de la Lune) has been approved by July 2014. It involves the Cerege (Centre de Recherche et d'Enseignement de Géosciences de l'Environnement, joint laboratory between Université Aix-Marseille, CNRS and IRD), the IPGP (Institut de Physique du Globe de Paris) and ISTerre (Institut des Sciences de la Terre). Associated with Cerege are Inria (Apics team) and Irphe (Institut de Recherche sur les Phénomènes Hors Équilibre, joint laboratory between Université Aix-Marseille, CNRS and École Centrale de Marseille). The goal of this project (led by geologists) is to understand the past magnetic activity of the Moon, especially to answer the question whether it had a dynamo in the past and which mechanisms were at work to generate it. Apics will participate in the project by providing mathematical tools and algorithms to recover the remanent magnetization of rock samples from the moon on the basis of measurements of the magnetic field it generates. The techniques described in Section 6.1 are instrumental for this purpose.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

Apics is part of the European Research Network on System Identification (ERNSI) since 1992.

System identification deals with the derivation, estimation and validation of mathematical models of dynamical phenomena from experimental data.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. IMPINGE

Title: Inverse Magnetization Problems IN GEosciences.

Inria principal investigator: Laurent Baratchart

International Partner (Institution - Laboratory - Researcher):

MIT - Department of Earth, Atmospheric and Planetary Sciences (United States) - Benjamin Weiss

Duration: 2013 - 2015
See details at : http://www-sop.inria.fr/apics/IMPINGE/
The purpose of the associate team IMPINGE is to develop efficient algorithms to recover the magnetization distribution of rock slabs from measurements of the magnetic field above the slab using a SQUID microscope (developed at MIT). The US team also involves a group at Vanderbilt Univ.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

MIT-France seed funding is a competitive collaborative research program ran by the Massachusetts Institute of Technology (Cambridge, Ma, USA). Together with E. Lima and . Weiss from the Earth and Planetary Sciences dept. at MIT, Apics obtained two-years support from the above-mentioned program to run a project entitled: "Development of Ultra-high Sensitivity Magnetometry for Analyzing Ancient Rock Magnetism"

Cyprus NF grant was obtained by N. Stylianopoulos (Univ. Cyprus) to conduct joint research with L. Baratchart, E.B. Saff (Vanderbilt Univ.) and V. Totik (Univ. Szeged, Hungary). The title of the grant is: "Orthogonal polynomials in the complex plane: distribution of zeros, strong asymptotics and shape reconstruction".

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Doug Hardin (Vanderbilt Univ., Nashville, USA, Aug 2014)
- Benjamin Lanfer (BESA, Munich, Germany, Oct 2014)
- Eduardo A. Lima (MIT, Cambridge, USA, Mar 2014)
- Moncef Mahjoub (ENIT LAMSIN, Tunis, Tunisia, Jun 2014)
- Michael Northington (Vanderbilt Univ., Nashville, USA, Aug 2014)
- Yves Rolain (Vrije Universiteit Brussel, Belgium, June 2014)
- Maxim Yattselev (Indiana University–Purdue University, Indianapolis, USA, May 2014)

8.5.1.1. Internships

- Olga Permiakova, Master 2 Computational Biology - UNSA (5 months), Inverse source problem for electromagnetic fields, with physical applications.

8.6. List of international and industrial partners

- Collaboration under contract with Thales Alenia Space (Toulouse, Cannes, and Paris), CNES (Toulouse), XLIM (Limoges), University of Bilbao (Universidad del País Vasco / Euskal Herriko Unibertsitatea, Spain), BESA company (Munich), Flextronics.
- Regular contacts with research groups at UST (Villeneuve d'Asq), Universities of Bordeaux-I (Talence), Orléans (MAPMO), Aix-Marseille (CMI-LATP), Nice Sophia Antipolis (Lab. JAD), Grenoble (IJF and LJK), Paris 6 (P. et M. Curie, Lab. JLL), Inria Saclay (Lab. Poems), Cerege-CNRS (Aix-en-Provence), CWI (the Netherlands), MIT (Boston, USA), Vanderbilt University (Nashville USA), Steklov Institute (Moscow), Michigan State University (East-Lansing, USA), Texas A&M University (College Station USA), University of Urana-Champaign at Indianapolis (Indianapolis, USA), Politecnico di Milano (Milan, Italy), University of Trieste (Italy), RMC (Kingston, Canada), University of Leeds (UK), of Maastricht (The Netherlands), of Cork (Ireland), Vrije Universiteit Brussel (Belgium), TU-Wien (Austria), TFH-Berlin (Germany), ENIT (Tunis), KTH (Stockholm), University of Cyprus (Nicosia, Cyprus), University of Macau (Macau, China), SIAE Microelettronica (Milano).
- The project is involved in the GDR-project AFHP (CNRS), in the ANR (Astrid program) project COCORAM (with XLIM, Limoges, and DGA), in the ANR (Défis de tous les savoirs program) project MagLune (with Cerege, IPGP, ISTerre, Irphe), in a MIT-France collaborative seed funding, in the Associate Inria Team IMPINGE (with MIT, Boston), and in a CSF program (with University of Cyprus).

ARAMIS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. ANR HM-TC

Participants: Olivier Colliot [Correspondant], Marie Chupin, Didier Dormont, Denis Schwartz, Dominique Hasboun, Linda Marrakchi-Kacem, Claire Cury.

Project acronym: HM-TC

Project title: Model of the hippocampo-cortical connectivity in "temporal consciousness" in normal and pathological memory derived from multimodal anatomical and functional brain imaging (aMRI, DT-MRI, MEG, fMRI)

Duration: Nov 2009- Nov 2014

Amount: 2M€

Coordinator: Olivier Colliot (ARAMIS) and Gianfranco Dalla Barba

Other partners: CENIR, ENS Cachan, Neurospin, Grenoble Institut des Neurosciences

Abstract: The aim of this project is to evaluate the role of the medial temporal lobe and its connections with various cortical regions in temporal consciousness related tasks and to derive a neuro-computational model of memory processing from multimodal imaging data. Temporal consciousness is defined as the ability to specify one's own time-location with respect to past, present and future, and is thus a more general framework than episodic memory. Based on an original cognitive model and relying on memory dysfunctions called confabulations, different groups of participants (controls, patients with Alzheimer's disease, patients with several memory disorders) will be evaluated through cognitive tests, MEG, anatomical, functional and diffusion-tensor MRI. New signal and image processing methods will be developed for all these modalities, in order to describe in a more robust and precise way both the anatomy and the function of the medial temporal lobe. First, using in vivo ultra high field MRI acquisitions (7 Tesla), we will build a precise anatomical atlas of the hippocampus and its inner structure. This model will allow designing efficient MEG source reconstruction in these regions, and new methods to analyse anatomical and functional connectivity. Using the most recent mathematical achievements in the theory of diffeomorphic deformations, we will propose new registration and morphometry methods in order to analyze very precisely the structural alterations of the medial temporal lobe. These new methods will be applied to the neuroimaging data acquired for the project in order to analyse extensively the relationships between memory disorders and structural and functional brain alterations revealed by neuroimaging.

8.1.1.2. ANR PREV-DEMALS

Participants: Olivier Colliot [Correspondant], Marie Chupin, Stanley Durrleman, Anne Bertrand.

Project acronym: PREV-DEMALS

Project title: Predict to prevent frontotemporal lobar degeneration (FTLD) and amyotrophic lateral sclerosis (ALS)

Duration: Avr 2015 - Avr 2019

Amount: 487k€

Coordinator: Isabelle Le Ber

Other partners: ICM, AP-HP, CHR de Lille, CHU Limoges, CHU Rouen, Laboratory of Biomedical Imaging

Abstract: The project focuses on C9ORF72, the most frequent genetic form of frontotemporal lobar degeneration (FTLD) and amyotrophic lateral sclerosis (ALS). Since 2006, major discoveries have helped elucidate the pathological bases and linked FTLD and ALS: 1) TDP-43 aggregates in neurons and 2) C9ORF72 mutations in both disorders. Two major pathological subtypes are now defined in FTLD, FTLD-TDP and FTLD-TAU. C9ORF72 mutations (associated to FTLD-TDP) are the most frequent genetic causes of FTLD (15%), FTLD-ALS (65%) and ALS (40%). No curative treatment actually exists, but therapeutics emerged against tau aggregation. The objectives of the project are to develop appropriate cognitive, brain imaging markers and peripheral biomarkers of the early phase of FTLD, to follow disease progression and to guide future targeted therapeutic trials. To address this questions, we will conduct a multimodal study (cognition, brain structural MRI, brain metabolism - FDG-PET) in C9ORF72 families. The cohort will be followed at 3-time points (M0, M18, M36). Longitudinal analyses will aim at characterizing the trajectory of decline across time. Brain structural changes will be evaluated by 1) morphometric analysis to assess global brain atrophy, cortical thickness and study of the cortical sulci; 2) functional connectivity analysis of resting-state MR data; 3) structural connectivity analysis of diffusion-weighted MRI. Brain metabolism will be evaluated with FDG-PET. We will use the most recent RNA sequencing technology to detect gene expression and RNA splicing alterations in lymphocytes of patients and presymptomatic carriers. The discovery of new markers involved in FTLD will have practical consequences for early and accurate diagnosis of FLD and ALS disease.

8.1.2. IHU

8.1.2.1. General program

Participants: Olivier Colliot, Mario Chavez, Stanley Durrleman, Marie Chupin, Didier Dormont, Dominique Hasboun, Damien Galanaud, Fabrizio de Vico Fallani.

Project acronym: IHU-A-ICM

Project title: Institute of Translational Neuroscience

Founded in 2011

General Director: Bertrand Fontaine

The IHU-A-ICM program was selected, in 2011, in a highly competitive national call for projects. A 10-year, 55M€ program, has been implemented by a recently created foundation for scientific cooperation. Based on the clinical and scientific strenghts of the ICM and the hospital Department of Nervous System Diseases, it mainly supports neuroscience research, but is also invested in improving care and teaching. ARAMIS is strongly involved in the IHU-A-ICM project, in particular in WP6 (neuroimaging and electrophysiology), WP7 (biostatistics), WP2 (Alzheimer) and WP5 (epilepsy). We have started collaborations with the new bioinformatics/biostatistics platform (IHU WP7, head: Ivan Moszer), in particular through a joint project on the integration of imaging and genomics data.

8.1.2.2. Internal Research projects

Participants: Mario Chavez, Fabrizio de Vico Fallani.

Project title: Non-invasive manipulation of brain synchrony to enhance brain function and rehabilitate faulty cognition in humans: A proof of concept

Founded in 2014

Coordinator: Antoni Valero Cabre

The long-term goal of this project is to develop the use of non-invasive manipulation of abnormal cerebral oscillations underlying cognitive activity to restore brain function in neurological patients. Cognitive functions emerge from large distributed networks organized in space and time. The short-term goal of this application is to study the causal role played by oscillatory activity in visual awareness and test whether their manipulation by non-invasive brain stimulation has the potential to restore its function in stroke patients.

8.1.3. CATI (Alzheimer Plan)

Participants: Olivier Colliot [Correspondant], Marie Chupin [Correspondant], Stanley Durrleman, Didier Dormont, Chabha Azouani, Ali Bouyahia, Johanne Germain, Xavier Badé, Sonia Djobeir, Hugo Dary, Ludovic Fillon, Takoua Kaaouana, Alexandre Routier, Sophie Lecomte, Mathieu Dubois.

Project acronym: CATI

Project title: Centre d'Acquisition et de Traitement des Images

Founded in 2011

Amount: 9M€

Coordinator: Jean-François Mangin

Other partners: Neurospin, CENIR, Inserm U678, IM2A

Abstract: The CATI project (funded by the National Alzheimer Plan for 9M€, 2.1M€ for ARAMIS) aims at creating a national platform for multicenter neuroimaging studies. CATI aims to be a national resource for the scientific, medical and industrial research community and will provide a wide range of services: access to a national acquisition network, standardization of acquisitions, image quality control, image analysis, databasing/archiving, meta-analyses. Through CATI, our team coordinates a large network composed of over 30 image acquisition centers. CATI already supports over 15 multicenter projects including the national cohort MEMENTO (2300 subjects). CATI is integrated with France Life Imaging (PI: F. Lethimonnier) and the Neugrid for you (N4U, PI: G. Frisoni) network.

8.1.4. National Networks

- GdR Statistics and Medicine - http://gdr.statsante.fr/Accueil.html

8.1.5. Other National Programs

8.1.5.1. Programme Hospitalier de Recherche Clinique (PHRC)

Participants: Olivier Colliot, Marie Chupin, Stanley Durrleman, Didier Dormont, Damien Galanaud.

- PHRC PredictPGRN, co-funding by Alzheimer Plan, *Caractérisation multimodale prospective de la démence frontotemporale dûe à des mutations du gène PGRN à un stade symptomatique et présymptomatique*. (Coordinator : A. Brice)
- PHRC ImaBio3, co-funding by Roche (pharmaceutical industry), *Rôle des réactions cellulaires sanguines, inflammatoires et immunitaires anti-amyloïde centrales et périphériques dans la maladie d'Alzheimer débutante*. (Coordinator : M. Sarazin)
- PHRC CAPP, *Caractérisation linguistique, anatomique/métabolique et biologique des différentes formes d'aphasie primaire progressive : vers le rationnel pour des essais pharmacologiques et des rééducations du langage ciblées*. (Coordinator: M. Teichmann)

8.1.5.2. Institut Universitaire d'Ingénierie pour la Santé (IUIS)

Participants: Mario Chavez, Xavier Navarro.

Project acronym: DYSPEV

Project title: Dépistage de la dyspnée par potentiels évoqués visuels

Founded in 2014

Amount: 38K€

Coordinator: Thomas Similowski

Other partners: UPMC, Inserm UMR 1158

Abstract: Steady state visual evoked potentials (SSVEP) have been widely utilized in brain computer interfacing (BCI) in last years. In this project, we explore the possibilities of SSVEP to manage the communication between patients suffering from respiratory disorders and health care providers. By imposing different breathing constraints, we use a SSVEP-based brain computer interface to help those subjects to communicate their breathing sensations (breathing well/breathing bad).

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

Participants: Stefan Thurner, Vito Latora, Albert Diaz-Guilera, Maxi San Miguel, Cecilia Mascolo, Mirco Musolesi, Mario Chavez [Correspondant].

Project acronym: LASAGNE

Project title: multi-LAyer SpAtiotemporal Generalized NEtworks

Founded in 2012

Amount: 1.6M€

Coordinator: Stefan Thurner

Other partners: Medical University of Vienna, Queen Mary University of London, Universitat de Barcelona, Universitat de les Illes Balears,University of Cambridge, University of Birmingham.

Abstract: The aim of the LASAGNE project is to provide a novel and coherent theoretical framework for analyzing and modelling dynamic and multi-layer networks in terms of multi-graphs embedded in space and time. To do this, we will treat time, space and the nature of interactions not as additional dimensions of the problem, but as natural, inherent components of the very same generalized network description. The theory will be validated on real-world applications involving large and heterogeneous data sets of brain networks, on- and off-line social systems, healthcare systems, and transportation flows in cities. The LASAGNE project will provide new quantitative opportunities in different fields, ranging from the prediction of pathologies to the diffusion of ideas and trends in societies, and for the management of socio-technological systems.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Non-contractual International Partners

S. Durrleman has an enduring collaboration with the Scientific Computing and Imaging (SCI) Institute at the University of Utah (USA). He is consultant for NIH Grant "4D shape analysis for modeling spatiotemporal change trajectories in Huntington's Disease "predict-HD". He is part of the PhD committees of J. Fishbaugh and A. Sharma supervised by professor Guido Gerig.

M. Chupin and O. Colliot have an enduring collaboration with the Center for Magnetic Resonance Research, University of Minnesota, USA (P-F Van de Moortele, T. Henry, M. Marjanska, K. Ugurbil) a leading center in 7T MRI.

D. Galanaud has an enduring collaboration with the Massachusetts General Hospital, Harvard University, USA (R. Gupta).

M. Chavez has a collaborations with the Departement of Mathematics, at Queen Mary University of London, UK (Prof. V. Latora); and the Physics Department of the Universitat de Barcelona, Spain (Prof. Albert Diaz-Guilera)

F. De Vico Fallani has a collaboration with the University Sapienza, Rome, Italy (Profs. Fabio and Claudio Babiloni) and with the IRCCS Fondazione Santa Lucia, Rome, Italy (M. Molinari and D. Mattia).

8.4. International Research Visitors

8.4.1. Visits to International Teams

8.4.1.1. Research stays abroad

M. Chavez spent 45 days as visiting researcher in the Physics Department of the Universitat de Barcelona, Spain (February, 2014)

ARIC Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The PhD grant of Valentina Popescu is funded by Région Rhône-Alpes through the ARC6 programme.

8.2. National Initiatives

8.2.1. ANR HPAC Project

Participants: Claude-Pierre Jeannerod, Nicolas Louvet, Clément Pernet, Nathalie Revol, Philippe Théveny, Gilles Villard.

"High-performance Algebraic Computing" (HPAC) is a four year ANR project that started in January 2012. The Web page of the project is http://hpac.gforge.inria.fr/. HPAC is headed by Jean-Guillaume Dumas (CASYS team, LJK laboratory, Grenoble); it involves AriC as well as the Inria project-team MOAIS (LIG, Grenoble), the Inria project-team PolSys (LIP6 lab., Paris), the ARITH group (LIRMM laboratory, Montpellier), and the HPC Project company.

The overall ambition of HPAC is to provide international reference high-performance libraries for exact linear algebra and algebraic systems on multi-processor architecture and to influence parallel programming approaches for algebraic computing. The central goal is to extend the efficiency of the LinBox and FGb libraries to new trend parallel architectures such as clusters of multi-processor systems and graphics processing units in order to tackle a broader class of problems in lattice-based cryptography and algebraic cryptanalysis. HPAC conducts researches along three axes:

- A domain specific parallel language (DSL) adapted to high-performance algebraic computations;
- Parallel linear algebra kernels and higher-level mathematical algorithms and library modules;
- Library composition, their integration into state-of-the-art software, and innovative high performance solutions for cryptology challenges.

8.2.2. ANR DYNA3S Project

Participants: Guillaume Hanrot, Gilles Villard.

Dyna3s is a four year ANR project that started in October 2013. The Web page of the project is http://www.liafa.univ-paris-diderot.fr/dyna3s/. It is headed by Valérie Berthé (U. Paris 7) and involves also the University of Caen.

The aim is to study algorithms that compute the greatest common divisor (gcd) from the point of view of dynamical systems. A gcd algorithm is considered as a discrete dynamical system by focusing on integer input. We are mainly interested in the computation of the gcd of several integers. Another motivation comes from discrete geometry, a framework where the understanding of basic primitives, discrete lines and planes, relies on algorithm of the Euclidean type.

8.2.3. ANR FastRelax Project

Participants: Nicolas Brisebarre, Guillaume Hanrot, Vincent Lefèvre, Jean-Michel Muller, Bruno Salvy, Serge Torres, Silviu Filip, Sébastien Maulat.

FastRelax stands for "Fast and Reliable Approximation". It is a four year ANR project started in October 2014. The web page of the project is http://fastrelax.gforge.inria.fr/. It is headed by B. Salvy and involves AriC as well as members of the Marelle Team (Sophia), of the Mac group (LAAS, Toulouse), of the Specfun and Toccata Teams (Saclay), as well as of the Pequan group in UVSQ and a colleague in the Plume group of LIP.

The aim of this project is to develop computer-aided proofs of numerical values, with certified and reasonably tight error bounds, without sacrificing efficiency. Applications to zero-finding, numerical quadrature or global optimization can all benefit from using our results as building blocks. We expect our work to initiate a "fast and reliable" trend in the symbolic-numeric community. This will be achieved by developing interactions between our fields, designing and implementing prototype libraries and applying our results to concrete problems originating in optimal control theory.

8.2.4. PEPS Quarenum

Participants: Nicolas Louvet, Nathalie Revol.

"Quarenum" is an abbreviation for *Qualité et Reproductibilité Numériques dans le Calcul Scientifique Haute Performance*. This project focuses on the numerical quality of scientific software, more precisely of high-performance numerical codes. Numerical validation is one aspect of the project, the second one regards numerical reproducibility.

8.3. International Initiatives

8.3.1. Inria Associate Teams

QOLAPS (Quantifier elimination, Optimization, Linear Algebra and Polynomial Systems) is an Associate Team between the Symbolic Computation Group at North Carolina State University (USA), the PolSys team at LIP6, Paris 6, and the AriC team. Participants: Clément Pernet, Nathalie Revol, Gilles Villard.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

Our international academic collaborators are from Courant Institute of Mathematical Sciences (USA), Hamburg University of Technology (Germany), Imperial College (UK), Macquarie University (Australia), Mc Gill University (Canada), Monash University (Australia), Nanyang Technological University (Singapore), North Carolina State University (USA), Technical University of Cluj-Napoca (Romania), University of California, Los Angeles (USA), University of Delaware (USA), University of Southern Denmark (Denmark), University of Western Ontario (Canada), University of Waterloo (Canada), Uppsala University (Sweden).

We also collaborate with Intel (Portland, USA).

8.3.3. Participation In other International Programs

- PICS CANTaL (Cryptography, Algorithmic Number Theory and Lattices). This is a collaborative project involving several AriC members (Nicolas Brisebarre, Guillaume Hanrot, Fabien Laguillaumie, Adeline Langlois and Damien Stehlé), and collaborators in several Australian universities: Christophe Doche (Macquarie University), Igor Shparlinski (UNSW) and Ron Steinfeld (Monash University). It was funded by the International office of the CNRS, for 2012, 2013 and 2014.
- IEEE P1788 working group for the standardization of interval arithmetic. We contributed to the creation in 2008 of this working group http://grouper.ieee.org/groups/1788/ and Nathalie Revol chairs this group since its creation. In 2014, the final draft text has been approved upon by the working group in June. The rest of the year was devoted to editorial polishing, before submitting the text to the "Sponsor ballot", which constitutes the final step and should be completed in 2015. The annual in-person meeting, chaired by Nathalie Revol, took place at the end of the SCAN 2014 conference in Würzburg, Germany, the 26 September.

  Vincent Lefèvre actively participated in various discussions, either in the mailing-list or in small subgroups.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Many colleagues from all other the world visit us regularly for seminars and collaborations. We list only long visits here.

Jie Chen (assistant professor at ECNU, China) visited us for a month, in November. He collaborated with Fabien Laguillaumie, Benoît Libert and Damien Stehlé on functional encryption.

Jung Hee Cheon (professor at SNU, South Korea) and Changmin Lee (PhD student at SNU, South Korea) visited us for a month, in August. They collaborated with Damien Stehlé on the approximate greatest common divisor problem and its applications in homomorphic cryptography.

8.4.1.1. Internships

Mihai-Ioan Popescu (ENS de Lyon) did a Master 1 internship from May to July, under the supervision of Damien Stehlé. He worked on heuristic algorithms for short lattice vector enumeration.

François Colas (U. Grenoble) did a Master 2 internship from March to June, under the supervision of Damien Stehlé. He worked on lattice-based homomorphic encryption.

Catalin Cocis (ENS de Lyon) did a Master 2 internship from February to June under the supervision of Fabien Laguillaumie. He worked on the implementation of multilinear maps.

Laura Chira (Technological U. of Cluj, Romania) did an L3 Summer internship from July to September 2014. This internship was supervised by Benoît Libert and devoted to the implementation of pseudo-random functions based on hard algorithmic problems in lattices.

Thomas Grégoire (ENS de Lyon) did a Master 2 internship from February to June under the supervision of Nicolas Brisebarre. He designed some tools for the certified approximation of functions in various orthogonal bases.

Saurabh Yadav (2nd year student, Indian Institute of Technology Delhi, India) did a Summer internship supervised by Benoît Libert in July and August 2014. The goal was to study and survey the applications of a cryptographic primitive built on top of multi-linear maps and called “indistinguishability obfuscation.”

ASAP Project-Team

8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. LABEX CominLabs

Participants: Anne-Marie Kermarrec, Davide Frey, Michel Raynal, François Taïani.

ASAP participates in the CominLabs initiative sponsored by the "Laboratoires d'Excellence" program. The initiative federates the best teams from Bretagne and Nantes regions in the broad area of telecommunications, from electronic devices to wide area distributed applications "over the top." These include, among the others, the Inria teams: ACES, ALF, ASAP, CELTIQUE, CIDRE, DISTRIBCOM, MYRIADS, TEMICS, TEXMEX, and Visages. The scope of CominLabs covers research, education, and innovation. While being hosted by academic institutions, CominLabs builds on a strong industrial ecosystem made of large companies and competitive SMEs. In this context, ASAP received funding for DeSeNt (a collaborative project with the Univ. Nantes / LINA).

8.1.2. ANR project SocioPlug

Participants: Davide Frey, Anne-Marie Kermarrec, Pierre-Louis Roman, François Taïani.

SocioPlug is a collaborative ANR project involving Inria (ASAP team), the Univ. Nantes, and LIRIS (INSA Lyon and Univ. Claude Bernard Lyon). The project emerges from the observation that the features offered by the Web 2.0 or by social media do not come for free. Rather they bring the implicit cost of privacy. Users are more of less consciously selling personal data for services. SocioPlug aims to provide an alternative for this model by proposing a novel architecture for large-scale, user centric applications. Instead of concentrating information of cloud platforms owned by a few economic players, we envision services made possible by cheap low-end plug computers available in every home or workplace. This will make it possible to provide a high amount of transparency to users, who will be able to decide their own optimal balance between data sharing and privacy.

8.1.3. DeSceNt CominLabs

Participants: Resmi Ariyattu Chandrasekharannair, Davide Frey, Michel Raynal, François Taïani.

The DeSceNt project aims to ease the writing of distributed programs on a federation of plug computers. Plug computers are a new generation of low-cost computers, such as Raspberry pi (25$), VIA- APC (49$), and ZERO Devices Z802 (75$), which offer a cheap and readily available infrastructure to deploy domestic on-line software. Plug computers open the opportunity for everyone to create cheap nano-clusters of domestic servers, host data and services and federate these resources with their friends, colleagues, and families based on social links. More particularly we will seek in this project to develop novel decentralized protocols than can encapsulate the notion of privacy-preserving federation in plug-based infrastructures. The vision is to use these protocols to provide a programming toolkit that can support the convergent data types being developed by our partner GDD (Gestion de Données Distribuées) at Univ. Nantes.

8.1.4. ANR Blanc project Displexity

Participants: George Giakkoupis, Anne-Marie Kermarrec, Michel Raynal.

The Displexity project started in Oct 2011. The aim of this ANR project that also involves researchers from Paris and Bordeaux is to establish the scientific foundations for building up a consistent theory of computability and complexity for distributed computing. One difficulty to be faced by DISPLEXITY is to reconcile two non necessarily disjoint sub-communities, one focusing on the impact of temporal issues, while the other focusing on the impact of spatial issues on distributed algorithms.

8.2. European initiatives

8.2.1. FP7 & H2020 projects

8.2.1.1. TOWARD THE ALLYOURS START-UP

Title: TOWARD THE ALLYOURS START-UP

Type: EIT-ICT Labs

Instrument: ACLD Computing in the Cloud

Duration: Jan - Dec 2014.

Coordinator: Inria (France)

Partners: Trento Rise, BDP EIT-ICT

See also: http://www.gossple.fr

Abstract: The goal of the Activity proposal is to turn the inventions from the ERC Starting Grant Project GOSSPLE to innovation by setting up a start-up (AllYours) targeting both Internet users as well as small to medium companies (SME) offering full-fledged personalization in notification systems. In this second year, the AllYours activity focused on the peer-to-peer and on the corporate version of AllYours through a collaborative initiative that involves the ASAP team, TrentoRise (Italy), and the Eindhoven EIT/ICT nodes. Our work consisted on refining and testing our implementations. For the p2p version, we ran a test with real users coordinated by TrentoRise from Sep to Nov 2014.

8.2.2. Collaborations with major European organizations

Ecole Polytechnique Federale de Lausanne EPFL Switzerland; collaboration on the Google Focused Award Web-Alter-Egos.

8.3. International Initiatives

8.3.1. Inria associate teams

8.3.1.1. RADCON

Title: Randomized Algorithms for Distributed Computing and Networks

International Partner (Institution - Laboratory - Researcher):

Univ. of Calgary (CANADA)

Duration: 2013 - 2015

See also: http://www.irisa.fr/asap/radcon

Over recent years, computing systems have seen a massive increase in parallelism and interconnectivity. Peer-to-peer systems, ad-hoc networks, sensor networks, or the "cloud" are based on highly connected and volatile networks. Individual nodes such as cell phones, desktop computers or high performance computing systems rely on parallel processing power achieved through multiple processing units. To exploit the power of massive networks or multiple processors, algorithms must cope with the scale and asynchrony of these systems, and their inherent instability, e.g., due to node, link, or processor failures. In this research project we explore randomized algorithms for large-scale networks of distributed systems, and for shared memory multi-processor systems.

For large-scale networks, decentralized gossip protocols have emerged as a standard approach to achieving fault-tolerant communication between nodes with simple and scalable algorithms. We will devise new gossip protocols for various complex distributed tasks, and we will explore the power and limits of gossip protocols in various settings.

For shared memory systems, randomized algorithms have proved extremely useful to deal with asynchrony and failures. Sometimes probabilistic algorithms provide the only solution to a problem; sometimes they are more efficient; sometimes they are simply easier to implement. We will devise efficient algorithms for some of the fundamental problems of shared memory computing, such as mutual exclusion, renaming, and consensus.

8.3.2. Inria international partners

Univ. of Calgary

Univ. Nacional Autonoma de Mexico

Univ. of Glasgow

8.4. International Research Visitors

8.4.1. Visits of international scientists

Yahya Benkaouz, ENSIAS Rabat, Morocco, from Dec 1 2013 to Feb 28 2014

Maryam Helmi Khomeirani, Univ. of Calgary, Canada, from Aug 15 to Oct 14 2014

Frederik Mallmann-Trenn, Simon Fraser Univ., Canada, from Jan 15 to Apr 20 and from Jun 16 to Jul 22 2014

Diogo Saraiva Lima, Univ. of Lisbon, Portugal, from Jul 1 to Aug 29 2014

8.4.2. Internships

Naman Goel; from Feb 1 to Apr 25 2014. *User profiles segmentation for efficient personalized recommendations*. Supervised by Anne-Marie Kermarrec and François Taiani.

Frederik Mallmann-Trenn; until Jul 31 2014. *Bounds on the Voting Time in Terms of Conductance.* Supervised by George Giakkoupis (and Petra Berenbrink of Simon Frazer Univ., Canada).

Mathieu Pasquet; from Feb 1 to Jun 30 2014. *Content-based orientation in decentralized recommenders.* Supervised by Davide Frey.

Martin Sansoucy; from May 15 to Aug 31 2014. *Caractérisation d'un protocole décentralisé de construction de topologies informatiques réparties à mémoire de forme*. Supervised by François Taiani.

8.4.3. Visits to international teams

George Giakkoupis, Univ. of Calgary, Canada, Mar 23 to Apr 10, and Oct 22 to Nov 9 2014.

Anne-Marie Kermarrec was a part-time visiting professor at EPFL, Switzerland, from Jan to Jul 2014.

Anne-Marie Kermarrec, Univ. of Sydney and NICTA, Australia, two weeks in Jan 2014.

Anne-Marie Kermarrec, Yandex, Moscow, Russia, one week in Jun 2014.

Antoine Rault, EPFL, Switzerland, Sep 1 to Nov 29 Nov 2014

ASCLEPIOS Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 & H2020 Projects

7.1.1.1. MD PAEDIGREE

Type: FP7

Defi: ICT for Health, Ageing Well, Inclusion and Governance

Instrument: Integrated Project

Objectif: Virtual Physiological Human

Duration: March 2013 - February 2017

Coordinator: Ospedale Pediatrico Bambino Gesu, Rome, Italy.

Partner: Siemens AG (DE), Siemens SCR (USA), Maat France (FR), MOTEK (NL), EMP (DE), VUmc (NL), Lynkeus (IT). Universities: KU Leuven (BE), Fraunhofer (DE), UMC Utrecht (NL), TU Delft(NL), Sheffield (UK), Athens (GR), Genoa (IT), Transilvania din Brasov (RO); Hospitals: OPBG (Roma, IT), Gaslini (Genoa, IT), GOSH/UCL (London, UK), JHU (Baltimore, USA).

Inria contact: Xavier Pennec

See also: http://www.md-paedigree.eu/

Abstract:MD-Paedigree is a clinically-driven and strongly VPH-rooted project, where 7 world-renowned clinical centres of excellence pursue improved interoperability of paediatric biomedical information, data and knowledge by developing together a set of reusable and adaptable multi-scale models for more predictive, individualised, effective and safer paediatric healthcare, being scientifically and technologically supported by one of the leading industrial actors in medical applications in Europe operating in conjunction with highly qualified SMEs and some of the most experienced research partners in the VPH community. MD-Paedigree validates and brings to maturity patient-specific computer-based predictive models of various paediatric diseases, thus increasing their potential acceptance in the clinical and biomedical research environment by making them readily available not only in the form of sustainable models and simulations, but also as newly-defined workflows for personalised predictive medicine at the point of care. These tools can be accessed and used through an innovative model-driven infostructure powered by an established digital repository solution able to integrate multimodal health data, entirely focused on paediatrics and conceived of as a specific implementation of the VPH-Share project, planned to be fully interoperable with it and cooperating, through it, also with p-Medicine. MD-Paedigree's goals are to integrate and share highly heterogeneous biomedical information, data and knowledge, using best practices from the biomedical semantic Web; develop holistic search strategies to seamlessly navigate through and manage the integrative model-driven infostructure and digital repository; jointly develop reusable, adaptable and composable multi-scale VPH workflow models, support evidence-based translational medicine at the point of care, and ultimately facilitate collaborations within the VPH community.

7.1.1.2. VP2HF

Type: FP7

Defi: ICT for Health, Ageing Well, Inclusion and Governance

Instrument: Specific Targeted Research Project

Objectif: Virtual Physiological Human

Duration: October 2013 - September 2016

Coordinator: King's College London (UK)

Partner: Philips Research Hamburg (DE), Universitat Pompeu Fabra (SP), Inria, French National Research Institute in Informatics and Mathematics (FR), Université Catholique de Louvain (BE), Caen University Hospital (FR), Philips Research Paris (FR), Simula Research Laboratory (NO), Centron Diagnostics (UK).

Inria contact: Maxime Sermesant

See also: http://vp2hf.eu/

Abstract: Heart failure (HF) is one of the major health issues in Europe, affecting 6 million patients and growing substantially because of the ageing population and improving survival following myocardial infarction. The poor short to medium term prognosis of these patients means that treatments such as cardiac re-synchronisation therapy and mitral valve repair can have substantial impact. However, these therapies are ineffective in up to 50% of the treated patients and involve significant morbidity and substantial cost. The primary aim of VP2HF is to bring together image and data processing tools with statistical and integrated biophysical models mainly developed in previous VPH projects, into a single clinical workflow to improve therapy selection and treatment optimisation in HF. The tools will be tested and validated in 200 patients (including 50 historical datasets) across 3 clinical sites, including a prospective clinical study in 50 patients in the last year of the project. The key innovations in VP2HF that make it likely that the project results will be commercially exploited and have major clinical impact are: 1) all tools to process images and signals, and obtain the statistical and biophysical models will be integrated into one clinical software platform that can be easily and intuitively used by clinicians and tried out in the prospective clinical study; and 2) by utilising a decision tree stratification approach, only the appropriate parts of the tool chain, that will add maximum value to the predictions, will be used in individual patients, so that the more resource intensive parts will be used when they will add real value. We expect that the study results of substantial improved efficacy of decision making over current guidelines, and an integrated package that is used as part of clinical workflow will ensure the industrial project partners, in particular Philips, will develop project outputs into dedicated products that will have significant clinical impact.

7.1.1.3. MedYMA

Type: FP7

Instrument: ERC Advanced Grant

Duration: April 2012 - March 2017

Coordinator: Inria (France)

Inria contact: Nicholas Ayache

Abstract: During the past decades, exceptional progress was made with in vivo medical imaging technologies for capturing the anatomical, structural and physiological properties of tissues and organs in a patient, with an ever increasing spatial and temporal resolution. The physician is now faced with a formidable overflow of information, especially when a time dimension is added to the already hard to integrate 3-D spatial, multimodal and multiscale dimensions of modern medical images. This increasingly hampers the early detection and understanding of subtle image changes which can have a vital impact on the patient's health. To change this situation, this proposal introduces a new generation of computational models for the simulation and analysis of dynamic medical images. Thanks to their enerative nature, they will allow the construction of databases of synthetic, realistic medical image sequences simulating various evolving diseases, producing an invaluable new resource for training and benchmarking. Leveraging their principled biophysical and statistical foundations, these new models will bring remarkable added clinical value after they are personalized with innovative methods to fit the medical images of any specific patient. By explicitly revealing the underlying evolving biophysical processes observable in the images, this approach

will yield new groundbreaking image processing tools to correctly interpret the patient's condition (computer aided diagnosis), to accurately predict future evolution (computer aided prognosis), and to precisely simulate and monitor an optimal and personalized therapeutic strategy (computer aided therapy). First applications will concern high impact diseases including brain tumors, Alzheimer's disease, heart failure and cardiac arrhythmia and will open new horizons in computational medical imaging.

7.1.2. Inria International Partners

7.1.2.1. Stanford, Statistics Department

France Stanford collaborative project grant (2013-2014):*Understanding Lower Back Pain through Geometric Statistical Analysis of computed tomography (CT) Images*. Stanford, Statistics Dept & Nice Univ. Hospital. Principal investigators X. Pennec (Inria) and S. Holmes (Stanford). Collaboration on statistics on group-valued trees and geometric subspace learning.

7.1.2.2. Informal International Partners

7.1.2.2.1. St Thomas' Hospital, King's College London, United Kingdom

Maxime Sermesant is a visiting lecturer in the Division of Imaging Sciences and Biomedical Engineering, St Thomas' Hospital, King's College London lead by Pr Reza Razavi. The XMR facility within this hospital is a unique opportunity to validate and exploit the cardiovascular modelling work.

7.1.2.2.2. Massachusetts General Hospital, Boston

A collaboration with Dr Jan Unklebach, Assistant Professor of Radiation Oncology and Dr Jayashree Kalpathy-Cramer, radiology instructor was initiated in 2013 around the topics of tumor growth modeling, radiotherapy planning and edema characterization from MRI. Matthieu Lê spent 2013 in the department of Radiation Physics at MGH.

7.1.2.2.3. Other International Hospitals

Collaborations with several other European hospitals have been established through the European projects VP2HF and MD PAEDIGREE.

7.2. International Research Visitors

7.2.1. Visits to International Teams

7.2.1.1. Research stays abroad

- Chloé Audigier spent 3 months at Siemens, Princeton, USA from September 22, 2014 to January 30, 2015.
- Jan Margeta spent 3 months at Microsoft Research, Cambrige, UK from July 1, 2014 to September 23, 2014.

ASCOLA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Competitiveness cluster Images-et-Reseaux

8.1.1.1. EcoCloud

Participant: Jean-Marc Menaud.

The project EcoCloud is a cooperative research project running for 2 years. Three other partners collaborate within the project that is coordinated by the company EasyVirt: the Ascola team and another company Pentasonic. The partners aim at developing an economically-valid and ecologic cloud platform in the context of micro and mono-site data centers (all resources are in the same physical location). A high SLA level must be provided with a specific focus on high availability satisfying strong redundancy and placement constraints.

8.2. National Initiatives

8.2.1. CominLabs laboratory of excellence

8.2.1.1. EPOC

Participants: Jean-Marc Menaud [coordinator], Thomas Ledoux.

The project EPOC (Energy Proportional and Opportunistic Computing system) is an (academic) Labex CominLabs project running for 4 years. Four other partners collaborate within the project that is coordinated by ASCOLA: Myriads team, and the three institutions ENIB, ENSTB and University of Nantes. In this project, the partners focus on energy-aware task execution from the hardware to application's components in the context of a *mono-site* data center (all resources are in the same physical location) which is connected to the *regular electric Grid and to renewable energy sources* (such as windmills or solar cells). Three major challenges are addressed in this context: Optimize the energy consumption of distributed infrastructures and service compositions in the presence of ever more dynamic service applications and ever more stringent availability requirements for services; Design a clever cloud's resource management which takes advantage of renewable energy availability to perform opportunistic tasks, then exploring the trade-off between energy saving and performance aspects in large-scale distributed system; Investigate energy-aware optical ultra high-speed interconnection networks to exchange large volumes of data (VM memory and storage) over very short periods of time.

One of the strengths of the project is to provide a systematic approach, and use a single model for the system (from hard to soft) by mixing constraint programming and behavioral models to manage energy consumption in data centers.

This year, we have proposed a Cloud energy broker [26], which can adjust the availability and price combination to buy Green energy dynamically from the market to make datacenter green.

8.2.1.2. SecCloud

Participants: Jacques Noyé [coordinator], Florent Marchand de Kerchove de Denterghem, Mario Südholt.

The high-level objective of the 3-year SecCloud (Secure Scripting for the Cloud) project is to enhance the security of devices on which web applications can be downloaded, i.e. to enhance client-side security in the context of the Cloud. In order to do so, the project relies on a language-based approach, focusing on three related issues:

- The definition of security policies for web architectures, especially on the client-side.
- Formally-proven analyses of web programming languages.
- Multi-level enforcement mechanisms for the security policies (based on static and dynamic analysis encompassing application-level and system-level software).

ASCOLA members are mainly interested in JavaScript as a programming language as well as the use of aspects as a seamless path from the definition of security policies and their composition to their implementation.

This year we have investigated how to extend real-world Javascript environments, such as Narcissus in a modular way.

8.2.2. ANR

8.2.2.1. MyCloud (ANR/ARPEGE)

Participants: Thomas Ledoux [coordinator], Jean-Marc Menaud, Yousri Kouki.

The MyCloud project is an ANR/ARPEGE project running for 42 months, starting in Nov. 2010. It was accepted in Jul. 2010 for funding amounting to 190 KEUR (ASCOLA only). MyCloud involves a consortium with three academic partners (Inria, LIP6, EMN) and one industrial partner (We Are Cloud).

Cloud Computing provides a convenient means of remote on-demand and pay-per-use access to computing resources. However, its ad-hoc management of quality-of-service (QoS) and SLA poses significant challenges to the performance, dependability and costs of online cloud services.

The objective of MyCloud (http://mycloud.inrialpes.fr) is to define and implement a novel cloud model: SLAaaS (SLA as a Service). The SLAaaS model enriches the general paradigm of Cloud Computing and enables systematic and transparent integration of SLA to the cloud. From the cloud provider's point of view, MyCloud proposes autonomic SLA management to handle performance, availability, energy and cost issues in the cloud. From the cloud customer's point of view, MyCloud provides SLA governance allowing cloud customers to be part of the loop and to be automatically notified about the state of the cloud, such as SLA violation and cloud energy consumption.

The project ended in April 2014. This year, our main contribution is a new system for the specification of service-level agreements in the Cloud presented at the IEEE/ACM CCGrid conference [27].

8.2.2.2. SONGS (ANR/INFRA)

Participants: Adrien Lebre [coordinator], Flavien Quesnel, Jonathan Pastor.

The SONGS project (Simulation of Next Generation Systems) is an ANR/INFRA project running for 48 months (starting in January 2012 with an allocated budget of 1.8MEuro, 95KEuro for ASCOLA).

The consortium is composed of 11 academic partners from Nancy (AlGorille, coordinator), Grenoble (MESCAL), Villeurbanne (IN2P3 Computing Center, GRAAL/Avalon - LIP), Bordeaux (CEPAGE, HiePACS, RUNTIME), Strasbourg (ICPS - LSIIT), Nantes (ASCOLA), Nice (MASCOTTE, MODALIS).

The goal of the SONGS project (http://infra-songs.gforge.inria.fr) is to extend the applicability of the SimGrid simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems.

8.2.3. FSN

8.2.3.1. OpenCloudware (FSN)

Participants: Jean-Marc Menaud [coordinator], Thomas Ledoux, Yousri Kouki.

The OpenCloudware project is coordinated by France Telecom, funded by the French Fonds National pour la Société Numérique (FSN, call Cloud n°1) and endorsed by competitiveness clusters Minalogic, Systematic and SCS. OpenCloudware is developed by a consortium of 18 partners bringing together industry and academic leaders, innovative technology start-ups and open source community expertise. Duration: 36 months - 2012–2014.

The OpenCloudware project aims at building an open software engineering platform, for the collaborative development of distributed applications to be deployed on multiple Cloud infrastructures. It will be available through a self-service portal. We target virtualized multi-tier applications such as JavaEE - OSGi. The results of OpenCloudware will contain a set of software components to manage the lifecycle of such applications, from modelling(Think), developing and building images (Build), to a multi-IaaS compliant PaaS platform (Run).

The ASCOLA project-team is mainly involved in the sub-projects "Think" (SLA model across Cloud layers) and "Run" (virtual machine manager for datacenters and placement constraints). In 2013, the team has developed btrCloudStack, a private cloud based on the OpenSource CloudStack and integrating the work on placement rules and energy optimization.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. ERC Starting Grant: The CoqHoTT project

Participant: Nicolas Tabareau [coordinator].

CoqHoTT stands for Coq for Homotopy Type Theory. The goal of this project is to go further in the correspondence between proofs and programs which has allowed in the last 20 years the development of useful proof assistants, such as Coq (developed by Inria). This project starts from the recent discovery by field medal Vladimir Voevosdky, of the strong link between homotopy theory (which studies the notion of continuous deformation in topology) and type theory (which is at the heart of the Coq proof assistant). The main goal of the CoqHoTT project is to provide a new generation of proof assistants based on this fascinating connection.

The CoqHoTT project should starts on March 2015 with a budget of 1,5M€.

8.3.1.2. A4Cloud (IP)

Participants: Mario Südholt [coordinator], Walid Benghabrit, Ronan-Alexandre Cherrueau, Rémi Douence, Hervé Grall, Jean-Claude Royer, Mohamed Sellami.

The integrated project “Accountability for the Cloud” (A4Cloud) is coordinated by HP Labs, UK, and fosters cooperation of a consortium of five industrial and eight academic partners. It has been started in Oct. 2012 for a duration of 42 months.

A4Cloud focuses on accountability properties for the cloud and other future internet services as the most critical prerequisite for effective governance and control of corporate and private data processed by cloud-based IT services. The research being conducted in the project will increase trust in cloud computing by devising methods and tools, through which cloud stakeholders can be made accountable for the privacy and confidentiality of information held in the cloud. These methods and tools will combine risk analysis, policy enforcement, monitoring and compliance auditing. They will contribute to the governance of cloud activities, providing transparency and assisting legal, regulatory and socio-economic policy enforcement. For further information, see http://www.a4cloud.eu. ASCOLA, whose financial support consists of 550 K€, is mainly involved in the sub-projects on the enforcement of accountability and security policies, as well as tool validation efforts.

This year we have proposed new logic-based and language-level means for the formal specification and implementation of accountability properties (see 6.3).

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. REAL

Title: Reasoning about Aspect-oriented Programs and security In Distributed Systems

International Partner (Institution - Laboratory - Researcher):

Universidad de Chile (CHILI)

Duration: 2010-2016

See also: http://real.gforge.inria.fr

While Aspect-Oriented Programming offers promising mechanisms for enhancing the modularity of software, this increased modularity raises new challenges for systematic reasoning. This project studies means to address fundamental and practical issues in understanding distributed aspect-oriented programs by focusing on the issue of security. To this end, the project tackles three complementary lines of work: 1. Designing a core calculus to model distributed aspect-oriented programming languages and reason about programs written in these languages. 2. Studying how aspects can be used to enforce security properties in a distributed system, based upon guarantees provided by the underlying aspect infrastructure. 3. Designing and developing languages, analyses and runtime systems for distributed aspects based on the proposed calculus, therefore enabling systematic reasoning about security. These lines of work are interconnected and confluent. A concrete outcome of RAPIDS will be prototypes for two concrete distributed aspect-oriented extensions of languages increasingly used by current practitioners: Javascript and Java/Scala.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

Apart from the Inria associate team rapids with the Pleiad group (Prof. Éric Tanter) at U. Chile, the Ascola team has formalized cooperations, notably in the context of co-financed and co-supervised PhD theses with the PROG group (Prof. Wofgang de Meuter) at VU Brussel, Belgium, and the Software Technology group (Prof. Mira Mezini) at TU Darmstadt, Germany.

Furthermore, the Ascola team has long-term cooperations that resulted in common results in 2014, typically joint publications or common software artifacts, with partners from the AIST research institute (Dr. Takahiro Hirofuchi) and U. of Bogota, Colombia (Prof. Rubby Casallas).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

Gustavo Soto Ridd has done an Inria master internship advised by Nicolas Tabareau from August to November 2014. The goal of the internship was to go beyond the work on aspectual session types 6.4 .

8.5.1.2. Researchers

Dr. Takahiro Hirofuchi, Researcher at AIST (Japan) spent one week in June 2014 to prepare a journal submission related to the Virtualization extensions we made in 2013 in Simgrid. The article is under review.

ASPI Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. PDMP Inférence, Évolution, Contrôle et Ergodicité (PIECE) — ANR Jeunes Chercheuses et Jeunes Chercheurs

Participant: Florent Malrieu.

January 2013 to December 2016.

Piecewise deterministic Markov processes (PDMP) are non-diffusive stochastic processes which naturally appear in many areas of applications as communication networks, neuron activities, biological populations or reliability of complex systems. Their mathematical study has been intensively carried out in the past two decades but many challenging problems remain completely open. This project aims at federating a group of experts with different backgrounds (probability, statistics, analysis, partial derivative equations, modelling) in order to pool everyone's knowledge and create new tools to study PDMPs. The main lines of the project relate to estimation, simulation and asymptotic behaviors (long time, large populations, multi-scale problems) in the various contexts of application.

7.1.2. Advanced Geophysical Reduced–Order Model Construction from Image Observations (GERONIMO) — ANR Jeunes Chercheuses et Jeunes Chercheurs

Participant: Patrick Héas.

March 2014 to February 2018.

The GERONIMO project aims at devising new efficient and effective techniques for the design of geophysical reduced–order models (ROMs) from image data. The project both arises from the crucial need of accurate low–order descriptions of highly–complex geophysical phenomena and the recent numerical revolution which has supplied the geophysical scientists with an unprecedented volume of image data. Our research activities are concerned by the exploitation of the huge amount of information contained in image data in order to reduce the uncertainty on the unknown parameters of the models and improve the reduced–model accuracy. In other words, the objective of our researches to process the large amount of incomplete and noisy image data daily captured by satellites sensors to devise new advanced model reduction techniques. The construction of ROMs is placed into a probabilistic Bayesian inference context, allowing for the handling of uncertainties associated to image measurements and the characterization of parameters of the reduced dynamical system.

7.2. International Initiatives

7.2.1. Inria International Partners

Arnaud Guyader collaborates with the group of Nicolas Hengartner at Los Alamos National Laboratories, on the development of fast algorithms to simulate rare events, and on iterative bias reduction techniques in nonparametric estimation. This collaboration has a long record of bilateral visits.

ATEAMS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Master Software Engineering

ATEAMS is the core partner in the Master Software Engineering at Universiteit van Amsterdam. This master is a collaboration between SWAT/ATEAMS, Universiteit van Amsterdam, Vrije Universiteit and Hogeschool van Amsterdam.

7.1.2. Early Quality Assurance in Software Production

The EQUA project is a collaboration among Hogeschool van Amsterdam (main partner) Centrum Wiskunde & Informatica (CWI), Technisch Universiteit Delft, Laboratory for Quality of Software (LaQuSo), Info Support, Software Improvement Group (SIG), and Fontys Hogeschool Eindhoven.

7.1.3. Next Generation Auditing: Data-assurance as a service

This is a collaboration between Centrum Wiskunde & Informatic (CWI) PriceWaterhouseCoopers (PWC), Belastingdienst (National Tax Office), and Computational Auditing, is to enable research in the field of computational auditing.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

Program: FP7 STREP

Project acronym: OSSMeter

Project title: Automated Measurement and Analysis of Open Source Software

Duration: 30 months (2012-10-01 – 2015-03-31)

Coordinator: Scott Hansen

Other partners: CWI, SOFTEAM (France), Tecnalia Research and Innovation (Spain), The Open Group (Belgium), University of L'Aquila (Italy), UNINOVA (Portugal), National Centre for Text Mining University of Manchester (UK), University of York (UK), Unparallel Innovation (Portugal).

7.3. International Research Visitors

7.3.1. Visits of International Scientists

7.3.1.1. Internships

- Cleverton Hentz, PhD Candidate at the Department of Informatics and Applied Mathematics (Dimap) at Federal University of Rio Grande do Norte (UFRN).

ATHENA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Projets Blancs 2014: Axe Interdisciplinaire de Recherche à l'échelle du pôle Nice - Sophia Antipolis

8.1.1.1. Real time detection of morpho-phonological computation in the brain

Participants: Maureen Clerc, Rachid Deriche, Théodore Papadopoulo, Demian Wassermann, Fabien Mathy [Université de Nice-Sophia Antipolis], Tobias Sheer [Université de Nice-Sophia Antipolis], Lucas Drevillon.

Duration: *June 2014 to November 2014*

The overall idea of this project is that current work [78] shows that it is possible to discriminate between morphological (i.e. concatenative) and phonological activity that is produced by the brain upon linguistic stimuli. That is, the experimental setup provides an on-line diagnostic for the presence or absence of phonological computation in the production of words.

On the neuroimaging side, the long-term challenge is to reproduce Sahin et al.'s [78] experiment with non-invasive methods (see the following section). If successful, the study will show that a processing sequence predicted on linguistic grounds is implemented in the brain in fine-grained spatiotemporally patterned activity. From the neuroimaging point of view, the development of such non-invasive methods that can accurately identify events in known regions will have an important impact on both computer science and neuroscience. Replacing deep electrode probes (implanted in the patient's brain) with algorithms to map cognitive processes onto brain activation will help developing new applications of functional neuroimaging. Note that results could also turn out to foster clinical tools in the diagnosis of patients affected by white matter abnormalities and altered structure-function relationships in the connectional anatomy of language.

This project aimed to perform a feasibility study for this research area. More precisely to investigate whether current neuroimaging technologies are able to provide the tools for the proposed linguistic analysis.

8.1.2. ARSLA-funded clinical study with Nice University Hospital

Participants: Maureen Clerc, Théodore Papadopoulo, Loïc Mahé, Asya Metelkina, Violaine Guy [Nice University Hospital], Claude Desnuelle [Nice University Hospital].

We are partners of Nice University Hospital in a project funded by "Association pour la Recherche sur la Sclérose Latérale Amyotrophique" (ARSLA), thanks to which we are conducting a clinical feasibility study on a Brain Computer Interface system called the P300 speller (see section New Results on Brain Computer Interfaces).

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ANR CO-ADAPT

Participants: Maureen Clerc [coordinator], Dieter Devlaminck, Sebastian Hitziger, Loïc Mahé, Théodore Papadopoulo, Eoin Thomas, Romain Trachel.

Duration: *December 2009 to April 2014*

The partners of this project were the INSERM U1028 laboratory of Bron, the "laboratoire de Neurologie de la cognition" UMR6155 CNRS of Marseille, the Inria Lille Sequel project-team and the "Laboratoire d'Analyse Topologie et Probabilités" UMR6632/CNRS of Université de Provence, Marseille.

Brain Computer Interfaces (BCI) provide a direct communication channel from the brain to a computer, bypassing traditional interfaces such as keyboard or mouse, and also providing a feedback to the user, through a sensory modality (visual, auditory or haptic). A target application of BCI is to restore mobility or autonomy to severely disabled patients, but more generally BCI opens up many new opportunities for better understanding the brain at work, for enhancing Human Computer Interaction, and for developing new therapies for mental illnesses.

In BCI, new modes of perception and interaction come into play, and a new user must learn to operate a BCI, as an infant learns to explore his/her sensorimotor system. Central to BCI operation are the notions of feedback and of reward, which we believe should hold a more central position in BCI research.

The goal of this project was to study the co-adaptation between a user and a BCI system in the course of training and operation. The quality of the interface was judged according to several criteria (reliability, learning curve, error correction, bit rate). BCI were considered under a joint perspective: the user's and the system's. From the user's brain activity, features must be extracted, and translated into commands to drive the BCI system. Feature extraction from data, and classification issues, are very active research topics in BCI. However, additional markers may also be extracted to modulate the system's behavior. It is for instance possible to monitor the brain's reaction to the BCI outcome, compared to the user's expectations. This type of information we refer to as meta-data because it is not directly related to the command, and it may be qualitative rather than quantitative.

The aim of CO-ADAPT was to propose new directions for BCI design, by modeling explicitly the co-adaptation taking place between the user and the system (web site http://coadapt.inria.fr).

This project has led to many concrete realizations, e.g. an international BCI Challenge on detecting Error Potentials, and software (CoAdapt P300 stimulator).

8.2.1.2. ANR Mosifah

Participants: Rachid Deriche, Maureen Clerc, Théodore Papadopoulo, Gonzalo Sanguinetti.

Duration: *October 2013 to September 2017*

This ANR Numerical Models 2013 project is about multimodal and multiscale modelling and simulation of the fiber architecture of the human heart. It started on October 2013 and involves three partners : Creatis Team, INSA, Lyon (I. Magnin, Y. Zhu); TIMC-IMAG, CNRS, Grenoble (Y. Uson) and the ATHENA project team.

It consists in modelling and simulating the ex vivo and in vivo 3D fiber architectures at various scales using multiphysical data from different imaging modalities working at different spatial resolutions. To this end, the myocardium of the human heart will be imaged using respectively Polarized Light Imaging (PLI) and dMRI.

Appropriate diffusion models will be explored including second and fourth order DTI models as well as HARDI models such as the single shell Q-Ball Imaging (QBI). These various types of images will be processed within the right Riemannian mathematical framework to provide tensor as well as Ensemble Average Propagator (EAP) and Orientation Distribution Function (ODF) fields. Virtual cardiac fiber structure (VCFS) will then be modelled using myocardial fiber information derived from each of these imaging modalities. Finally, diffusion behavior of water molecules in these VCFSs will be simulated by means of quantum spin theory, which allows computing ex vivo and in vivo virtual diffusion magnetic resonance (MR) images at various scales ranging from a few microns to a few millimeters. From the obtained virtual diffusion MR images, multiscale and probabilistic atlas describing the 3D fiber architecture of the heart ex vivo and in vivo will be constructed. Meanwhile, the simulation involving a large number of water molecules, grid computing will be used to cope with huge computation resource requirement.

We expect to construct a complete database containing a very wide range of simulated (noise and artifact-free) diffusion images that can be used as benchmarks or ground-truth for evaluating or validating diffusion image processing algorithms and create new virtual fiber models allowing mimicking and better understanding the heart muscle structures. Ultimately, the proposed research can open a completely novel way to approach the whole field of heart diseases including the fundamental understanding of heart physiology and pathology, and new diagnosis, monitoring and treatment of patients.

8.2.1.3. ANR MULTIMODEL

Participants: Théodore Papadopoulo, Maureen Clerc, Sebastian Hitziger, Emmanuel Olivi.

Duration: *December 2010 to May 2014*

The MULTIMODEL project stems from a conjoint INSERM-Inria scientific initiative launched in December 2008 and ended in 2010. It involves 5 partners (Inserm U751 in Marseille, U678 in Paris, U836 in Grenoble, U642 in Rennes and Inria ATHENA project-team).

The general objectives of the MULTIMODEL project were :

- To develop computational models at the level of neuronal systems that will help interpreting neuroimaging data in terms of excitation-, inhibition- and synchronization-related processes.
- To acquire multimodal datasets, obtained in rats and humans under physiological and epileptogenic conditions, which will be used to develop the biophysical models and to test their face validity and predictability.

Specifically, the following questions were dealt with:

- How can models be integrated in order to link data from different modalities (electro/magneto-encephalography, optical imaging, functional MRI)?
- What is the influence of hidden parameters on the observed signals (e.g. ratio of excitation/inhibition and synchronization degree across regions)?
- To what extent can biophysical modelling bring valuable insights on physiological and pathological brain activity ?

We operated at the level of population of cells, i.e. at a scale compatible with the resolution of neuroimaging tools (at the level of the mm). A novel model structure was investigated, which includes astrocytes at this "mesoscopic" level and operates in networks of connected regions. Moreover, models in physiological and pathological conditions were compared, which is a step towards a better understanding of mechanisms underlying epileptic condition.

8.2.1.4. ANR VIBRATIONS

Participants: Théodore Papadopoulo, Maureen Clerc, Rachid Deriche, Demian Wassermann.

Duration: *Early 2014 to early 2018*

This Translational ANR project has just been been accepted.

Computational modeling, under the form of a "virtual brain" is a powerful tool to investigate the impact of different configurations of the sources on the measures, in a well-controlled environment.

The VIBRATIONS project proposes to simulate in a biologically realistic way MEG and EEG fields produced by different configurations of brain sources, which will differ in terms of spatial and dynamic characteristics. The research hypothesis is that computational and biophysical models can bring crucial information to clinically interpret the signals measured by MEG and EEG. In particular, they can help to efficiently address some complementary questions faced by epileptologists when analyzing electrophysiological data.

The project follows a three-fold strategy:

- construct virtual brain models with both dynamic aspects (reproducing both hyperexcitability and hypersynchronisation alterations observed in the epileptic brain) and a realistic geometry based on actual tractography measures performed in patients
- explore the parameter space though large-scale simulations of source configurations, using parallel computing implemented on a computer cluster.
- confront the results of these simulations to simultaneous recordings of EEG, MEG and intracerebral EEG (stereotactic EEG, SEEG). The models will be tuned on SEEG signals, and tested versus the surface signals in order to validate the ability of the models to represent real MEG and EEG signals.

The project constitutes a translational effort from theoretical neuroscience and mathematics towards clinical investigation. A first output of the project will be a database of simulations, which will permit in a given situation to assess the number of configurations that could have given rise to the observed signals in EEG, MEG and SEEG. A second – and major - output of the project will be to give the clinician access to a software platform which will allow for testing possible configurations of hyperexcitable regions in a user-friendly way. Moreover, representative examples will be made available to the community through a website, which will permit its use in future studies aimed at confronting the results of different signal processing methods on the same 'ground truth' data.

8.2.2. ADT

8.2.2.1. ADT BOLIS

Participants: Théodore Papadopoulo, Juliette Leblond [APICS], Jean-Paul Marmorat [APICS].

Duration:*December 2014 to December 2016* ADT BOLIS aims to build a sofware platform dedicated to inverse source localisation, building upon the elements of software found in FindSources3D. The platform will be modular, ergonomic, accessible and interactive. It will offer a detailed visualisation of the processing steps and the results.

8.2.2.2. ADT OpenViBE-X

Participants: Théodore Papadopoulo, Maureen Clerc, Nathanaël Foy.

Duration: *October 2014 to October 2016*

The OpenViBE-X ADT addresses the OpenViBE Brain Computer Interfaces (BCI) platform, in order to:

1. make BCI easier to apprehend by end-users
2. enrich the interaction with multimodal biosignals (eye gaze, heart-rate)
3. implement methods for auto-calibration and online adaptation of the classification
4. provide support, maintenance and dissemination for this software.

The OpenViBE platform is a central element to BCI research at Inria, and in the international community.

8.2.2.3. ADT OpenViBE-NT

Participants: Théodore Papadopoulo, Maureen Clerc, Loïc Mahé.

Duration: *October 2012 to December 2014*

OpenViBE is an opensource software which development started in 2005 with the goal of offering an open research tool for BCI and for supporting disabled people. Since its release in 2009, this software has received a lot of success (+10.000 downloads). But since 2005, new use have appeared as well as some limitations. The current software thus lacks of some features that limit its use, deployment and perennity. The goal of this ADT is to solve these problems, to improve and to extend OpenViBe One main goal was to improve the usability and the attractivity of the software and to retain a large community of users so as to ensure its sustainability. This ADT also supported the research made in four Inria teams (ATHENA, HYBRID, NEUROSYS and POTIOC) on hot topics such as adaptive or hybrid BCIs. In September 2014, the partners of this ADT organized a workshop on OpenViBE at the 6th international conference on Brain Computer Interfaces in Graz.

8.2.2.4. ADT MedInria-NT

Participants: Jaime Garcia Guevara, Loïc Cadour, Théodore Papadopoulo, Maureen Clerc, Rachid Deriche.

Duration: *December 2010 to December 2012, prolongated to December 2014*

The goal of this technical project, funded by Inria for 2 years, is to introduce some tools developed at ATHENA into the medInria platform. There are basically two such facilities:

- Integrate the tools developed for the statistical characterization of brain white matter fiber bundles.
- Develop an interface for M/EEG data within MedInria. This will focus on two main goals:
  - Create a facility to read and visualize M/EEG signals.
  - Integrate M/EEG forward problem tools.

8.3. European Initiatives

8.3.1. ChildBrain ETN

Duration: *March 2015 to March 2019*

ATHENA is an Associated Partner in this European Training Network: the team will participate in training workshops and receive PhD students in secondments.

Program: European Training Network

Project acronym: ChildBrain

Project title: Advancing brain research in children's developmental neurocognitive disorders

Duration: mois année début - mois année fin

Coordinator: Prof. Paavo Leppänen, University of Jyváskylä, Finland

Other partners: University of Leuven (Belgium), University of Münster (Germany), Rabboud University (The Netherlands), Aston University (United Kingdom), IcoMetrix (Belgium), Elekta (Finland), BESA (Germany)

Abstract: The purpose of the ChildBrain ETN is to train young scientists, i.e. Early Stage Researchers (ESRs), to utilise evidence-based neuroscientific knowledge for helping children, especially those at high risk for dropout due to neurocognitive disorders, to meet future educational and societal demands.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. BRAINCONNECTIVITIES

Title: Fusing anatomical and functional connectivity information using diffusion MRI, MEG and EEG.

International Partner (Institution - Laboratory - Researcher):

Ecole de Technologie Supérieure, Université du Québec, (CANADA)

Duration: Jan. 2012 - Dec. 2014

See also: http://brainconnectivities.inria.fr/wordpress

Currently brain connectivity is studied through two different lenses: 1) Anatomical connectivity aims at recovering the "wires" that connect the various brain cortical "units", 2) Functional connectivity studies when and how cortical regions are connected. Providing tools to fuse these two complementary views is the central goal of this project. Our effort will focus on three imaging modalities: diffusion MRI (dMRI) , Electroencephalography (EEG) and Magnetoencephalography (MEG). dMRI (jointly with traditional MRI) provides a detailed anatomical view of the brain. It allows the recovery of the fiber structure of the white matter: these are the electrical connexions between distant cortical areas. But dMRI does not provide any clue on: 1) on the actual use of connexions during brain activity, 2) on the way information propagates along time for a given task. On the opposite, EEG and MEG (jointly named MEEG) provide (after source reconstruction) time courses of the activity of the cortical areas. It is possible to recover some connectivity information from these time courses, but these are purely signal based and do not take account of the anatomy so there are multiple solutions that are sometimes difficult to discriminate. Furthermore source reconstructions are regularized with purely mathematical a priori taking only partially account of the actual brain structures.The main goals of this project are to provide tools: 1) To acquire diffusion data more efficiently, 2) To use the information of dMRI to define better models and regularization schemes for spatio-temporal MEEG source reconstruction, 3) To use MEEG data to better understand the task-dependent spatio-temporal structure of connectivity patterns.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

- CMRR, University of Minnesota, USA (Christophe Lenglet)
- Department of CISE, the University of Florida, Gainesville, USA (Baba C. Vemuri)
- Centre for Medical Image Computing (CMIC), Dept. Computer Science, UCL, UK (D. Alexander)
- SBIA, University of Pennsylvania Medical School, USA (R. Verma).
- University Houari Boumedienne (USTHB, Algiers) (L. Boumghar) and University of Boumerdes, (D. Cherifi), Algeria.
- BESA company on EEG/MEG source localisation.

8.4.3. Participation In other International Programs

- Programme Samuel de Champlain - Université de Sherbrooke, Canada.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Thinhinane Megherbi (USTHB, Algiers) visited ATHENA from May 30 until June 30, 2014.
- Kevin Whittingstall (Université de Sherbrooke) visited ATHENA from June 2 until June 5, 2014.
- Cristina Campi (Genoa University) visited ATHENA on March 28, 2014.

8.5.1.1. Internships

- Hughes Thomas (Queens's University, Ontario) visited ATHENA from May 5h until July 31
- Russel Taylor (Queens's University, Ontario) visited ATHENA from May 5th until July 31

ATLANMOD Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Program: **Pole Images et Reseaux - Appel Projets PME 2011**

Project title: StreamMaster

Duration: 2012 - 2014

Coordinator: Data Syscom

Other partners: Research and University (University of Nantes, Ecole de Design Nantes Atlantique, ESC Rennes) and Vendors and service providers (IMINFO)

Abstract: The purpose of the StreamMaster project is creating a universal software solution for the smart management of document streams, providing an added value over all the chain. StreamMaster will provide: an hybrid (local and remote) technological platform to allow user access, the possibility of connection to every information system and every input and output stream, the management of all the parameters of the document stream (cost, speed, delay, quality, environmental impact), security and reinforced document authentication mechanisms, non-falsifiable documents by means of invisible document tatooing, an innovative and multimodal HMI.

Program: **Pays de la Loire regional funding. Call: Creation of new teams**

Project title: AtlanMod New Team Creation

Duration: 2011 - 2014

Coordinator: AtlanMod

Other partners: None

Abstract: AtlanMod has been funded by the Pays de la Loire Regional Council new research teams program. This funding will mainly cover a PhD Student and two years of a postdoc to work on the quality of models research line.

7.2. National Initiatives

7.2.1. FUI

Program: FUI - AAP 15

Project acronym: MoNoGe

Project title: Atelier de Modélisation de Nouvelle Génération

Duration: 2013 - 2016

Coordinator: Softeam

Other partners: Industry (DCNS), Research and University (ARMINES AtlanMod, LIP6) and Vendors and service providers (Softeam, Soft-Maint, Mia-Software)

Abstract: There is currently in companies a wide diversity of models and modeling tools according to the application domains, services or contexts which are concerned. This implies different problems forbidding their plain exploitation: traceability, global coherence, continuity between works, knowledge management, etc. All are largely penalized by this situation that harms the mastering of the complexity of the related systems and software. The MoNoGe project has for objective to bring innovative solutions allowing to ensure the agility of the models and modeling tools. The term agility is here referring to the properties of interoperability, extensibility and evolution of models. The dynamic extension mechanism to be developed in MoNoGe, potentially inspiring from the OMG MEF

standard currently under definition, is intended to preserve the original metamodel which can be conserved, partially hidden or extended. Thus, the legacy data and models can stay operational with the extended metamodel. The user does not have to deal with heavy migration or conversion operations, and can this way focus on its modeling activities while continuously exploiting past models. Our focus within the project is on defining conceptually such a (meta)model extension solution and proposing an implementing prototype based on Eclipse/EMF. To this intent, we are already studying the potential reuse (and improvement) of our EMF Views prototype in this given context.

Program: FUI - AAP 13

Project acronym: TEAP

Project title: TOGAF Entreprise Architecture Platform

Duration: 2012 - 2014

Coordinator: Obeo

Other partners: Industry (DCNS), Research and University (Inria AtlanMod) and Vendors and service providers (Obeo, Capgemini)

Abstract: The fast evolution of technologies (SOA, Cloud, mobile environments), the systems complexity and the growing need for agility require to be able to represent information systems as a whole. The high-level approach promoted by Enterprise Architecture (EA) is a key element in this context and intends to address all the systems dimensions: software components, associated physical resources, relationships with the companies requirements and business processes, implied actors/roles/structures, etc. The objective of the TEAP project was to specify and implement an EA platform based on the Open Group international standard named TOGAF and on the SmartEA technical solution. In addition to its base modeling capabilities, this platform now allows data federation from different existing sources (e.g. for reverse engineering purposes such as retro-cartography) as well as the definition of possible transformation chains (for governance and modernization). As part of this project, we have been notably using in practice (and improving accordingly) some of our works and corresponding prototypes such as EMF Views, ATL or some MoDisco components.

Program: FUI - AAP 13

Project acronym: ITM Factory

Project title: Information Technology Modernisation Factory

Duration: 04/2012 - 10/2014

Coordinator: Soft-Maint (Groupe SODIFRANCE)

Other partners: Mia-Software (Groupe SODIFRANCE), ACAPNOS, MMA and Inria AtlanMod.

Abstract: Application maintenance represents about 80 per cent of the computer market (at the French and global level). The challenge of software maintenance is to keep running applications with technologies that are no longer required to be maintained and with changing development teams and whose skills are not always validated on ancient languages. The main goal of the ITM Factory is to propose a software modernization framework, based on the ModDisco project and including: (i) an integrated workbench for software modernization engineers and (ii) a set of ready to use modernization cartirdges, i.e., a solution brick that meets a business challenge level, as opposed to a technical bricks that provides technical solutions that are integrated into a business solution.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

7.3.1.1. ARTIST

Type: COOPERATION

Defi: Cloud Computing, Internet of Services and Advanced Software engineering

Instrument: Integrated Project

Duration: October 2012 - September 2015

Coordinator: Clara Pezuela (ATOS Spain)

Partner: ATOS and TECNALIA (Spain), Inria AtlanMod (France), Fraunhofer (Germany), TU Wien and Sparks (Austria), ENGINEERING (Italy), Spikes (Belgium), ATC and ICCS (Greece)

Inria contact: Hugo Bruneliere

Abstract: Nowadays Cloud Computing is considered as the ideal environment for engineering, hosting and provisioning applications. A continuously increasing set of cloud-based solutions is available to application owners and developers to tailor their applications exploiting the advanced features of this paradigm for elasticity, high availability and performance. Even though these offerings provide many benefits to new applications, they often incorporate constrains to the modernization and migration of legacy applications by obliging the use of specific development technologies and explicit architectural design approaches. The modernization and adaptation of legacy applications to cloud environments is a great challenge for all involved stakeholders, not only from the technical perspective, but also in business level with the need to adapt the business processes and models of the modernized application that will be offered from now on, as a service. The purpose of the ARTIST project is to propose and develop a novel model-driven approach for the migration of legacy applications in modern cloud environments which covers all aspects and phases of the migration process, as well as an integrated framework that supports all migration process.

7.3.1.2. MONDO

Title: Scalable Modelling and Model Management on the Cloud

Type: COOPERATION (ICT)

Defi: Cloud Computing, Internet of Services and Advanced Software engineering

Instrument: Small or medium-scale focused research project (STREP)

Duration: November 2013 - May 2016

Coordinator: The Open Group - X/Open Company

Partners: The Open Group - X/Open Company (United Kingdom), University of York (United Kingdom), Universidad Autonoma de Madrid (Spain), Budapest University of Technology and Economics (Hungary), IKERLAN (Spain), MIA Software (France), Cassidian (Germany)

Inria contact: Massimo Tisi

Abstract: As Model Driven Engineering (MDE) is increasingly applied to larger and more complex systems, the current generation of modelling and model management technologies are being pushed to their limits in terms of capacity and efficiency, and as such, additional research is imperative in order to enable MDE to remain relevant with industrial practice and continue delivering its widely recognised productivity, quality, and maintainability benefits. The aim of MONDO is to tackle the increasingly important challenge of scalability in MDE in a comprehensive manner. Achieving scalability in modelling and MDE involves being able to construct large models and domain specific languages in a systematic manner, enabling teams of modellers to construct and refine large models in a collaborative manner, advancing the state-of-the-art in model querying and transformations tools so that they can cope with large models (of the scale of millions of model elements), and providing an infrastructure for efficient storage, indexing and retrieval of large models. To address these challenges, MONDO brings together partners with a long track record in performing internationally-leading research on software modelling and MDE, and delivering research results in the form of robust, widely-used and sustainable open-source software, with industrial partners active in the fields of reverse engineering and systems integration, and a global consortium including more than 400 organisations from all sectors of IT.

7.3.1.3. Automobile

Title: Automated Mobile App Development

Type: Research For SMEs

Duration: November 2013 - October 2015

Coordinator: WebRatio s.r.l.

Partners: WebRatio, Politecnico di Milano (ITaly), AtlanMod-Armines, Moon Submarine (UK), ForwardSoftware (Rumania).

Inria contact: Jordi Cabot

Abstract:The AutoMobile project aims at designing and bringing to the market innovative methodologies, software tools, and vertical applications for the cost-effective implementation of cross-platform, multi-device mobile applications, i.e. business applications that can be accessed by users on a variety of devices and operating systems, including PC, cellular / smart phones and tablets.

Cross-platform and multi-device design, implementation and deployment is a barrier for today's IT solution providers, especially SME providers, due to the high cost and technical complexity of targeting development to a wide spectrum of devices, which differ in format, interaction paradigm, and software architecture.

AutoMobile will exploit the modern paradigm of Model-Driven Engineering and code generation to dramatically simplify multi-device development, reducing substantially cost and development times, so as to increase the profit of SME solution providers and at the same time reduce the price and total cost of ownership for end-customers.

AutoMobile will rely on modeling languages such as IFML (Interaction Flow Modeling Languages) and on tools like WebRatio.

7.3.2. Collaborations in European Programs, except FP7 & H2020

Program: CORE Multi-annual thematic research programme. Fonds National de la Recherche Luxembourg.

Project acronym: TOOM

Project title: Testing Orders of Magnitude

Duration: September 2013 - August 2015

Coordinator: SnT/University of Luxembourg

Other partners: the iTrust company, EBRC, Inria Rennes/University of Nantes and the UFPR (Brazil).

Abstract: Over the last decade, large-scale systems drew much attention due to scalability and resiliency features. Many popular large-scale data-oriented systems (i.e., BigData), including, Peer-to-peer (P2P) and MapReduce, reached millions of users and processed petabytes of data, such as: Hadoop, Skype, Bittorrent, and Gnutella. The main reason is due to a decentralized manner to remove potential performance bottlenecks and centralized points of failure. Recently, cloud computing is gathering all these BigData systems underneath its layers (e.g. Paas, Saas, Iaas) to free developers from large-scale issues, such as: deployment, distribution, resiliency, security, and performance. Several companies around the globe rely on cloud computing to build robust and reliable services for their business operations (e.g. eBay, Amazon, Skype) mainly to handle heavy load conditions (e.g. seasonal sales, Internet-scale malicious attacks). Testing robustness and reliability of cloud computing services is a hard activity, the state of the art shows that the existing testing techniques suffer to handle aspects, such as: the scale of the cloud, the dynamism of the nodes, and the amount of data and load. In general, these testing techniques rely on a combination of unit tests with some mocking approach that may hide the cloud aspects and may not be suited for large-scale testing. The TOOM project is planned to present a solution for testing robustness of cloud computing services built on top of P2P technology to address scalability and dynamism aspects. The main contributions lie on two main steps. The first one is to validate the overall resilience

and reliability of cloud services. The second one is to reproduce large-scale stress loads, such as Distributed Denial of Service (DDoS) and peak loads, either gathered from the real load traces or synthetically generated. We plan to leverage data warehouse technology to house real load traces and use them during testing. To generate synthetic loads, we plan to use known load patterns or adapt them to new load trends. To assess the effectiveness of the TOOM outcomes, we will reproduce stress loads submitted by P2P technology across the cloud infrastructure on top of step-stress testing methodologies. In this manner, we can progressively increase the load in orders of magnitude up to a peak load. Then, we will measure the effectiveness either by code coverage whether the SUT is open-source, by the quality of service (QoS) of the SUT, or by the coverage of network and computing components used by the cloud computing services.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Informal International Partners

The four main research partners of the team are:

- Politecnico di Milano (Italy) - DB Group, specially with Marco Brambilla
- TU Wien (Austria) - BiG Group, specially Manuel Wimmer
- Politecnica de Catalunya (Spain) - GESSI Group, specially Xavier Franch
- Universitat Polièc nica de València (Spain) - ISSI Group, specially José H. Canós

7.5. International Research Visitors

7.5.1. Visits of International Scientists

Javier Criado (University of Almeria, Spain), June-July

7.5.1.1. Internships

Rolandi, María Belén

Subject: Democracy in Open Source projects

Date: from May 2014 until Oct 2014

Institution: Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina)

7.5.2. Visits to International Teams

7.5.2.1. Research stays abroad

In March, M. Tisi visited the National Institute of Informatics (NII) of Tokyo, Japan, for one month, in the frame of a collaboration on bidirectionalization of model-transformation languages.

AVALON Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. French National Fund for the Digital Society Project (FSN)

8.1.1.1. FSN XLcloud, 2012-2014

Participants: Jean-Patrick Gelas, Laurent Lefèvre, François Rossigneux.

Focused on high-performance computing, the XLcloud collaborative project sets out to define and demonstrate a cloud platform based on *HPC-as-a-Service*. This is designed for computational intensive workloads, with interactive remote visualisation capabilities, thus allowing different users to work on a common platform. XLcloud project's members design, develop and integrate the software elements of a High Performance Cloud Computing (HPCC) System.

Expected results of the projects include : Functional and technical specification of the XLcloud platform architecture, open source API of the XLcloud platform, implementation of algorithms for 3D and video streaming display, prototype of the XLcloud platform including the support of on-demand virtual clusters and remote visualisation service, use cases for validation, illustrating the performance and suggesting future improvements.

XLcloud aims at overcoming some of the most important challenges of implementing operationally high performance applications in the Cloud. The goal is to allow partners of the project to take leadership position in the market, as cloud service providers, or as technology providers. XLcloud relies on a consortium of various partners (BULL (project leader), TSP, Silkan, EISTI, Ateme, Inria, CEA List, OW2, AMG.Lab).

In this project, the Avalon team investigates the issue of energy awareness and energy efficiency in OpenStack Cloud based platforms.

8.1.2. French National Research Agency Projects (ANR)

8.1.2.1. ANR EMERGENCE CloudPower, Cloud Service providing HPC on-demand to innovative SME's, 35 months, ANR-12-EMMA-0038

Participants: Gilles Fedak, Sylvain Bernard.

High performance computing (HPC) allows scientists and industries to run large numerical application on huge data volumes. The HPC is a key factor in knowledge and innovation in many fields of industry and service, with high economic and social issues: aerospace, finance and business intelligence, energy and environment, chemicals and materials, medicine and biology , digital art and games, Web and social networks, ... Today, acquiring HPC supercomputer is very expensive, making HPC unreachable to SMIs / SMEs for their research and development. The CloudPower project results from the XtremWeb research and development project. Its goal is to offer a low cost Cloud HPC service for small and medium-sized innovative companies. With CloudPower, companies and scientists will run their simulations to design and develop new products on a powerful, scalable, economical, reliable and secure infrastructure.

The project will lead the creation of a new and innovative company operating the platform implemented in the framework of the ANR Emergence. CloudPower will implement SaaS / PaaS portal for customers and develop extensions to allow commercial exploitation of unused resources. Building on the network of SMIs from the competitiveness clusters System@tic and LyonBiopole, we will implement scenarios and/or demonstrators which illustrate the ability of CloudPower to increase competitiveness, research and marketing of innovative SMEs.

8.1.2.2. ANR INFRA MOEBUS, Multi-objective scheduling for large computing platforms, 4 years, ANR-13-INFR-000, 2013-2016

Participants: Christian Perez, Laurent Lefèvre, Frédéric Suter.

The ever growing evolution of computing platforms leads to a highly diversified and dynamic landscape. The most significant classes of parallel and distributed systems are supercomputers, grids, clouds and large hierarchical multi-core machines. They are all characterized by an increasing complexity for managing the jobs and the resources. Such complexity stems from the various hardware characteristics and from the applications characteristics. The MOEBUS project focuses on the efficient execution of parallel applications submitted by various users and sharing resources in large-scale high-performance computing environments.

We propose to investigate new functionalities to add at low cost in actual large scale schedulers and programming standards, for a better use of the resources according to various objectives and criteria. We propose to revisit the principles of existing schedulers after studying the main factors impacted by job submissions. Then, we will propose novel efficient algorithms for optimizing the schedule for unconventional objectives like energy consumption and to design provable approximation multi-objective optimization algorithms for some relevant combinations of objectives. An important characteristic of the project is its right balance between theoretical analysis and practical implementation. The most promising ideas will lead to integration in reference systems such as SLURM and OAR as well as new features in programming standards implementations such as MPI or OpenMP.

8.1.2.3. ANR ARPEGE MapReduce, Scalable data management for Map-Reduce-based data-intensive applications on cloud and hybrid infrastructures, 4 years, ANR-09-JCJC-0056-01, 2010-2014

Participants: Frédéric Desprez, Gilles Fedak, Sylvain Gault, Christian Perez, Anthony Simonet.

MapReduce is a parallel programming paradigm successfully used by large Internet service providers to perform computations on massive amounts of data. After being strongly promoted by Google, it has also been implemented by the open source community through the Hadoop project, maintained by the Apache Foundation and supported by Yahoo! and even by Google itself. This model is currently getting more and more popular as a solution for rapid implementation of distributed data-intensive applications. The key strength of the MapReduce model is its inherently high degree of potential parallelism.

In this project, the AVALON team participates to several work packages which address key issues such as efficient scheduling of several MapReduce applications, integration using components on large infrastructures, security and dependability, and MapReduce for Desktop Grid.

8.1.2.4. ANR INFRA SONGS, Simulation Of Next Generation Systems, 4 years, ANR-12-INFRA-11, 2012-2015

Participants: Frédéric Desprez, Jonathan Rouzaud-Cornabas, Frédéric Suter.

The last decade has brought tremendous changes to the characteristics of large scale distributed computing platforms. Large grids processing terabytes of information a day and the peer-to-peer technology have become common even though understanding how to efficiently such platforms still raises many challenges. As demonstrated by the USS SIMGRID project, simulation has proved to be a very effective approach for studying such platforms. Although even more challenging, we think the issues raised by petaflop/exaflop computers and emerging cloud infrastructures can be addressed using similar simulation methodology.

The goal of the SONGS project is to extend the applicability of the SIMGRID simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area.

Any sound study of such systems through simulations relies on the following pillars of simulation methodology: Efficient simulation kernel; Sound and validated models; Simulation analysis tools; Campaign simulation management.

8.1.3. Inria Large Scale Initiative

8.1.3.1. HEMERA, 4 years, 2010-2014

Participants: Christian Perez, Laurent Pouilloux, Laurent Lefèvre.

Hemera deals with the scientific animation of the GRID'5000 community. It aims at making progress in the understanding and management of large scale infrastructure by leveraging competences distributed in various French teams. Hemera contains several scientific challenges and working groups. The project involves around 24 teams located in all around France.

C. Pérez is leading the project; L. Lefevre and L. Pouilloux are managing scientific challenges on GRID'5000.

8.1.3.2. C2S@Exa, Computer and Computational Sciences at Exascale, 4 years, 2013-2017

Participants: Frédéric Desprez, Christian Perez, Laurent Lefèvre, Jérôme Richard.

Since January 2013, the team is participating to the C2S@Exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

8.1.4. Inria ADT

8.1.4.1. Inria ADT Aladdin, 4 years, 2008-2014

Participants: Simon Delamare, Frédéric Desprez, Matthieu Imbert, Laurent Lefèvre, Christian Perez.

ADT ALADDIN is an Inria support action of technological development which supports the GRID'5000 instrument. Frédéric Desprez is leading this action (with David Margery from Rennes as the Technical Director). More information at Section 5.8 .

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. PRACE 2IP

Participants: Vincent Lanore, Christian Perez, Jérôme Richard.

Title: PRACE – Second Implementation Phase Project

Type: Integrated Infrastructure Initiative Project (I3)

Instrument: Combination of Collaborative projects and Coordination and support action

Duration: September 2011 - August 2014

Coordinator: Thomas Lippert (Germany)

Others partners: Jülich GmbH, GCS, GENCI, EPSRC, BSC, CSC, ETHZ, NCF, JKU, Vetenskapsradet, CINECA, PSNC, SIGMA, GRNET, UC-LCA, NUI Galway, UYBHM, CaSToRC, NCSA, Technical Univ. of Ostrava, IPB, NIIF

See also: http://prace-ri.eu

Abstract: The purpose of the PRACE RI is to provide a sustainable high-quality infrastructure for Europe that can meet the most demanding needs of European HPC user communities through the provision of user access to the most powerful HPC systems available worldwide at any given time. In tandem with access to Tier-0 systems, the PRACE-2IP project will foster the coordination between national HPC resources (Tier-1 systems) to best meet the needs of the European HPC user community. To ensure that European scientific and engineering communities have access to leading edge supercomputers in the future, the PRACE-2IP project evaluates novel architectures, technologies, systems, and software. Optimizing and scaling of application for Tier-0 and Tier-1 systems is a core service of PRACE.

Inria participates to Work Package 12 which is about novel programming techniques.

8.2.1.2. PaaSage

Participants: Christian Perez, Jonathan Rouzaud-Cornabas.

Title: PaaSage: Model-based Cloud Platform Upperware

Type: Seventh Framework Programme

Instrument: Collaborative project

Duration: October 2012 - September 2016 (48 months)

Coordinator: Pierre Guisset (GEIE ERCIM)

Others partners: SINTEF, STFC, HLRS, University of Stuttgart, Inria, CETIC, FORTH, be.wan, EVRY, SysFera, Flexiant, Lufthansa Systems, AG GWDG, Automotive Simulation Center Stuttgart e.V.

See also: http://paasage.eu

Abstract: PaaSage will deliver an open and integrated platform, to support both deployment and design of Cloud applications, together with an accompanying methodology that allows model-based development, configuration, optimization, and deployment of existing and new applications independently of the existing underlying Cloud infrastructures. Specifically it will deliver an IDE (Integrated Development Environment) incorporating modules for design time and execution time optimizations of applications specified in the CLOUD Modeling Language (CLOUD ML), execution-level mappers and interfaces and a metadata database.

8.2.2. Collaborations in European Programs, except FP7 & H2020

8.2.2.1. CHIST-ERA STAR

Participants: Laurent Lefèvre, Olivier Glück.

Title: SwiTching And tRansmission project

Type: CHIST-ERA (European Coordinated Research on Long-term Challenges in Information and Communication Sciences & Technologies ERA-Net)

Duration: 2013-2015

Coordinator: Jaafar Elmirghani (University of Leeds - UK)

Others partners: Inria ,University of Cambridge (UK), University of Leeds (UK), AGH University of Science and Technology Department of Telecommunications (Poland)

See also: http://www.chistera.eu/projects/star

Abstract: The Internet power consumption has continued to increase over the last decade as a result of a bandwidth growth of at least 50 to 100 times. Further bandwidth growth between 40% and 300% is predicted in the next 3 years as a result of the growing popularity of bandwidth intensive applications. Energy efficiency is therefore increasingly becoming a key priority for ICT organizations given the obvious ecological and economic drivers. In this project we adopt the GreenTouch energy saving target of a factor of a 100 for Core Switching and Routing and believe this ambitious target is achievable should the research in this proposal prove successful. A key observation in core networks

is that most of the power is consumed in the IP layer while optical transmission and optical switching are power efficient in comparison, hence the inspiration for this project. Initial studies by the applicants show that physical topology choices in networks have the potential to significantly reduce the power consumption, however network optimization and the consideration of traffic and the opportunities afforded by large, low power photonic switch architectures will lead to further power savings. Networks are typically over provisioned at present to maintain quality of service. We will study optimum resource allocation to reduce the overprovisioning factor while maintaining the quality of service. Protection is currently provided in networks through the allocation of redundant paths and resources, and for full protection there is a protection route for every working route. Avalon is contributing to STAR in terms of software network protocols and services optimizations which will be combined with more efficient photonic switches in order to obtain a factor of 100 power saving in core networks can be realised through this project with significant potential for resulting impact on how core photonic networks are designed and implemented.

8.2.2.2. COST IC1305 : Nesus

Participants: Laurent Lefèvre, Marcos Dias de Assunçao.

Program: COST

Project acronym: IC1305

Project title: Network for Sustainable Ultrascale Computing (NESUS)

Duration: 2014-2019

Coordinator: Jesus Carretero (Univ. Madrid)

Abstract: Ultrascale systems are envisioned as large-scale complex systems joining parallel and distributed computing systems that will be two to three orders of magnitude larger that today's systems. The EU is already funding large scale computing systems research, but it is not coordinated across researchers, leading to duplications and inefficiencies. The goal of the NESUS Action is to establish an open European research network targeting sustainable solutions for ultrascale computing aiming at cross fertilization among HPC, large scale distributed systems, and big data management. The network will contribute to glue disparate researchers working across different areas and provide a meeting ground for researchers in these separate areas to exchange ideas, to identify synergies, and to pursue common activities in research topics such as sustainable software solutions (applications and system software stack), data management, energy efficiency, and resilience. In Nesus, Laurent Lefevre is co-chairing the Working on Energy Efficiency (WG5).

8.2.2.3. SEED4C

Program: Celtic-Plus

Project acronym: SEED4C

Project title: Security Embedded Element and Data privacy for the Cloud.

Duration: 2012-2015

Coordinator: Stéphane Betge-Brezetz (Alcatel-Lucent lab)

Other partners: Gemalto, ENSI Bourges, Inria, Wallix, VTT Technical Research centre of Finland, Mikkelin Puhelin Oyj, Cygate, Nokia Siemens Networks, Finceptum OY (Novell), Solacia, Innovalia Association, Nextel, Software Quality Systems, Ikusi, Vicomtech, Biscaytik

Abstract: SEED4C is a Celtic-Plus project: an industry-driven European research initiative to define, perform and finance through public and private funding common research projects in the area of telecommunications, new media, future Internet, and applications and services focusing on a new "Smart Connected World" paradigm. Celtic-Plus is a EUREKA ICT cluster and is part of the inter-governmental EUREKA network.

The cloud security challenge not only reflects on the secure running of software on one single machine, but rather on managing and guaranteeing security of a computer group or cluster seen as a single entity. Seed4C focus is to evolve from cloud security with an isolated point or centralized points of enforcement for security to cloud security with cooperative points of enforcement for security.

8.3. International Initiatives

8.3.1. Inria International Labs

8.3.1.1. Inria-UIUC-NCSA Joint Laboratory for Petascale Computing

Participants: Eddy Caron, Frédéric Desprez, Olivier Glück, Vincent Lanore, Laurent Lefèvre, Christian Perez, Jonathan Rouzaud-Cornabas.

The Joint Laboratory for Petascale Computing focuses on software challenges found in complex high-performance computers. The Joint Laboratory is based at the University of Illinois at Urbana-Champaign and includes researchers from the French national computer science institute called Inria, Illinois' Center for Extreme-Scale Computation, and the National Center for Supercomputing Applications. Much of the Joint Laboratory's work will focus on algorithms and software that will run on Blue Waters and other petascale computers.

8.3.2. Participation In other International Programs

8.3.2.1. HPC visibility and strategy Workshop Algeria- Inria – Bull

Under high patronage of his Excellency the Minister for Higher Education and Scientific Research in Association of the Head Office of Scientific Research and Technological Development, this meeting comes within the framework of the partnership between Algeria, Inria and the Bull company, to set up an ambitious program, based on a great show of a material and software infrastructure for the digital simulation which will allow major steps forward in various scientific fields and important progress in term of industrial competitiveness and innovation.

Facing the growing evolution of the complexity of the feigned systems and the used volumes of data, the supercomputing becomes so major. This meeting which will gather about 150 participants, of whom persons in charge of supercomputing Algerian centers, will allow to exchange on problems related to modeling, simulation and HPC. The meeting will be organized around three main points: education research, bridge industry - research and ecosystem.

Eddy Caron (Avalon team) is an expert in the steering committee of the Ecosystem group.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Tchimou N'Takpé, Assistant Professor

Date: Oct 2014 - Nov 2014

Institution: Université Nangui Abrogoua, Abidjan (Cote d'Ivoire)

Mircea Moca, Assistant Professor

Date: Nov 15th, 2014 - Dec 15th, 2014

Institution: Babes-Bolyai University (Roumania)

Mircea Moca, Assistant Professor

Date: Nov 15th, 2014 - Dec 15th, 2014

Institution: Babes-Bolyai University (Roumania)

Asma Ben Cheikh Ahmed, PhD Student

Date: Sep 15th, 2014 - Dec 15th, 2014

Institution: Faculté des Sciences de Tunis (Tunisia)

Miranda Qian Zhang, PhD Student

Date: Sep 8th, 2014 - Oct 9th, 2014

Institution: Australian National University (Australia)

Julio Anjos, PhD student

Date: May 4th, 2014 - May 4th, 2015

Institution: Universidade Federal do Rio Grande do Sul (Brazil)

8.4.1.1. Internships

Anshul Gupta

Date: May 2014 - Jul 2014

Institution: LNM Institute of Information Technology (India)

AVIZ Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR FITOC: From Individual To Collaborative Visual Analytics

Participants: Petra Isenberg [correspondant], Jean-Daniel Fekete, Pierre Dragicevic, Wesley Willett.

The project addresses fundamental problems of technological infrastructure and the design of data representation and interaction to build a bridge between individual and team work for visual data analysis. In collaboration with the University of Magdeburg we have begun to tackle this challenge through the design of tangible widgets that help to bridge the gap between individual and collaborative information seeking.

8.1.2. ANR EASEA-Cloud

Participants: Evelyne Lutton [correspondant], Waldo Cancino, Hugo Gilbert, Pierre Collet.

The aim of the EASEA-CLOUD project is to exploit the massively parallel resources that are offered by clusters or a grid of modern GPU-equipped machines in order to find solutions to inverse problems whose evaluation function can be intrinsically sequential. Massive parallelization of generic sequential problems can be achieved by evolutionary computation, that can efficiently exploit the parallel evaluation of thousands of potential solutions (a population) for optimization or machine-learning purposes. The project consists in turning the existing EASEA (EAsy Specification of Evolutionary Algorithms, http://easea.unistra.fr/) research platform into an industrial-grade platform that could be exploited by running in "cloud" mode, on a large grid of computers (ISC-PIF/CREA is the current manager of the French National Grid). The necessary steps are to develop:

- a professional-grade API, development environment and human-computer interface for the existing academic EASEA platform,
- cloud-management tools (in order to launch an experiment on a grid of computers, monitor the experiment and bill the laboratories or companies that will be using EASEA-CLOUD for intensive computation,
- novel visualisation tools, in order to monitor an evolutionary run, potentially launched on several hundred heterogeneous GPU machines.

The consortium is made of thee partners: LSIIT/UDS (which is developing the EASEA platform), ISCPIR/CREA (for its experience in grid and cloud computing), AVIZ/Inria (for its experience in visualization tools for evolutionary computation) and two subcontractors: LogXLabs (a software development company in order to create industrial-grade code and interfaces) an BIOEMERGENCE-IMAGIF, the "valorisation" department of CNRS Gif s/Yvette. Valorisation will take place in strong collaboration with UNISTRA VALO, the valorisation structure of Université de Strasbourg. The project started on October 1st, 2012, for 2 years. AVIZ is in charge of developing new visualisation tools adapted to the monitoring of the optimization process.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. CENDARI

Program: Infrastructures

Project acronym: **CENDARI**

Project title: Collaborative EuropeaN Digital/Archival Infrastructure

Duration: 01/2012 - 12/2015

Coordinator: Trinity College, Dublin (IE),
Other partners: Freie Universitaet Berlin (DE), Matematicki Institut Sanu u Beogradu (Serbia), University of Birmingham (UK), King's College London (UK), Georg-August-Universitaet Goettingen Stiftung Oeffentlichen Rechts (DE), Narodni Knihovna Ceske Republiky (Czech Republic), Societa Internazionale per lo Studio del Medioevo Latino-S.I.S.M.E.L. Associazione (IT), Fondazione Ezio Franceschini Onlus (IT), Ministerium fur Wissenschaft, Forschung und Kunst Baden-Wurttemberg (DE), Consortium of European Research Libraries (UK), Koninklijke Bibliotheek (NL), UNIVERSITA DEGLI STUDI DI CASSINO (IT).
Abstract:

The Collaborative EuropeaN Digital Archive Infrastructure (CENDARI) will provide and facilitate access to existing archives and resources in Europe for the study of medieval and modern European history through the development of an 'enquiry environment'. This environment will increase access to records of historic importance across the European Research Area, creating a powerful new platform for accessing and investigating historical data in a transnational fashion overcoming the national and institutional data silos that now exist. It will leverage the power of the European infrastructure for Digital Humanities (DARIAH) bringing these technical experts together with leading historians and existing research infrastructures (archives, libraries and individual digital projects) within a programme of technical research informed by cutting edge reflection on the impact of the digital age on scholarly practice.

The enquiry environment that is at the heart of this proposal will create new ways to discover meaning, a methodology not just of scale but of kind. It will create tools and workspaces that allow researchers to engage with large data sets via federated multilingual searches across heterogeneous resources while defining workflows enabling the creation of personalized research environments, shared research and teaching spaces, and annotation trails, amongst other features. This will be facilitated by multilingual authority lists of named entities (people, places, events) that will harness user involvement to add intelligence to the system. Moreover, it will develop new visual paradigms for the exploration of patterns generated by the system, from knowledge transfer and dissemination, to language usage and shifts, to the advancement and diffusion of ideas.

See more at http://cendari.eu/ and http://www.aviz.fr/Research/CENDARI.

8.2.2. Collaborations with Major European Organizations

Fraunhofer Institute, IGD (DE)
We are collaborating on visual analytics, setting up European projects and coordinating European initiatives on the subject.
University of Dresden, (DE)
We have been collaborating with Raimund Dachselt on stackable tangible devices for faceted browsing [55], [54].

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

AVIZ researchers collaborate with a number of international partners, including:

- Google, Mountain View, USA
- Microsoft Research, Redmond, USA
- New York University, USA
- University of Toronto, Canada
- University of Calgary, Canada
- University of British Columbia, Canada
- University of Kent, UK
- University of Konstanz, Germany
- University of Magdeburg, Germany

8.3.1.2. Informal International Partners

- Arizona State University, USA
- University of Vienna, Austria
- University of Groningen, the Netherlands
- University of Granada, Spain

8.3.2. Inria International Labs

- *Massive Data team*, Inria Chile.

8.3.3. Collaboration with Google

AVIZ collaborates with Google on several projects, related to the Google Research Grant and to evaluation methodology in information visualization.

8.3.4. Collaboration with Microsoft Research

AVIZ collaborates with several researchers from Microsoft Research Redmond, in particular on the topic of new interactions for information visualization and brain connectivity visualization.

8.3.5. Collaboration with New-York University

Jean-Daniel Fekete collaborates with Claudio Silva and Juliana Freire from NYU-Poly on the VisTrails workflow system for visual analytics (http://www.vistrails.org). Rémi Rampin, intern from the Univ. Paris-Sud Master in HCI, has spent one month at Orsay and 5 months at NYU-Poly to allow VisTrails to run Java-based applications and Toolkits. Rémi successfully connected the traditional Python-C implementation of VisTrails to the Java virtual machine using the JPype package. Jean-Daniel Fekete is now porting the Obvious Toolkit [47] in this environment to integrate all its components [50].

8.4. International Research Visitors

8.4.1. Visits to International Teams

8.4.1.1. Sabbatical programme

Jean-Daniel Fekete

Date: Jan 2015 - Dec 2015

Institution: University of New-York (USA)

AYIN Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- Seong-Gyun Jeong, Nazre Batool, Yuliya Tarabalka and Josiane Zerubia have been in contact with Didier Zugaj, image processing expert for early clinical evaluation at Garlderma R&D in Sophia Antipolis http://www.galderma.com/About-Galderma/Worldwide-presence/R-D-Locations to discuss AYIN's research on wrinkle detection.
- Zhao Liu and Josiane Zerubia discussed several times with Prof. Bahadoran from CHU Nice/Inserm (Faculty of Medicine, Dermatology department, at l'Archet 2 hospital in Nice) and Dr Queille-Roussel, CPCAD managing director at CHU Nice (Faculty of Medicine, Dermatology department, at l'Archet 2 hospital in Nice) about Ayin's research on semi-automatic acne detection.

7.2. European Initiatives

7.2.1. Collaborations with Major European Organizations

LIRA consortium

Partners: Philips R&D (Eindhoven), CWI (Amsterdam), Fraunhofer Institutes (Berlin, Stuttgart, Darmstadt), Inria-SAM

Skincare image and signal processing: analysis, modeling and characterization of the condition of human skin.

7.3. International Initiatives

7.3.1. Informal International Partners

Qiyin Fang and Samir Sahli.

Subject: New optical sensors for skin imaging and their biomedical applications.

Institution: McMaster University (Canada).

Stuart Jones and Jochen Einbeck.

Subject: Shape modelling applied to subterranean sand bodies.

Institution: Department of Earth Sciences and Department of Mathematical Sciences, Durham University (UK).

Zoltan Kato, Tamas Sziranyi and Csaba Benedek.

Subjects: Multi-layer Markovian models for change detection in aerial and satellite images. Random field models of shape.

Institution: Szeged University and MTA SZTAKI (Hungary).

Gabriele Moser and Sebastiano Serpico.

Subject: Hierarchical Markov random fields for multi-temporal and multi-resolution classification in remote sensing.

Institution: Genoa University (Italy).

Anuj Srivastava.

Subject: Statistical shape analysis of functions, curves, and surfaces.

Institution: Florida State University (USA).

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Csaba Benedek (MTA SZTAKI, Hungary, one week in January 2014).
- Qiyin Fang (McMaster University, Canada, one week in May 2014).
- Joseph Francos (Ben-Gurion University, Israel, one week in July 2014).
- Zoltan Kato (Szeged University, Hungary, one month, from mid-July till mid-August 2014).
- Vladimir Krylov (Genoa University, Italy, one week in September 2014).
- Zhao Liu (University of Manchester, one week in Dec 2014).
- Gabriele Moser (Genoa University, Italy, one week in July 2014).
- Samir Sahli (McMaster University, Canada, one week in September 2014).
- Thomai Tsiftsi (Durham University, UK, one week in March 2014).

7.4.1.1. Internships

Emmanuel Maggiori (from May until November 2014)

Subject: Optimizing partition trees for multi-class segmentation with shape prior.

Institution: Universidad Nacional del Centro de la Provincia de Buenos Aires and Inria.

Shu-Chi Yeh (from May until August 2014)

Subject: Hyperspectral skin image processing.

Institution: McMaster University, Canada.

7.4.2. Visits to International Teams

- Josiane Zerubia was invited in June to visit several laboratories in Israel: Electrical Eng. and Remote Sensing Departements at BGU in Beer Sheva, Computer Science Department at HUJI in Jerusalem, Computer Science Department at Haifa University, Multimedia Department at IDC University in Herzlyia, as well as 2 industrial research centers at Herzlyia (General Motors and Superdimension/Covidian). She also visited 2 start-up companies working in image processing: ORCAM in Jerusalem and GIVIEW in Ramat Gan. Finally she attended the Israel Computer Graphics day 2014 at Weizmann Institute in Rehovot.
- Josiane Zerubia visited in August the Computer Vision and Geometric Modeling lab at the University of Montreal, the Biophotonics lab at the Dept. of Engineering Physics of Mc Master University, as well as the Juravinski cancer research center in Hamilton, and two laboratories working in medical imaging and biological sciences at Sunnybrook Research Institute in Toronto.
- Josiane Zerubia was invited by University of Szeged and the Hungarian Academy of Sciences in December to visit the research group on visual computation at the Informatics Department, as well as the BIOMAG research group of the Synthetic and Systems Biology Unit, located both at Szeged University. She also visited 3 laboratories related to remote sensing, image processing and computer graphics in MTA SZTAKI in Budapest.

BACCHUS Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

Title: TIDES: Robust simulation tools for non-hydrostatic free surface flows

Type: Apple à Projets Recherche du Conseil de la Région Aquitaine

Coordinator: M. Ricchiuto

Other partners: UMR EPOC (P. Bonneton)

Abstract: This project proposes to combine modern high order adaptive finite elements techniques with state of the art nonlinear and non-hydrostatic models for free sruface waves to provide an accurate tool for the simulation of near shore hydrodynamics, with application to the study and prediction of tidal bores. The Garonne river will be used as a case study. This project co-funds (50%) the PhD of A. Filippini.

6.2. National Initiatives

6.2.1. Inria Project Lab

6.2.1.1. C2S@Exa - Computer and Computational Scienecs at Exascale

Participants: Olivier Aumage [RUNTIME project-team, Inria Bordeaux - Sud-Ouest], Jocelyne Erhel [SAGE project-team, Inria Rennes - Bretagne Atlantique], Philippe Helluy [TONUS project-team, Inria Nancy - Grand-Est], Laura Grigori [ALPINE project-team, Inria Saclay - Île-de-France], Jean-Yves L'excellent [ROMA project-team, Inria Grenoble - Rhône-Alpes], Thierry Gautier [MOAIS project-team, Inria Grenoble - Rhône-Alpes], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Michel Kern [POMDAPI project-team, Inria Paris - Rocquencourt], Stéphane Lanteri [Coordinator of the project], François Pellegrini [BACCHUS project-team, Inria Bordeaux - Sud-Ouest], Christian Perez [AVALON project-team, Inria Grenoble - Rhône-Alpes], Frédéric Vivien [ROMA project-team, Inria Grenoble - Rhône-Alpes].

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

6.2.1.2. FUI Rodin

Title: Robust structural Optimization for Design in Industry (Rodin)

Type: FUI

Duration: July 2012 - July 2015

Coordinator: ALBERTELLI Marc (Renault)

Abstract: From the research point of view, the RODIN project will focus on: (1) extending level set methods to nonlinear mechanical or multiphysics models and to complex geometrical constraints, (2) developing algorithms for moving meshes with a possible change of topology, (3) adapting in a level-set framework second-order optimization algorithms having the ability of handling a large number of design variables and constraints.

The project will last 3 years and will be supported by a consortium of 7 partners: (1) 2 significant end-users, Renault and EADS, who will provide use-cases reflecting industrial complexity; (2) 3 academics partners, CMAP, J.-L. Lions laboratory and Inria of Bordeaux, who will bring expertise in applied mathematics, structural optimization and mesh deformation; (3) A software editor, ESI Group, who will provide mechanical software package and will pave the way of an industrialization; (4) A SME, Eurodecision, specialized in large-scale optimization.

6.2.1.2.1. ANR MAIDESC

Title: Maillages adaptatifs pour les interfaces instationnaires avec deformations, etirements, courbures.

Type: ANR

Duration: 48 months

Starting date : 1st Oct 2013

Coordinator: Dervieux Alain (Inria Sophia)

Abstract: Mesh adaptive numerical methods allow computations which are otherwise impossible due to the computational resources required. We address in the proposed research several well identified main obstacles in order to maintain a high-order convergence for unsteady Computational Mechanics involving moving interfaces separating and coupling continuous media. A priori and a posteriori error analysis of Partial Differential Equations on static and moving meshes will be developed from interpolation error, goal-oriented error, and norm-oriented error. From the minimization of the chosen error, an optimal unsteady metric is defined. The optimal metric is then converted into a sequence of anisotropic unstructured adapted meshes by means of mesh regeneration, deformation, high stretching, and curvature. A particular effort will be devoted to build an accurate representation of physical phenomena involving curved boundaries and interfaces. In association with curved boundaries, a part of studies will address third-order accurate mesh adaption. Mesh optimality produces a nonlinear system coupling the physical fields (velocities, etc.) and the geometrical ones (unsteady metric, including mesh motion). Parallel solution algorithms for the implicit coupling of these different fields will be developed. Addressing efficiently these issues is a compulsory condition for the simulation of a number of challenging physical phenomena related to industrial unsolved or insufficiently solved problems. Non-trivial benchmark tests will be shared by consortium partners and by external attendees to workshops organized by the consortium. The various advances will be used by SME partners and proposed in software market.

6.2.1.2.2. ANR UFO

Title: Uncertainty quantification For compressible fluid dynamics and Optimisation.

Type: ANR

Duration: 36 months

Starting date : 1st June 2011

Coordinator: Remi Abgrall (Inria Bordeaux Sud-Ouest)

Abstract: This project deals with the simulation and the optimization of stochastic flows where the uncertainties can be both in the data and in the models. The focus will be on handling the uncertainties coming from the turbulence models or thermodynamics models in dense-gas flows. Since the thermodynamic models for dense-gas flows are not well-known, it is mandatory to compute the probability density functions of some quantities of interest by starting from the experimental data. Several methods have been developed for both reducing the global computational cost and increasing the accuracy in the statistics computation.

6.2.1.2.3. PIA TANDEM

Title: Tsunamis in the Atlantic and the English ChaNnel: Definition of the Effects through numerical Modeling (TANDEM)

Type: PIA - RSNR (Investissement d'Avenir, "Recherches en matière de Sûreté Nucléaire et Radioprotection")

Duration: 48 months

Starting date : 1st Jan 2014

Coordinator: H. Hebert (CEA)

Abstract: TANDEM is a project dedicated to the appraisal of coastal effects due to tsunami waves on the French coastlines, with a special focus on the Atlantic and Channel coastlines, where French civil nuclear facilities have been operated since about 30 years. As identified in the call RSNR, this project aims at drawing conclusions from the 2011 catastrophic tsunami, in the sense that it will allow, together with a Japanese research partner, to design, adapt and check numerical methods of tsunami hazard assessment, against the outstanding observation database of the 2011 tsunami. Then these validated methods will be applied to define, as accurately as possible, the tsunami hazard for the French Atlantic and Channel coastlines, in order to provide guidance for risk assessment on the nuclear facilities.

6.2.1.3. PEPS

Title On a new mathematical and numerical approach for simulations in coastal engineering

Type : PEPS IDEX-CNRS

Duration : 12 months

Starting : Date May 2013

Coordinator : M. Colin

Abstract : The modeling of free surface flows is a major challenge in coastal engineering and its understanding is crucial if one wants to predict the impact of large-scale phenomena such as Tsunami propagations for example. The aim of this project is to provide pertinent and efficient numerical asymptotic models describing fluid flows in view of producing a computational plate-form. We will give a particular attention to scalar models in order to describe wave breaking in the near-shore region. Finally , we will introduce a new method to obtain numerical asymptotic models which consists in inverting the usual paradigm

Full models→Asymptotic models→Numerical scheme.

6.2.1.4. APP Bordeaux 1

Title : Reactive fluid flows with interface : macroscopic models and application to self-healing materials

Type : Project Bordeaux 1

Duration : 36 months

Starting : September 2014

Coordinator : M. Colin

Abstract : Because of their high strength and low weight, ceramic-matrix composite materials (CMCs) are the focus of active research, for aerospace and energy applications involving high temperatures. Though based on brittle ceramic components, these composites are not brittle due to the use of a fiber/matrix interphase that manages to preserve the fibers from cracks appearing in the matrix. The lifetime-determining part of the material is the fibers, which are sensitive to oxidation; when the composite is in use, it contains cracks that provide a path for oxidization. The obtained lifetimes can be of the order of hundreds of thousands of hours. These time spans make most experimental investigations impractical. In this direction, the aim of this project is to furnish predictions based on computer models that have to take into account: 1) the multidimensional topology of the composite made up of a woven ceramic fabric; 2) the complex chemistry taking place in the material cracks; 3) the flow of the healing oxide in the material cracks.

6.3. European Initiatives

6.3.1. FP7 & H2020 Projects

6.3.1.1. STORM

Type: COOPERATION

Defi: NC

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: October 2013 - September 2016

Coordinator: SNECMA (France)

Partner: SNECMA SA (FR), AEROTEX UK LLP (UK), AIRBUS OPERATIONS SL (ES), Airbus Operations Limites (UK), AIRCELLE SA (FR), ARTTIC (FR), CENTRO ITALIANO RICERCHE AEROSPAZIALI SCPA (IT), CRANFIELD UNIVERSITY (UK), DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV (DE), EADS DEUTSCHLAND GMBH (DE), ONERA (FR), TECHSAPACE AERO SA (BE)

Inria contact: Heloise Beaugendre

Abstract: During the different phases of a flight, aircraft face severe icing conditions. When this ice then breaks away, and is ingested through the reminder of the engine and nacelle it creates multiple damages which have a serious negative impact on the operations costs and may also generate some incident issues. To minimise ice accretion, propulsion systems (engine and nacelle) are equipped with Ice Protection Systems (IPS), which however have themselves performance issues. Design methodologies used to characterise icing conditions are based on empirical methods and past experience. Cautious design margins are used non-optimised designs solutions. In addition, engine and nacelle manufacturers are now limited in their future architectures solutions development because of lack of knowledge of icing behaviour within the next generation of propulsive systems solutions, and of new regulations adopted that require aero engine manufacturers to address an extended range of icing conditions.

In this context that STORM proposes to: characterise ice accretion and release through partial tests ; Model ice accretion, ice release and ice trajectories ; Develop validated tools for runback ; characterise ice phobic coatings ; select and develop innovative low cost and low energy anti-icing and de-icing systems. Thus, STORM will strengthen the predictability of the industrial design tools and reduce the number of tests needed. It will permit lower design margins of aircraft systems, and thus reduce the energy consumption as well as prevent incidents and break downs due to icing issues.

6.4. International Initiatives

6.4.1. Inria Associate Teams

6.4.1.1. AQUARIUS2

Title: Uncertainty quantification and numerical simulation of high Reynolds number flows

International Partner (Institution - Laboratory - Researcher):

Stanford University (ÉTATS-UNIS)

Duration: 2011 - 2016

See also: http://www.stanford.edu/group/uq/aquarius/index3.html

This research project deals with uncertainty quantification and numerical simulation of high Reynolds number flows. It represents a challenging study demanding accurate and efficient numerical methods. It involves the Inria team BACCHUS and the groups of Pr. Charbel Farhat from the Department of Aeronautics and Astronautics and Pr. G. Iaccarino from the Department of Mechanical Engineering at Stanford University. The first topic concerns the simulation of flows when only partial information about the physics or the simulation conditions (initial conditions, boundary conditions) is available. In particular we are interested in developing methods to be used in complex flows where the uncertainties represented as random variables can have arbitrary probability density functions. The second topic focuses on the accurate and efficient simulation of high Reynolds number flows. Two different approaches are developed (one relying on the XFEM technology, and one on the Discontinuous Enrichment Method (DEM), with the coupling based on Lagrange multipliers). The purpose of the proposed project is twofold : i) to conduct a critical comparison of the approaches of the two groups (Stanford and Inria) on each topic in order to create a synergy which will lead to improving the status of our individual research efforts in these areas ; ii) to apply improved methods to realistic problems in high Reynolds number flow.

6.4.1.2. AMoSS

Title: Advanced Modeling on Shear Shallow Flows for Curved Topography : water and granular flows.

International Partner (Institution - Laboratory - Researcher):

Inria Sophia-Antipolis and University of Nice (France)

Inria Bordeaux and University of Bordeaux (France)

University of Marseille (France)

National Cheng Kung University, Tainan, Taiwan

National Taiwan University and Academia Sinica,Taipei, Taiwan

Duration: 2014 - 2016

See also: https://team.inria.fr/amoss/

Our objective is to generalize the promising modeling strategy proposed in G.L. Richard and S.L. Gavrilyuk 2012, to genuinely 3D shear flows and also take into account the curvature effects related to topography. Special care will be exercised to ensure that the numerical methodology can take full advantage of massively parallel computational platforms and serve as a practical engineering tool. At first we will consider quasi-2D sheared flows on a curve topography defined by an arc, such as to derive a model parameterized by the local curvature and the nonlinear profile of the bed. Experimental measurements and numerical simulations will be used to validate and improve the proposed modeling on curved topography for quasi-2D flows. Thereafter, we will focus on 3D flows first on simple geometries (inclined plane) before an extension to quadric surfaces and thus prepare the generalization of complex topography in the context of geophysical flows.

6.4.2. Inria International Partners

6.4.2.1. Informal International Partners

University of Zurich : R. Abgrall. Collaboration on penalisation on unstructured grids and high order adaptive methods for CFD and uncertainty quantification.

Politecnico di Milano, Aerospace Department (Italy) : Pr. A. Guardone. Collaboration on ALE for complex flows (compressible flows with complex equations of state, free surface flows with moving shorelines).

von Karman Institute for Fluid Dynamics (Belgium). With Pr. T. Magin we work on Uncertainty Quantification problems for the identification of inflow condition of hypersonic nozzle flows. With Pr. H. Deconinck we work on the design of high order methods, including goal oriented mesh adaptation strategies

University of Nottingham, Department of Mathematics : Dr. M.E. Hubbard. Collaboration on high order schemes for time dependent shallow water flows

Technical University of Crete, School of Production Engineering & Management : Pr. A.I. Delis. Collaboration on high order schemes for depth averaged free surface flow models, including robust code to code validation

Chalmers University (C. Eskilsson) and Technical University of Denmark (A.-P. Engsig-Karup) : our collaboration with Chalmers and with DTU compute in Denmark aims at developing high order non hydrostatic finite element Boussinesq type models for the simulation floating wave energy conversion devices such as floating point absorbers ;

6.4.3. Participation In other International Programs

6.4.3.1. Inria-CNPq

In the context of the HOSCAR project jointly funded by Inria and CNPq, coordinated by Stéphane LANTERI on the French side, François Pellegrini and Pierre Ramet have participated in a joint workshop in Petrópolis last September. A collaboration is envisioned regarding parallel graph partitioning algorithms for data placement in the context of big data applications.

6.5. International Research Visitors

6.5.1. Visits of International Scientists

- Prof. B. Muller (Norwegian University of Science and Technology) has been hosted for a sabbatical from January to May. During his stay he has interacted with P. Congedo and M.G. Rodio on the milling of compressible multiphase flows ;
- Prof. A.I. Delis (Technical University of Crete) has been hosted during the whole month of September (funding from the mathematics department invited professors campaign, university of Bordeaux). During his stay he worked with M. Ricchiuto on the set up of a robust code-to-code comparison strategy for long wave run-up ;
- A. Larat (CNRS, EM2C lab Paris) has been hosted for a month during November and December to work with M. Ricchiuto on space time Galerkin schemes for KdV type equations.

Besides these longer stays, this year we have hosted several of our collaborators such as K. AOKI (Kyoto University), E. Miglio (Politecnico di Milano), S. Blaise (University of Louvain la Neuve), C. Eskilsson (Chalmers University), A.-P. Engsig-Karup (DTU Compute), and many others.

6.5.1.1. Research stays abroad

In the context of the associated team AQUARIUS2, three 1-month visits have been done during September-October 2014 in Stanford University (Pietro Marco Congedo, Maria Giovanna Rodio, Francesca Fusi).

BAMBOO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ABS4NGS

- Title: Solutions Algorithmiques, Bioinformatiques et Logicielles pour le Séquençage Haut Débit
- Coordinator: E. Barillot
- BAMBOO participant(s): V. Lacroix
- Type: ANR (2012-2015)
- Web page: Not available

7.1.2. Colib'read

- Title: Methods for efficient detection and visualization of biological information from non assembled NGS data
- Coordinator: P. Peterlongo
- BAMBOO participant(s): V. Lacroix, A. Julien-Lafferière, C. Marchet, G. Sacomoto, M.-F. Sagot, B. Sinaimeri
- Type: ANR (2013-2016)
- Web page: http://colibread.inria.fr/

7.1.3. Exomic

- Title: Functional annotation of the transcriptome at the exon level
- Coordinator: D. Auboeuf (Inserm, Lyon)
- BAMBOO participant(s): V. Lacroix, M.-F. Sagot
- Type: INSERM Systems Biology Call (2012-2015)
- Web page: Not available

7.1.4. Effets de l'environnement sur la stabilité des éléments transposables

- Title: Effets de l'environnement sur la stabilité des éléments transposables
- Coordinator: C. Vieira
- BAMBOO participant(s): C. Vieira
- Type: Fondation pour la Recherche Médicale (FRM) (2014-2016)
- Web page: Not available

7.1.5. ExHyb

- Title: Exploring genomic stability in hybrids
- Coordinator: C. Vieira
- BAMBOO participant(s): C. Vieira
- Type: ANR (2014-2018)
- Web page: Not available

7.1.6. IMetSym

- Title: Immune and Metabolic Control in Intracellular Symbiosis of Insects

- Coordinator: A Heddi
- BAMBOO participant(s): H. Charles, S. Colella
- Type: ANR Blanc (2014-2017)
- Web page: Not available

7.1.7. ImmunSymbArt

- Title: Immunity and Symbiosis in Arthropods
- Coordinator: D. Bouchon
- BAMBOO participant(s): F. Vavre
- Type: ANR Blanc (2010-2014)
- Web page: Not available

7.1.8. Metagenomics of Bemisia tabaci

- Title: Metagenomics of *Bemisia tabaci* symbiotic communities
- Coordinator: L. Mouton (LBBE, UCBL)
- BAMBOO participant(s): F. Vavre, M.-F. Sagot
- Type: Genoscope Project
- Web page: Not available

7.1.9. SpeciAphid

- Title: Evolutionary genetics and mechanisms of plant adaptation in aphids
- Coordinator: Jean-Christophe Simon (IGEPP, INRA, Rennes)
- BAMBOO participant(s): H. Charles, S. Colella, Y. Rahbé
- Type: ANR (2012-2014)
- Web page: Not available

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. BacHBerry

Title: BACterial Hosts for production of Bioactive phenolics from bERRY fruits

Coordinator: Jochen Förster, DTU Danemark

BAMBOO participant(s): R. Andrade, L. Bulteau, A. Julien-Laferriére, V. Lacroix, D. Parrot, M.-F. Sagot, A. Viari, M. Wannagat

Type: FP7 - KBBE (2013-2016)

Web page: http://www.bachberry.eu/

7.2.1.2. DroParCon

- Title: Drosophila parasitoid consortium
- Coordinator: Jochen Förster (Novo Nordisk Foundation Center for Biosustainability (CFB), Copenhagen, Danemark)
- BAMBOO participant(s): F. Vavre
- Type: PHC (2012-2014)
- Web page: http://www.droparcon.org

7.2.1.3. Microme

- Title: The Microme Project: A Knowledge-Based Bioinformatics Framework for Microbial Pathway Genomics
- Coordinator: P. Kersey (EBI)
- European partners: Amabiotics (France), CEA (France), CERTH (Greece), CSIC (Spain), CNIO (Spain), DSMZ (Germany), EBI (UK), HZI (Germany), Isthmus (France), Molecular Nertwork (Germany), SIB (Switzerland), Tel Aviv Univ. (Israel), Université Libre de Bruxelles (Belgium), WTSI (UK), Wageningen Univ. (The Netherlands)
- BAMBOO participant(s): Anne Morgat
- Type: Collaborative Project. Grant Agreement Number 222886-2
- Web page: http://www.microme.eu

7.2.1.4. SISYPHE

- Title: Species Identity and SYmbiosis Formally and Experimentally explored
- Coordinator: M.-F. Sagot
- BAMBOO participant(s): Whole BAMBOO team
- Type: ERC Advanced Grant (2010-2015)
- Web page: http://pbil.univ-lyon1.fr/members/sagot/htdocs/team/projects/sisyphe/sisyphe.html

7.2.1.5. SWIPE

- Title: Predicting whitefly population outbreaks in changing environments
- Coordinator: E. Zchori-Fein
- BAMBOO participant(s): F. Vavre
- Type: European ERA-NET program ARIMNET (2012-2015)
- Web page: Not available

7.2.1.6. Symbiox

- Title: Role of the oxidative environment in the stability of symbiotic associations
- Coordinator: F. Vavre
- BAMBOO participant(s): F. Vavre
- Type: Marie Curie IOF for Natacha Kremer (2011-2014)
- Web page: Not available

7.3. International Initiatives

7.3.1. Inria International Labs

BAMBOO participates in a project within the Inria-Chile CIRIC (Communication and Information Research and Innovation Center) titled “Omics Integrative Sciences”. The main objectives of the project are the development and implementation of mathematical and computational methods and the associated computational platforms for the exploration and integration of large sets of heterogeneous omics data and their application to the production of biomarkers and bioidentification systems for important Chilean productive sectors. The project started in 2011 and is coordinated in Chile by Alejandro Maass, Mathomics, University of Chile, Santiago.

7.3.2. Inria International Partners

Bamboo has an Inria International Partnership, called AMICI (see http://team.inria.fr/bamboo/amici/), with three partners in Italy (Universities of Rome “La Sapienza", Florence, and Pisa) and one in the Netherlands (Free University of Amsterdam / CWI). There are two unifying interests to all the projects of AMICI: algorithmics, and biology. At the present time, mostly because the current work of BAMBOO is centered on the ERC project SISYPHE (“Species Identity and SYmbiosis Formally and Experimentally explored"), the biology is very oriented to the general study, at the molecular level, of the symbiotic relation (genomics and other associated “omics", evolution, biochemical and interaction networks). This should evolve in future to extend the symbiotic study to either the ecological or a more health-oriented level, or to address new biology-related problems using mathematical modelling and techniques, and algorithmics.

7.3.3. Participation In other International Programs

BAMBOO is coordinator of a CNRS-UCBL-Inria Laboratoire International Associé (LIA) with the Laboratório Nacional de Computação Científica (LNCC), Petrópolis, Brazil. The LIA has for acronym LIRIO ("Laboratoire International de Recherche en bIOinformatique") and is coordinated by Ana Tereza Vasconcelos from the LNCC and Marie-France Sagot from BAMBOO. The LIA was created in January 2012 for 4 years, renewable once. A preliminary web page for the LIA LIRIO is available at this address: http://team.inria.fr/bamboo/en/cnrs-lia-laboratoire-international-associe-lirio/.

BAMBOO coordinates another project with Brazil. This is a CAPES-COFECUB project titled: "Multidisciplinary Approach to the Study of the Biodiversity, Interactions and Metabolism of the Microbial Ecosystem of Swines". The coordinators are M.-F. Sagot (France) and A. T. Vasconcelos (LNCC, Brazil) with also the participation of Arnaldo Zaha (Federal University of Rio Grande do Sul. The project started in 2013 for 2 years, renewable once. The main objective of this project is to experimentally and mathematically explore the biodiversity of the bacterial organisms living in the respiratory tract of swines, many of which are pathogenic.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

During 2014, the team had 4 international scientists visiting our group for at least one week. These included:

- Franciele Maboni, Federal University of Rio Grande do Sul, Porto Alegre, Brazil, two visits of, respectively, 15 days and 1 week;
- Maria Cristina Motta, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil, two visits of approximately 15 days;
- Susana Vinga, INESC-ID, IST Lisbon, Portugal, visit of 1 week;
- Arnaldo Zaha, Federal University of Rio Grande do Sul, Porto Alegre, Brazil, visit of 10 days.

The above does not count the frequent visits of our external collaborators, members of the Inria International Partnership AMICI or of the LIA LIRIO.

BEAGLE Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. Labex Ecofect Call

- IntraCell-X-Evo (2014-2015): Experimental evolution of an intracellular bacterium within its host cell. Supervisor: Thomas Henry, INSERM Lyon. Participants: Eric Tannier.

6.2. National Initiatives

6.2.1. ANR

- Stochagene (2011-2014). Objective: identify the molecular basis of the stochasticity of gene expression in eukaryotic cells. Partners: CGPhyMC (O Gandrillon, Lyon, Leader), Genethon (A Paldi, Evry). Participants: G Beslon, H Berry, G Kaneko
- Ancestrome: phylogenetic reconstruction of ancestral "-omes", a five-year project (2012-2017), call "Bioinformatics" of the "Investissements d'avenir". Supervisor: V Daubin (CNRS, LBBE, Lyon) ; with Institut Pasteur, ENS Paris, ISEM (Univ Montpellier 2) Participant: E Tannier.
- Foster: Spatiotemporal data mining: application to the understanding and monitoring of soil erosion (2011-2014). Supervisor: N Selmaoui and F Flouvat (PPME Univ. Nouvelle Caledonie); with LISTIC Univ. Savoie, ICube Univ. Strasbourg, BlueCham Company. Participant: C Rigotti.
- Dopaciumcity (2014-2017) (Dopamine modulation of calcium influx underlying synaptic plasticity): a 4-year project (2014-2017) funded by a grant from the ANR-NSF-NIH Call for French-US Projects in Computational Neuroscience. With L. Venance, College de France, CIRB, CNRS/UMR 7241 - INSERM U1050, Paris, France and K Blackwell, Krasnow Institute of Advanced Studies, George Mason University, Fairfax, VA, USA. Supervisor: L Venance (for France) and K.L. Blackwell (for US). Participants: H Berry, I Prokin, A Foncelle

6.3. European Initiatives

6.3.1. FP7 & H2020 Projects

6.3.1.1. EvoEvo

Type: FP7

Defi: Future and Emerging Technologies

Instrument: Specific Targeted Research Project

Objectif: FET Proactive: Evolving Living Technologies

Duration: September 2013 - August 2016

Coordinator: Guillaume Beslon

Partner: Université Joseph Fourier (France, D. Schneider), Utrecht University (Netherland, P. Hogeweg), University of York (UK, S. Stepney), and CSIC (Spain, S. Elena)

Inria contact: Guillaume Beslon

Abstract: Evolution is the major source of complexity on Earth, at the origin of all the species we can observe, interact with or breed. On a smaller scale, evolution is at the heart of the adaptation process for many species, in particular micro-organisms (e.g. bacteria, viruses...). Microbial evolution results in the emergence of the species itself, and it also contributes to the organisms' adaptation to perturbations or environmental changes. These organisms are not only organised by evolution, they are also organised to evolve. The EvoEvo project will study this process of "evolution of evolution" and use this knowledge to develop new evolutionary approaches in information science. Our ultimate goal is to address open-ended problems, where the specifications are either unknown or too complicated to express, and to produce software able to operate in unpredictable, varying conditions.

6.3.1.2. Neuron-Astro-Nets

Type: FP7

Defi: NC

Instrument: Marie Curie International Outgoing Fellowships for Career Development

Objectif: NC

Duration: (2013-2017)

Coordinator: H. Berry, M. De Pittà (Inria)

Partner: N Brunel (University of Chicago, Dept Statistics and Neurobiology, Chicago, USA)

Inria contact: Maurizio DE PITTA

Abstract: This project aims at developing a new model of synaptic plasticity that takes into account astrocyte signaling, its extension to astrocytes-synapse biochemical interactions in ensembles of synapses enwrapped by the same astrocyte and, eventually, to the firing of a single neuron or networks.

6.4. International Initiatives

6.4.1. Inria International Partners

6.4.1.1. Declared Inria International Partners

- Nadia El-Mabrouk, from the University of Montreal in Canada, came as an Inria invited researcher in 2012 and 2013. Since then we have several co-authored papers, including one submitted this year, and a co-edited book.
- Cedric Chauve from Simon Fraser University in Vancouver, Canada, is a very regular collaborator of Eric Tannier. We still have a publication in preparation. Cedric was visiting the LBBE lab in june 2014. We obtained a PIMS (Pacific Institute of Mathematics Studies) grant for a visit in 2015.
- Istvan Miklos, from the Renyi Institute in Budapest, is a regular collaborator of Eric Tannier, and we have a co-publication in 2014 [22].
- Joao Meidanis, from the University of Campinas in Brazil, is a collaborator of Eric Tannier. Priscila Biller, supervised by J. Meidanis, is spending 12 months in the BEAGLE team.

6.4.1.2. Informal International Partners

- Wolfgang Banzhaf (New Foundland Memorial University, Canada). Together with Wolfgang Banzhaf, we initiated a theoretical work on the concept of "open-endedness". We are currently writing a collective position paper to precisely define this currently informal concept and to design minimal conditions to simulate it in silico.

6.4.2. Participation In other International Programs

- Dopaciumcity (2014-2016): Dopamine modulation of calcium influx underlying synaptic plasticity. Partners: George Mason University, Fairfax, VA, USA (Kim L. Blackwell, US project leader) Collège de France, Paris, France (Laurent Venance, French project leader) Inria Rhône-Alpes, France, (H. Berry) from the ANR-NSF-NIH Call for French-US Projects in Computational Neuroscience.

- User-friendly Phylogenomics (2014): Bayesian simultaneous reconstruction of gene trees and species trees. France Berkeley Fund. Inria Participants: Eric Tannier. Common project with J. Huelsenbeck's lab (UC Berkeley, USA) on the development of probabilistic models of genome and sequence evolution to simultaneously reconstruct gene trees and species trees, and thus study how species and their genomes have changed through time.
- ANR/NSF Bilateral programme for Collaborative Research in Computational Neuroscience (CRCNS): Modelling the vocal apparatus of birds (2013-2016) This joint project with F. Theunissen (UC Berkeley, USA) aims at modelling the vocal apparatus of birds (Zebra Finches) to recreate vocal range of this bird using a sparser representation than the spectrum. This new representation can be used as a new parameter space to test acoustic neural coding. This collaboration has been granted by ANR/NSF Bilateral program for Collaborative Research in Computtional Neuroscience (CRCNS)(CRCNS 2012), which promotes collaborations between French and American teams. BEAGLE (H. Soula) is coordinator of the project for the French side and supervises the modeling aspects.

6.5. International Research Visitors

6.5.1. Visits of International Scientists

- Sergei Fedotov (Department of Mathematics, University of Manchester, UK) was a visiting professor in BEAGLE from June 5 to June 17, 2014. Collaboration with H. Berry and A. Mateos-Gonzalez

6.5.1.1. Internships

- Priscilla Biller spends a year in the BEAGLE team, during her Ph-D preparation in University of Campinas, Brazil

6.5.2. Visits to International Teams

- G Beslon spent a week in New Foundland Memorial University (July 2014) to attend a workshop on the concept of "open-endedness".
- C Rocabert spent 10 days in Utrecht University to collaborate with the bioinformatics and theoretical biology group. The objective was to exchange ideas to develop and integrated evolutionary model.
- H. Berry was invited to the BioMedTech Institute of Tampere University of Technology for one week (8-12 Dec. 2014)

BIGS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Project "Handle your heart" Creation of a drug prescription support software for the treatment of heart failure, in collaboration with the University Hospital of Nancy, headed by J.-M. Monnez.

7.2. National Initiatives

- *Truffinet* (2014), TRUFFles' microbial interaction Inference by NETwork analysis, Funding organism: PEPS CNRS-Université de Lorraine, Leader: A. Muller-Gueudin. Collaboration with IECL (Anne Gégout-Petit), CRAN (S. Martin, C. Morarescu), INRA (A. Deveau).
- *Optique-PDT* (2012-2014), mOdélisation et oPTimisation de l'Irradiance dans les tissus biologiQUEs hétérogènes traités par Thérapie PhotoDynamique interstitielle, Funding organism: *PEPS CNRS-INSERM-Inria*, Leader: M. Thomassin (CRAN, U. Lorraine).
- *Nano-Xrays* (2011-2014), Nanoparticles-based X ray-induced photodynamic therapy in glioblastoma multiform, Funding organism: Institut National du Cancer (INCa), Leader: M. Barberi-Heyob (CRAN, U. Lorraine), T. Bastogne.
- GDR 3477 Géométrie Stochastique, Leaders: Pierre Calka, David Coupier, Viet Chi Tran, C. Lacaux.
- GDR 3475 Analyse Multifractale, Leader: Stéphane Jaffard (C. Lacaux).
- *PhotoBrain* (2015-17), AGuIX® theranostic nanoparticles for vascular-targeted interstitial photodynamic therapy of brain tumors, Funding organism: EuroNanoMed II, Leader: M. Barberi-Heyob (CRAN).
- (2014-16), A library of Near-InfraRed absorbing photosensitizers: tailoring and assessing photophysical and synergetic photodynamic properties, Funding organism: PHC Bosphore - Campus France, Leader: M. Barberi-Heyob (CRAN).

7.3. International Research Visitors

7.3.1. Visits of International Scientists

2014/05/11-2014/05/25: visit of Gennady Samorodnitsky (Cornell, USA) to C. Lacaux.

7.3.2. Visits to International Teams

7.3.2.1. Sabbatical programme

S. Tindel was on sabbatical at the University of Kansas from August 2013 to June 2014, working on inference for Gaussian systems with D. Nualart and Y. Hu.

BIOCORE Project-Team

8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. National programmes

- **ANR-GeMCo:** The objective of this project is to do model reduction, experimental validation, and control for the gene expression machinery in E. coli. The project is funded by ANR (2010-BLAN-0201-01) coordinated by M. Chaves, and ran through April 2014.
- **ANR-Facteur 4:** The objective of this project (2012-2015) is to propose non OGM strains of microalgae with enhanced performance. BIOCORE is involved in the directed selection of microalgae with interesting properties from an industrial point of view. The theory of competition is used to give a competitive advantage to some species. This competitive advantage can be provided by an online closed loop controller.
- **ANR-Purple Sun:** The objective of this project (ANR-13-BIME-004: 2013-2017) is to propose, study, and optimize a new concept consisting in coupling the production of microalgae with photovoltaic panels. The main idea is to derive the excess of light energy to PV electricity production, in order to reduce both the phenomena of photoinhibition and process overwarming.
- **ANR-Phycover:** The overall objective of the project (2014-2018) is to draw the scientific, technical and industrial contexts for an evolution of wastewater treatment plants, combining three modules: a high-rate algal pond dedicated to the treatment of municipal wastewater, an anaerobic digester, and a module aiming at enhancing the digestate valorization.
- **ANR-FunFit:** The objective of this project (2013-2017) is to develop a trait-based approach linking individual fitness of fungal plant pathogens to ecological strategies. The idea is to derive eco-epidemiological strategies from fitness optimization in colonized environments and during colonization, as well as understanding the coexistence of sibling species. This project is co-coordinated by F. Grognard.
- **ANR-TripTic:** The objective of this project (2014-2018) is to document the biological diversity in the genus of the minute wasps *Trichogramma*, and to study the behavioral and populational traits relevant to their use in biological control programs.
- **ANR-GESTER:** "Management of crop resistances to diseases in agricultural landscapes as a response to new constraints on pesticide use", ANR Agrobiosphère, 2011–2015. This project aims at producing allocation scenarios of resistant varieties at the scale of cultivated landscapes, that will allow to limit disease development while ensuring sustainable efficiency of genetic resistances. BIOCORE participates in this project via MIA, INRA Jouy-en-Josas.
- **RESET:** The objective of this project is to control the growth of *E. coli* cells in a precise way, by arresting and restarting the gene expression machinery of the bacteria in an efficient manner directed at improving product yield and productivity. RESET is an "Investissements d'Avenir" project in Bioinformatics (managed by ANR) and it is coordinated by H. de Jong (Ibis, Inria)
- **MIHMES:** "Multi-scale modelling, from animal Intra-Host to Metapopulation, of mechanisms of pathogen spread to Evaluate control Strategies", ANR – Investissement d'avenir, action Bioinformatique (ANR-10-BINF-07) & Fond Européen de Développement Régional des Pays-de-la-Loire (FEDER), 2012–2016. This project aims at producing scientific knowledge and methods for the management of endemic infectious animal diseases and veterinary public health risks. BIOCORE participates in this project via MIA, INRA Jouy-en-Josas.

- **SIGNALIFE:** Biocore is part of this Labex (scientific cluster of excellence) whose objective is to build a network for innovation on Signal Transduction Pathways in Life Sciences, and is hosted by the Université Nice Sophia Antipolis.
- **Peps BMI 2013** -J-A Sepulchre (INLN CNRS UNS) - Projet "Pectolyse". Study of a virulence factor of a bacterium.
- **FUI-Salinalgue:** The objective of this project is to take benefit of endemic microalgae species in areas of high salinity (previously used to produce salt) to produce both biofuel (either lipid based or methane) and co-products. BIOCORE is in charge of lab scale experiments and of the modeling of the process.
- **OPTIBIO:** This project is devoted to the analysis of optimal control problems related to bioprocesses. The project is funded by Programme Gaspard Monge pour L'Optimisation et la Recherche Opérationnelle and coordinated by T. Bayen (U. Montpellier 2).

8.1.2. INRA funding

- **Dynamique spatiale:** INRA-SPE is funding the project "Intégration des approches comportementales et démographiques de la dynamique spatiale des populations d'insectes" in which Biocore is a partner with INRA Sophia Antipolis and Agrocampus Ouest (2012-2014).
- **Take Control:** This project, "Deployment strategies of plant quantitative resistance to take control of plant pathogen evolution," is funded by the PRESUME call of the SMAcH INRA metaprogram. BIOCORE is a partner together with INRA PACA (Sophia Antipolis and Avignon) and INRA Toulouse (2013-2016). This project provides the major part of the funding for the experiments held for Elsa Rousseau's thesis.
- **Coexistence:**. INRA-SPE is funding the project "Coexistence d'espèces cryptiques par différenciation temporelle de niches écologiques : de la théorie à l'application via l'exemple des oïdiums du chêne et de la vigne", which aims at understanding the co-existence of closely related plant pathogens in temperate environments. It is closely related to the FunFit ANR project.
- **K-Masstec:** "Knowledge-driven design of management strategies for stem canker specific resistance genes", INRA Metaprogramme SMaCH, PRESUME action, 2013–2016. The project aims at demonstrating that the knowledge issued from the understanding of the molecular interaction between distinct avirulence genes, and mainly the discovery of non-conventional gene-for-gene interactions, can be used to develop efficient strategies for the deployment of genetic resistance in the field.
- **PRRSeval:** "An integrated approach to PRRS (Porcine Reproductive and Respiratory Syndrome)", INRA Metaprogramme GISA, 2013–2015. PRRSeval has three main objectives: to develop a live-attenuated, miRNA-controlled vaccine effective to protect from emerging PRRSV strains; to identify and prioritize relevant parameters for dynamic epidemiology of herds based on in vivo profiling of PRRSV and vaccine response; and to consolidate and empower the existing French networks and collaborations with external partners and stakeholders. BIOCORE participates in this project via MIA, INRA Jouy-en-Josas.

8.1.3. Networks

- **M3D:** "Mathématiques et décision pour le développement durable", supported by the RNSC (Réseau National des Systèmes Complexes) and INRA, MIA department. BIOCORE participates in the M3D network. L. Mailleret and S. Touzeau are among the network's co-leaders.
- **GDR PROBBE:** The objective of this GDR is the development of new biotechnological processes based on microorganisms producing metabolites which can be used as fuel for transportation (lipids, sugars, methane, hydrogen, ...). BIOCORE is taking part mainly in the modeling and control aspects of the processes involving anaerobic bacteria or microalgae.
- **GDR Invasions Biologiques:** The objectives of this GDR are to encourage multidisciplinary research approaches on invasion biology. It has five different thematic axes: 1) invasion biology scenarios, 2) biological invasions and ecosystem functioning, 3) environmental impact of invasive species, 4) modeling biological invasions, 5) socio-economics of invasion biology. L. Mailleret is a member of the scientific comittee of the GDR

- **Seminar:** BIOCORE organizes a regular seminar "Modeling and control of ecosystems" at the station zoologique of Villefranche-sur-Mer, at INRA-ISA or at Inria.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. PURE

Title: Pesticide Use-and-Risk reduction in European farming systems with Integrated Pest Management

Type: COOPERATION (ICT)

Instrument: Collaborative Project (CP)

Duration: 2011 - 2014

Coordinator: Françoise Lescourret (INRA Avignon, FR)

Other partners: **Research:** Institut National de la Recherche Agronomique - INRA (FR) Rothamsted Research - RReS (UK) Aarhus University - AU (DK) Julius Kühn Institut - JKI (DE) Stichting DLO - DLO (NL) Wageningen University - WU (NL) Consiglio Nazionale delle Ricerche - CNR (IT) Agricultural Institute of Slovenia - KIS (SLO) James Hutton Institute - JHI (UK) Fondazione Edmund Mach - FEM (IT) Instituto Valenciano de Investigacio- nes Agrarias - IVIA (ES) Institute of Plant Protection - IOR (PL) University of Debrecen - Centre of Agricultural Sciences - UDCAS (HU) Joint Research Centre - Institute for Prospective Technological Studies - JRC-IPTS (EU **Extension:** Knowledge Centre for Agriculture - VFL (DK) Association de Coordination Technique Agricole - ACTA (FR) **Industry:** Bayer Crop Science (DE) BIOTOP (FR) Natural Plant Protection (FR) Burkard Manufacturing Co Ltd (UK) Blgg Bv (NL) **Management:** INRA Transfert (FR)

See also: http://www.pure-ipm.eu/project

Abstract: The overall objective of PURE is to provide practical integrated pest management (IPM) solutions to reduce dependence on pesticides in selected major farming systems in Europe, thereby contributing to a reduction of the risks to human health and the environment and facilitating the implementation of the pesticides package legislation while ensuring continued food production of sufficient quality.
PURE will provide IPM solutions and a practical toolbox for their implementation in key European farming systems (annual arable and vegetable, perennial, and protected crops) in which reduction of pesticide use and better control of pests will have major effects. In that project, L. Mailleret develops modeling approaches dedicated to the optimization of plant protection methods relying on biological control and integrated pest management.

8.2.2. Collaborations with Major European Organizations

Imperial college, Department of Chemical engineering (UK):

Modeling and optimization of microalgal based processes.

Imperial College, Centre for Synthetic Biology and Innovation, Dept. of Bioengineering (UK):

Study of metabolic/genetic models

University of Stuttgart, Institute for Systems Theory and Automatic Control (D):

Identification of gene networks

8.3. International Initiatives

8.3.1. Inria International Labs

BIOCORE is involved in the Bionature project from Inria Chile – CIRIC (the Communication and Information Research and Innovation Center), in collaboration with four Chilean universities (Universidad de Chile, Universidad Tecnica Federico Santa Maria, Pontificia Universidad Catolica de Valparaiso, and Universidad de la Frontera). The Bionature project is devoted to natural resources management and the modeling and control of bioprocesses.

8.3.2. Inria Associate Teams

8.3.2.1. GREENCORE

Title: Modelling and control for energy producing bioprocesses

International Partner (Institution - Laboratory - Researcher):

Communication and information Research and Innovation Center (CHILI)

Duration: 01/2014 - 12/2016

See also: https://team.inria.fr/eagreencore/

The worldwide increasing energy needs together with the ongoing demand for CO2 neutral fuels represent a renewed strong driving force for the production of energy derived from biological resources. In this scenario, the culture of oleaginous microalgae for biofuel and the anaerobic digestion to turn wastes into methane may offer an appealing solution. The main objective of our proposal is to join our expertise and tools, regarding these bioprocesses, in order to implement models and control strategies aiming to manage and finally optimize these key bioprocesses of industrial importance. By joining our expertises and experimental set-up, we want to demonstrate that closed loop control laws can significantly increase the productivity, ensure the bioprocess stability and decrease the environmental footprint of these systems. This project gathers experts in control theory and optimization (BIOCORE, UTFSM) together with experts in bioprocesses (PUCV and UFRO) and software development (CIRIC).

8.3.3. Inria International Partners

8.3.3.1. Inria informal international partners

Universidad Técnica Federico Santa María, Departamento de Matemática, Valparaíso, Chile
Universidad de Chile, Departamento de Matemáticas, Ñuñoa Santiago, Chile
Ben-Gurion University of the Negev, Microalgal Biotechnology Laboratory, Beer Sheva, Israel
Center for Environmental Technology and Engineering, Massey University , Palmerston North, New Zealand.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Benoit Chachuat (Imperial College, Department of chemical engineering, UK), 1 week;
- Claude Aflalo (Ben Gurion University of the Neguev, Israel), 1 week;
- Diego Oyarzún (Imperial College London), 1 week;
- Andrei Akhmetzhanov (Université de Montpellier II, F), 1 week.

8.5. Project-team seminar

BIOCORE organized a 3-day seminar in November in Saint-Etienne de Tinée. On this occasion, every member of the project-team presented his/her recent results and brainstorming sessions were organised. Alain Rapaport of the Inria MODEMIC team was invited as a guest speaker.

An additionnal 2-day seminar was dedicated to modeling and control of microalgae.

BIPOP Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- CHASLIM Chattering Free Sliding Mode Control: ANR BLAN 2011 BS03 007 01 (octobre 2011–octobre 2015), coordinator B. Brogliato.
- SLOFADYBIO Slow-fast dynamics applied to the biosciences (january 2015 – december 2016), coordinateur: Mathieu Desroches (Inria Rocquencourt).

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

Florence Bertails-Descoubes was awarded in November 2014 an ERC starting grant to work on the parameter identification of slender structures subject to contact and friction. The grand will start in 2015 and will serve to fund 3 PhD students, 2 post-docs and 1 engineer on a total project duration of 5 years.

8.3. International Initiatives

8.3.1. Inria International Labs

Vincent Acary is on sabbatical at Santiago from September 2014 to August 2016.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Ryo Kikuuwe (Associate professor, Khushu University, Japan) from 01 September 2014 to 28 February 2015.
- Nathan Krislock (Associate professor, North Illinios University, USA) from 01 June to 10 July.

8.4.2. Visits to International Teams

8.4.2.1. Sabbatical programme

Acary Vincent

Institution: CMM Chili (Date : Sep 2014 - Aug 2016)

Institution: Inria Chile (Date: Sep 2014 - Aug 2015)

BONSAI Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Projet émergent call 2011. "Scénarios d'évolution génomique basés sur les régions de cassure des réarrangements génomiques" involving GEPV (UMR CNRS 8198, Université Lille 1) and BONSAI. The project led to the recruitment of Amandine Perrin in 2014.
- SIRIC OncoLille supports our research in collaboration with Lille hospital on quantification of lymphocyte rearrangements, funding the contract of Marc Duez in 2014.

8.2. National Initiatives

8.2.1. ANR

- PIA France Génomique: National funding from Investissements d'Avenir (call *Infrastructures en Biologie-Santé*). France Génomique is a shared infrastructure, whose goal is to support sequencing, genotyping and associated computational analysis, and increase French capacities in genome and bioinformatics data analysis. It gathers 9 sequencing platforms and 8 bioinformatics platforms. Within this consortium, we are responsible for the workpackage devoted to the computational analysis of sRNA-seq data, in coordination with the bioinformatics platform of Génopole Toulouse-Midi-Pyrénées
- Mastodons (2014): National funding from CNRS (call *Scientific big data*). This call targets the management, analysis and exploitation of massive scientific data sets. We have a collaborative project for Next Generation Sequencing data analysis with LIRMM (Montpellier) and Genscale (Inria Rennes).
- PEPS Bio-Math-Info *ReSeqVar* (2013-2014): National funding from CNRS. This new project aims at designing new read mapping algorithms in the context of human genome resequencing, taking into account known variants. There are two partners: UMR 8199 (Génomique et maladie métabolique, Ph Froguel, O. Sand, part of the LIGAN sequencing platform) and BONSAI.

8.2.2. ADT

- ADT biosciences resources (2012-2014): This ADT aims to build a portal of available applications in bioinformatics at Inria. The projects involves all the 8 teams from theme Bio-A and is more specifically developed by BONSAI and Rennes. The engineer hired from 2012 to 2014 in Lille finished its contract at fall. The portal is available at http://ibr.genouest.org.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7 & H2020

- International ANR RNAlands (2014-2017): National funding from the French Agency Research (call *International call*). The subject is fast and efficient sampling of structures in RNA Folding Landscapes. The project gathers three partners: Amib from Inria Saclay, the Theoretical Biochemistry Group from Universität Wien and Bonsai.
- EuroClonality-NGS: This working group belongs to the ESLHO (European Scientific foundation for Laboratory HematoOncology), which aims at standardizing laboratory diagnostics focused on lymphoid malignancies, it is also responsible for quality controls of European laboratories. The EuroClonality-NGS working group itself is dedicated to provide new standards using high-throughput sequencing.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. CG-ALCODE

The title of the project is "Comparative Genomics for the analysis of gene structure evolution: ALternative CODing in Eukaryote genes through alternative splicing, transcription, and translation.". The project involves partners from EPI BONSAI and from the Université du Québec À Montréal (UQÀM, Canada), from year 2014 to year 2017 (see also: http://thales.math.uqam.ca/~cgalcode/).

The aim of this Associated Team is the development of comparative genomics models and methods for the analysis of eukaryotes gene structure evolution. The goal is to answer very important questions arising from recent discoveries on the major role played by alternative transcription, splicing, and translation, in the functional diversification of eukaryote genes.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

- *Novo Nordisk Foundation Center for Biosustainability, Technical University of Denmark:* Collaboration with Tilmann Weber on nonribosomal peptides.
- *Computational Biology Research Center, Tokyo*: Collaboration with Martin C. Frith on transition spaced seeds [3].
- *Department of Statistics of the North Carolina State University (Raleigh)*: Collaboration with Donald E.K. Martin one spaced seeds coverage [6].
- *Institut für Biophysik und physikalische Biochemie', University of Regensburg*: Collaboration with Rainer Merkl on ancestral sequence inference and synthesis.
- *University of Bielefeld*: Collaboration with Robert Giegerich on RNA bioinformatics [4].

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Anne Bergeron, professor, UQÀM, Canada (from July 7 to July 11 2014).
- Paul Guertin, UQÁM (from July 7 to July 24).

CAGIRE Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Predicting pressure losses in aeronautical fuel injectors

This is a 3-year programme, funded by Conseil Régional d'Aquitaine (call 2014) and two small-size companies, MMP (Gurmençon, France) and GDTECH (Bordes, France). A one-year post-doc will be recruited beginning of 2015. The objective is to investigate the possibility of using advanced RANS or hybrid RANS-LES approaches to better predict the pressure losses in injector.

8.2. National Initiatives

8.2.1. GIS Success

We are members of the CNRS GIS Success (Groupement d'Intérêt Scientifique) organised around the two major codes employed by the Safran group, namely AVBP and Yales 2.No specific activity has been devoted around those codes during 2014.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

Participants: Vincent Perrier [responsible of the team contribution], Pascal Bruel [substitute], Simon Delmas [PhD].

Program: Propulsion

Project acronym: IMPACT-AE

Project title: Intelligent Design Methodologies for Low Pollutant Combustors for Aero-Engines

Duration: 01/11/2011 - 31/10/2015

Coordinator: Roll Royce Deutschland

Other partners:

- France: Insa of Rouen, ONERA, Snecma, Turbomeca.
- Germany: Rolls-Royce Deutschland, MTU Aeo Engine Gmbh, DLR, Technology Institute of Karlsruhe, University of Bundeswehr (Munich)
- Italy: AVIOPROP SRL, AVIO S.P.A., University of Florence
- United Kingdom: Rolls Royce PLC, Cambridge University, Imperial College od Science, Technology and Medecine, Loughborough University.

Abstract: The environmental benefits of low emissions lean burn technology in reducing NOx emissions up to 80only be effective when these are deployed to a large range of new aero-engine applications. While integrating methodologies for advanced engine architectures and thermodynamic cycles. It will support European engine manufacturers to pick up and keep pace with the US competitors, being already able to exploit their new low emission combustion technology to various engine applications with short turn-around times. Key element of the project will be the development and validation of design methods for low emissions combustors to reduce NOx and CO emissions by an optimization of the combustor aero-design process. Preliminary combustor design tools will be coupled with advanced parametrisation and automation tools. Improved heat transfer and NOx models will increase the accuracy of the numerical prediction. The contribution of our team is to create with AeroSol a direct numerical simulations (DNS) database relevant to the configuration of film cooling for subsequent improvement of RANS based simulations of isothermal and non isothermal wall flows with discrete mass transfer.

8.4. International Initiatives

8.4.1. Informal International Partners

- Collaboration [RM] with the M. Hadziabdic (International university of Sarajevo, Bosnia and Herzegovina) on the turbulence and heat transfer modelling of jets impinging on a heated, rotating disk.
- Collaboration [RM] with the A.T. Nguyen (University of Vietnam-Ho Chi Minh City) on the development of a new hybrid RANS/LES method based on temporal filtering.
- Collaboration [RM] with E. Juntasaro (King Mongkut's University of Technology North Bangkok, Thailand) on the modelling of transition to turbulence.
- Collaboration [RM] with S. Lardeau (CD-Adapco, London, UK) on the development of an industrial version of the EB-RSM model and its implementation in the commercial CFD software STAR-CCM+.
- Collaboration [PB, VP, YM] with E. Dick (University of Ghent, Belgium) on the development of schemes for the simulation of unsteady low Mach number flows.
- Collaboration [PB] with A. Allouhi, A. Jamil, Y. Mourad (Ecole Supérieure de Technologie of Fès, Marocco) on energy issues related to transition and phase change materials.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- June 2014 (5 days): Prof. Erik Dick from Ghent University (Belgium) concerning the development of low Mach number schemes.
- July 2014 (10 days) Dr. Paulo Correia from Evora University (Portugal) concerning the possibility of cooperating with the Cagire team.

8.5.2. Visits to International Teams

- University of Calabria (Italy): [YM] and [PB] stayed during three days there and met Dr Carmine de Bartolo, Fr Alessandra Nigro and Prof. Francesco Bassi (University of Bergame) to discuss the possibility of a future cooperation.
- University of Evora (Portugal): [PB] stayed there during five days paying back his visit to Dr Correia who came to Pau in July. Dr Correia is willing to work with the Cagire team on the topic of synthetic turbulence generation.

CAIRN Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Images & Réseaux Competitivity Cluster - Embrace (2014-2016)

Participants: Raphaël Bardoux, Arnaud Carer, Matthieu Gautier, Olivier Sentieys.

Embrace (Embedded Radio Accelerator) is a project which involves CAIRNand two Small Medium Enterprises (SMEs): Digidia and PrimeGPS. Embrace aims at developing a software radio platform to enable the digital demodulation of HF signals. Both SMEs will use this platform as the first step to implement new products. These products will be dedicated to two different applications (Global Navigation Satellite System and Navigation Safety) at the heart of the markets of the SMEs. CAIRNgoal is the technological transfer of the methods proposed by the team that enable the rapid prototyping of digital radios.

8.2. National Initiatives

The CAIRNteam mainly collaborates with the following laboratories: CEA List, CEA Leti, LEAT Nice, Lab-Sticc (Lorient, Brest), LIRMM (Montpellier, Perpignan), LIP6 Paris, IETR Rennes, DTIM-ONERA Toulouse, LAAS Toulouse, IRIT Toulouse, Inria Socrate.
The team participates in the activities of the following research organization of CNRS (GdR for in French *"Groupe de Recherche"*):

- GdR SOC-SIP (*System On Chip & System In Package*), working groups on reconfigurable architectures, embedded software for SoC, low power issues. E. Casseau is in charge of the architecture topic of the reconfigurable platform working group.
- GdR ISIS (*Information Signal ImageS*), working group on *Algorithms Architectures Adequation*.
- GdR ASR (*Architectures Systèmes et Réseaux*)
- GdR IM (*Informatique Mathématiques*), C2 working group on Codes and Cryptography and ARITH working group on Computer Arithmetic

8.2.1. ANR Blanc - PAVOIS (2012–2016)

Participants: Arnaud Tisserand, Emmanuel Casseau, Philippe Quémerais, Jérémie Métairie, Nicolas Veyrat-Charvillon, Karim Bigou.

PAVOIS (in French: *Protections Arithmétiques Vis à vis des attaques physiques pour la cryptOgraphIe basée sur les courbeS elliptiques*) is a project on Arithmetic Protections Against Physical Attacks for Elliptic Curve based Cryptography. It involves IRISA-CAIRN(Lannion) and LIRMM (Perpignan and Montpellier). This project will provide novel implementations of curve based cryptographic algorithms on custom hardware platforms. A specific focus will be placed on trade-offs between efficiency and robustness against physical attacks. One of our goal is to theoretically study and practically measure the impact of various protection schemes on the performance (speed, silicon cost and power consumption). Theoretical aspects will include an investigation of how special number representations can be used to speed-up cryptographic algorithms, and protect cryptographic devices from physical attacks. On the practical side, we will design innovative cryptographic hardware architectures of a specific processor based on the theoretical advancements described above to implement curve based protocols. We will target efficient and secure implementations for both FPGA an ASIC circuits. For more details see http://pavois.irisa.fr.

8.2.2. ANR INFRA 2011 - FAON (2012-2015)

Participants: Raphaël Bardoux, Arnaud Carer, Matthieu Gautier, Pascal Scalart.

The FAON (Frequency based Access Optical Networks) project objectives are to demonstrate the technology and feasibility of a new type of Passive Optical Network (PON) for broadband access which uses a Frequency based shared access technique known as Frequency Division Multiplexing (FDM). These goals completely fall into the line of the expected capacity increase in PON which is today forecasted to go from 100 Mbps per user to 1 Gbps. For more details, see http://www.agence-nationale-recherche.fr/en/anr-funded-project/?tx_lwmsuivibilan_pi2[CODE]=ANR-11-INFR-0005. Faon involves Orange Labs, CEA-LETI, University of South Brittany (Lab-STICC laboratory) and Univ. Rennes I (Foton laboratory and CAIRNteam). CAIRNaims at developing a high-rate architecture at the receiver side. Specific receiver algorithms (synchronization and equalization) and FPGA implementation are the key issues that will be addressed.

8.2.3. Equipex FIT - Future Internet (of Things)

Participants: Olivier Sentieys, Arnaud Carer, Matthieu Gautier, Ganda-Stéphane Ouedraogo.

FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's "Équipements d'Excellence" (Equipex) research grant programme. FIT involves UPMC, Inria, LSIIT and the Institut Mines-Telecom and runs over a nine-year period. FIT offers a federation of several independent experimental testbeds to provide a larger-scale, more diverse and higher performance platform for accomplishing advanced experiments. For more details, see http://fit-equipex.fr/. Inria (CAIRNand Socrate teams) develops the cognitive radio testbed that will provide a full experimental environment for evaluating the coexistence and the cooperation between heterogeneous multistandard nodes. To this aim, a fully open architecture based on software defined radio nodes is developed. CAIRNaims at proposing an FPGA based software defined radio with high level specifications. Cognitive radio testbed development is supported by an ADT funding of Inria.

8.2.4. ANR Ingénérie Numérique et Sécurité - ARDyT (2011-2015)

Participants: Arnaud Tisserand, Philippe Quémerais.

ARDyT (in French: *Architecture Reconfigurable Dynamiquement Tolérante aux fautes*) is a project on a Reliable and Reconfigurable Dynamic Architecture. It involves IRISA-CAIRN(Lannion), Lab-STICC (Lorient), LIEN (Nancy) and ATMEL. The purpose of the ARDyT project is to provide a complete environment for the design of a fault tolerant and self-adaptable platform. Then, a platform architecture, its programming environment and management methodologies for diagnosis, testability and reliability have to be defined and implemented. The considered techniques are exempt from the use of hardened components for terrestrial and aeronautics applications for the design of low-cost solutions. The ARDyT platform will provide a European alternative to import ITAR constraints for fault-tolerant reconfigurable architectures. For more details see http://ardyt.irisa.fr.

8.2.5. ANR Ingénérie Numérique et Sécurité - COMPA (2011-2015)

Participants: Emmanuel Casseau, Steven Derrien, Antoine Courtay, Mythri Alle, Yaset Oliva Venegas.

COMPA (model oriented design of embedded and adaptive multiprocessor) is a project which involves CAIRN, IETR (Rennes) and Lab-STICC (Lorient). The aim of the project is to design adaptive multiprocessor embedded systems for executing dataflow programs. The use case is the Reconfigurable Video Coding (RVC) standard. More specifically, we focus on the portable and platform-independent RVC-CAL language to describe the applications. We use transformations to refine, increase parallelism and translate the application model into software and hardware components. Specific scheduling and actor's mapping are also investigated for runtime execution. For more details see http://www.compa-project.org.

8.2.6. ANR Ingénérie Numérique et Sécurité - DEFIS (2011-2015)

Participants: Olivier Sentieys, Romuald Rocher, Nicolas Simon.

DEFIS (Design of fixed-point embedded systems) is a project which involves CAIRN, LIP6 (University of Paris 6), LIRMM (University of Perpignan), CEA LIST, Thales, Inpixal. The main objectives of the project are to propose new approaches to improve the efficiency of the floating-point to fixed-point conversion process and to provide a complete design flow for fixed-point refinement of complex applications. This infrastructure will reduce the time-to-market by automating the fixed-point conversion and by mastering the trade-off between application quality and implementation cost. Moreover, this flow will guarantee and validate the numerical behavior of the resulting implementation. The proposed infrastructure will be validated on two real applications provided by the industrial partners. For more details see http://defis.lip6.fr.

8.2.7. Labex CominLabs - BoWI (2014-2018)

Participants: Olivier Sentieys, Antoine Courtay, Olivier Berder, Pascal Scalart, Arnaud Carer, Viet-Hoa Nguyen, Zhongwei Zheng.

The BoWi project (Body Wold Interactions) aims at designing an accurate gesture and body movement estimation using very-small and low-power wearable sensor nodes. It initially stems from a proposal of the CominLabs think thank focused on the society challenge called Digital Environment for the Citizen. It is also related to the social challenge ICT for Personalized Medicine and to the research track Energy Efficiency in ICT. The main objective of the project is to propose pioneer interfaces for an emerging interacting world based on smart environments (house, media, information and entertainment systems...). Basically the project relies on Wireless Body Areas Sensor Networks; the aim is the accurate Gesture and Body Movement estimation with extremely severe constraints in terms of footprint and power consumption according to on-body energy harvesting perspectives. The BoWI geolocation approach will combine radio communication distance measurement and inertial sensors and it will also strongly benefit from cooperative techniques based on multiple observations and distributed computation. Different types of applications, as health care, activity monitoring and environment control, will be considered and evaluated along with a human-machine interface expertise.

The scientific challenge is global and deals with the solution to be interactively invented by all partners: a short-range geolocation method based on distributed and coopering devices processing multisource data issued from radio-communication distance estimation and integrated inertial sensors. It includes several specific contributions:

- Dynamic and cooperative communication coding and protocol for inter-nodes communications. This includes cooperative communications and protocols such as cooperative MIMO, relaying, error coding, network coding and MAC and wake-up radio protocols.
- Node hardware/software architecture design and self-adaptive distributed processing for geolocation with aggressive low-power run-time optimisation.
- Channel models and antennas for short-range communications. This study will be performed for various radio standards from upcoming BAN 802.15.6, 802.15.4a technologies to future UWB solutions.
- Channel models and antennas for WBASN at millimeter waves. This is a promising perspective for antenna miniaturization, however no front-ends are yet available.
- In depth and specific analysis of human-machine interactions to set system constrains and define user requirement according to various application perspectives.

In practice the BoWi partners aim to deliver the design of basic components, a prototype based on available radio front-ends and energy harvesting devices as well as a system simulator including mm-wave models. Results will also concern the specification of future radio-front ends. The BoWI involves CAIRN, IETR (Rennes), and Lab-STICC (Brest, Lorient, Vannes). For more details see http://www.bowi.cominlabs.ueb.eu/fr.

8.2.8. Labex CominLabs - 3DCORE (2014-2018)

Participants: Olivier Sentieys, Daniel Chillet, Cédric Killian, Jiating Luo, Van Dung Pham.

3DCORE (3D Many-Core Architectures based on Optical Network on Chip) is a project which involves CAIRN, FOTON (Rennes, Lannion) and Institut des Nanotechnologies de Lyon. 3D integration in the ultra deep submicron domain means the implementation of billions of transistors or of hundreds of cores on a single chip with the need to ensure a large number of exchanges between cores, and the obligation to limit the power consumption. Focusing on system integration rather than transistor density, allows for both functional and technological diversification in integrated systems. The functional diversification allows for non-digital functionalities to migrate from the board level into the (on-)chip level. This allows for integration of new technologies that enable high performance, low power, high reliability, low cost, and high design productivity. Use of Optical Network-on-Chip (ONoC) promises to deliver significantly increased bandwidth, increased immunity to electromagnetic noise, decreased latency, and decreased power consumption while wavelength routing and Wavelength Division Multiplexing (WDM) contributes to the valuable properties of optical interconnect by permitting low contention or even contention free routing. WDM allows for multiple signals to be transmitted simultaneously, facilitating higher throughput. Individual realization of CMOS compatible optical components, such as, waveguides, modulators, and detectors lets the community foresee that such integration may be possible in the next ten years. The aim of the project is therefore to investigate new optical interconnect solutions to enhance by 2 to 3 magnitude orders energy efficiency and data rate of on-chip interconnect in the context of a many-core architecture targeting both embedded and high-performance computing. Moreover, we envisage taking advantage of 3D technologies for designing a specific photonic layer suitable for a flexible and energy efficient high-speed optical network on chip (ONoC).

8.2.9. Labex CominLabs - RELIASIC (2014-2018)

Participants: Emmanuel Casseau, Arnaud Tisserand, Huu Van Long Nguyen.

RELIASIC (Reliable Asic) is a project which involves CAIRN, Lab-STICC (University of Bretagne Sud) and IETR (Institut d'Electronique et de Télécommunications de Rennes). One of the most critical challenges of the next design technologies will be fault-tolerant computation. The increase in integration density and the requirement of low-energy consumption can only be sustained through low-powered components, with the drawback of a looser robustness against transient errors. In the near future, electronic gates to process information will be inherently unreliable. New techniques will be required to increase the reliability of operators and components. The aim of the project is to address this problem with a bottom-up approach, starting from an existing application as a use case (a GPS receiver) and adding some redundant mechanisms to allow the GPS receiver to be tolerant to transient errors due to low voltage supply.

8.2.10. Labex CominLabs & Lebesgue - H-A-H (2014-2017)

Participants: Arnaud Tisserand, Nicolas Veyrat-Charvillon, Karim Bigou, Gabriel Gallin.

H-A-H for *Hardware and Arithmetic for Hyperelliptic Curves Cryptography* is a project on advanced arithmetic representation and algorithms for hyper-elliptic curve cryptography. It involves IRISA-CAIRN(Lannion) and IRMAR (Rennes).

Arithmetic has an important role to play in providing algorithms robust against physical attacks (e.g., analysis of the power consumption, electromagnetic radiations or computation timings). Currently, there are only a very few hardware implementations of HECC (without any open source availability). This project will provide novel implementations of HECC based cryptographic algorithms on custom hardware platforms. For more details see http://h-a-h.inria.fr/.

8.3. European Initiatives

8.3.1. FP7 FLEXTILES

Participants: Olivier Sentieys, Emmanuel Casseau, Antoine Courtay, Daniel Chillet, Philippe Quémerais, Christophe Huriaux, Quang Hoa Le.

Program: FP7-ICT-2011-7

Project acronym: Flextiles

Duration: Oct. 2011 - Mar. 2015

Coordinator: Thales

Other partners: Thales (FR), UR1 (FR), KIT (GE), TU/e (NL), CSEM (SW), CEA LETI (FR), Sundance (UK)

Project title: Self Adaptive Heterogeneous Manycore Based on Flexible Tiles

A major challenge in computing is to leverage multi-core technology to develop energy-efficient high performance systems. This is critical for embedded systems with a very limited energy budget as well as for supercomputers in terms of sustainability. Moreover the efficient programming of multi-core architectures, as we move towards manycores with more than a thousand cores predicted by 2020, remains an unresolved issue. The FlexTiles project will define and develop an energy-efficient yet programmable heterogeneous manycore platform with self-adaptive capabilities. The manycore will be associated with an innovative virtualisation layer and a dedicated tool-flow to improve programming efficiency, reduce the impact on time to market and reduce the development cost by 20 to 50%. FlexTiles will raise the accessibility of the manycore technology to industry - from small SMEs to large companies - thanks to its programming efficiency and its ability to adapt to the targeted domain using embedded reconfigurable technologies.

8.3.2. FP7 ALMA

Participants: Steven Derrien, Romuald Rocher, Olivier Sentieys, Ali Hassan El-Moussawi.

Program: FP7-ICT-2011-7

Project acronym: Alma

Project title: Architecture oriented paraLlelization for high performance embedded Multicore systems using scilAb

Duration: Sep. 2011 - Nov. 2014

Coordinator: KIT

Other partners: KIT (GE), UR1 (FR), Recore Systems (NL), Univ. of Peloponnese (GR), TEI-MES (GR), Intracom SA (GR), Fraunhofer (GE)

The mapping process of high performance embedded applications to today's multiprocessor system on chip devices suffers from a complex toolchain and programming process. The problem here is the expression of parallelism with a pure imperative programming language which is commonly C. This traditional approach limits the mapping, partitioning and the generation of optimized parallel code, and consequently the achievable performance and power consumption of applications from different domains. The Architecture oriented paraLlelization for high performance embedded Multicore systems using scilAb (ALMA) project aims to bridge these hurdles through the introduction and exploitation of a Scilab-based toolchain which enables the efficient mapping of applications on multiprocessor platforms from high-level abstraction descriptions. This holistic solution of the toolchain allows the complexity of both the application and the architecture to be hidden, which leads to a better acceptance, reduced development cost and shorter time-to-market. Driven by the technology restrictions in chip design, the end of Moore's law and an unavoidable increasing request of computing performance, ALMA is a fundamental step forward in the necessary introduction of novel computing paradigms and methodologies. ALMA helps to strengthen the position of Europe in the world market of multiprocessor targeted software toolchains. The challenging research will be achieved by the unique ALMA consortium which brings together industry and academia. High class partners from industry such as Recore and Intracom, will contribute their expertise in reconfigurable hardware technology for multi-core systems-on-chip, software development tools and real world applications. The academic partners will contribute their outstanding expertise in reconfigurable computing and compilation tools development.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. HARDIESSE

Title: Heterogeneous Accelerators for Reconfigurable DynamIc, Energy efficient, Secure SystEms

International Partner (Institution - Laboratory - Researcher):

University of Massachusetts at Ahmerst (USA)

Duration: 2014 - 2016

See also: https://team.inria.fr/cairn/hardiesse/

Rapid evolutions of applications and standards require frequent in-the-field system modifications and thus strengthen the need for adaptive devices. This need for a strong flexibility, combined with technology evolution (and the so-called power wall) has motivated the surge towards the use of multiple processor cores on a single chip (MPSoC). While it is now clear that we have entered the multi-core era, it is however indisputable that, especially for energy-efficient embedded systems, these architectures will have to be heterogeneous, by combining processor cores and specialized accelerators. We foresee a need for systems able to continuously adapt themselves to changing environments where software updates alone will not be enough for tackling energy management and error tolerance challenges. We believe that a dynamic and transparent adaptation of the hardware structure is the key to success. Security will also be an important challenge for embedded devices. Protections against physical attacks will have to be integrated in all secured components. In this Associated Team, we will study new reconfigurable structures for such hardware accelerators with specific focus on: energy efficiency, runtime dynamic reconfiguration, security, and verification.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

Computer Science Department, Colorado State University in Fort-Collins (USA), Prof. Sanjay Rajopadhye, Loop parallelization, development of high-level synthesis tools, Inria Associate Team (2010-2012).

Department of Computer Science, Lund University (Sweden), Prof. Krzysztof Kuchcinski, Hardware accelerators modeling using constraint-based programming.

Tampere University of Technology (Finland), Prof. Jarmo Takala, From dataflow-based video applications to embedded multicore platforms.

University College Cork (Ireland), Prof. Liam Marnane and Prof. Emanuel Popovici, Arithmetic operators for cryptography, side channel attacks for security evaluation, energy-harvesting sensor networks, and sensor networks for health monitoring.

University of Massachusetts at Amherst (USA), Prof. Russel Tessier and Prof. Maciej Ciesielski, Methods and tools for automatic reconfigurable arithmetic circuit generation.

8.4.2.2. Informal International Partners

Imec (Belgium), Optimization of embedded systems using fixed-point arithmetic.

Electrical Engineering Department, Indian Institute of Technology Delhi (India), Cooperative and MIMO wireless communications.

Ecole Polytechnique Fédérale de Lausanne - EPFL (Switzerland), Optimization of embedded systems using fixed-point arithmetic.

Technical University of Madrid - UPM (Spain),

Optimization of embedded systems using fixed-point arithmetic.

LRTS laboratory, Laval University in Québec (Canada), Architectures for MIMO systems, Wireless Sensor Networks, Inria Associate Team (2006-2008).

LSSI laboratory, Québec University in Trois-Rivières (Canada), Design of architectures for digital filters and mobile communications.

Department of Electrical and Computer Engineering, University of Patras (Greece), Wireless Sensor Networks, data merging, priority scheduling, loop transformations for memory optimizations.

Karlsruhe Institute of Technology - KIT (Germany), Loop parallelization and compilation techniques for embedded multicores.

Ruhr - University of Bochum - RUB (Germany), Reconfigurable architectures.

University of Science and Technology of Hanoi (Vietnam), Participation of several CAIRN's members in the Master ICT / Embedded Systems.

8.4.3. Participation In other International Programs

8.4.3.1. CNRS PICS - SPiNaCH (2012 - 2014)

Title: Secure and low-Power sensor Networks Circuits for Healthcare embedded applications

Principal investigator: Arnaud Tisserand, Olivier Berder, Olivier Sentieys

International Partner (Institution - Laboratory - Researcher): Code&Crypto group in University College Cork (Ireland)

Duration: 2012 - 2014

Biomedical sensor networks may be used more and more in the future. For instance, they allow patient's health-care parameters to be remotely monitored at home. In this project, we plan to address two important challenges in the design of biomedical sensors networks: i) design of low-power sensor devices for embedded autonomous systems (health monitoring, pace-maker...) with long battery life; ii) confidentiality and security aspects and especially with public key cryptography processor that are robust against side channel attacks (measure of the computation time, the power consumption or the electromagnetic radiations of the circuit) and with limited power-energy resources.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Prof. Liam Marnane (University College Cork, Ireland) for one week in November (funded by CNRS PICS SpiNaCH project).

Fiona Edwards-Murphy, PhD student, (University College Cork, Ireland) for two weeks in September (funded by CNRS PICS SpiNaCH project).

Prof. Sanjay Rajopadhye (Colorado State University, USA) for one week in June (visiting professor position from University Rennes 1).

8.5.1.1. Internships

Singh Rajhans, B.Eng. student, Indian Institute of Technology Roorkee (Roorkee, India), Intrinsic Fault Tolerance of Hopfield Artificiel Neural Network Model for task scheduling in RSoC, from May 2014 to July 2014 [63].

Jiating Luo, Master's student, École centrale de Pékin (Beijing, China), Design of a Wavelength Allocator for Optical Network-on-Chips, from May 2014 to Sep 2014.

8.5.2. Visits to International Teams

Viet Hoa Nguyen, PhD student, visited IIT Delhi for 3 months between October and December 2014.

Christophe Huriaux, PhD student, visited UMASS for 3 months between May and July 2014.

Steven Derrien visited UMASS for 1 week in December 2014.

CAMUS Team

8. Partnerships and Cooperations

8.1. National Initiatives

Philippe Clauss, Alain Ketterlin, Cédric Bastoul and Vincent Loechner are involved in the Inria Project Lab entitled "Large scale multicore virtualization for performance scaling and portability" and regrouping several french researchers in compilers, parallel computing and program optimization [0]. The project started officially in January 2013. In this context and since January 2013, Philippe Clauss is co-advising with Erven Rohou of the Inria team ALF, Nabil Hallou's PhD thesis focusing on dynamic optimization of binary code.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

Program: ITEA

Project acronym: MANY

Project title: Many-core Programming and Resource Management for High-Performance Embedded Systems

Duration: 09/2011 - 12/2014

Coordinator: XDIN

Other partners: France: Thales Communications and Security, CAPS Entreprise, Telecom SudParis; Spain: UAB; Sweden: XDIN; Korea: ETRI, TestMidas, SevenCore; Netherlands: Vector Fabrics, ST-Ericsson, TU Eindhoven; Belgium: UMONS.

Abstract: Adapting Industry for the for the disruptive landing of many-core processors in Embedded Systems in order to provide scalable, reusable and very fast sofware development.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. ANCOME

Title: Memory and applications memory behavior

International Partner (Institution - Laboratory - Researcher):

Universidad de Buenos Aires (ARGENTINE)

Duration: 2011 - ___AT.ANNEEMOISFIN???___

See also: http://lafhis.dc.uba.ar/wiki/index.php/EA-Ancome

This associate team focuses on developing original methods for the analysis of programs memory behavior, in particular in the context of applications using dynamic memory allocation. The proposed approaches consist in analyzing and modeling the runtime behavior, where extracted properties are then verified thanks to static analysis processes. Thus pure static approaches limits will be overpassed. Further, the case of multi-threaded applications run on multi-core architectures will be studied in order to elaborate and extend our analysis techniques and to extract properties specific to this context. The issues are mainly concerned with the conception of real-time applications using dynamic memory allocation.

[0] https://team.inria.fr/multicore

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

The CAMUS team maintains regular contacts with the following entities:

- Reservoir Labs, New York, NY, USA
- Intel, Santa Clara, CA, USA
- UPMARC, University of Uppsala, Sweden
- University of Batna, Algeria
- University El Manar, Tunis, Tunisia
- Ohio State University, Colombus, USA
- Louisiana State University, Baton Rouge, USA
- Indian Institute of Science (IIIS) Bangalore, India
- University of Delaware, DE, USA

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Matías Hernando Pérez Matías

Date: May 2014 - Nov 2014

Institution: Universidad de Buenos Aires (Argentina)

Sabater César Rufino

Date: May 2014 - Oct 2014

Institution: Universidad Nacional de Rosario (Argentina)

Campostrini Luis Esteban

Date: Jul 2014 - Dec 2014

Institution: Universidad Nacional de Rosario (Argentina)

CARAMEL Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

The team participates in the "Calcul formel, arithmétique, protection de l'information" research pole of the GDR-IM (CNRS Research Group on Mathematical Computer Science). The team is a member of the "Arithmétique", "Calcul formel" and "Codage et Cryptographie" working groups.

8.1.1. ANR CATREL (Cribles: Améliorations Théoriques et Résolution Effective du Logarithme discret)

Participants: Cyril Bouvier, Nicholas Coxon, Jérémie Detrey, Pierrick Gaudry, Laurent Grémy, Hamza Jeljeli, Emmanuel Thomé [contact], Marion Videau, Paul Zimmermann.

The CATREL proposal has been accepted in ANR "programme Blanc" in 2012. This project involves CARAMEL as a leading team, in cooperation with two other partners which are INRIA project-team GRACE (INRIA Saclay, LIX, École polytechnique), and the ARITH team of the LIRMM Laboratory (Montpellier). The project targets algorithms for solving the discrete logarithm problem in finite fields, using the Number Field Sieve and the Function Field Sieve algorithms. Actual work on the CATREL project started in January 2013. Four meetings have taken place already: in Nancy on December 14, 2012 (kick-off), in Palaiseau on June 19, 2013, in Montpellier on November 12-13, 2013, and in Nancy in June 18-19, 2014.

8.2. International Research Visitors

8.2.1. Visits of International Scientists

- Masahiro Ishii is a visiting PhD student from the Nara Institute of Science and Technology, Nara (Japan), from February 2014 until February 2015. His PhD supervisors are Atsuo Inomata and Kazutoshi Fujikawa. Locally, he is supervised by Jérémie Detrey and Pierrick Gaudry.

CARMEN Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Modélisation of the multinodal date (years 2012–2015) funded by the Conseil Regional Aquitaine. Coordinator J.-F. Aujol (Pr University Bordeaux). The PhD of G. ravon is funded within this project: 3D reconstruction by inverse problem in cardiac optical mapping.

7.2. National Initiatives

7.2.1. IHU LIRYC

Our work is partially funded by the LIRYC project (ANR 10-IAHU 04).

- For 2014: the salary of M. Potse, member of Carmen, is payed by the LIRYC..
- For 2012-2015: 1/2 PhD thesis associated to the project *Modélisation pour les données multimodales* (see section Regional Initiaves).

7.2.2. ANR HR-CEM

In 2014, we are supported for the project "High Resolution Cardiac Electrophysiology Models: HR-CEM" within the call for project « Modèles Numériques » of the ANR.

The scientific start of the project was on November, 4th, 2013.

It is an international project that involves three partners, Inria (coordinator), IHU LIRYC, and UMI-CRM at Montréal (Canada). The project has some external collaborators in Univ. Bordeaux and Univ. Pau.

Based on these collaborations and new developments in structural and functional imaging of the heart available at LIRYC, we plan to reconsider the concepts behind the models in order to improve the accuracy and efficiency of simulations. Cardiac simulation software and high-resolution numerical models will be derived from experimental data from animal models. Validation will be performed by comparing of simulation output with experimentally recorded functional data. The validated numerical models will be made available to the community of researchers that take advantage of in-silico cardiac simulation and, hopefully, become references. In particular we shall provide the first exhaustive model of an animal heart including the four chambers coupled through the special conduction network, with highly detailed microstructure of both the atria and the ventricles. Such a model embedded in high-performance computational software will provide stronger medical foundations for in-silico experimentation, and elucidate mechanisms of cardiac arrhythmias.

7.2.3. AMIES – Medic Activ

We were granted by the Agency AMIES a financial support to complete the one obtained from the Région Aquitaine for the Medic Activ project (see above). The objective of this support is to developp reduced order models of cardiac electrophysiology that might enter the MedicActiv framework. The difficulty is to define qualitatively realistic but fast numerical simulations of the ECG and cardiac function, for educational purpose.

7.2.4. ANR Labcom CardioXcomp

We are participant in the ANR Labcom project between Inria and the society Notocord (www.notocord.com). At Inria, the proejct is leaded by JF. Gerbeau from the Reo team and we participate to the study and developpment of cardiac electrophysiology models suited to the context of the proejct.

7.2.5. REO

The CARMEN team is a partner with the REO team at Inria Paris Rocquencourt and NOTOCORD companie in the CardioXcomp project.

7.2.6. MedicActiv

The CARMEN team cooperate in interaction with the MedicActiV project.

7.3. International Initiatives

7.3.1. Inria International Labs

- LIRIMA: Equipe Problèmes Inverses et Contrôle (EPIC), University Tunis Al Manar et Laboratoire de Modélisation Mathématique et Numérique dans les Sciences de l'Ingénieur (LAMSIN), Tunisia.

  The EPIC team has an important experience in dealing with ill-posed inverse problems for static and evolution problems. The goal of this collaboration is to apply the methods developed in this team to inverse problems in electrocardiography.

  This collaboration is mainly supported by the international laboratory LIRIMA.
- Cooperation with Laboratoire de Modélisation Mathématique et Numérique dans les Sciences de l'Ingénieur (LAMSIN in Tunisia.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

In the framework of the EPIC project in the LIRIMA lab, N. Zemzemi has invited:

- Mohamed Jebalia assistant professor from LAMSIN Tunisia
- Moncef Mahjoub assistant professor from LAMSIN Tunisia
- Jamila Lassoued. Phd student from LAMSIN Tunisia
- Najib Fikal PHD student from University MohamedV, Moroco
- El Mahid El Guarmah assitant professor from University of Marrakech. Moroco.

7.4.2. Internships – Visiting PhD Students

- Carlos Chavez Borgesn, from may 2014 to Sep 2014,*Inverse Problem of Electrocardiography: estimating the location of cardiac isquemia in a 3D geometry*
- Ali Gharaviri, from Apr 2014 to May 2014
- Wajih Mbarki, until Aug 2014, *Analysis of an interaction problem in biomathematics: purkinje/myocardium coupling in the heart*
- Jamila Lassoued, until Aug 2014, *Construction of reduced order methods for optimization problems in cardiac electrophysiology*

CARTE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Région Lorraine- Université de Lorraine

Simon Perdrix is the principal investigator of the project *measurement-based quantum computing* funded by Région Lorraine and Université de Lorraine.

7.2. National Initiatives

7.2.1. ANR

- The team is a funding partner in ANR Elica (2014-2019), "Elargir les idées logistiques pour l'analyse de complexité". The Carte team is reknown for its expertise in implicit computational complexity.
- The team is a funding partner in ANR Binsec (2013-2017), whose aim is to fill part of the gap between formal methods over executable code, and binary-level security analyses currently used in the security industry. Two main applicative domains are targeted: vulnerability analysis and virus detection. Two other closely related applications will also be investigated: crash analysis and program deobfuscation.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

7.3.1.1. FI-WARE

Title: Morphus

Type: COOPERATION

Defi: PPP FI: Technology Foundation: Future Internet Core Platform

Instrument: Integrated Project (IP)

Objectif: PPP FI: Technology Foundation:Future Internet Core Platform

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Other Partners: Thales, SAP, Inria

Inria contact: Olivier Festor

Abstract: FI-WARE will deliver a novel service infrastructure, building upon elements (called Generic Enablers) which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability and production costs linked to Internet Applications for building a true foundation for the Future Internet.

7.4. International Initiatives

7.4.1. Informal International Partners

- Submission of an Inria associate team proposal THOR (complexity Theory at Higher ORder) in collaboration with Syracuse University, Wesleyan University (Royer, Danner, Ramyaa Ramyaa) and Egypt-Japan University (Walid Gomaa).

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Cristóbal Rojas (Univ. Andres Bello, Chili) was Inria "Chercheur Invité" for 3 months from July to September 2014. The collaboration led to the paper [20] accepted at STACS 2015.
- Visit of Marco Gaboardi, full researcher at Dundee University, for one week in March 2014.

7.5.2. Short Visits to International Teams

- Romain Péchoux, two one-week visits to Dundee University in March and August 2014.
- Simon Perdrix, visit to the quantum group, Oxford University Computing Laboratory, 1 week in October 2014.
- Simon Perdrix, visit to the Tsinghua University, Beijing, 1 week in December 2014.

CASCADE Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives with Industrials

- **ANR ARPEGE PRINCE: Proven Resilience against Information leakage in Cryptographic Engineering.**
  Participants: Michel Ferreira Abdalla, Sonia Belaid, Fabrice Ben Hamouda, Alain Passelègue, David Pointcheval.

  From December 2010 to May 2015.
  Partners: UVSQ, Oberthur Technologies, Ingenico, Gemalto, Tranef.
  We aim to undertake research in the field of leakage-resilient cryptography with a practical point of view. Our goal is to design efficient leakage-resilient cryptographic algorithms and invent new countermeasures for non-leakage-resilient cryptographic standards. These outcomes shall realize a provable level of security against side-channel attacks and come with a formally verified implementation. For this every practical aspect of the secure implementation of cryptographic schemes must be taken into account, ranging from the high-level security protocols to the cryptographic algorithms and from these algorithms to their implementation on specific devices which hardware design may feature different leakage models.
- **ANR INS SIMPATIC: SIM and PAiring Theory for Information and Communications security.**
  Participants: Angelo de Caro, Houda Ferradi, David Pointcheval, Olivier Sanders, Damien Vergnaud.

  From February 2013 to July 2016.
  Partners: Orange Labs,INVIA, Oberthur Technologies, STMicroelectronics, Université Bordeaux 1, Université de Caen Basse-Normandie, Université de Paris VIII
  We aim at providing the most possible efficient and secure hardware/software implementation of a bilinear pairing in a SIM card.
- **FUI CryptoComp.**
  Participants: Rafael Del Pino, Vadim Lyubashevsky.

  From October 2014 to September 2017.
  Partners: CEA, UVSQ, CryptoExperts, Dictao, XLIM, ViAccess Orca, CNRS, Bertin Technologies, KalRay, Gemalto
  We aim at studying delegation of computations to the cloud, in a secure way.

6.2. National Collaborations within Academics

- **ANR JCJC ROMAnTIC: Randomness in Mathematical Cryptography.**
  Participants: Thierry Mefenza, David Pointcheval, Sylvain Ruhault, Adrian Thillard, Damien Vergnaud.

  From October 2012 to September 2016.
  Partners: ANSSI, Univ. Paris 7, Univ. Paris 8.
  The goal of this project is to get a better understanding of the interplay between randomness and cryptography and to study the security of various cryptographic protocols at different levels (information-theoretic and computational security, number-theoretic assumptions, design and provable security of new and existing constructions).

- **ANR JCJC CLE: Cryptography from Learning with Errors.**
  Participants: Vadim Lyubashevsky, Pierrick Méaux, Thomas Prest.

  From October 2013 to September 2017.
  Partners: UVSQ, Univ. Paris 8, Inria/SECRET.
  The main objective of this project is to explore the potential practical implications of the Learning with Errors problem and its variants. The plan is to focus on the constructions of essential primitives whose use is prevalent in the real world. Toward the end of the project, the hope is to propose and standardize several public key and symmetric key schemes that have specific advantages over ones that are currently deployed.
- **ANR JCJC EnBiD: Encryption for Big Data.**
  Participant: Hoeteck Wee.

  From October 2014 to September 2018.
  Partners: Univ. Paris 2, Univ. Paris 8.
  The main objective of this project is to study techniques for efficient and expressive functional encryption schemes. Functional encryption is a novel paradigm for public-key encryption that enables both fine-grained access control and selective computation on encrypted data, as is necessary to protect big, complex data in the cloud.

6.3. European Initiatives

- **SecFuNet: Security for Future Networks.**
  Participants: Michel Ferreira Abdalla, Vadim Lyubashevsky, David Pointcheval.

  From July 2011 to April 2014.
  The goal of the SECFUNET project is to design and develop a coherent security architecture for virtual networks and cloud accesses.
- **ICT COST CryptoAction: Cryptography for Secure Digital Interaction**
  Participant: Vadim Lyubashevsky.

  From April 2014 to April 2018.
  The aim of this COST Action is to stimulate interaction between the different national efforts in order to develop new cryptographic solutions and to evaluate the security of deployed algorithms with applications to the secure digital interactions between citizens, companies and governments.
- **ERC CryptoCloud: Cryptography for the Cloud.**
  Participants: Michel Ferreira Abdalla, Florian Bourse, Fabrice Ben Hamouda, Geoffroy Couteau, Thomas Peters, David Pointcheval, Hoeteck Wee.

  From June 2014 to May 2019.

6.4. Other Grants

- **Google: Google Research Award.**
  Participant: Hoeteck Wee.

  On the security of TLS. The goal of this project is to initiate a formal cryptographic treatment of new mechanisms and proposals for reducing the latency in the TLS Handshake Protocol and to enhance our cryptographic understanding of the TLS Handshake Protocol.

6.5. International Research Visitors

- Hugo Krawczyk (IBM)
- Serdar Pehlivanoğlu (Zirve University, Turkey)
- Kai-Min Chung (Academia Sinicia, Taiwan)

- Daniel Wichs (Northeastern)
- Mehdi Tibouchi (NTT)
- Vinod Vaikuntanathan (MIT)
- Kenny Paterson (RHUL)
- Tal Malkin (Columbia)
- David Cash (Rutgers)
- Igor Shparlinski
- Zvika Brakerski (Weizmann)
- Elette Boyle (Technion)
- Giuseppe Persiano (Salerno)
- Yuval Ishai (Technion)
- Eike Kiltz (RUB)

CASSIS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- The Franche-Comté Region project SyVAD (SysML Verification and Validation), coordinated by Fabrice Bouquet, duration: 3 years, started in September 2011. This project focuses on the SysML models for the validation and verification of micro-systems, in particular for a distributed micro airduct. Several teams of the FEMTO-ST institute work together on micro-systems specification, simulation and validation.

8.2. National Initiatives

8.2.1. ANR

- ANR PROSE *Security protocols : formal model, computational model, and implementations*, duration: 4 years, started in December 2010. The goal of the project is to increase the confidence in security protocols, and in order to reach this goal, provide security proofs at three levels: *(i)* the symbolic level, in which messages are terms, *(ii)* the computational level, in which messages are bitstrings, and *(iii)* the implementation level: the program itself. Partners are EPI Prosecco and EPI Cascade Paris (leader), LSV Cachan, Cassis and Verimag Grenoble.
- ANR FREC *Frontiers of recognizability*, duration: 4 years, starting in October 2010. The goal of this project is to be a driving force behind the extension of the algebraic theory of regular languages made possible by recent advances. Four directions will be investigated: tree languages, λ-terms, automata with counters, algebraic and topological tools. Partners are LABRI (leader), LIAFA (University Paris 7). Pierre-Cyrille Héam is a member of this project, attached to Paris 7 for administrative facilities.
- ANR SEQUOIA *Security properties, process equivalences and automated verification*, duration: 4 years, starting in October 2014. Most protocol analysis tools are restricted to analyzing reachability properties while many security properties need to be expressed in terms of some process equivalence. The increasing use of observational equivalence as a modeling tool shows the need for new tools and techniques that are able to analyze such equivalence properties. The aims of this project are *(i)* to investigate which process equivalences-among the plethora of existing ones-are appropriate for a given security property, system assumptions and attacker capabilities; *(ii)* to advance the state-of-the-art of automated verification for process equivalences, allowing for instance support for more cryptographic primitives, relevant for case studies; *(iii)* to study protocols that use low-entropy secrets expressed using process equivalences; *(iv)* to apply these results to case studies from electronic voting.

8.2.2. Fondation MAIF

Project *Protection de l'information personnelle sur les réseaux sociaux*, duration: 3 years, started in October 2014. The goal of the project is to lay the foundation for a risk verification environment on privacy in social networks. Given social relations, this environment will rely on the study of metrics to characterize the security level for a user. Next, by combining symbolic and statistical techniques, it is a question to synthesize a model of risk behavior as a rule base. Finally, a verifier à la model-checking will be developed to assess the security level of user. Partners are Cassis (leader), Orpailleur and Fondation Maif.

8.2.3. Competitivity Clusters

- Project "Investissement d'Avenir - Développement de l'Economie Numérique" DAST (Dynamic Application Security Testing), duration: 2 years, starting in September 2012. The goal of this project is to generate automatically the tests to prevent vulnerabilities. We have proposed an automated model-based vulnerability testing approach, that focuses on Criss-Site Scripting vulnerabilities in web applications. It relies on a behavioral model that describes the web application and a set of security test patterns formalizing ways to detect the vulnerabilities. This partnership includes NBSystem, Smartesting (coordinator), Thales, Trusted-Labs and Inria Cassis.

8.3. European Initiatives

8.3.1. FP7 Projects

- Nessos is a Network of Excellence on Engineering Secure Future Internet Software Services and Systems in FP7-ICT (starting in October 2010 for a period of 42 months). Nessos has 12 partners and aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. Partner Inria is involved through project-teams Arles, Triskell and Cassis. Cassis focusses on developping tools for service security verification and testing tasks.
- ProSecure (2011-2016) [0]— ERC Starting Grant Project on Provably secure systems: foundations, design, and modularity. This long-term project aims at developing provably secure systems such as security protocols. The goal is to propose foundations for a careful analysis and design of large classes of up-to-date protocols. To achieve this goal, we foresee three main tasks. First, we plan to develop general verification techniques for new classes of protocols that are of primary interest in nowadays life like e-voting protocols, routing protocols or security APIs. Second, we will consider the cryptographic part of the primitives that are used in such protocols (encryption, signatures, ...), obtaining higher security guarantees. Third, we aim at proposing modular results both for the analysis and design of protocols. Véronique Cortier is the leader of the project.

8.4. International Initiatives

8.4.1. Inria Associate Teams

BANANAS (2012-2014) [0] — *Automated design and autonomous control of hybrid solver cooperations*. In order to tackle large scale instances and intricate problem structures, sophisticated solving techniques have been developed, combined, and hybridized to provide efficient solvers. A common idea to get more efficient and robust algorithms consists in combining several resolution paradigms in order to take advantage of their respective assets. Autonomous Search is a very attractive approach for designing adaptive systems with the capability of improving its solving performance by selecting and adapting its search strategies to the problem at hand. The main goal of the project is to apply the Autonomous Search approach to hybrid solver cooperations, by automating the selection and the cooperation of solvers, by tuning the cooperation parameters, and by adapting the cooperation during solving. The international partners are Technical University Federico Santa Maria, Valparaíso (Chile) — Department of Computer Science — Carlos Castro and Eric Monfroy; University of Chile (Chile) — Center for Mathematical Modeling — Jorge Amaya. The Inria principal investigator is Christophe Ringeissen.

8.4.2. Inria International Partners

- Collaboration with Bogdan Warinschi (Bristol University) on defining game-based privacy for e-voting protocols.
- Collaboration with Myrto Arapinis (University of Edinburgh) on simplification results for the formal analysis of e-voting protocols.

[0] http://www.loria.fr/~cortier/ProSecure.html
[0] http://www.loria.fr/~ringeiss/CHILI/bananas

- Collaboration with Matteo Maffei (CISPA, Germany) on type systems for e-voting systems.
- Collaboration with Paliath Narendran's group (SUNY Albany) on automated deduction.
- Collaboration with Hanifa Boucheneb's group (Ecole Polytechnique de Montréal) on model-checking of collaborative systems.
- Collaboration with John Mullins's group (Ecole Polytechnique de Montréal) on information hiding.

8.4.3. Participation in International Programs

French-Canadian project on *Automata for Hiding and Disclosing Information*, in the framework of the CFQCU program. We collaborate with the CRAC team at the Ecole Polytechnique de Montréal, Canada, and the MoVe team/LIP6 at the UPMC, Paris, France.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Myrto Arapinis (University of Edinburgh), March, December 2014
- David Bernhard (Bristol University), March 2014
- Fabienne Eigner (University of Saarbruecken), February, May 2014
- Joshua Guttman (MITRE), January 2014
- Olivier Pereira (University of Louvain-la-Neuve), March 2014
- Nicolas Pouillard (DemTech, University of Copenhagen), February 2014

8.5.1.1. Internships

Tushant Jha

Subject: Synthesis of Secure Services Composition

Supervisor: Michaël Rusinowitch

Date: from May 2014 until July 2014

Institution: IIIT Hyderabad

Gemma Puig-Quer

Subject: New protocols for private e-voting

Supervisors: David Galindo-Chacon and Véronique Cortier

Date: from Sep 2013 until Mar 2014

Institution: UPC Barcelona (Spain)

Itsaka Rakotonirina

Subject: Automated verification of security protocols with loops

Supervisor: Steve Kremer

Date: from June 2014 until July 2014

Institution: ENS Cachan

Ludovic Robin

Subject: Analysis of security protocols using weak secrets

Supervisor: Steve Kremer

Date: from April 2014 until September 2014

Institution: U. Bordeaux

CASTOR Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- ANEMOS : ANR-11-MONU-002

  ANEMOS : Advanced Numeric for Elms : Models and Optimized Strategies associates JAD Laboratory/Inria (Nice, Manager), IRFM-CEA (Cadarache), Maison de la Simulation (Saclay) and Inria EPI Bacchus (Bordeaux). Elms are disruptive instabilities occurring in the edge region (SOL) of a tokamak plasma. The development of Elms poses a major challenge in magnetic fusion research with tokamaks, as these instabilities can damage plasma-facing components, particularly divertor plates. The mitigation or suppression of large Elms is a critical issue for successful operation of ITER. Goal for ANEMOS is to develop and improve numerical tools in order to simulate physical mechanisms of Elms and to qualify some strategies for their control. We then need to design efficient numerical strategies on the most advanced computers available to contribute to the science base underlying of proposed burning plasma tokamak experiments such as ITER.
- ANR IODISSEE : IOnospheric DIsturbanceS and SatEllite-to-Earth communications. http://iodissee.math.cnrs.fr/project/index.html. In this ANR project, CASTOR will address the use of data-models coupling method to identify the input model parameters (especially, the initial data for the electronic density).

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

- EUROfusion Grant agreement number 633053. Enabling Research program.
  - JOREK, BOUT++ non-linear MHD modelling of MHD instabilities and their control in existing tokamaks and ITER.
  - Synergetic numerical-experimental approach to fundamental aspects of turbulent transport in the tokamak edge. Grant agreement number 633053.
- EUROfusion WPCD (Working Package Code Development)
  - ACT1: Extended equilibrium and stability chain (participation)
  - ACT2: Free boundary equilibrium and control (participation and coordination)

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. AMOSS

Title: Advanced Modeling on Shear Shallow Flows for Curved Topography : water and granular flows.

International Partner (Institution - Laboratory - Researcher):

NCKU (TAIWAN)

Our objective here is to generalize the promising modeling strategy proposed by S. Gavrilyuk (2012-2013) to genuinely 3D shear flows and also take into account the curvature effects related to topography. Special care will be exercised to ensure that the numerical methodology can take full advantage of massively parallel computational platforms and serve as a practical engineering tool. Cross validations will be achieved by experiments and numerical simulations with applications to landslides.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

In the context of the AMoSS Team :

- Key-Ming Shyue of the National Taiwan University, Juilly 3 to July 13 2014, Numerical Methods: Implicit and Thinc interpolation.
- Chih-Yu Kuo, Associate Research Fellow, Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan,
- Chyan-Deng Jan, Professor, National Cheng Kung University, Tainan, Taiwan. Workshop on the Modeling of dry granular flows, CIRM Marseille: September 8 to September 13 2014.

CELTIQUE Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. The PiCoq ANR project

Participants: Alan Schmitt, Petar Maksimovic.

Process calculi, Verification, Proof Assistants

The goal of the PiCoq project is to develop an environment for the formal verification of properties of distributed, component-based programs. The project's approach approach lies at the interface between two research areas: concurrency theory and proof assistants. Achieving this goal relies on three scientific advances, which the project intends to address:

- Finding mathematical frameworks that ease modular reasoning about concurrent and distributed systems: due to their large size and complex interactions, distributed systems cannot be analysed in a global way. They have to be decomposed into modular components, whose individual behaviour can be understood.
- Improving existing proof techniques for distributed/modular systems: while behavioural theories of first-order concurrent languages are well understood, this is not the case for higher-order ones. We also need to generalise well-known modular techniques that have been developed for first-order languages to facilitate formalization in a proof assistant, where source code redundancies should be avoided.
- Defining core calculi that both reflect concrete practice in distributed component programming and enjoy nice properties w.r.t. behavioural equivalences.

The project partners include Inria, LIP, and Université de Savoie. The project runs from December 2010 to November 2014.

6.1.2. The ANR VERASCO project

Participants: Sandrine Blazy, Delphine Demange, Vincent Laporte, André Oliveira Maroneze, David Pichardie.

Static program analysis, Certified static analysis

The VERASCO project (2012–2015) is funded by the call ISN 2011, a program of the Agence Nationale de la Recherche. It investigates the formal verification of static analyzers and of compilers, two families of tools that play a crucial role in the development and validation of critical embedded software. It is a joint project with the Inria teams ABSTRACTION, GALLIUM, The VERIMAG laboratory and the Airbus company.

6.1.3. The ANR Binsec project

Participants: Frédéric Besson, Sandrine Blazy, Pierre Wilke, Colas Le Guernic.

Binary code, Static program analysis

The Binsec project (2013–2017) is founded by the call ISN 2012, a program of the Agence Nationale de la Recherche. The goal of the BINSEC project is to develop static analysis techniques and tools for performing automatic security analyses of binary code. We target two main applicative domains: vulnerability analysis and virus detection.

Binsec is a joint project with the Inria CARTE team, CEA LIS, VERIMAG, EADS IW and VUPEN SECURITY. ABSTRACTION, The VERIMAG laboratory and the Airbus company.

6.1.4. The ANR MALTHY project

Participant: David Cachera.

The MALTHY project, funded by ANR in the program INS 2013, aims at advancing the state-of-the-art in real-time and hybrid model checking by applying advanced methods and tools from linear algebra and algebraic geometry. MALTHY is coordinated by VERIMAG, involving CEA-LIST, Inria Rennes (Estasys and Celtique), Inria Saclay (MAXPLUS) and VISEO/Object Direct.

6.1.5. The ANR AJACS project

Participants: Martin Bodin, Thomas Jensen, Alan Schmitt.

The goal of the AJACS project is to provide strong security and privacy guarantees on the client side for web application scripts. To this end, we propose to define a mechanized semantics of the full JavaScript language, the most widely used language for the Web. We then propose to develop and prove correct analyses for JavaScript programs, in particular information flow analyses that guarantee no secret information is leaked to malicious parties. The definition of sub-languages of JavaScript, with certified compilation techniques targeting them, will allow us to derive more precise analyses. Finally, we propose to design and certify security and privacy enforcement mechanisms for web applications, including the APIs used to program real-world applications.

The project partners include the following Inria teams: Celtique, Indes, Prosecco, and Toccata; it also involves researchers from Imperial College as external collaborators. The project runs from December 2014 to June 2018.

6.1.6. The ANR DISCOVER project

Participants: Sandrine Blazy, Delphine Demange, Thomas Jensen, David Pichardie.

The DISCOVER project project aims at leveraging recent foundational work on formal verification and proof assistants to design, implement and verify compilation techniques used for high-level concurrent and managed programming languages. The ultimate goal of DISCOVER is to devise new formalisms and proof techniques able to scale to the mechanized correctness proof of a compiler involving a rich class of optimizations, leading to efficient and scalable applications, written in higher-level languages than those currently handled by cutting-edge verified compilers.

In the light of recent work in optimizations techniques used in production compilers of high-level languages, control-flow-graph based intermediate representations seems too rigid. Indeed, the analyses and optimizations in these compilers work on more abstract representations, where programs are represented with data and control dependencies. The most representative representation is the sea-of-nodes form, used in the Java Hotspot Server Compiler, and which is the rationale behind the highly relaxed definition of the Java memory model. DISCOVER proposes to tackle the problem of verified compilation for shared-memory concurrency with a resolute language-based approach, and to investigate the formalization of adequate program intermediate representations and associated correctness proof techniques.

The project runs from October 2014 to September 2018.

6.1.7. Labex COMIN Labs Seccloud project

Participants: Frédéric Besson, Thomas Jensen, Alan Schmitt, Thomas Genet, Martin Bodin.

The SecCloud project, started in 2012, will provide a comprehensive language-based approach to the definition, analysis and implementation of secure applications developed using Javascript and similar languages. Our high level objectives is to enhance the security of devices (PCs, smartphones, ect.) on which Javascript applications can be downloaded, hence on client-side security in the context of the Cloud. We will achieve this by focusing on three related issues: declarative security properties and policies for client-side applications, static and dynamic analysis of web scripting programming languages, and multi-level information flow monitoring.

This is a joint project with Supelec Rennes and Ecole des Mines de Nantes.

6.2. International Initiatives

6.2.1. Inria Associate Teams

6.2.1.1. JCERT

Title: Verified Compilation of Concurrent Managed Languages

International Partner (Institution - Laboratory - Researcher):

Purdue University (ÉTATS-UNIS)

Duration: 2014 -

See also: http://www.irisa.fr/celtique/ea/jcert/

Safety-critical applications demand rigorous, unambiguous guarantees on program correctness. While a combination of testing and manual inspection is typically used for this purpose, bugs latent in other components of the software stack, especially the compiler and the runtime system, can invalidate these hard-won guarantees. To address such concerns, additional laborious techniques such as manual code reviews of generated assembly code are required by certification agencies. Significant restrictions are imposed on compiler optimizations that can be performed, and the scope of runtime and operating system services that can be utilized. To alleviate this burden, the JCert project is implementing a verified compiler and runtime for managed concurrent languages like Java or C#.

6.2.2. Inria International Partners

6.2.2.1. Informal International Partners

Yann Salmon spent one month in Luke Ong's group at Oxford University (UK) between january and february. The objective of this stay was, on the one side, to promote Yann's work on strategy-dependant analysis of functional programs and, on the other side, to learn from Luke Ong's group on the analysis principles for higher-order functions.

6.2.2.1.1. JSCert

The JSCert project is an informal collaboration between Inria (Celtique and Toccata teams) and Imperial College. Alan Schmitt (Celtique) and Arthur Charguéraud (Toccata) are external collaborators for the "Certified Verification of Client-Side Web Programs" EPSRC project, led by Imperial College. Sergio Maffeis and Philippa Gardner are external collaborators for the "AJACS" ANR project, led by Inria.

6.3. International Research Visitors

6.3.1. Visits to International Teams

6.3.1.1. Sabbatical programme

Jensen Thomas

Date: Sep 2014 - Aug 2015

Institution: University of Copenhagen, Denmark

Pichardie David

Date: Sep 2011 - Aug 2012

Institution: Purdue University (PAYS???)

6.3.1.2. Explorer programme

Salmon Yann

Date: Jan 2014 - Feb 2014

Institution: University of Oxford (UK)

CIDRE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **Région Bretagne ARED grant:** the PhD of Regina Marin on privacy protection in distributed social networks is supported by a grant from the Région Bretagne.
- **Labex COMINLAB contract (2012-2015): "POSEIDON" - http://www.poseidon.cominlabs.ueb.eu/fr/**

  POSEIDON deals with the protection of data in outsourced or shared systems such as cloud computing and peer-to-peer networks. While these approaches are very promising solutions to outsource storage space, contents, data and services, they also raise serious security and privacy issues since users lose their sovereignty on their own data, services and systems. Instead of trying to prevent the bad effects of the cloud and of peer-to-peer systems, the main objective of the POSEIDON project is to turn benefit from their main characteristics (distribution, decentralization, multiple authorities, etc.) to improve the security and the privacy of the users' data, contents and services.

  This project is conducted in cooperation with Télécom Bretagne and Université de Rennes I. The PhD of Julien Lolive (co-supervised by Sébastien Gambs and Caroline Fontaine), which deals with the entwining of identification and privacy mechanisms, is funded by the POSEIDON project. The postdoctoral researcher of Wei Pan (co-supervised by Gouenou Coatrieux and Nicolas Prigent) that deals with a distributed system to ensure patients' privacy in the context of medical imaging is also funded by this project.
- **Labex COMINLAB contract (2012-2015): "SecCloud" - http://www.seccloud.cominlabs.ueb.eu**

  Nowadays attacks targeting the end-user and especially its web browser constitute a major threat. Indeed web browsers complexity has been continuously increasing leading to a very large attack surface. Among all possible threats, we tackle in the context of the SecCloud project those induced by client-side code execution (for example javascript, flash or html5).

  Existing security mechanisms such as os-level access control often only rely on users identity to enforce the security policy. Such mechanisms are not sufficient to prevent client-side browser attacks as the web browser is granted the same privileges as the user. Consequently, a malicious code can perform every actions that are allowed to the user. For instance, it can read and leak user private data (credit cart numbers, registered passwords, email contacts, etc.) or download and install malware.

  One possible approach to deal with such threats is to monitor information flows within the web browser in order to enforce a security information flow policy. Such a policy should allow to define fine-grained information flow rules between user data and distant web sites. This implies to propose an approach and to design and implement a mechanism that can handle both OS-level and browser-level information flows.

  Dynamically monitoring information flow at the web browser level may dramatically impact runtime performances of executed codes. Consequently, an important aspect of this work will be to benefit as far as possible from static analysis of application code. This static-dynamic hydride approach should reduce the number of verifications performed at run time.

  This study is conducted in cooperation with other Inria Teams (Ascola and Celtique). Deepak Subramanian is doing his PhD in the context of this project.

- **Labex COMINLAB contract (2013-2016): "DeSceNt" - http://www.descent.cominlabs.ueb.eu**

  In DeSceNt, we propose to investigate how decentralized home-based networks of plug computers can support personal clouds according to sound architectural principles, mechanisms, and programming abstractions. To fulfill this vision we see three core scientific challenges, which we think must be overcome. The first challenge, decentralized churn-poor design, arises from the nature of plug federations, which show much lower levels of churn than traditional peer-to-peer environments. The second challenge, quasi-causal consistency, is caused by the simultaneous needs to produce a highly scalable environment (potentially numbering millions of users), that also offers collaborative editing capabilities of mutable data-structures (to offer rich social interactions). The third and final challenge, intuitive data structures for plug programming, arises from the need by programmers for intuitive and readily reusable data-structures to rapidly construct rich and robust decentralized personal cloud applications.

  This study is conducted in cooperation with other teams (GDD Team (University of Nantes), Inria team ASAP)

- **Labex COMINLAB contract (2014-2017): "Kharon-Security" - http://www.securite.cominlabs.ueb.eu/**

  Google Play offers more than 800'000 applications (apps), and this number increases every day. Google play users have performed more than 25 billion app downloads. These applications vary from games to music, video, books, tools, etc. Unfortunately, each of these application is an attack vector on Android. The number of malicious applications (pieces of malware) discovered during the first six months of 2013 exceeds the number of pieces of malware discovered during the 2010 to 2012 period, more than 700 thousand malicious and risky applications were found in the wild. In this context, we propose the Security project to stem the progression of Android pieces of malware. We propose to combine status and dynamic monitoring to compute a behavioral signature of Android malware. Behavioral signatures are helpful to understand how malware infect the devices and how they spread information in the Android operating system. Static analysis is essential to understand which particular event or callback triggers malware payload.

  In the project we aim to imagine and develop a malware scanning service that will permit users to analyze their own applications. This service will be available on a online platform that will also deliver previously computed signatures of known malware.

  Project members are from Celtique and Cidre Inria teams.

8.2. National Initiatives

8.2.1. ANR

- **ANR INS Project: AMORES (2011-2015) - http://amores-project.org/**

  Situated in the mobiquitous context characterized by a high mobility of individuals, most of them wearing devices capable of geolocation (smartphones or GPS-equipped cars), the AMORES project is built around three use-cases related to mobility, namely (1) dynamic carpooling, (2) real-time computation of multi-modal transportation itineraries and (3) mobile social networking. For these three use cases, the main objective of the AMORES project is to define and develop geo-communication primitives at the middleware level that can offer the required geo-located services, while at the same time preserving the privacy of users, in particular with respect to their location (notion of geo-privacy). Within this context, we study in particular the problem of anonymous routing and the design of a key generation protocol tied to a particular geographical location. Each of these services can only work through cooperation of the different entities composing the mobile network. Therefore, we also work on the development of mechanisms encouraging entities to cooperate together in a privacy-preserving manner. The envisioned approach consists in the definition of generic primitives such as the management of trust and the incentive to cooperation.

This project is joint between the Université de Rennes I, Supélec, LAAS-CNRS, Mobigis and Tisséo. The research project AMORES received the Innovation Award at the Toulouse Space Show in June 2013. Simon Boche and Paul Lajoie-Mazenc are doing their PhD in the context of this project.

- **ANR INS Project: LYRICS (2011-2015) - http://projet.lyrics.orange-labs.fr/**

  With the fast emergence of the contactless technology such as NFC, mobile phones will soon be able to play the role of e-tickets, credit cards, transit pass, loyalty cards, access control badges, e-voting tokens, e-cash wallets, etc. In such a context, protecting the privacy of an individual becomes a particularly challenging task, especially when this individual is engaged during her daily life in contactless services that may be associated with his identity. If an unauthorized entity is technically able to follow all the digital traces left behind during these interactions then that third party could efficiently build a complete profile of this individual, thus causing a privacy breach. Most importantly, this entity can freely use this information for some undesired or fraudulent purposes ranging from targeted spam to identity theft. The objective of LYRICS (ANR INS 2011) is to enable end users to securely access and operate contactless services in a privacy-preserving manner that is, without having to disclose their identity or any other unnecessary information related to personal data. Within this project, we work mainly on the privacy analysis of the risks incurred by users of mobile contactless services as well as on the development of the architecture enabling the development of privacy-preserving mobile contactless services. The project is joint between France Télécom, Atos Wordline, CryptoExperts, ENSI Bourges, ENSI Caen, MoDyCo, Oberthur Technologies, NEC Corporation, Microsoft and Université de Rennes I.

  The project was originally suppose to end in 2014 but an extension was granted until May 2015. The project has finished to develop a first prototype that illustrates how can be used privacy preserving protocols for the transport use case. The prototype implements a transportation pass (similar to the Navigo pass) embedded in the SIM card. This transport pass can be interact with a gate at the entrance of the transportation network in order to check the validity of the pass and answers wirelessly, in less than 300ms, without revealing any information about the user. This result has been presented in "Salon Cartes 2012", in [21], and in several French newspapers. It will be published at the end of 2014 in [15]. During 2014, the partners of the LYRICS projects have also worked on two new use cases and their corresponding prototypes: digital surveys and e-cash solutions that respect the privacy of users.

- **ANR INFRA Project: SOCIOPLUG (2013-2017) - http://socioplug.univ-nantes.fr/index.php/SocioPlug_Project**

  SocioPlug is a collaborative ANR project involving Inria (ASAP and CIDRE teams), the Nantes University, and LIRIS (INSA Lyon and Université Claude Bernard Lyon). The project emerges from the observation that the features offered by the Web 2.0 or by social media do not come for free. Rather they bring the implicit cost of privacy. Users are more of less consciously selling personal data for services. SocioPlug aims to provide an alternative for this model by proposing a novel architecture for large-scale, user centric applications. Instead of concentrating information of cloud platforms owned by a few economic players, we envision services made possible by cheap low-end plug computers available in every home or workplace. This will make it possible to provide a high amount of transparency to users, who will be able to decide their own optimal balance between data sharing and privacy.

8.2.2. Inria Project Labs

- **CAPPRIS (2012-2016)**

  CAPPRIS stands for “Collaborative Action on the Protection of Privacy Rights in the Information Society”. The main objective of CAPPRIS is to tackle the privacy challenges raised by the most recent developments and usages of information technologies such as profiling, data mining, social networking, location-based services or pervasive computing by developing solutions to enhance the protection of privacy in the Information Society. To solve this generic objective, the project focuses in particular on the following four fundamental issues:

- The design of appropriate metrics to assess and quantify privacy, primarily by extending and integrating the various possible definitions existing for the generic privacy properties such as anonymity, pseudonymity, unlinkability and unobservability, as well as notions coming from information theory or databases such as the recent but promising concept of differential privacy;
- The definition and the understanding of the fundamental principles underlying "privacy by design", with the hope of deriving practical guidelines to implement notions such as data minimization, proportionality, purpose specification, usage limitation, data sovereignty and accountability directly in the formal specifications of our information systems;
- The integration between the legal and social dimensions, intensely necessary since the developed privacy concepts, although they may rely on computational techniques, must be in adequacy with the applicable law (even in its heterogeneous and dynamic nature). In particular, privacy-preserving technologies cannot be considered efficient as long as they are not properly understood, accepted and trusted by the general public, an outcome which cannot be achieved by the means of a mathematical proof.

Three major application domains have been identified as interesting experimentation fields for this work: online social networks, location-based services and electronic health record systems. Each of these three domains brings specific privacy-related issues. The aim of the collaboration is to apply the techniques developed to the application domains in a way that promotes the notion of privacy by design, instead of simply considering them as a form of privacy add-ons on the top of already existing technologies. CAPPRIS is a joint project between Inria, LAAS-CNRS, Université de Rennes I, Supélec, Université de Namur, Eurecom, and Université de Versailles. The postdoctoral position of Cristina Onete since September 2014 is funded by CAPPRIS.

8.2.3. Research mission "Droit et Justice"

- **Droit à l'oubli (2012-2014)** The "right to be forgotten" can be viewed as a consequence and an extension of the right to privacy and to personal data protection, emphasized by the inherent difficulty to erase any given information from the omnipresent digital world. The French ministry of Justice has launched two twin projects (one of which is the DAO project), in order to explore the possible legal definitions of a "right to be forgotten". Even though there are no legal foundations for such a right in France at the moment, the concept is already known from the general public and is also present in courts. Furthermore, individuals expect to be protected by such a right, thus it is important to understand why, how, in which circumstances and to which extent this new right may apply before envisioning a legal notion defining it. The DAO project involves a major legal component, a sociological survey and a technical study. In a nutshell, the legal part explores the possible boundaries and requirements of a right to be forgotten with respect to labor law, civil statuses, personal data protection, legal prescription and IT law. The sociological survey aims at understanding the root causes making people build a desire for forgetfulness in others. Finally, the objective of the computer science part is to elaborate a state of the art of the techniques that could be used to enforce a right to be forgotten in practice in the digital world. The expected output of the project as a whole is a detailed recommendation about whether an independent legislation proposal for the right to be forgotten would be justified, and how it should be done. This final report summarizing the thinkings of the project will be published at the end of 2014 or the beginning of 2015. The project is joint between Université de Rennes I, Inria and Supélec.

8.2.4. Competitivity Clusters

The AMORES project (ANR INS 2011, http://www.images-et-reseaux.com/en/content/amores) is recognized by the Images & Réseaux cluster.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

The **PANOPTESEC** project (http://www.panoptesec.eu) started on the 1st of November 2013. It deals with the automated and assisted security management of IT and SCADA system. The main objective of PANOPTESEC is to provide an integrated solution that will allow to efficiently monitor SCADA systems, detect intrusions and react to them. To that end, it encompasses many of the research topics that are addressed by the CIDRE team: alerts aggregation and correlation, policy-aware intrusion detection, architecture-aware intrusion detection, automated trust management, trust-based automated reaction and visualization.

The CIDRE team is involved in the project on all of these aspects. The partners are:

- REHA (BE),
- Alcatel-Lucent Bell Labs France (FR),
- Epistematica (IT),
- The University of Rome (IT),
- the University of Hamburg (GE),
- the Institut Mines-Telecom (FR),
- ACEA (IT),
- Supélec (FR).

This year, our work focused on requirements and design. CIDRE was the WP leader of *WP2 - Deficiency and Requirement Analysis* and was also particularly involved in *WP4 - Data Collection and Correlation*, *WP5 - Dynamic Risk Management* and *WP6 - Visual Analytics and Display*. In WP2, we produce an document presenting the state of the art and current limitations in the fields of security data collection and correlation, mission impact evaluation, threat assessment, automated and semi-automated reaction and visualization and interaction. We also produced an operational requirement analysis. In WP4, we produced a document presenting the system requirements for data collectin and low-level correlation. In WP5, we produced a document presenting the system requirements for risk evaluation and dynamic risk management. In WP6, we produced a document presenting visualization challenges and requirements in the context of PANOPTESEC. More generally, we also contributed to the design and architecture of what will be the PANOPTESEC system.

8.4. International Initiatives

8.4.1. Informal International Partners

Sébastien Gambs is collaborating with Jean-Marc Robert (ETS, Montréal, Canada) on the development of privacy-preserving and secure distance-bounding protocols and with Alain Tapp (Université de Montréal, Montréal, Canada) on the design of cryptographic architectures for privacy. He is also collaborating with Panagiotis Papadimitratos (KTH, Stockholm, Sweden) on privacy for location-based services.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Jean-Marc Robert

Date: June 2014

Institution: École de Technologie Supérieure (Canada).

8.5.1.1. Internships

Sackmann Mario Julián

Date: Sep 2014 - Jan 2015

Institution: Universidad de Buenos Aires (Argentine)

8.5.2. Visits to International Teams

8.5.2.1. Explorer programme

Sébastien Gambs

Date: May 2014

Institution: Institute of Big Data Analytics, Dalhousie University (Halifax, Canada)

8.5.2.2. Research stays abroad

We built a collaboration with Yvan Labiche of the Carleton University in Ottawa to supervise the PhD thesis of Mouna Hkimi. In the context of this collaboration and thanks to the support of SUPELEC and go the SUPELEC foundation, Eric Totel went in Carleton University for four months from March to June 2014, to work on the subject of the modeling of distributed applications.

In May 2014, Sébastien Gambs visited Stan Matwin at the Institute of Big Data Analytics located at Dalhousie university (Halifax, Canada). This visit has foster the beginning of a collaboration on the privacy-preserving analysis of large scale data. In particular, we have started to develop a novel method for sanitizing CDRs (Call Details Records) dataset based on differentially-private variants of sketches, which has been submitted to the D4D challenge. We will also prepare a submission for an associate Inria team for the 2015 call.

Thanks to the support of SUPELEC, Christophe Bidan has joined the ETS (École Supérieure de Technologie) of Montréal from july 2014 to july 2015 for working with Prof. Jean-Marc Robert. This stay results from a collaboration that has been initiated 2 years ago when Prof. Jean-Marc Robert has spent 4 months (from september to december 2012) in the CIDRE research group.

From September 2014 to May 2015, Antoine Guellier has joined the "Securing Cyberspace" team leaded by Prof. Batten, at Deakin University (Melbourne, Australia). This stay is possible thanks to the international outgoing fellowships of Rennes Métropole and of the UEB (Université Européenne de Bretagne).

CLASSIC Project-Team

5. Partnerships and Cooperations

5.1. National Initiatives

ANR project in the blank program: Calibration (2012–2015; involves Vincent Rivoirard, who is the coordinator; see https://sites.google.com/site/anrcalibration/home)

CLIME Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- The ANR project Estimair aims at quantifying the uncertainties of air quality simulations at urban scale. The propagation of uncertainties requires the use of model reduction and emulation. A key uncertainty source lies in the traffic emissions, which will be generated using a dynamic trafic assignment model. Ensembles of traffic assignments will be calibrated and used in the uncertainty quantification. Estimair is led by Clime.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

Program: COST Action ES104.

Project acronym: EuMetChem.

Project title: European framework for online integrated air quality and meteorology modeling.

Duration: January 2011 - December 2014.

Coordinator: Alexander Baklanov, Danish Meteorological Institute (DMI) Danemark.

Other partners: around 14 European laboratories, experts from United States, ECMWF.

Abstract: European framework for online integrated air quality and meteorology modeling (EuMetChem) focuses on a new generation of online integrated Atmospheric Chemical Transport (ACT) and Meteorology (Numerical Weather Prediction and Climate) modeling with two-way interactions between different atmospheric processes including chemistry (both gases and aerosols), clouds, radiation, boundary layer, emissions, meteorology and climate. Two application areas of the integrated modeling are considered: (i) improved numerical weather prediction (NWP) and chemical weather forecasting (CWF) with short-term feedbacks of aerosols and chemistry on meteorological variables, and (ii) two-way interactions between atmospheric pollution/ composition and climate variability/change. The framework consists of four working groups namely: 1) Strategy and framework for online integrated modeling; 2) Interactions, parameterizations and feedback mechanisms; 3) Chemical data assimilation in integrated models; and finally 4) Evaluation, validation, and applications. Establishment of such a European framework (involving also key American experts) enables the EU to develop world class capabilities in integrated ACT/NWP-Climate modeling systems, including research, forecasting and education.

8.2.2. Collaborations with Major European Organizations

Partner: ERCIM working group “Environmental Modeling”.

The working group gathers laboratories working on developing models, processing environmental data or data assimilation.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

Partner: Chilean meteorological office (Dirección Meteorológica de Chile)

The partner produces its operational air quality forecasts with Polyphemus. The 3-day forecasts essentially cover Santiago. The forecasts are accessible online in the form of maps, time series and video (http://www.meteochile.gob.cl/modeloPOLYPHEMUS.php).

Partner: Marine Hydrophysical Institute http://mhi.nas.gov.ua/en/index.html, Ukraine.

The collaboration concerns the study of the Black Sea surface circulation and the issue of image assimilation in forecasting models.

Partner: IBM Research, Dublin, Ireland

The collaboration addresses the assimilation of classical observations as well as images, with application to geophysics. New assimilation methods are developed, mainly based on minimax filtering.

COAST Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR ConcoRDanT ANR-10-BLAN-0208 (2010–2014)

Participants: Pascal Urso [contact], Mehdi Ahmed-Nacer, Claudia-Lavinia Ignat, Gérald Oster.

Partners: REGAL project-team (Inria Paris - Rocquencourt / LIP6, coordinator), CITI institute (Universidade Nova de Lisboa, Portugal), GDD team (University of Nantes) and SCORE team.

Website: http://concordant.lip6.fr/

Massive computing systems and their applications suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone.

The ConcoRDanT project (oct. 2010 – apr. 2014) investigates a promising new approach that is simple, scales, and provably ensures eventual consistency. A Commutative Replicated Data Type (CRDT) is a data type where all concurrent operations commute. If all replicas execute all operations, they converge; no complex concurrency control is required. We have shown in the past that CRDTs can replace existing techniques in a number of tasks where distributed users can update concurrently, such as co-operative editing, wikis, and version control. However CRDTs are not a universal solution and raise their own issues (e.g., growth of metadata).

The ConcoRDanT project engages in a systematic and principled study of CRDTs, to discover their power and limitations, both theoretical and practical. Its outcome will be a body of knowledge about CRDTs and a library of CRDT designs, and applications using them. We are hopeful that significant distributed applications can be designed using CRDTs, a radical simplification of software, elegantly reconciling scalability and consistency.

7.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2014)

Participants: Gérald Oster [coordinator], Luc André, Claudia-Lavinia Ignat, Pascal Urso.

Partners: SCORE team (coordinator), ASAP project-team (University of Rennes 1 / Inria Rennes - Bretagne Atlantique), CASSIS project-team (Inria Nancy - Grand Est / Nancy University), REGAL project-team (Inria Paris - Rocquencourt / LIP6) and GDD team (University of Nantes / LINA)

Website: http://streams.loria.fr/

The STREAMS project (nov. 2010 – may 2014) proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that reduce the disadvantages of centralised architectures. These solutions are meant to replace a central authority-based collaboration with a distributed collaboration that offers support for decentralisation of services.

The STREAMS project aims to advance the state of the art on peer-to-peer networks for social and real-time applications. Scalability is generally considered as an inherent characteristic of peer-to-peer systems. It is traditionally achieved using replication techniques. Unfortunately, the current state of the art in peer-to-peer networks does not address replication of continuously updated content due to real-time user changes. Moreover, there exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issue in social applications is how to balance collaboration with access control to shared objects. Interaction is aimed at making shared objects available to all who need them, whereas access control seeks to ensure this availability only to users with proper authorisation. STREAMS project aims at providing theoretical solutions to these challenges as well as practical experimentations.

7.1.3. ANR Kolflow (2011–2014)

Participant: Gérôme Canals.

Partners: GDD team (University of Nantes / LINA), Loria (Orpailleur and SCORE Teams), Silex Team (LIRIS, University of Lyon), Edelweiss (Inria Project).

Website: http://kolflow.univ-nantes.fr/

Kolflow aims at building a social semantic space where humans collaborate with smart agents in order to produce knowledge understandable by humans and machines. Humans are able to understand the actions of smart agents. Smart agents are able to understand actions of humans. Kolflow targets the co-evolution of content and knowledge as the result of interactions of humans and machines. Our work in the Kolflow project focus on implementing knowledge base testing strategies.

7.1.4. FSN OpenPaaS (2012–2015)

Participants: Olivier Perrin, Ahmed Bouchami.

Partners: Samovar team (Telecom SudParis), SCORE team (Université de Lorraine, Loria), ARMINES (Ecole des Mines d'Albi), Brake France, Linagora.

Website: http://www.open-paas.org/

The OpenPaaS project aims at developing a PaaS (Platform as a Service) technology dedicated to enterprise collaborative applications deployed on hybrid clouds (private/public). OpenPaaS is a platform that allows to design and deploy applications based on proven technologies provided by partners such as collaborative messaging systems, integration and workflow technologies that will be extended in order to address Cloud Computing requirements. Available as an open-source Enterprise Social Network, the OpenPaaS project innovates both at the collaborative level and by its capacity to leverage heterogeneous cloud technologies at the IaaS level (Infrastructure as a Service). This project is funded under the French FSN umbrella (Fond National pour la société Numérique).

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. SyncFree (2013-2016)

Participants: Pascal Urso [contact], Jordi Martori Adrian.

Program: FP7-ICT-2013-10

Project acronym: SyncFree

Project title: Large-scale computation without synchronisation

Duration : October 2013 - September 2016

Coordinator: Marc Shapiro, Inria

Other Partners: REGAL project-team (Inria Paris - Rocquencourt / LIP6, coordinator), Basho Technologies Limited (United Kingdom), Trifork AS (Denmark), Rovio Entertaiment OY (Finland), Faculdade de Ciências e Tecnologia (Universidade Nova de Lisboa, Portugal), Université Catholique de Louvain (Belgium), Ko c University (Turkey), Technische Universität Kaiserslautern (Germany) and COAST team.

Abstract: Large-scale on-line services including social networks and multiplayer games handle huge quantities of frequently changing shared data. Maintaining its consistency is relatively simple in a centralised cloud, but no longer possible due to increased scalability requirements. Instead, data must replicated across several distributed data centres, requiring new principled approaches to consistency that will be explored by the SyncFree project. http://syncfree.lip6.fr/

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. USCOAST

Title: User Studies on Trustworthy Collaborative Systems

International Partner (Institution - Laboratory - Researcher):

Wright State University (USA)

Duration: 2013 - 2015

See also: http://uscoast.loria.fr/

USCoast has as main objective the validation of trustworthy collaborative systems using experimental user studies. This type of validation requires the expertise of both computer scientists that designed the systems and social scientists for conceptualizing and measuring human behaviour in collaborative work. The project will focus on the real-time requirements and trust policies in collaborative editing, resulting in a theory for the effect of real-time constraints in collaborative editing and awareness management for the coordination of work in the presence of conflict and disruption. The project includes also validation of proposed light security mechanisms for decentralised collaboration, based on posted measures of voluntary compliance with data sharing restrictions. We will develop new methods for the cost-effective evaluation of collaborative work to compensate for otherwise unrealistic sample sizes and costly engineering, using game theory to inspire task analogues and simulated users along with human users.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Weihai Yu

Date: August 2013 - June 2014

Institution: University of Tromsø (Norway)

Weihai Yu examined issues concerning undo in collaborative editing and proposed an approach using a layered commutative replicated data type (CRDT) for strings.

Valerie Shalin

Date: Nov 2013 - Jul 2014

Institution: Wright State University (USA)

Valerie Shalin worked on experimental user studies of real-time collaborative editing and on the design of a game theory approach for the validation of trust-based collaboration.

Ehtesham Zahoor

Date: June, 1 2014 - July, 31 2014

Institution: National University of Computer and Emerging Sciences (Pakistan)

7.4.1.1. Internships

Fox Olivia

Date: Apr 2014 - Jul 2014

Institution: Wright State University (USA)

COATI Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. ANR Blanc STINT, 2014-2017

Participants: Jean-Claude Bermond, David Coudert, Frédéric Havet, Luc Hogie, Ana Karolinna Maia de Oliveira, Nicolas Nisse, Stéphane Pérennes, Michel Syska.

The STINT projet (*STructures INTerdites*) is leaded by the MC2 group (LIP, ENS-Lyon) and involves the G-SCOP laboratory (Grenoble).

The aim of STINT is to answer the following fondamental question: *given a (possibly infinite) family ψ of graphs, what propoerties does a ψ-free graph have?*. To this end, it will firstly establish bounds on some classical graph parameters (e.g., clique number, stability number, chromatic number) for ψ-free graphs. Then, it will design efficient algorithms to recognize ψ-free graphs and to determine or approximate some parameters for those graphs. These studies shall result in the development of new proof techniques.

(http://www.ens-lyon.fr/LIP/MC2/STINT/)

8.1.2. GDR Actions

8.1.2.1. Action ResCom, ongoing (since 2006)

Réseaux de communications, working group of GDR ASR, CNRS.

(http://rescom.asr.cnrs.fr/)

8.1.2.2. Action Graphes, ongoing (since 2006)

Action Graphes, working group of GDR IM, CNRS.

(http://gtgraphes.labri.fr/)

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. EULER

Participants: David Coudert, Luc Hogie, Aurélien Lancin, Bi Li, Nicolas Nisse.

Title: EULER (Experimental UpdateLess Evolutive Routing)

Type: COOPERATION (ICT)

Defi: Future Internet Experimental Facility and Experimentally-driven Research

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - June 2014

Partners: Alcatel-Lucent Bell (leader) (Antwerp, Belgique), iMind (Ghent, Belgium), UCL (Louvain, Belgium), RACTI (Patras, Grece), UPC (Barcelona, Spain), UPMC (ComplexNetworks, Paris 6), Inria (COATI, GANG, CEPAGE). Coordinator: ALCATEL-LUCENT (Belgium)

STREP EULER (Experimental UpdateLess Evolutive Routing) is part of FIRE (Future Internet Research and Experimentation) objective of FP7. It aims at finding new paradigms to design, develop, and validate experimentally a distributed and dynamic routing scheme suitable for the future Internet and its evolution. COATI is the leader of WP3 on Topology Modelling and Routing scheme experimental analysis.

See also: http://www-sop.inria.fr/mascotte/EULER/wiki/

8.2.2. Collaborations with Major European Organizations

Participants: David Coudert, Alvinice Kodjo, Truong Khoa Phan.

Discrete Optimization group : Lehrstuhl II für Mathematik, RWTH Aachen (Germany)

Robust optimization in backbone networks for energy efficient designs, and chance-constrained programming in backhaul networks subject to link capacity variations.

8.2.3. COLOR Inria Sophia Antipolis-méditerranée DIT University of Athens

Participants: Jean-Claude Bermond, David Coudert, Frédéric Giroire, Nicolas Nisse, Stéphane Pérennes.

Title : Algorithms Design and Games for Location, Placement and Infrastructure Leasing (AlGaLoP)

Duration: June 2013- September 2014

COATI and DIT University of Athens (responsible Vassilis Zissimopoulos)

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. AlDyNet

Title: Algorithm for large and Dynamic Networks

Inria principal investigator: Nicolas Nisse

International Partner (Institution - Laboratory - Researcher):

Universidad Adolfo Ibañez, Santiago, Chile
Facultad de Ingeniería y Ciencias
Karol Suchan

Duration: 2013 - 2015

See also: http://team.inria.fr/coati/projects/aldynet/

The main goal of this Associate Team is to study the structure of networks (modeled by graphs) to design both efficient distributed algorithms and reliable network topologies suitable to applications. We are interested both in large-scale (Facebook, Internet, etc.) and in smaller networks (e.g., WDM) that handle heavy traffic. More precisely, we aim at designing new techniques of distributed and localized computing to test structural properties of networks and to compute structures (e.g., decompositions) to be used in applications. Concerning the applications, we will first focus on routing and subgraph packing problems.

There are two main objectives:

- Find efficient localized algorithms to test certain graph properties or to prove that no such algorithms exist. We will formalize several distributed computing models and analyze which properties can and which cannot be tested in them.
- Define graph properties , computable or approximable in distributed systems , such as structures/decompositions/representations. The driving idea is to combine several well studied graph properties in order to obtain more specific structures which we hope to be more easily computable.

To verify the practical efficiency of our results, the designed algorithms will be implemented and compared to existing ones. For this purpose, a particular effort will be put to design and implement algorithms to generate graphs that satisfy properties of interest, in order to use them to test the algorithms.

The originality of the proposal is to combine powerful tools of graphs theory (e.g., FPT complexity) and of combinatorial optimization (Mixed Integer Programming) with distributed computing. One challenge here is to balance between the degree of locality of desired algorithms and the relevance of properties that may be computed.

8.3.2. Participation In other International Programs

Action ECOS-SUD: ALgorithmes Distribués pour le calcul de la structure des réseaux, with Chile, 2013-2015.

GAIATO : Graphs And Algorithms Applied To Telecommunications, International Cooperation FUNCAP/FAPs/Inria/INS2i-CNRS, no. INC-0083-00047.01.00/13, with Federal University of Ceara, Brasil, 2014-2016.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Professors / Researchers

Xavier Défago

Date: until Jan 31 2014

Institution: JAIST, Japan

Michele Flammini

Date: Jun 30 - Jul 13 2014

Institution: Univ. L'aquila, Italy

Brigitte Jaumard

Date: Dec 15-21, 2014

Institution: Concordia Univ., Montréal, Canada

Mejdi Kaddour

Date: Oct 13-19 2014

Institution: Univ. Oran, Algeria

Takako Kodate

Date: Mars 21 - Apr 3 2014

Institution: Tokyo Woman's Christian Univ., Suginami-ku, Tokyo, Japan

Arie M. C. A. Koster

Date: Jun 10-13, 2014

Institution: RWTH Aachen Univ., Germany

Gianpiero Monaco

Date: Jul 9-17, 2014

Institution: Univ. L'aquila, Italy

Gabriele Muciaccia

Date: Jan 10-16, 2014

Institution: Royal Holloway, University of London, UK

Jean-Sébastien Sereni

Date: Fev 2-7, 2014

Institution: LORIA, Nancy, France

Julio-Cesar Silva Araújo

Date: Jun 23 - Jul 25 2014

Institution: Univ. Federal do Ceara, Fortaleza, Brazil

Karol Suchan

Date: Sep 7-28 2014

Institution: Univ. Adolfo Ibanez, Santiago, Chile

Joseph Yu

Date: Mar 1 - Apr 18, 2014

Institution: Abbotsford and SFU, Vancouver, Canada

Vassilis Zissimopoulos

Date: Jul 4-12 2014

Institution: NKUA, Athens, Greece

8.4.1.2. PhD students

Marthe Bonamy

Date: Jan 27 - Fev 7, 2014

Institution: LIRMM, Montpellier, France

Akram Kout

Date: Sep 1 - Oct 25, 2014

Institution: Univ. Mentouri, Constantine, Algeria,

Esteban H. Roman Catafau

Date: May 8 - Jul 23 2014

Institution: Univ. Adolfo Ibanez, Santiago, Chile

8.4.1.3. Internships

Claudio Carvallho

Date: Dec 2013-Feb 2014

Institution: Federal University of Ceara, Brasil

Supervisor: Frédéric Havet

Renan Dantas

Date: Dec 2013-Feb 2014

Institution: Federal University of Ceara, Brasil

Supervisor: Frédéric Havet

Doldan Juan

Date: Apr 2014 - Aug 2014

Institution: Universidad de Buenos Aires (Argentina)

Supervisor: Nicolas Nisse

8.4.2. Visits to International Teams

8.4.2.1. Research stays abroad

Jean-Claude Bermond

Department of Informatics and Telecommunications of the National and Kapodistrian University of Athens, Greece, May 31 -June 14, 2014

David Coudert

Research Unit 1 (RU1) of the Computer Technology Institute and Press "Diophantus" (CTI), Patras, Greece, March 12-16, 2014

Department of Informatics and Telecommunications of the National and Kapodistrian University of Athens, Greece, March 16-22, 2014

Univ. Adolfo Ibañez, Santiago, Chile, November 17-30, 2014

Frédéric Giroire

LIAFA, Paris, France, March 19, 2014

PARGO, Federal University of Ceará, Fortaleza, Brazil, June 9-20, 2014

Frédéric Havet

LIP, ENS Lyon, France, December 15-17, 2014

Nicolas Nisse

JAIST, Kanazawa, Japan, July 22 - August 8, 2014

Univ. Adolfo Ibañez, Santiago, Chile, November 17 - December 12, 2014

COFFEE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

The ANR-project Monumentalg, led by M. Ribot, is devoted to the modeling and simulation of biological damage on monuments and algae proliferation.

7.1.2. National and European networks

- GdR MoMas.

  The research group MoMaS (Mathematical Modeling and Numerical Simulation for Nuclear Waste Management Problems) has activities centered around scientific computing, design of new numerical schemes and mathematical modelling (upscaling, homogenization, sensitivity studies, inverse problems,...). Its goal is to coordinate research in this area, as well as to promote the emergence of focused groups around specific projects
- S. Junca is involved in the GdR-e "Wave Propagation in Complex Media for Quantitative and non Destructive Evaluation".
- GdR EGRIN is a newly created CNRS-network, devoted to gravitational flows and naturals risks; Coffee is among the members of this network.

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. COKLYCO

Title: Modeling, analysis and simulation of kinetic and fluid models for MEMS

International Partner (Institution - Laboratory - Researcher):

Kyoto (JAPON)

Duration: 2014 -

See also: https://team.inria.fr/coffee/?page_id=323

The team led the led the project CoKLyCo, a collaborative program with Kyoto University and the team Khaliffe in Lyon. We wish to elaborate and analyse new models of microscopic and macroscopic type for Micro-Electro-Mechanical Systems (MEMS). The tiny scales of such technical devices induce new and challenging difficulties. A specific attention will be paid to the treatment of coupling conditions from moving boundaries, and to the multi-scale character of the problem. The project is based on a strong interplay between mathematical analysis, experiments and numerical simulations, made possible by the composition of the team.

7.2.2. Participation In other International Programs

Quite recently, S. Junca has started a collaboration with Mathias Legrand, from the Mechanical Engineering department at Mc Gill, Montréal with the supervision of the internship of a master student (S. Heng, 6 months, June-Nov. 2013). Furthermore, S. Junca is an active member of the European network "Wave propagation in complex media for quantitative and non destructive evaluation" http://www.gdre-us.cnrs-mrs.fr/spip.php?rubrique8

S. Krell has a collaboration with Martin Gander (University of Geneva, Switzerland) on domain decomposition methods, adapted to DDFV discretizations.

M. Ribot started a collaboration with Roberto Natalini a couple of years ago. Connections with experts in Firenze was the starting point of the research on biofilm formation and algae proliferation. M. Ribot and R. Natalini have also worked on new well-balanced strategy — the so-called AHO schemes — in order to preserve equilibria and to capture correctly large time solutions for complex PDEs system, without knowing explicitly the equilibrium solution. They have co-advised 2 PhD thesis.

Finally, we have many international collaborations, with variable peaks of activity, in our research networks: A. Vasseur (U. T. Austin), P.E. Jabin (Univ. Maryland), J.-A. Carrillo (Imperial College London), S. Jin (U. W. Madison and Jiao Tong Univ.), R. Aavatsmark (Univ. of Bergen), etc.

COMETE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Large-scale initiatives

Project acronym: CAPPRIS

Project title: Collaborative Action on the Protection of Privacy Rights in the Information Society

Duration: October 2011 - September 2015

URL: https://cappris.inria.fr/

Coordinator: Daniel Le Metayer, Inria Grenoble

Other partner institutions: The project involves four Inria research centers (Saclay, Saphia-Antipolis, Rennes and Grenoble), CNRS-LAAS, Eurecom and the university of Namur. Besides computer scientists, the consortium also includes experts in sociology and in law, thus covering the complementary areas of expertise required to reach the objectives.

Abstract: The goal of this project is to study the challenges related to privacy in the modern information society, trying to consider not only the technical, but also the social and legal ones, and to develop methods to enhance the privacy protection.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. MEALS

Program: FP7-PEOPLE-2011-IRSES

Project acronym: MEALS

Project title: Mobility between Europe and Argentina applying Logic to Systems

Duration: October 2011 - September 2015

URL: http://www.meals-project.eu/

Coordinator: Holger Hermans, Saarland University, Germany

Coordinator for the Inria sites: Catuscia Palamidessi, Inria Saclay

Other partner institutions: Rheinisch-Westfälische Technische Hochschule Aachen, Germany. Technische Universität Dresden, Germany. Inria, France. Imperial College of Science, Technology and Medicine, UK, University of Leicester, UK. Technische Universiteit Eindhoven, NL. Universidad Nacional de Cordoba, AR. Universidad de Buenos Aires, AR. Instituto Tecnologico de Buenos Aires, AR. Universidad Nacional de Rio Cuarto, AR.

Abstract: In this project we focus on three aspects of formal methods: specification, verification, and synthesis. We consider the study of both qualitative behavior and quantitative behavior (extended with probabilistic information). We aim to study formal methods in all their aspects: foundations (their mathematical and logical basis), algorithmic advances (the conceptual basis for software tool support) and practical considerations (tool construction and case studies).

7.3. International Initiatives

7.3.1. Inria-MSR joint lab

7.3.1.1. Privacy-Friendly Services and Apps

Title: Privacy-Friendly Services and Applications

Inria principal investigator: Catuscia Palamidessi

International Partners:

Cedric Fournet, Microsoft Research Lab, Cambridge, UK

Andy Gordon, Microsoft Research Lab, Cambridge, UK

Duration: 2014 - 2016

URL: http://www.msr-inria.fr/projects/privacy-friendly-services-and-apps/

Abstract: This is a project sponsored by Microsoft Research Lab, on methods to preserve privacy in web services and location-based services.

7.3.2. Inria Associate Teams

7.3.2.1. PRINCESS

Title: Protecting privacy while preserving data access

Inria principal investigator: Catuscia Palamidessi

International Partners:

Geoffrey Smith, Florida International University (United States)

Andre Scedrov, University of Pennsylvania (United States)

Duration: 2013 - 2016

URL: http://www.lix.polytechnique.fr/comete/Projects/Princess/

Abstract: PRINCESS is an Inria associated team focusing on the protection of privacy and confidential information. In particular, we study the issues related to the leakage of confidential information through public observables.

We aim at developing a meaningful notion of measure in order to quantify the leakage of information, and to design mechanisms to limit the amount of leakage, without interfering too severely with the utility of the information that is meant to be disclosed.

The main topics currently investigated are quantitative information flow, where we are developing a decision-theoretic approach, and differential privacy, where we are developing an extension which lifts the basic notion of privacy meant for databases to arbitrary domains.

7.3.3. Inria International Partners

7.3.3.1. Informal International Partners

Moreno Falaschi, Professor, University of Siena, Italy

Mario Ferreira Alvim Junior, Assistant Professor, Federal University of Minas Gerais, Brazil

Annabelle Mciver, Associate Professor, Macquarie University, Australia

Charles Carroll Morgan, Professor, University of New South Wales, Australia

Carlos Olarte, Adjunct professor at Universidade Federal do Rio Grande do Norte, Brazil

Camilo Rueda, Professor, Universidad Javeriana Cali, Colombia

7.3.4. Participation In other International Programs

7.3.4.1. PACE

Program: ANR Blanc International

Project title: Beyond plain Processes: Analysis techniques, Coinduction and Expressiveness

Duration: January 2013 - December 2016

URL: http://perso.ens-lyon.fr/daniel.hirschkoff/pace/

Coordinator: Daniel Hirschkoff, Ecole Normale Supérieure de Lyon

Other PI's and partner institutions: Catuscia Palamidessi, Inria Saclay. Davide Sangiorgi, University of Bologna (Italy). Yuxi Fu, Shanghai Jiao Tong University (China).

Abstract: This project objective is to enrich and adapt these methods, techniques, and tools to much broader forms of interactive models, well beyond the realm of "traditional" processes.

7.3.4.2. LOCALI

Program: ANR Blanc International

Project title: Logical Approach to Novel Computational Paradigms

Duration: October 2011 - September 2015

URL: http://lcs.ios.ac.cn/~locali2013/

Coordinator: Gilles Dowek, Inria Rocquencourt

Other PI's and partner institutions: Catuscia Palamidessi, Inria Saclay. Thomas Erhard, Paris VII. Ying Jiang , Chinese Academy of Science in Beijin (China).

Abstract: This project aims at exploring the interplays between logic and sequential/distributed computation in formalisms like the lambda calculus and the π calculus. Going back to the fundamentals of the definitions of these calculi, the project plans to design new programming languages and proof systems via a logical approach.

7.3.4.3. MUSICAL

Program: CNPq Science Without Borders.

Project title: Music and Spatial Interaction with Constraints, Algebra and Logic: Foundations and Applications.

Duration: Oct 2014- Oct 2016

URL: http://cic.puj.edu.co/~caolarte/musical/Musical/Welcome.html

Coordinator: Elaine Pimentel, Universidade Federal do Rio Grande do Norte (Brazil),

Other PI's and partner institutions: Camilo Rueda, PUJ Cali (Colombia). Carlos Olarte, Universidade Federal do Rio Grande do Norte (Brazil). Frank Valencia, CNRS-LIX and Inria Saclay (France). Gerard Assayag, IRCAM (France).

Abstract: This multi-disciplinary project aims to develop and integrate tools from logic and concurrency theory for the design and analysis of reactive systems and to their application to musical processes and multimedia systems.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Mauricio Cano, Masters Student, Universidad Javeriana Cali, Colombia, Nov 2014

Moreno Falaschi, Professor, University of Siena, Italy, from July 2014 until Aug 2014

Mario Ferreira Alvim Junior, Assistant Professor, Federal University of Minas Gerais, Brazil, Dec 2014

Maurizio Gabbrielli, Professor, University of Bologna, Italy, from July 2014 until Aug 2014

Daniel Gebler, PhD student, Free University of Amsterdam, The Netherlands, Jun 2014

Justin Hsu, PhD student, University of Pennsylvania, USA, Nov 2014

Annabelle McIver, Associate Professor, Macquarie University, Australia, Dec 2014

Hernan Claudio Melgratti, Associate Professor, University of Buenos Aires, Argentina, Apr 2014

Carroll Morgan, Professor, University of New South Wales and NICTA, Australia, Dec 2014

Carlos Olarte, Adjunct professor at Universidade Federal do Rio Grande do Norte, Brazil, from June 2014 until Jul 2014

Camilo Rueda, Professor, Universidad Javeriana Cali, Colombia, from Nov 2014 to Nov 2014

Geoffrey Smith, Professor, Florida International University, USA, Dec 2014

7.4.1.1. Internships

7.4.1.1.1. Raphaelle Crubillé

Duration: From Mar 2014 until Jul 2014

Subject: Formal modelling of RFID distance bounding protocols

Institution: ENS Lyon

7.4.2. Visits to International Teams

Konstantinos Chatzikokolakis and Catuscia Palamidessi visited the team of Annabelle McIver and Carroll Morgan at Macquarie University, Australia, July 2014.

Frank Valencia visited the team of Camilo Rueda (AVISPA) at Pontifical Universidad Javeriana Cali, from July 2014 until July 2014

COMMANDS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- F. Bonnans is coordinator of the ICODE project "Strategic crowds: analysis and simulation", with U. Limoges, Paris-Sud.
- F. Bonnans participates to two PGMO project: "Hydro-electric scheduling under uncertainty", with U. Auckland, "Perturbation analysis for deterministic and stochastic optimal control problems", with U. Limoges and TSE (Toulouse),
- P. Martinon participates to the OPTIBIO project, supported by FMJH-PGMO, devoted to "New challenges in the optimal control of bioprocesses", with U. Angers, Lille 1 / Limoges

8.2. National Initiatives

8.2.1. DGA

Participants: Olivier Bokanowski, Anna Désilles, Hasnaa Zidani.

This project is a collaboration in the framework of a 3-year (2012-2015) research program funded by DGA. The title of the project is "Problèmes de commande optimale pour des systèmes non-linéaires en présence d'incertitudes et sous contraintes de probabilité de succès".

8.2.2. ANR HJNet

Participants: Olivier Bokanowski, Zhiping Rao, Hasnaa Zidani.

The team is part of the collaborative project HJNet funded by the French National Research Agency (ANR-12-BS01-0008-01). It started in January 2013 and will end in December 2013. Website: http://hjnet.math.cnrs.fr

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. SADCO

Type: FP7

Defi: NC

Instrument: Initial Training Network

Objectif: NC

Duration: January 2011 - December 2014

Coordinator: Inria

Partner: Univ. of Louvain, Univ. Bayreuth, Univ. Porto, Univ. Rome - La Sapienza, ICL, Astrium-Eads, Astos solutions, Volkswagen, Univ. Padova, Univ. Pierre et Marie Curie.

Inria contact: Hasnaa Zidani

Abstract: Optimisation-based control systems concern the determination of control strategies for complex, dynamic systems, to optimise some measures of best performance. It has the potential for application to a wide range of fields, including aerospace, chemical processing, power systems control, transportation systems and resource economics. It is of special relevance today, because optimization provides a natural framework for determining control strategies, which are energy efficient and respect environmental constraints. The multi-partner initial training network SADCO aims at: Training young researchers and future scientific leaders in the field of control theory with emphasis on two major themes sensitivity of optimal strategies to changes in the optimal control problem specification, and deterministic controller design; Advancing the theory and developing new numerical methods; Conveying fundamental scientific contributions within European industrial sectors.

See: http://itn-sadco.inria.fr

8.4. International Initiatives

8.4.1. Inria International Labs

We are involved in the CIRIC team "Optimization and control of energy", jointly with U. de Chile at Santiago. This collaboration involved several visits of the team in Santiago: F. Bonnans (1 week), B. Heymann (2 months) and P. Martinon (2 weeks).

8.4.2. Inria Associate Teams

8.4.2.1. OCONET

Title: Optimization and control in network economics

International Partner:

Universidad de Chile (CHILI)

Duration: 2012 - 2014.

See also: http://www.cmm.uchile.cl/EA_OCONET/

Limited resources in telecommunication, energy, gas and water supply networks, lead to multi-agent interactions that can be seen as games or economic equilibrium involving stochastic optimization and optimal control problems. Interaction occurs within a network, where decisions on what to produce, consume, trade or plan, are subject to constraints imposed by node and link capacities, risk, and uncertainty, e.g. the capacity of generators and transmission lines; capacity of pipeline in gas supply; switches and antennas in telecommunication. At the same time, nonlinear phenomena arise from price formation as a consequence of demand-supply equilibria or multi-unit auction processes in the case of energy and telecommunication. We will focus first in this project in electricity markets in which there are producers/consumers PCs, and an agent called ISO (Independent system operator) in charge of the management of the network. One major application we have in mind is the one of smart (electrical) grids, in view of the increased use of renewable energies, that is, a massive entry of wind, geothermal, solar in particular.

8.4.3. Inria International Partners

8.4.3.1. Informal International Partners

Collaboration with the CIFASIS lab of U. Rosario, Argentina (3 months visit of J. Gianatti).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Andew Philpott, U. Auckland (NZ), 6 weeks. Research on stochastic optimization with F. Bonnans and F. Wahid.

8.5.1.1. Internships

- Justina Gianatti, Cifasis, U. Rosario (Argentina), 3 months. Research on stochastic control with F. Bonnans.

COMPSYS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. In Relation with the LYONCALCUL Initiative

Compsys follows or participates to the activities of LyonCalcul (http://lyoncalcul.univ-lyon1.fr/), a network to federate activities on high-performance computing in Lyon. In this context, and with the support of the Labex MILYON (http://milyon.universite-lyon.fr/), Compsys organized a thematic quarter on compilation from April 2013 to July 2013 (http://labexcompilation.ens-lyon.fr). A new thematic quarter is in preparation for 2016, initiated by Violaine Louvet (Institute Camille Jordan), with the participation of the LIP teams Avalon, Compsys, and Roma. Also, Alain Darte and Alexandre Isoard have regular exchanges with Violaine Louvet and Thierry Dumont on tiling code optimizations.

8.1.2. Streaming Day with CITI Laboratory

Compsys has some common research interests with the Socrate Inria team from the CITI laboratory (Insa-Lyon), in particular streaming languages. In this context, Socrate (Lionel Morel), with the help of Compsys (Alain Darte), organized in April 2014, a thematic day on the "compilation and execution of streaming programs" in Domaine des Hautannes, St Germain au Mont d'Or, with 7 speakers and 32 participants. See the webpage of the event http://streaming.conf.citi-lab.fr.

8.2. National Initiatives

8.2.1. French Compiler Community

Until 2010, the french compiler community had no official national meetings. Laure Gonnord and Fabrice Rastello decided to motivate the different french actors to meet regularly. All groups whose activities are related to compilation were contacted and the first "compilation day" was organized in September 2010 in Lyon. The next sessions, in a form of 3-days workshops, took place in Aussois (winter 2010), Dinard (spring 2011), Saint-Hippolyte (autumn 2011), Rennes (summer 2012), Annecy (spring 2013, organized by Compsys again), Dammarie-les-lys (winter 2013), and Nice (summer 2014). This effort is a success: the community (http://compilfr.ens-lyon.fr) is now well identified and such an event occurs at least once a year. The community is still animated by Laure Gonnord and Fabrice Rastello, and now also by Florian Brandner (ENSTA), and is now recognized as a sub-group of the CNRS GDRs ASR (Architecture, System, Network) and GPL (Software Engineering and Programming). As a subgroup of GPL, the community is (from 2014) now in charge of organizing one day during the Research school "Ecole des jeunes chercheurs en Algorithmique et Programmation".

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations: HIPEAC network

Compsys members participate to the European Network of Excellence on High Performance and Embedded Architecture and Compilation (HiPEAC, http://www.hipeac.net/), either as members or affiliate members. The International Workshop on Polyhedral Compilation Techniques (IMPACT, see Section 8.4.1.2), co-created by Christophe Alias in 2011, is now an annual event of the HIPEAC conference, as an official workshop. The 5th edition, IMPACT'15, is co-organized and co-chaired by Alain Darte (see http://impact.gforge.inria.fr/impact2015/).

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

- Christophe Alias has a regular collaboration with Sanjay Rajopadhye from the Colorado State University (USA), through the advising of the PhD thesis of Guillaume Iooss. This year, this collaboration led to several publications, see Sections 6.8 and 6.5 .
- Laure Gonnord has a regular collaboration with Fernando Magno Quintao Pereira from the University of Mineas Gerais (Brazil). This year, this collaboration led to several results, see Sections 6.4 and 6.3 . In Jan.-Feb. 2015, Compsys will host Fernando Pereira as an invited professor.

8.4.1.2. Polyhedral Community

In 2011, as part of the organization of the workshops at CGO'11, Christophe Alias (with C. Bastoul) organized IMPACT'11 (international workshop on polyhedral compilation techniques, http://impact2011.inrialpes.fr/). This workshop in Chamonix was the very first international event on this topic, although it was introduced by Paul Feautrier in the late 80s. Alain Darte gave the introductory keynote talk. After this first very successful edition (more than 60 people), IMPACT continued as a satellite workshop of the HIPEAC conference, in Paris (2012), Berlin (2013), Vienna (2014). Alain Darte is program chair for the next edition, in Amsterdam (2015). The creation of IMPACT, now the annual event of the polyhedral community, helped to identify this community and to make it more visible. This effort was complemented by the organization of the first (and for the moment unique) school on polyhedral code analysis and optimizations (http://labexcompilation.ens-lyon.fr/polyhedral-school/). Alain Darte also manages two new mailing lists for news (polyhedral-news@listes.ens-lyon.fr) and discussions (polyhedral-discuss@listes.ens-lyon.fr) on polyhedral code analysis and optimizations.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

- Romain Labolle, a L3 ENS-Lyon student, worked, from June 2014 to July 2014, on the adaptation of parametric tiling with inter-tile data reuse to GPUs (reuse for global memory, reuse for shared memory, reuse for registers, i.e., register tiling), supervised by Alain Darte and Alexandre Isoard.
- Shikhar Makkar, a student from the National Institute of Technology Kurukshetra in India, worked, from June 2014 to August 2014, on the mapping of piece-wise affine functions on FPGAs, supervised by Christophe Alias. His internship was funded by the LIP.
- Amir Teshome Wonjiga, a M1 ENS-Lyon student from Ethiopia, worked, from May 2014 to August 2014, on an implementation of an operational semantics of the X10 language, supervised by Paul Feautrier and Laure Gonnord. His internship was funded by Compsys and the LIP.

CONVECS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. FSN (Fonds national pour la Société Numérique)

8.1.1.1. OpenCloudware

Participants: Rim Abid, Hugues Evrard, Frédéric Lang, Gwen Salaün [correspondent], Lina Ye.

OpenCloudware [0] is a project funded by the FSN. The project is led by France Telecom / Orange Labs (Meylan, France) and involves 18 partners (among which Bull, OW2, Thalès, Inria, etc.). OpenCloudware aims at providing an open software platform enabling the development, deployment and administration of cloud applications. The objective is to provide a set of integrated software components for: (i) modeling distributed applications to be executed on cloud computing infrastructures; (ii) developing and constructing multi-tier virtualized applications; and (iii) deploying and administrating these applications (PaaS platform) possibly on multi-IaaS infrastructures.

OpenCloudware started in January 2012 for three years and nine months. The main contributions of CONVECS to OpenCloudware (see § 6.5.4) are the formal specification of the models, architectures, and protocols (self-deployment, dynamic reconfiguration, self-repair, etc.) underlying the OpenCloudware platform, the automated generation of code from these specifications for rapid prototyping purposes, and the formal verification of the aforementioned protocols.

8.1.1.2. Connexion

Participants: Hubert Garavel [correspondent], Frédéric Lang, Raquel Oliveira.

Connexion [0] (*COntrôle commande Nucléaire Numérique pour l'EXport et la rénovatION*) is a project funded by the FSN, within the second call for projects "*Investissements d'Avenir — Briques génériques du logiciel embarqué*". The project, led by EDF and supported by the *Pôles de compétitivité* Minalogic, Systematic, and *Pôle Nucléaire Bourgogne*, involves many industrial and academic partners, namely All4Tech, Alstom Power, ArevA, Atos Worldgrid, CEA-LIST, CNRS/CRAN, Corys Tess, ENS Cachan, Esterel Technologies, Inria, LIG, Predict, and Rolls-Royce. Connexion aims at proposing and validating an innovative architecture dedicated to the design and implementation of control systems for new nuclear power plants in France and abroad.

Connexion started in April 2012 for four years. In this project, CONVECS will assist another LIG team, IIHM, in specifying human-machine interfaces formally using the LNT language and in verifying them using CADP (see § 6.5.7).

8.1.2. Competitivity Clusters

8.1.2.1. Bluesky for I-Automation

Participants: Hubert Garavel, Fatma Jebali, Jingyan Jourdan-Lu, Frédéric Lang, Eric Léo, Radu Mateescu [correspondent].

Bluesky for I-Automation is a project funded by the FUI (*Fonds Unique Interministériel*) within the *Pôle de Compétitivité* Minalogic. The project, led by Crouzet Automatismes (Valence), involves the SMEs (*Small and Medium Enterprises*) Motwin and VerticalM2M, the LCIS laboratory of Grenoble INP, and CONVECS. Bluesky aims at bringing closer the design of automation applications and the Internet of things by providing an integrated solution consisting of hardware, software, and services enabling a distributed, Internet-based design and development of automation systems. The automation systems targeted by the project are networks of programmable logic controllers, which belong to the class of GALS (*Globally Asynchronous, Locally Synchronous*) systems.

[0] http://www.opencloudware.org
[0] http://www.cluster-connexion.fr

Bluesky started in September 2012 for three years. The main contributions of CONVECS to Bluesky (see § 6.1.3 and § 6.5.5) are the definition of GRL, the formal pivot language for describing the asynchronous behavior of logic controller networks, and the automated verification of the behavior using compositional model checking and equivalence checking techniques.

8.1.3. Other National Collaborations

Additionally, we collaborated in 2014 with the following Inria project-teams:

- OASIS (Inria Sophia-Antipolis – Méditerranée): Eric Madelaine and Ludovic Henrio,
- ESTASYS (Inria Rennes – Bretagne Atlantique): Kevin Corre and Axel Legay,
- MEXICO (Inria Saclay – Île-de-France): Alban Linard.

Beyond Inria, we had sustained scientific relations with the following researchers:

- Gaëlle Calvary and Sophie Dupuy-Chessa (LIG, Grenoble),
- Fabrice Kordon and Lom Messan Hillah (LIP6, Paris),
- Alexandre Hamez (ISAE, Toulouse),
- Noël De Palma and Fabienne Boyer (LIG, Grenoble),
- Xavier Etchevers (Orange Labs, Meylan),
- Matthias Güdemann (Systerel, Aix-en-Provence),
- Meriem Ouederni (IRIT, Toulouse),
- Christophe Deleuze, Ioannis Parissis, and Mouna Tka Mnad (LCIS, Valence),
- Pascal Poizat (LIP6, Paris).

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. SENSATION

Participants: Hubert Garavel [correspondent], Radu Mateescu, Jose Ignacio Requeno, Wendelin Serwe.

SENSATION [0] (*Self ENergy-Supporting Autonomous computaTION*) is a European project no. 318490 funded by the FP7-ICT-11-8 programme. It gathers 9 participants: Inria (ESTASYS and CONVECS project-teams), Aalborg University (Denmark), RWTH Aachen and Saarland University (Germany), University of Twente (The Netherlands), GomSpace (Denmark), and Recore Systems (The Netherlands). The main goal of SENSATION is to increase the scale of systems that are self-supporting by balancing energy harvesting and consumption up to the level of complete products. In order to build such Energy Centric Systems, embedded system designers face the quest for optimal performance within acceptable reliability and tight energy bounds. Programming systems that reconfigure themselves in view of changing tasks, resources, errors, and available energy is a demanding challenge.

SENSATION started on October 1st, 2012 for three years. CONVECS contributes to the project regarding the extension of formal languages with quantitative aspects (see § 6.3.1), studying common semantic models for quantitative analysis, and applying formal modeling and analysis to the case studies provided by the industrial partners (see § 6.5.6).

8.2.2. Collaborations with Major European Organizations

The CONVECS project-team is member of the FMICS (*Formal Methods for Industrial Critical Systems*) working group of ERCIM [0]. R. Mateescu was the chairman of the FMICS working group until November 1st, 2014. H. Garavel is member of the FMICS board, in charge of dissemination actions.

[0] http://sensation-project.eu/
[0] http://fmics.inria.fr

H. Garavel was appointed to a new Working Group within Informatics Europe: "*Parallel Computing (Supercomputing) Education in Europe: State-of-Art*". This is a relatively small working group (about 10 people) with the following missions: to show the need for urgent changes in higher education in the area of computational sciences, to compose a survey of the current landscape of parallel computing and supercomputing education in Europe with respect to different universities and countries, and to prepare a set of recommendations on how to bring ideas of parallel computing and supercomputing into higher educational systems of European countries.

8.2.3. Other European Collaborations

In addition to our partners in aforementioned contractual collaborations, we had scientific relations in 2014 with several European universities and research centers, including:

- Saarland University (Alexander Graf-Brill, Holger Hermanns, and Felix Freiberger),
- RWTH Aachen (Joost-Pieter Katoen and Xiaoxiao Yang),
- Oxford University (Ernst-Moritz Hahn and Marta Kwiatkowska),
- University of Birmingham (Dave Parker),
- Technical University of Eindhoven (Anton Wijs),
- University of Twente (Marieke Huisman and Jaco van de Pol),
- University of Málaga (Carlos Canal, Francisco Duran and Ernesto Pimentel), and
- Brandenburg University of Technology Cottbus - Senftenberg (Monika Heiner).

Our partnership with Saarland University was sustained by the Humboldt Forschungspreis received by H. Garavel, who continued his regular visits to Saarland University.

8.3. International Initiatives

8.3.1. Inria International Labs

H. Garavel is a member of IFIP (*International Federation for Information Processing*) Technical Committee 1 (*Foundations of Computer Science*) Working Group 1.8 on Concurrency Theory chaired successively by Luca Aceto and Jos Baeten.

8.3.2. Other International Collaborations

In 2014, we had scientific relations with several universities abroad, including:

- University of California at Santa Barbara, USA (Tevfik Bultan),
- University of Utah, USA (Chris Myers and Zhen Zhang), and
- Universidad Nacional de Cordoba, Argentina (Pedro d'Argenio).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Alexandre Hamez (ISAE, Toulouse) visited us on March 26-28, 2014. He gave a seminar entitled "*Symbolic Model Checking and Hierarchical Set Decision Diagrams*".
- Chris Myers (University of Utah, USA) visited us from July 7–11, 2014. He gave a talk entitled "*Genetic Design Automation*" on July 8, 2014.
- The annual CONVECS seminar was held in Herbelon (France) on June 23-25, 2014. The following invited scientists attended the seminar:
  - Laurence Pierre (TIMA, Grenoble, France) gave on June 23, 2014 a talk entitled "*Verification of Correctness and Safety Requirements for SoC Models*".
  - Matthias Güdemann (Systerel, Aix-en-Provence) gave on June 24, 2014 a talk entitled "*Industrial Formal Methods*".
  - Lom Messan Hillah (LIP6, Paris) gave on June 25, 2014 a talk entitled "*Formal Methods in Model-Driven Development and Model-Driven Development in Formal Methods: Practice Makes a Better Bridge*".

CORIDA Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

Most of the members of our team are involved in at least one ANR program.

Marius Tucnsak is local coordinator of ANR blanc project Hamecmopsys. This ANR project will be active up to 2015.

Antoine Henrot is head of the ANR blanc project OPTIFORM since September 2012. This project is devoted to the Geometric Analysis of Optimal Shapes. It gathers scientist from Grenoble, Chambéry, Lyon, Rennes and Paris Dauphine. This ANR project will be active up to August 2016.

Xavier Antoine is coordinator for partner 2 of ANR blanc project BECASIM since September 2013. This ANR project will be active up to 2017.

7.1.2. GDR

Thomas Chambrion has been animator of the EDP group of GDR MAC since October 2014.

7.2. International Research Visitors

7.2.1. Visits of International Scientists

Prof Gengsheng Wang, University of Wuhan, China, visited our team for 3 months.

Prof George Weiss, University of Tel Aviv, Israel, visited our team for 1 month.

7.2.2. Visits to International Teams

Julie Valein has been invited for 3 months (October-December) in the Department of Applied Physics and Applied Mathematics (APAM) at Univeristy of Columbia, New-York, USA.

CQFD Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Chaire Inria-AIRBUS-Conseil régional d'Aquitaine

The chaire is funding the PhD thesis of Christophe Nivot on the optimization of the assembly line of a launcher. It comprises several steps from the production of the subassemblies to the final launch. The aim of the thesis is finding the best rates of delivery of the subassemblies, the best choice of architecture (regarding stock capacities) and the best times when to stop and restart the workshops to be able to carry out twelve launches a year according to a predetermined schedule at minimal cost.

8.1.2. Inter-LabEx project between CPU and TRAIL

The topic of the project is "Advanced statistical methods for analysis of multidimensional databases of human brain imaging". The project focuses on the analysis of variability factors driving hemispheric specialization (HS) of the brain, a human specific character, for which a dedicated database has recently been built by GIN (Neurofunctional Imaging Group from L). GIN provides the database and performs genotyping of fifty loci potentially affecting HS. The "Probability and Statistics" group (EPS) from the LabEx CPU works on the methodological developments of statistical tools to analyze these high dimensional data. Interactions between GIN and EPS allow to identify and to characterize the best variables, to perform additional analyses, and to suggest appropriate additional variables, especially in the case of the voxel being implemented. GIN is also involved in the interpretation of the statistical results generated throughout the project.

Dr Solveig Badillo has been hired as Postdoctoral researcher in may 2014 on this project for 20 months.

8.2. National Initiatives

8.2.1. ANR ADAPTEAU

The ANR project ADAPTEAU has been obtained for the period 2012-2016 and will start in january 2012.

ADAPTEAU aims to contribute to the analysis and management of global change impacts and adaptation patterns in River-Estuarine Environments (REEs) by interpreting the scientific challenges associated with climate change in terms of: i) scale mismatches; ii) uncertainty and cognitive biases between social actors; iii) interdisciplinary dialogue on the "adaptation" concept; iv) critical insights on adaptive governance and actions, v) understanding the diversity of professional, social and economic practices vis-à-vis global change. The project aims to build an integrative and interdisciplinary framework involving biophysical and social sciences, as well as stakeholders and civil society partners. The main objective is to identify adaptive strategies able to face the stakes of global change in REEs, on the basis of what we call 'innovative adaptation options'.

We consider the adaptation of Social-Ecological Systems (SES) through the expected variations of the hydrological regimes (floods / low-flow) of the Garonne-Gironde REE—a salient issue in SW France, yet with a high potential for genericity The ADAPTEAU project will be organised as follows:

- Achieve and confront socio-economic and environmental assessments of expected CC impacts on the Garonne-Gironde river-estuarine continuum (task 1);
- Identify the emerging 'innovative adaptation options' endorsed by various social, economic, political actors of the territory (depolderisation, 'room for rivers' strategies, changes in economic activities, agricultural systems or social practices), then test their environmental, economic and social robustness through a selected subset (task 2);
- Scientists, representatives from administrators and civil society collaborate to build adaptation scenarios, and discuss them in pluralistic arenas in order to evaluate their social and economic feasibility, as well as the most appropriate governance modes (task 3).
- Disseminate the adaptation strategies to academics and managers, as well as to the broader society (task 4).

The expected results are the definition and diffusion of new regional-scale reference frameworks for the discussion of adaptation scenarios in REE and other SESs, as well as action guidelines to better address climate change stakes.

The CQFD team work on tasks 1 and 3.

8.2.2. ANR Piece

ANR Piece (2013-2016) of the program *Jeunes chercheuses et jeunes chercheurs* of the French National Agency of Research (ANR), lead by F. Malrieu (Univ. Tours). The Piecewise Deterministic Markov Processes (PDMP) are non-diffusive stochastic processes which naturally appear in many areas of applications as communication networks, neuron activities, biological populations or reliability of complex systems. Their mathematical study has been intensively carried out in the past two decades but many challenging problems remain completely open. This project aims at federating a group of experts with different backgrounds (probability, statistics, analysis, partial derivative equations, modeling) in order to pool everyone's knowledge and create new tools to study PDMPs. The main lines of the project relate to estimation, simulation and asymptotic behaviors (long time, large populations, multi-scale problems) in the various contexts of application.

8.2.3. ANR BNPSI "Bayesian Non Parametric methods for Signal and Image Processing"

Statistical methods have become more and more popular in signal and image processing over the past decades. These methods have been able to tackle various applications such as speech recognition, object tracking, image segmentation or restoration, classification, clustering, etc. We propose here to investigate the use of Bayesian nonparametric methods in statistical signal and image processing. Similarly to Bayesian parametric methods, this set of methods is concerned with the elicitation of prior and computation of posterior distributions, but now on infinite-dimensional parameter spaces. Although these methods have become very popular in statistics and machine learning over the last 15 years, their potential is largely underexploited in signal and image processing. The aim of the overall project, which gathers researchers in applied probabilities, statistics, machine learning and signal and image processing, is to develop a new framework for the statistical signal and image processing communities. Based on results from statistics and machine learning we aim at defining new models, methods and algorithms for statistical signal and image processing. Applications to hyperspectral image analysis, image segmentation, GPS localization, image restoration or space-time tomographic reconstruction will allow various concrete illustrations of the theoretical advances and validation on real data coming from realistic contexts.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

IRSES FP7 MARIE CURIE ACOBSEC: http://cordis.europa.eu/project/rcn/109603_en.html
Over the last decade, Human-Computer Interaction (HCI) has grown and matured as a field. Gone are the days when only a mouse and keyboard could be used to interact with a computer. The most ambitious of such interfaces are Brain-Computer Interaction (BCI) systems. BCI's goal is to allow a person to interact with an artificial system using brain activity. A common approach towards BCI is to analyze, categorize and interpret Electroencephalography (EEG) signals in such a way that they alter the state of a computer. ACoBSEC's objective is to study the development of computer systems for the automatic analysis and classification of mental states of vigilance; i.e., a person's state of alertness. Such a task is relevant to diverse domains, where a person is required to be in a particular state. This problem is not a trivial one. In fact, EEG signals are known to be noisy, irregular and tend to vary from person to person, making the development of general techniques a very difficult scientific endeavor. Our aim is to develop new search and optimization strategies, based on evolutionary computation (EC) and genetic programming (GP) for the automatic induction of efficient and accurate classifiers. EC and GP are search techniques that can reach good solutions in multi-modal, non-differentiable and discontinuous spaces; and such is the case for the problem addressed here. This project combines the expertise of research partners from five converging fields: Classification, Neurosciences, Signal Processing, Evolutionary Computation and Parallel Computing in Europe (France Inria, Portugal INESC-ID,

Spain UNEX) and South America (Mexico ITT, CICESE). The exchange program goals and milestones give a comprehensive strategy for the strengthening of current scientific relations amongst partners, as well as for the construction of long-lasting scientific relationships that produce high quality theoretical and applied research.

8.3.2. Collaborations in European Programs, except FP7 & H2020

Numerical methods for Markov decision processes (2013-2015). This project is funded by the Gobierno de Espana, Direcion General de Investigacion Cientifica y Tecnica (reference number: MTM2012-31393) for three years to support the scientific collaboration between Tomas Prieto-Rumeau, Jonatha Anselmi and François Dufour. This research project is concerned with numerical methods for Markov decision processes (MDPs). Namely, we are interested in approximating numerically the optimal value function and the optimal controls for different classes of constrained and unconstrained MDPs. Our methods are based on combining the linear programming formulation of an MDP with a discretization procedure referred to as quantization of a probability distribution, underlying the random transitions of the dynamic system. We are concerned with optimality criteria such as the total expected cost criterion (for finite horizon problems) and, on the other hand, the total expected discounted cost and the average cost optimality criteria (for infinite horizon problems).

8.4. International Initiatives

8.4.1. Participation In other International Programs

Control of Dynamic Systems Subject to Stochastic Jumps USP-COFECUB grant (2013-2014). This collaboration is also supported by the **Associate Team Inria: CDSS (2014-2016)**. The main goals of this joint cooperation is to study the control of dynamic systems subject to stochastic jumps. Three topics are considered. In the first topic we study the control problem of piecewise-deterministic Markov processes (PDMP's) considering constraints. In this case the main goal is to obtain a theoretical formulation for the equivalence between the original optimal control problem of PDMP's with constrains and an infinite dimensional static linear optimization problem over a space of occupation measures of the controlled process. F. Dufour at Inria and O. Costa in USP carry out this topic. In the second topic we focus on numerical methods for solving control and filtering problems related to Markov jump linear systems (MJLS). This project allows a first cooperation between B. de Saporta and E. Costa. The third research subject is focused on quantum control by using Lyapunov-like stochastic methods and P. Rouchon and P. Pereira da Silva conduct it.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Tomas Prieto-Rumeau (Department of Statistics and Operations Research, UNED, Madrid, Spain) visited the team during two weeks in 2014. The main subject of the collaboration is the approximation of Markov Decision Processes.

Oswaldo Costa (Escola Politécnica da Universidade de São Paulo, Brazil) collaborate with the team on the theoretical aspects of continuous control of piecewise-deterministic Markov processes. He visited the team during two weeks in 2014 supported by the USP-COFECUB grant and the Associate Team Inria: CDSS.

Alexey Piunovskiy (University of Liverpool) visited the team during six weeks in 2014. The main subject of the collaboration is the linear programming approach for Markov Decision Processes. This research was supported by the Clusters d'excellence CPU.

Giuliano Casale (Imperial College), invited from December 10th to December 12nd 2014 to continue his collaboration with Jonatha Anselmi.

Leonardo Trujillo (ITT Tijuana, Mexico) visited the team for one month in october 2014 to continue his collaboration with Pierrick Legrand.

8.5.2. Visits to International Teams

Francois Dufour visited Alexey Piunovskiy (University of Liverpool) to continue his work about the linear programming approach for Markov Decision Processes.

Pierrick Legrand visited Leonardo Trujillo (ITT Tijuana, Mexico) in nov 2014.

CRYPT Team

5. Partnerships and Cooperations

5.1. National Initiatives

5.1.1. MOST's 973 Grant

Grant 2013CB834205

PIs Phong Nguyen and Xiaoyun Wang

Duration 2013-17

MOST is China's Ministry of Science and Technology.

5.1.2. NSFC Grant

Grant NSFC Key Project 61133013

PIs Phong Nguyen and Xiaoyun Wang

Duration 2013-16

NSFC is the National Natural Science Foundation of China.

5.2. European Initiatives

5.2.1. Collaborations with Major European Organizations

CWI: Cryptography team of Ronald Cramer (Netherlands) organisme 1, labo 1 (pays 1) This team is officially a partner of LIAMA's CRYPT international project.

5.3. International Initiatives

5.3.1. Inria International Labs

- CRYPT is an international project from LIAMA in China, hosted by Tsinghua University in Beijing. It is a joint project between Inria, Tsinghua University, CAS Academy of Mathematics and System Sciences, and CWI (Netherlands).
- Phong Nguyen is the European director of LIAMA.

5.3.2. Inria International Partners

5.3.2.1. Informal International Partners

- Univ. Oklahoma, USA
- Univ. Wisconsin, USA

5.4. International Research Visitors

5.4.1. Visits of International Scientists

Cheng Qi (Univ. Oklahoma, USA)

Mehdi Tibouchi (NTT, Japan)

Guangwu Xu (Univ. Wisconsin, USA)

CTRL-A Exploratory Action

8. Partnerships and Cooperations

8.1. Regional Initiatives

The Labex Persyval-lab is a large regional initiative, supported by ANR, where we are contributing through two projects:

8.1.1. Projet Exploratoire STAARS

This project, defined for one and a half year, grouped members from Inria, LIG and Gipsa-lab, and concerned the general topic of control for computing, with a special emphasis on relating stochastic models with logical discrete control. It enabled us to organize two international workshops in Grenoble: https://persyval-lab.org/en/exploratory-project/staars

8.1.2. Equipe-action HPES

This project groups members from Inria, LIG, Gipsa-lab, TIMA and Gipsa-lab, around the topic of High-Performance Computing benefitting from technologies originally developed for Embedded Systems. Ctrl-A is directly involved in the co-advising of the PhD of Naweiluo Zhou, with J.F. Méhaut (LIG), on the topic of autonomic management of software transactional memory mechanisms: https://persyval-lab.org/en/sites/hpes

8.2. National Initiatives

8.2.1. ANR

Ctrl-Green[0] is an ANR project on Autonomic energy management for virtualized datacenter. The Coordinator is UJF, and the duration: 2011-2014. Others Partners are: Inria Rennes, IRIT, Eolas.

In Ctrl-A, it is funding the PhD thesis of Soguy Gueye, defended in december 2014; before that it funded the post-doc of Nicolas Berthier in 2012. In both cases, co-advising was done with Noeël de Palma (LIG).

8.2.2. Informal National Partners

We have contacts with colleagues in France, with whom we are submitting collaboration projects, co-organizing events and workshops, etc. They feature : Avalon Inria team in Lyon (F. Desprez), LIP6 (J. Malenfant), Scales Inria team in Sophia-Antipolis (L. Henrio), LIRRM in Montpellier (A. Gamatié, K. Godary, D. Simon), IRISA/Inria Rennes (J. Buisson, J.L. Pazat, ...), Telecom Paris-Tech (A. Diaconescu, E. Najm), LAAS (Thierry Monteil).

8.2.3. Informal National Industrial Partners

We have ongoing discussions with several industrial actors in our application domains, some of them in the framework of cooperation contracts, other more informal: Eolas/Business decision (G. Dulac), ST Microelectronics (V. Bertin), Schneider Electric (C. El-Kaed, P. Nappey, M. Pitel), Orange labs (J. Pulou, G. Privat).

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

We have ongoing relations with international colleagues in the emerging community on our topic of control for computing e.g., in Sweden at Lund (K.E. Arzen, M. Maggio) and Linnaeus Universities (D. Weyns, N. Khakpour), in the Netherlands at CWI/leiden University (F. Arbab), in China at Heifei University (Xin An), in Italy at University Milano (C. Ghezzi, A. Leva), in the USA at Ann Arbor University (S. Lafortune).

[0] http://www.en.ctrlgreen.org/

8.3.2. Participation In other International Programs

Eric Rutten is a member of the IFAC Technical Committee 1.3 on Discrete Event and Hybrid Systems, for the 2011-2014 triennium, and for the 2014-2017 triennum http://tc.ifac-control.org/1/3 ; and of the IEEE Control Systems Society Discrete Event Systems Technical Committee http://discrete-event-systems.ieeecss.org.

DAHU Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

Acronym: PRODAQ

Title: Proof systems for Data Queries

Coordinator: Sylvain Schmitz

Duration: January 2015 – September 2019

Abstract: The project aims at developing proof systems for data logics. It is at the interface between several research communities in database theory, infinite-state system verification and proof theory. The main thrust behind the project is the investigation of proof-theoretic tools for data logic, using in particular insights from substructural logics, and using counter systems as a means to obtain algorithms and complexity results.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Declared Inria International Partners

Victor Vianu, UC San Diego, USA. Chaire Inria depuis 2013.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Thomas Schwentick

  Subject: Automata methods for data processing

  Institution: Dortmund University, Dortmund, Germany.
- Sławomir Lasota

  Subject: Reasoning with data using sets with atoms

  Institution: Warsaw University, Warsaw, Poland.

DANTE Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. IXXI

8.1.1.1. Linguistic usage and social networks: agent based models and direct observation of verbal interactions. (ULMMA)
Participants: Éric Fleury, Márton Karsai.

8.1.1.2. A sociolinguistics of Twitter : social links and linguistics variation
Participants: Éric Fleury, Márton Karsai.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. Equipex FIT (Futur Internet of Things)
Participant: Éric Fleury.

FIT is one of 52 winning projects in the Equipex research grant program. It will set up a competitive and innovative experimental facility that brings France to the forefront of Future Internet research. FIT benefits from 5.8€¨ million grant from the French government Running from 22.02.11 – 31.12.2019. The main ambition is to create a first-class facility to promote experimentally driven research and to facilitate the emergence of the Internet of the future.

8.2.1.2. ANR INFRA DISCO (DIstributed SDN COntrollers for rich and elastic network services)
Participants: Thomas Begin [correspondant], Anthony Busson, Isabelle Guérin Lassous.

The DANTE team will explore the way SDN (Software Designed Network) can change network monitoring, control, urbanisation and abstract description of network resources for the optimisation of services. More specifically, the team will address the issues regarding the positioning of SDN controllers within the network, and the implementation of an admission control that can manage IP traffic prioritization.

8.2.1.3. ANR REFLEXION (REsilient and FLEXible Infrastructure for Open Networking)
Participants: Thomas Begin [correspondant], Anthony Busson, Isabelle Guérin Lassous.

The DANTE team will work on the monitoring of NFV proposing passive and light-weight metrology tools. They will then investigate the modeling of low-level resources consumptions and finally propose methods to dynamically allocate these resources taking into account performance constraints.

8.2.1.4. ANR CONTINT CODDDE
Participants: Éric Fleury [correspondant], Christophe Crespelle, Márton Karsai.

It is a collaborative project between the ComplexNetwork team at LIP6/UPMC; Linkfluence and Inria Dante. The CODDDE project aims at studying critical research issues in the field of real-world complex networks study:

- How do these networks evolve over time?
- How does information spread on these networks?
- How can we detect and predict anomalies in these networks?

In order to answer these questions, an essential feature of complex networks will be exploited: the existence of a community structure among nodes of these networks. Complex networks are indeed composed of densely connected groups of that are loosely connected between themselves.

The CODDE project will therefore propose new community detection algorithms to reflect complex networks evolution, in particular with regards to diffusion phenomena and anomaly detection.

These algorithms and methodology will be applied and validated on a real-world online social network consisting of more than 10 000 blogs and French media collected since 2009 on a daily basis (the dataset comprises all published articles and the links between these articles).

8.2.1.5. ANR RESCUE

Participants: Thomas Begin, Isabelle Guérin Lassous [correspondant].

In the RESCUE project, we investigate both the underlying mechanisms and the deployment of a substitution network composed of a fleet of dirigible wireless mobile routers. Unlike many projects and other scientific works that consider mobility as a drawback, in RESCUE we use the controlled mobility of the substitution network to help the base network reduce contention or to create an alternative network in case of failure. The advantages of an on-the-fly substitution network are manifold: Reusability and cost reduction; Deployability; Adaptability.

The RESCUE project addresses both the theoretical and the practical aspects of the deployment of a substitution network. From a theoretical point of view, we will propose a two-tiered architecture including the base network and the substitution network. This architecture will describe the deployment procedures of the mobile routing devices, the communication stack, the protocols, and the services. The design of this architecture will take into account some constraints such as quality of service and energy consumption (since mobile devices are autonomous), as we want the substitution network to provide more than a best effort service. From a practical point of view, we will provide a proof of concept, the architecture linked to this concept, and the necessary tools (*e.g.*, traffic monitoring, protocols) to validate the concept and mechanisms of on-the-fly substitution networks. At last but not least, we will validate the proposed system both in laboratory testbeds and in a real-usage scenario.

8.2.1.6. ANR FETUSES

Participant: Paulo Gonçalves.

The goals of this ANR project consist in the development of statistical signal processing tools dedicated to per partum fetal heat rate characterization and acidosis detection, and are organized as follows: *(i)* construction of a large dataset of per partum fetal heart rate recordings, which is well documented and of significant clinical value; *(ii)* Developments of adaptive (*e.g.* data driven) algorithms to separate data into trend (deceleration induced by contractions) and fluctuation (cardiac variability) components; *(iii)* Developments of algorithms to characterize the non stationary and multifractal properties of per partum fetal heart rate ; *(iv)* Acidosis detection and assessment using the large datasets; *(v)* Algorithm implementation for performing tests in real clinical situations. ANR is a joint project between DANTE, the Physics Lab of ENS de Lyon (SiSyPhe team) and the *Hôpital Femme-Mère-Enfant* of Bron (Lyon). Fetuses started in january 2012 and will end in june 2015.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

University of Namur: Department of Mathematics/Naxys (Belgium). Collaboration with Renaud Lambiotte on dynamical processes on dynamical networks and communities detections.

Aalto University: Department of Biomedical Engineering and Computational Science (Finland). Collaboration with Jari Saramaki on modeling temporal networks and community like modular structure

Central European University (Hungary). Collaboration with János Kertész on modeling complex contagion phenomena.

ISI Foundation (Italy). Collaboration with Laetitia Gauvin on multiplex networks and transportation systems

UPC (Spain): Department of Telematic Engineering. Collaboration with Monica Aguilar Igartua and Luis J. de la Cruz Llopis on vehicular and community networks.

University of Bergen: Institute of Computer Science (Norway). Collaboration with Pinar Heggernes on graph editing problems for analysis and modeling of complex networks.

Ecole Polytechnique Fédérale de Lausanne (Switzerland). Collaboration with Pierre Vandergheynst on Graph Signal Processing

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

- Taiwan, ACADEMIA SINICA & IIIS. Signature of a MoU in the framework of IoT-LAB.

8.4.2. Participation in other International Programs

8.4.2.1. STIC AMSUD

- Understanding and predicting human demanded COntent and mObiLity (UCOOL). To define solutions for the identification and modeling of correlations between the user mobility – describing changes in the user positioning and the current environment he/she is in – and the traffic demand he/she generates. Partners are: LNNC Brasil, Facultad de Ingenieri´a, Universidad de Buenos Aires (FI/UBA), Universidad Tecnica Federico Santa Maria (USM) Chile,

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Invited professors

Ha Duong PHAN (invited professor of ENS Lyon and UCBL)

Date: March 2014 - April 2014

Institution: Institute of Mathematics of the Vietnam Academy of Science and Technology (Vietnam).

Alexandre BRANDWAJN (Invited Inria Researcher Program)

Date: September 29, 2014 - October 29, 2014

Institution: University of California, Santa Cruz (USA).

8.5.1.2. Invited researchers

Laetita Gauvin

Date: one week each month, February 2014 - December 2014

Institution: ISI Foundation (Italy)

Tommaso Panini (PhD Student)

Date: from Oct 2014 until Jan 2014

Institution: Collegio Carlo Alberto (Italy)

Andres Marcelo Vazquez Rodasi (PhD Student)

Date: from un 2014 until Sep 2014

Institution: UPC (Spain)

8.5.1.3. Internships

Karathanos Christos

Date: Apr 2014 - Jul 2014

Institution: Université Nationale Capodistrienne d'Athènes (Greece)

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

- Thomas Begin, 2 weeks in Spring 2014, University of California Santa Cruz, Jack Baskin School of Engineering, USA.
- Christophe Crespelle, 1 week in December 2014, Institute of Computer Science of the University of Bergen, Norway.
- Christophe Crespelle is in CNRS delegation for 1 year (2014-2015) at the Institute of Mathematics, Vietnam Academy of Science and Technology, Hanoï.
- Christophe Crespelle, 2 months in June-July 2014, Vietnam Institute for Advanced Study in Mathematics (VIASM), Hanoï.
- Christophe Crespelle, 2 months in January-February 2014, Institute of Mathematics, Vietnam Academy of Science and Technology, Hanoï.
- Márton Karsai, 2 times 2 weeks in March and July 2014, Department of Biomedical Engineering and Computational Science, Aalto University, Finland
- Márton Karsai, 1 week June 2014, ISI Foundation Torino, Italy
- Márton Karsai, 1 week December 2014, Central European University, Hungary

DEDUCTEAM Exploratory Action

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Locali

We are coordinators of the ANR-NFSC contract Locali with the Chinese Academy of Sciences.

7.1.2. ANR BWare

We are members of the ANR *BWare*, which started on September 2012 (David Delahaye is the national leader of this project). The aim of this project is to provide a mechanized framework to support the automated verification of proof obligations coming from the development of industrial applications using the *B* method. The methodology used in this project consists in building a generic platform of verification relying on different theorem provers, such as first order provers and SMT solvers. We are in particular involved in the introduction of Deduction modulo in the first order theorem provers of the project, i.e. *Zenon* and *iProver*, as well as in the backend for these provers with the use of *Dedukti*.

The ANR mid-term review of the project took place in October 2014 and the members of the project received very positive feedbacks from the reviewers. A more detailed report is expected from the reviewers in early 2015.

7.1.3. ANR Tarmac

We are members of the ANR Tarmac on models of computation, coordinated by Pierre Valarcher.

7.2. International Research Visitors

7.2.1. Visits to International Teams

7.2.1.1. Research stays abroad

Olivier Hermant was an invited researcher at the Natal University (UFRN, Brazil) in December 2014.

DEFI Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- H. Haddar is the DEFI coordinator of the ANR: Modelization and numerical simulation of wave propagation in metamaterials (METAMATH), program MN, 2011-2015. This is a joint ANR with POEMS, Inria Scalay Ile de France project team (Coordinator, S. Fliss), DMIA, Département de Mathématiques de l'ISAE and IMATH, Laboratoire de Mathématiques de l'Université de Toulon. https://www.rocq.inria.fr/poems/metamath
- J.R. Li is the coordinator of the Inria partner of the project "Computational Imaging of the Aging Cerebral Microvasculature", funded by ANR Program "US-French Collaboration". French Partners (Coordinating partner CEA Neurospin): CEA Neurospin (Coordinator Luisa Ciobanu), Inria Saclay (Coordinator Jing-Rebecca Li). US Partner: Univ of Illinois, bioengineering department (Coordinator Brad Sutton). Duration: Sept 2013- Sept 2016.

8.2. European Initiatives

8.2.1. Collaborations with Major European Organizations

Partner 1: University of Bremen, Department of Math. (Germany)

Joint PhD advising of T. Rienmuller, partly funded by French-German university. Correspondant: Armin Lechleiter.

Partner 2: University of Goettingen, Department of Math. (Germany)

Development of conformal mapping method to electrostatic inverse problems. Correspondant: Rainer Kress.

Partner 3: University of Genova, Department of Math. (Italy)

Development of qualitative methods in inverse scattering problems. Correspondant: Michele Piana.

8.3. International Initiatives

8.3.1. Inria International Labs

- H. Haddar is member and the Inria correspondant of EPIC, an Inria team of LIRIMA Afrique.

8.3.2. Inria International Partners

8.3.2.1. Declared Inria International Partners

Title: Qualitative Approaches to Scattering and Imaging (QUASI)

International Partner (Institution - Laboratory - Researcher):

University of Delaware, Department of Mathematical Sciences (USA)

Duration: since 2013

Abstract: We concentrate on the use of qualitative methods in acoustic and electromagnetic inverse scattering theory with applications to nondestructive evaluation of materials and medical imaging. In particular, we would like to address theoretical and numerical reconstruction techniques to solve the inverse scattering problems using either time harmonic or time dependent measurements of the scattered field. The main goal of research in this field is to not only detect but also identify geometric and physical properties of unknown objects in real time.

8.3.3. Participation In other International Programs

- Olivier Pantz is in charge of the french side of the PHC (Hubert Curien Project) *Sur l'étude de quelques problèmes d'équations aux dérivées partielles issus de la physique* (with H. Zorgati of the University of Tunis in charge for the Tunisian side).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

We had short visits (one week) of the following collaborators

- Fioralba Cakoni
- David Colton
- Drossos Gintides
- Ozgur Ozdemir
- Rainer Kress
- Armin Lechleiter
- Nicolas Chaulet

8.4.1.1. Internships

- Shixu Meng
- Jacob Rezac
- Irena de Teresa-Trueba
- Thi Minh Phuong Nguyen
- Afa Saaidi

8.4.1.2. Research stays abroad

- H. Haddar spent one month research visit to the University of Sfax in October 2014.

DEMAR Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. AOI PARK DEMAR

Participants: Christine Azevedo Coste, Benoît Sijobert.

Appel d'Offre Interne (AOI) CGS Merri (CHU Montpellier). Development and evaluation of Freezing detection system in parkinson disease.

7.1.2. LABEX NUMEV

Participants: Christine Azevedo Coste, Christian Geny, Benjamin Gilles.

A M2 internship will be funded by the NUMEV Labex on the dynamic cartography of tremor using muscular echography.

7.2. National Initiatives

7.2.1. DEMAR / MXM Innovation Lab "SoftStim" project

Participants: David Guiraud, David Andreu.

Inria Innovation-Lab "SoftStim" project (2011-2014). 1 engineer (3 y.), 20keuros.

The aim of this Inria national initiative is to favor the scientific collaboration and technological transfer of the innovation between DEMAR and MXM.

Innovation Lab "SoftStim" has ended in december 2014. The aim of this project was to prototype concepts conjointly patented like stimulation unit 's embedded sequencer and processor (new set of instructions), and implantable FES controller with its dedicated software environment.

The industrial transfer has been achieved, notably through the design and realization of prototypes of neural stimulators.

7.2.2. BCI-LIFT: an Inria Project-Lab

Participants: Mitsuhiro Hayashibe BCI-LIFT is a large-scale 4-year research initiative (officially under peer-review evaluation) whose aim is to reach a next generation of non-invasive Brain-Computer Interfaces (BCI), more specifically BCI that are easier to appropriate, more efficient, and suit a larger number of people.

7.2.3. Cosinus ANR - SoHuSim

Participants: Benjamin Gilles, Mitsuhiro Hayashibe, David Guiraud, Maxime Tournier.

Project SoHuSim on modeling muscle tissue during contraction in 3D movements using SOFA software and functional modeling of the organs. 150 kE. Partners: Inria Evasion, Tecnalia, HPC, CHU Montpellier (Oct. 2010 - Oct. 2014).

7.2.4. ADT SENSAS - SENSBIO

Participants: Christine Azevedo-Coste, David Andreu, Benoît Sijobert.

SENSAS is an Inria ADT (Actions de Développement Technologique), implying several Inria project teams on the âSENSor network ApplicationSâ theme. SENSAS aims to propose applications based on wireless sensor and actuator network nodes provided from the work done around senslab and senstools preliminary projects. SENSAS is organized around the following work packages :

- SensRob : Robotics applications
- SensBio : Bio-Logging applications
- SensMGT : Wireless sensor/actuator network management/configuration applications
- SensBox : Wireless sensor/actuator network simulation applications and tools

Our team is mainly implied in the SensBio work package, in particular for the following applications: Spinal Cord Injured Patients FES-Assisted Sit to Stand, Post-Stroke Hemiplegic Patient FES-correction of drop foot, Gait analysis of parkinson freezing and Motion analysis of longterm race data.

7.2.5. INTENSE project

Participants: David Guiraud, Olivier Rossel, Melissa Dali, Christine Azevedo-Coste, David Andreu, Jérémy Salles, Guy Cathébras, Fabien Soulier.

INTENSE (Initiative Nationale Technologique d'Envergure pour une NeuroStimulation Evoluée) is a PIA-PSPC Project (Programme Investissement d'Avenir, Projets RD Structurants des Pôles de Compétitivité) [2012-2018]. The aim of this project is to develop new implantable devices, based on neurostimulation, for heart failure.

Partners of this project are: DEMAR, SORIN CRM, MXM-Obélia, 3D plus, CEA-Leti, INRA Rennes, INSERM Rennes, HEGP, CHU Rennes.

7.2.6. INSEP FFS

Participants: Christine Azevedo Coste, Benoît Sijobert, Roger Pissard-Gibollet.

INSEP (Institut National du Sport, de l'Expertise et de la Performance) supports the project "Impact of the gaze direction on the skier trajectory" leaded by the Fédération Française de Ski (FFS).

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

Program: FP7

Project acronym: EPIONE

Project title: Natural sensory feedback for phantom limb pain modulation and therapy

Duration: 2013-2017

Coordinator: AAU (Aalborg, Denmark)

Other partners: École polytechnique fédérale de Lausanne (EPFL), IUPUI (Indianapolis, USA), Lund University (LUNDS UNIVERSITET), MXM (Vallauris, France), Novosense AB (NS), IMTEK (Freiburg, Germany), UAB (Barcelona, Spain), Aalborg Hospital, Universita' Cattolica del Sacro Cuore (UCSC), Centre hospitalier Universitaire Vaudois (CHUV)

Abstract: http://project-epione.eu/
Participants: David Guiraud, David Andreu, Thomas Guiho, Arthur Hiairrassarry, Christine Azevedo Coste, Pawel Maciejasz.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. NEUROPHYS4NEUROREHAB

Title: Development of neurophysiological test setup for customizing and monitoring patient-specific non-invasive electrical stimulation-facilitated neurorehabilitation.

International Partner (Institution - Laboratory - Researcher):

IITH (INDE)

Duration: 2014 - 2016

See also: https://team.inria.fr/nphys4nrehab/

Stroke presents with heterogeneous patient-specific impairments in motor, sensory, tone, visual, perceptual, cognition, aphasia, apraxia, coordination, and equilibrium where the functional limitations following stroke are varied, including gait dysfunction, fall risk, limited activities of daily living, difficulties in swallowing, reduced upper extremity function, altered communication, besides others. These heterogeneous patient-specific impairments make planning of the neurorehabilitation therapy challenging. Here, it may be important to stratify the stroke survivors for restorative neurorehabilitation based on the prognosis and the ability of the stroke survivor to undergo therapy depending on their cardiovascular and neuromuscular capacity besides psychological factors such as motivation where the therapy needs to be tailored to individual health condition. The WHO International Classification of Functioning (ICF) model recommends intervention at multiple levels (e.g., impairment, activity, participation) where environment and personal factors can play an important role in resource-limited India. In fact, deconditioned chronic stroke survivor will need to recondition their cardiovascular endurance, metabolic fitness, and muscle conditions with a gradual increase in the intensity (number of hours per day) and frequency (number of days per week) of therapy, providing a higher level as they improve their function. Towards that overarching goal in a low-resource setting, we propose development of neurophysiological screening and monitoring tools using low-cost sensors.

7.4.2. Inria International Partners

Technology artificial and natural control assisted by electrical stimulation in functional transfers for subjects with disabilities after spinal cord injury
Inria principal investigator: Christine Azevedo Coste
International partner: Faculty of Ceilandia/ University of Brasilia - Emerson Fachin Martins, leader of the NTAAI-team. Nucleus of Assistive Technology, Accessibility and Innovation.
CAPES, Scholarship: BEX 3160/13-0 (Montpellier/France - December 2013 - February 2015)
CAPES, Appel: 88881.068134/2014-01 (2015 - 2017)

Around 90 million people acquired disabilities from Spinal Cord Injury (SCI) worldwide. The options available to stand up individuals with SCI without orthotics devices do not provide a functional upright position. The wheelchairs and seats to verticalize do not ensure an active participation based in a technology-human interaction. Moreover, the Verticalization devices are rarely used outside. The present international collaboration initiates a series of collaborations between the DEMAR-team and the NTAAI-team based on academic mobility of students and researchers. The general aim of this project is investigated technologies based in the functional electrical stimulation to promote functional transfers of the individuals with disabilities after SCI.

7.4.2.1. Informal International Partners

Katja Mombaur, Heidelberg University (Germany). Research Group Optimization in Robotics and Biomechanics, IWR Robotics Lab.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

Emerson Fachin Martins. Brazilian program: Science without borders (Ciências sem fronteiras) CAPES, Scholarship: BEX 3160/13-0 (Montpellier/France - December 2013 - February 2015)

7.5.1.1. Internships

Mitsuhiro Hayashibe supervised Saugat Bhattacharyya on "Study on Probabilistic nature of Motor Imagery Electroencephalography signals for control", PhD internship, Svaagata.eu: experience Europe as an Indian Erasmus Mundus, Jadavpur University, Kolkata, India, from Oct. 2014 to Jun. 2015.
Mitsuhiro Hayashibe supervised Roberto Baptista on "Framework for Automatic Assessment of Human Motion for Rehabilitation", PhD internship, bourse d'etudes du Gouvernement Bresilien, Fondation Capes, Universidade de Brasilia (UnB), Brasil, from May 2014 to Apr. 2015.

7.5.2. Visits to International Teams

Mitsuhiro Hayashibe was Visiting Researcher at RIKEN BSI-TOYOYA research institute and worked on "Tacit Synergetic Motor Learning for rehabilitation" (Jul.-Aug. 2014).
M. Hayashibe was invited to talk at International Workshop on Human Assistive Systems Based on Human Modeling in Tokyo, on December 14, 2014, organized by Prof. Toshiaki Tsuji, Saitama University, Prof. Yuichi Kurita, Hiroshima University

DIANA Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Plate-forme Télécom (PFT) (2011-2014) is a DGCIS funded project, in the context of the competitivity cluster SCS, that aims at providing to PACA region industrials wishing to develop or validate new products related to future mobile networks and services and M2M application, a networking infrastructure and tools helpful for development, test and validation of those products. Other partners : 3Roam, Audilog Groupe Ericsson, Ericsson, Eurecom, Inria, iQsim, MobiSmart, Newsteo, OneAccess, Orange Labs, Pôle SCS, ST Ericsson, Telecom Valley. Our contribution is centred around providing a test methodology and tools for wireless networks experimentation.

7.2. National Initiatives

7.2.1. ANR

- **ANR FIT** (2011-2018): FIT (Future Internet of Things) aims at developing an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet. FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's "Équipements d'Excellence" (Equipex) research grant programme. The project will benefit from a 5.8 million euro grant from the French government. Other partners are UPMC, IT, Strasbourg University and CNRS. See also http://fit-equipex.fr/.
- **ANR DISCO** (2013-2016): DISCO (DIstributed SDN COntrollers for rich and elastic network services) aims at exploring the way how Software Defined Networking changes network monitoring, control, urbanisation and abstract description of network resources for the optimisation of services. The project works throughout experimentations and application use cases on the next generation of Software-Defined Networking solutions for large and critical distributed systems. The project will study the distribution of the current SDN control plane and the optimization of network operations that the integrated system view of cloud computing-based architectures allows.
- **ANR REFLEXION** (2015-2016): REFLEXION (REsilient and FLEXible Infrastructure for Open Networking) research project will study the robustness and scalability of the current SDN architectures and the flexibility leveraged by SDN for provisioning resources and virtualized network functions (VNF). The project will address four main scientific objectives: (1) Fault and disruption management for virtualized services, (2) Robust and scalable control plane for next generation SDN, (3) Dynamic performance management of low level resources in SDN/NFV environments and (4) Distribution and optimization of virtual network functions in SDN environments. Our contribution in this project will be focused on fault and disruption management for virtualized services.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

Program: FP7 FIRE programme

Project acronym:

Project title: Fed4Fire

Duration: mois October 2012 - October 2016

Coordinator: iMinds (Belgium)

Other partners: 17 european partners including iMinds (Belgium), IT Innovation (UK), UPMC (Fr), Fraunhofer (Germany), TUB (Germany), UEDIN (UK), NICTA (Australia), etc.

Web site: http://www.fed4fire.eu/

Abstract: Fed4FIRE will deliver open and easily accessible facilities to the FIRE experimentation communities, which focus on fixed and wireless infrastructures, services and applications, and combinations thereof. The project will develop a demand-driven common federation framework, based on an open architecture and specification. It will be widely adopted by facilities and promoted internationally. This framework will provide simple, efficient, and cost effective experimental processes built around experimenters' and facility owners' requirements. Insight into technical and socio-economic metrics, and how the introduction of new technologies into Future Internet facilities influences them, will be provided by harmonized and comprehensive measurement techniques. Tools and services supporting dynamic federated identities, access control, and SLA management will increase the trustworthiness of the federation and its facilities. A FIRE portal will offer brokering, user access management and measurements. Professional technical staff will offer first-line and second-line support to make the federation simple to use. The project will use open calls to support innovative experiments from academia and industry and to adapt additional experimentation facilities for compliance with Fed4FIRE specifications. A federation authority will be established to approve facilities and to promote desirable operational policies that simplify federation. A Federation Standardization Task Force will prepare for sustainable standardization beyond the end of the project. The adoption of the Fed4FIRE common federation framework by the FIRE facilities, the widespread usage by both academic and industrial experimenters, and the strong links with other national and international initiatives such as the FI-PPP, will pave the way to sustainability towards Horizon 2020.

7.3.2. EIT KIC funded activities

Program: **FNS Future Networking Solutions Action Line**

Project acronym: **NFMD**

Project title: Networks for Future Media Distribution (14082)

Duration: January 2014 to December 2014

Coordinator: Acreo, Sweden

Other partners: VTT (Finland), Ericsson, Lund University, SICS (Sweden).

Abstract: The EIT ICT Labs' Networks for Future Media Distribution (NFMD) activity 14082 has as a specific innovation object set out in the application: "Information centric networking is a novel approach of distributing content based on information rather than traditional host routing. The impact foreseen is novel content distribution networks. This is high risk but gives potentially very high impacts. Solutions for media distribution, based on caching in the network and with advanced tools for quality of experience monitoring, as well as optimization for user demand content patterns as monitored in live services, will be considered." The expected outcomes envisioned also in the application were seen over the total length of the project of 2-3 years and would give:

- Building blocks for high performance media service distribution at low cost
- Optimized caching strategies
- Information centric networking solutions
- Quality of Experience tools
- Prototypes, standardization and open source
- Greater mobility, better performance of media services and reduced cost
- Sharing of experience; increased cooperation; new or extended partnerships

Program: **FNS Future Networking Solutions Action Line**

Project acronym: **SDN**

Project title: Software Defined Networking (13153)

Duration: January 2014 to December 2014

Coordinator: Aalto University, Finland

Other partners: Helsinky University (Finland), Thales (France), Deutsche Telecom, Fraunhofer, TU München, TU Berlin (Germany).

Abstract: SDN still requires improvements to be used in mobile networks considering aspects such as security, resilience/robustness and efficient usage of resources in the mobile access. This activity addresses the design of security in mobile access networks (Distributed FW for attack detection and mitigation), Efficient resource usage in mobile access networks (redistribution of traffic based on congestion, mobility patterns) and Resilient control-plane (supporting high speed carrier mobile networks). The expected outcomes are the following:

- Security outcome: Dynamically allocate resources to countermeasure the cyber attack. Isolation of the part of the network under attack so rest is not compromised.
- Efficient resource usage in mobile access networks outcome: Optimal redirection of flows following optimized caching policy and pattern based mobility.
- Resilient control-plane outcome: Understand QoS and make that information available in routing to ensure resiliency.

7.4. International Initiatives

7.4.1. Inria International Labs

We collaborate with Javier Bustos from Inria Chile and his group on the measurements of users' quality of experience and its interpretation in terms of measurements carried on within the devices of the end-users. This collaboration comes to extend Adkintun Mobile with experience-level measurements, and to leverage the results to obtain for the analysis and calibration of users' experience new models and to develop network troubleshooting techniques in case of service degradation. This collaboration fits within our project ACQUA on predicting quality of user experience at Internet access. In 2014, we started integrating the feedback of users revealing their experience into Adkintun Mobile, and the work is currently focusing on obtaining the targeted measurements.

7.4.2. Inria Associate Teams

7.4.2.1. SIMULBED

Title: SIMULBED: Large-Scale Simulation Testbed for Realistic Evaluation of Network Protocols and Architectures

International Partner (Institution - Laboratory - Researcher):

NICT and University of Tokyo (Japan), Hitoshi Asaeda and Yuji Sekiya.

Duration: 2012 - 2014

Participants from Inria in 2014: Walid Dabbous, Emilio Mancini, Alina Quereilhac, Hardik Soni, Julien Tribino and Thierry Turletti.

Participants from NICT in 2014: Hitoshi Asaeda, Ruidong Li and Kazuhisa Matsuzono.

Participants from Univeristy of Tokyo in 2014: Yuji Sekiya and Hajime Tazaki.

Web site: http://planete.inria.fr/Simulbed/

Abstract: Simulators and experimental testbeds are two different approaches for the evaluation of network protocols and they provide a varying degree of repeatability, scalability, instrumentation and realism. Network simulators allow fine grained control of experimentation parameters, easy instrumentation and good scalability, but they usually lack realism. However, there is a growing need to conduct realistic experiments involving complex cross-layer interactions between many layers of the communication stack and this has led network researchers to evaluate network protocols on experimental testbeds.

The use of both simulators and testbeds to conduct experiments grants a better insight on the behavior of the evaluated network protocols and applications. In this project, we focus on the design of SIMULBED, an experimentation platform that aims at providing the best of both worlds. Our project builds on the following state-of-the-art tools and platforms: the open source ns-3 network simulator and the PlanetLab testbed. ns-3 is the first network simulator that includes a mechanism to execute directly within the simulator existing real-world Linux protocol implementations and applications. Furthermore, it can be used as a real-time emulator for mixed (simulation-experimentation) network scenarios. PlanetLab is the well-known international experimental testbed that supports the development and the evaluation of new network services. It is composed of nodes connected to the Internet across the world, and uses container-based virtualization to allow multiple experiments running independently on the same node while sharing its resources.

The overall objective of the project is to make available to networking research community, the SIMULBED platform that will: (1) allow to conduct easily mixed simulation-experimentation evaluation of networking protocols and (2) scale up the size of the PlanetLab experimental testbed, while maintaining a high degree of realism and increasing controllability and reproducibility. We will use the NEPI unified programming environment recently developed in the Planète project-team to help in simplifying the configuration, deployment and run of network scenarios on the platform. See the 2014 Update on the Simulbed web site.

7.4.2.2. Community

Title: COMMUNITY: Message delivery in heterogeneous networks

International Partner (Institution - Laboratory - Researcher):

University of California Santa Cruz (United States) - School of Engineering - Katia Obraczka

Duration: 2009 - 2014

Participants from Inria in 2014: Thierry Turletti, Chadi Barakat, Damien Saucez, Xuan Nam Nguyen, Hardik Soni and Bruno Nunes.

Participants from USCS in 2014: Katia Obraczka and Mateus Santos, PhD Student, USP (research intern at UCSC in 2014).

Participants from USP in 2014: Cintia Borges Margi.

Web site: http://inrg.cse.ucsc.edu/community/

Abstract: This Inria - UC Santa Cruz Team investigates a number of research challenges raised by message delivery in environments consisting of heterogeneous networks that may be subject to episodic connectivity.

During the first three years of the COMMUNITY associate team, we have explored solutions to enable efficient delivery mechanisms for disruption-prone and heterogeneous networks (i.e. challenged networks). In particular, we have designed the MeDeHa framework along with the Henna naming scheme, which allow communication in infrastructure and infrastructure-less networks with varying degrees of connectivity. We have also proposed efficient routing strategies adapted to environment with episodic connectivity that take into account the utility of nodes to relay messages. The various solutions have been evaluated using both simulations and real experimentations in testbeds located at Inria and UCSC. These solutions have demonstrated good performance in challenged networks.

However, the ossification of the Internet prevents the deployment of such solutions in large scale. So, in 2012 we decided to extend our collaboration in two research directions: (1) The exploration of the software-defined networking paradigm to facilitate the implementation and large scale deployment of new network architectures to infrastructure-less network environments, and (2) the design of innovative information-centric communication mechanisms adapted to challenged networks. In particular, we are designing mechanisms to p rovide flexible, efficient, and secure capacity sharing solutions by leveraging SDN in hybrid networked environments, i.e., environments that consist of infrastructure-based as well as infrastructureless networks. We are also investigating solutions to optimize caching in infrastructure and infrastructureless networks using SDN. We have also designed a content-optimal delivery algorithm, called CODA, for distributing named data over challenged networks. See the 2014 Update on the Community web site.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Visiting PhDs

PhD Student: Sahar Hoteit
Date: from May 12th 2014 until May 21st 2014
Subject: On ICN Cache Allocation to Content Providers
Institution: LIP6, University of Pierre and Marie Curie

7.5.1.2. Internships

Student: Salim Afra
Date: from March 2014 until August 2014
Institution: Polytech Nice Sophia, Ubinet Master

Student: Nicolas Aguilera Miranda
Date: from October 2014 February 2015
Subject: Measurements of users' quality of experience over Adkintun Mobile
Institution: University of Chile

Student: Lelio Renard-Lavaud
Date: from April 2014 until July 2014
Subject: Popularity and placement of content in Delay Tolerant Networks
Institution: Ecole Polytechnique - Palaiseau

Student: Hardik Soni
Date: from March 2014 until August 2014
Subject: On managing wireless mesh networks using an SDN architecture
Institution: Polytech Nice Sophia, Ubinet Master

Student: Mahdi Shoja
Date: from March 2014 until August 2014
Subject: Evaluation of network protocols with Direct Code Execution
Institution: Polytech Nice Sophia, Ubinet Master

Student: Phuong Tran Huu
Date: from May 2014 until October 2014
Subject: A Future Internet Technologies benchmark
Institution: Polytech Nice Sophia

7.5.2. Visits to International Teams

Bruno Astuto A. Nunes and Thierry Turletti, visited UCSC in March in the context of the Community associated team.

Hardik Soni and Thierry Turletti, visited NICT and Univ. of Tokyo in november in the context of the Simulbed associated team.

DICE Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

DICE is involved in a regional project of the Rhône-Alpes region, ARC6 "Innovative Services for Social Networks", with Telecom Saint Etienne.

7.2. National Initiatives

7.2.1. ANR

DICE is involved in two ANR projects, to start at the end of 2013,

- C3PO, on Collaborative Creation of Contents and Publishing using Opportunistic networks, with LT2C Telecom Saint-Etienne, INSA LYON, IRISA, ChronoCourse, et Ecole des Mines de Nantes.
- Socioplug, Social Cloud over Plug Networks, Enabling Symmetric Access to Data and Preserving Privacy, with LINA / Université de Nantes, Université de Rennes 1, INSA Lyon.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

DICE is involved in the CSA project "Big data roadmap and cross-disciplinarY community for addressing socieTal Externalities (BYTE)", Objective ICT-2013.4.2 Scalable data analytics (c) Societal externalities of Big Data roadmap.

7.4. International Initiatives

7.4.1. Inria International Labs

DICE is involved in the Inria IPL citylab project headed by Valerie Issarny.

7.4.2. Participation In other International Programs

DICE has a joint project on BigData and intermediation "Promises of intermediation platforms for services frugal in resources" that is carried out within the cooperation framework JORISS between ENS Lyon and ECNU Shanghai.

DICE is starting a cooperation with CERN for the design of a new Javascript 2D/3D architecture for LHC event display experiments.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

In 2014, the team DICE supervised three internships of master students, including two international students.

DIONYSOS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- Adlen Ksentini is participating at 20% of his time to the IRT BCOM granted by the ANR.
- Yassine Hadjadj-Aoul is participating at 20% of his time to the IRT BCOM granted by the ANR.

7.2. European Initiatives

7.2.1. Collaborations in European Programs, except FP7 & H2020

7.2.1.1. QuEEN project

Program: CELTIC

Project acronym: QuEEN

Project title: Quality of Experience Estimators in Networks

Duration: October 2011 - January 2015

Coordinator: Orange Labs

Other partners: 24 partners in many European partners

Abstract: QuEEN is a large 3-year Celtic project going from end 2011 to January 2015. Its objectives are to develop automatic QoE measurement modules for Web services and applications, and to organize these measurement modules as a network of cooperative agents in order to allow each agent to take advantage of the measurements done by the others. Dionysos was involved in most of the activities of the project, and QuEEN partners have benefit from our experience in developing the PSQA technology. QuEEN involved many companies and academic institutions (24 European partners); the project leader was Orange Labs, in Sophia Antipolis.

For more details, visit http://celtic-queen.inria.fr/dokuwiki/doku.php?id=start

7.2.1.2. DPDM1

Program: IT for Knowledge Management, IT4 Innovations, National Supercomputing Center, Ostrava, Czech Republic

Project acronym: DPDM1

Project title: Database of Performance and Dependability Models 1

Duration: October 2014 – March 2015

Coordinator: Technical University of Ostrava

Other partners: Inria (G. Rubino, Dionysos)

Abstract: the project consists in using the supercomputing facilities at Ostrava to build very large models with known numerical solutions, that will serve as a benchmark to many types of techniques designed to compute numerically exact values, bounds, estimations, etc., under research efforts all over the world (areas: Markovian models, rare event problems, neural networks, etc.).

7.2.2. Collaborations with Major European Organizations

Partner 1: FTW, Vienna (Austria)

We work with FTW on network economics.

Partner 2: VTT, Oulu, Finland

We work with VTT on Quality of Experience estimation and use.

7.3. International Initiatives

7.3.1. Inria International Labs

7.3.1.1. CIRIC

In the context of CIRIC, we cooperate with the team of Reinaldo Vallejos, professor at the UTFSM, Valparaíso, Chile, on different topics related to networking and modeling issues. Specifically, these activities are organized around two collaborative projects, 7.3.2.1 and 7.3.4.1 , where one can find the scientific details. We start to work also with Javiera Barrera's team at the University Adolfo Ibañez, Santiago de Chile, on stochastic optimization problems.

7.3.2. Inria Associate Teams

7.3.2.1. MANAP

Title: MANAP (Markovian ANalysis and APplications)

International Partner (Institution - Laboratory - Researcher):

Universidad Técnica Federico Santa María (Valparaíso, Chile)

Duration: 2013 - · · ·

See also: http://people.rennes.inria.fr/Gerardo.Rubino/RESEARCH/MANAP/manap.html

This project has two goals. The main one is to develop techniques allowing to accelerate solving techniques for Markov models, both in equilibrium and in their transient phases. The applications behind these efforts are the evaluation of performance, dependability and performability properties of complex communication systems. The second goal is to apply these solving techniques to specific problems in networking, concerning optical and wireless infrastructures. On both cases there is some emphasis on dependability aspects: fault tolerance routing schemes in the first case, complex dependability characteristics and their analysis in the second one. A third explicit objective is to produce a software tool implementing the techniques coming from the main research direction of the project, designed to be used both by engineers and researchers.

7.3.3. Inria International Partners

7.3.3.1. MOCQUASIN

Title: Monte Carlo and Quasi- Monte Carlo for rare event simulation

International Partner (Institution - Laboratory - Researcher):

University of Montreal (Canada)

Duration: 2013 - · · ·

See also: http://www.irisa.fr/dionysos/pages_perso/tuffin/MOCQUASIN/

The goal of this team is to compute integrals, sums or to solve equations or optimization problems by means of Monte Carlo methods, which are statistical tools used when the models have a high complexity (for instance a large dimension). They are unavoidable tools in areas such as finance, electronics, seismology, computer science, engineering, physics, transport, biology, social sciences... Nonetheless, they have the reputation of being slow, i.e. to require a large computational time to reach a given precision. The goal of the project is to work on acceleration techniques, meaning methods allowing to reach the targeted precision in a shorter computational time. A typical framework is that of rare event simulation for which getting even only one occurrence of the event could require a very long time. In this case, there are two main acceleration techniques: importance sampling and splitting, on which we work.

7.3.4. Participation In other International Programs

7.3.4.1. Stic AmSud with UDELAR, Uruguay, and UTFSM, Chile

Program: Stic AmSud

Title: Accelerating Markov Models for analysis and design of dynamic WDM optical networks (AMMA)

Inria principal investigator: Gerardo Rubino

International Partners (Institution - Laboratory - Researcher):

University of the Republic (UDELAR), Montevideo, Uruguay – Computer Science at the Engineering Faculty – prof. Héctor Cancela

Technical University Federico Santa María (UTFSM), Valparaíso, Chile – Electronics Department – Prof. Reinaldo Vallejos

Duration: 2 years, Jan. 2013 – Dec. 2014

This project has two main scientific goals: (i) to develop methods capable of solving Markov models faster than with state-of-the-art techniques, and (ii) to apply these techniques to the design of fault-tolerant optical networks. The rationale behind (i) is that the group has ideas and some preliminary promising unpublished results that makes it expect that its approach will be effective in producing new nice solving procedures. Concerning (ii), we have already produced results in simpler cases (without taking into account failures), and we also have results on all the associated areas (dependability analysis, combinatorial optimization, etc.). These main research lines are completed with other goals all concerned with the quantitative analysis of such complex communication systems.

7.3.4.2. Math AmSud with UDELAR, Uruguay, and UV, Chile

Program: Math AmSud

Title: Stochastic Analysis, Statistics Inference, Numerical Analysiss (SIN)

Inria principal investigator: Gerardo Rubino

Main International Partners (Institution - Laboratory - Researcher):

University of the Republic (UDELAR), Montevideo, Uruguay – Computer Science at the Engineering Faculty – prof. Paola Bermolen

University of Valparaíso, Chile — Prof. Soledad Torres

Duration: 2 years, Jan. 2013 – Dec. 2014

Stochastic calculus with respect to the standard Brownian motion or more generally with respect to semi-martingales is currently one of the most important components of international research in probability theory. The applications of this theory largely exceed the original probabilistic framework and have repercussions in various fields, including differential geometry, differential partial equations, theoretical physics, modeling in finance, hydrology, telecommunications and biology. Recently, many authors have been interested in developing a stochastic calculus with respect to Gaussian processes which are not necessarily semi-martingales, as for instance the well known fractional Brownian motion. This research project is articulated around the analysis and the applications of stochastic differential equations driven by long memory processes.

SIN is a large project with many partners. Our team participates in looking at differential equations and stocastic differential equations as limits of discrete Markov processes.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Professor Héctor Cancela

  Subject: network reliability (see 7.3.4.1 , 7.3.2.1)

  Institution: UDELAR, Montevideo, Uruguay

  Duration: December 14 to December 31

- Professors Reinaldo Vallejos and Marta Barría

  Subject: network modeling and Markov chain analysis (see 7.3.4.1 , 7.3.2.1 , 7.3.1.1)

  Institutions: UTFSM and UV, Valparaíso, Chile

  Duration: October 17 to October 27
- Leslie Murray

  Subject: Monte Carlo methods (see 5.6)

  Institution: University of Rosario, Argentina

  Duration: November 21 to December 19
- Assistant Professor Pablo Romero

  Subject: network modeling and network reliability (see 7.3.4.1 , 7.3.2.1)

  Institutions: UDELAR, Montevideo, Uruguay

  Duration: September 4 to November 14
- Luis Gutiérrez Begovich

  Subject: neural networks

  Institution: IPN (Instituto Politécnico Nacional), Mexico DF, Mexico

  Duration: December 6, 2013, to February 28, 2014
- Assistant Professor Jorge Graneri

  Subject: neural networks and human memory modeling (preparation for a future PhD work)

  Institutions: UDELAR, Montevideo, Uruguay

  Duration: October 1 to November 21

7.4.2. Visits to International Teams

7.4.2.1. Research stays abroad

Gerardo Rubino

Date: Jan 6 - Jan 10

Institution: Kaust, Saudi Arabia

G. Rubino visited the Center for Uncertainty Quantification in Computational Science and Engineering, Kaust, Saudi Arabia, one week in January, where he gave a seminar. He also served at the international Advisory Board of this Center

Gerardo Rubino

Date: Jun 25 - Jun 28

Institution: National Supercomputing Center, Technical University of Ostrava, Czech Republic

This was a research visit, which included a tutorial on rare event analysis using Monte Carlo techniques, and the preparation of a project

DISCO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- DIGITEO Project (DIM LSC) ALMA3

  Project title: Mathematical Analysis of Acute Myeloid Leukemia (AML) and its treatments

  September 2014 - August 2017

  Coordinator: Catherine Bonnet

  Other partners: Inria Paris-Rocquencourt, France, L2S, France, UPMC, St Antoine Hospital Paris

  Abstract: this project follows the regional projects ALMA (2010-2014) and ALMA2 (2011-2013). Starting from the work of J. L. Avila Alonso's PhD thesis in ALMA the aim of this project is to provide a refined coupled model of healthy and cancer cell dynamics in AML whose (stability) analysis will enable evaluation of polychemiotherapies delivered in the case of AML which have a high level of Flt-3 duplication (Flt-3-ITD).

- DIGITEO Project (DIM LSC) MOISYR

  Project title: Monotonie, observaterus par intervalles et systèmes à retard.

  Dedember 2011- December 2014

  Coordinator: Frédéric Mazenc

  Other partners: L2S, France, Mines-ParisTech, France

  Abstract: MOISYR is concerned with the problem of extending the theory of monotone systems to the main families of continuous time systems with delay along with the application of this theory to the design of observers and interval observers. In particular, nonlinear systems with pointwise and distributed delays and stabilizable systems with delay in the input shall be considered. In a second step, we extend our result to discrete time systems and to a specific class of continuous/discrete systems calles Networked Control Systems.

8.2. National Initiatives

8.2.1. ANR

An ANR Blanc SIMI 3 *Multidimensional Systems: Digression On Stabilities* (MSDOS) has started at the beginning of 2014. Its main goal is to constructively study stabilities and stabilization problems of (nonlinear) multidimensional systems. For more details, see http://www.lias-lab.fr/perso/nimayeganefar/doku.php. Alban Quadrat is the local leader for Inria Saclay.

Guillaume Sandou is the head of the RISEGrid Institute. The Institute is dedicated to the study, modelling and simulation of smart electric distribution grids and their interactions with the whole electric power system. It is located in Supélec and gathers about 20 people (academic and industrial researchers, PhD students, post-doctoral researchers).

Frédéric Mazenc is member of the Conseil du Laboratoire of Laboratoire des Signaux et Systèmes (L2S).

Frédéric Mazenc is member of the commission scientifique du CRI Saclay- Ile-de-France.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7 & H2020

Program: **GDRI (European research network founded by CNRS)**

Project acronym: DelSys

Project title: Delay Systems

Duration: 2011-2015

Coordinator: Silviu Iulian Niculescu

Other partners: GIPSA-Lab and LAAS France, Ancona University Italy, Czech Technical University in Prague Czech Republic, Kent University Great-Britain, KTH Stockholm Sweden and KU Leuven Belgium.

Abstract: the aim of this GDRI is to bring together the main European teams which work in the fiels of Delay systems. This network meets once a year.

——

Program: **PHC Pessoa (Portugal)**

Project acronym: 28750QA

Project title: Robust Distributed Model Predictive Control of Medium- and Large- Scale Systems

Duration: 2013-2014

Coordinator: Cristina Stoica (French leader), Fernando Lobo Perreira (Portuguese leader)

Other partners: Sorin Olaru

——

Program:**PHC Brancusi (Romania)**

Project acronym: 28705PF

Project title: Adaptive and predictive control of bioprocesses (modelling, identification and control of interconnected bioprocesses)

Duration: 2013-2014

Coordinator: Sihem Tebbani (French leader), Dan Selisteanu (Romanain leader)

Other partners: Sorin Olaru

——

Program:**PHC Parrot**

Project acronym: CASCAC

Project title: Computer Algebra, Symbolic Computation, and Automatic Control

Duration: 2013 - 2014

Coordinator: Alban Quadrat (French leader), Maris Tõnso (Estonian leader)

Other partners: Institute of Cybernetics, University of Tallinn

Abstract: The CASCAC project is at the interfaces of control theory, computer algebra and software engineering. The goals of the project are: 1. Develop new theoretical results on nonlinear control systems defined by functional equations (e.g., ordinary differential equations, partial differential equations, differential time-delay equations, partial difference equations). 2. Implement them on dedicated softwares developed in the computer algebra system Mathematica. In particular, Mathematica versions of the OREMODULES and OREMORPHISMS packages will be developed. 3. Develop an interface between the C library BLAD (http://www.lifl.fr/~boulier/pmwiki/pmwiki.php?n=Main.BLAD) − dedicated to differential algebra techniques − and Mathematica. This interface will allow one to have access to differential elimination techniques in Mathematica and to use them in decision methods for nonlinear control theory. 4. Co-supervise the Master thesis of Kristina Halturina with Prof. Ülle Kotta on constructive aspects of differential flatness and its applications to control theory (e.g., tracking, motion planning).

——

Program:**PHC GALILEE 2014**

Project acronym: SeTASDelSys - 30188PK

Project title: Set theoretic analysis of switched and time delay systems with application to fault tolerant control systems

Duration: January 2014 - December 2014

Coordinator: Sorin Olaru (France), Stefano Miani (Italy)

Other partners: Dipartimento di Ingegneria Elettrica, Gestionale e Meccanica, Universita' degli Studi di Udine, Italy

Abstract: The present Galileo project intends to initiate a collaborative research relationship based on the common interest of the French and Italian teams in the set-theoretic analysis of switched and delay time dynamics. On a broad perspective, the results on these topics can be extended to different aspects of the control design (as fault tolerance, constraints handling or robustness with respect to communication uncertainties). The scientific objective is to address two main open problems : i) the construction of (positive) invariant sets for switched dynamical systems; ii) the definition of the appropriate concepts of set invariance for delay time systems and their algorithmic construction.

——

Program: **PHC Rila (Bulgaria)**

Project acronym: 29401YJ

Project title: Robust Distributed Model Predictive Control of Medium- and Large- Scale Systems

Duration: 2013-2014

Coordinator: Sorin Olaru (French leader), Alexandra Grancharova (Bulgarian leader)

Other partners: Bulgarian Academy of Science

Abstract: The project intends to address the control design of large scale dynamical systems with an emphasis on distributed predictive control strategies. There are two points of view with respect to the control synthesis in this framework: a. avoid the use of a global prediction model in the receding horizon optimal control of the subsystems and privilege the use of a coordination level in the decision process; b. consider the distributed synthesis for a network of discrete-time constrained linear systems without central coordinator. In the present project we intend to contribute to both of these directions by: a. Prediction of the interactions in between subsystems in a decomposition-coordination scheme. This can be done by imposing a reduced set of constraints for the MPC problems at the lower levels. b. With respect to the MPC design in the absence of coordination one of the issues will be the definition of appropriate terminal sets, ensuring invariance properties or at least recursive feasibility for the global functioning. We will investigate the construction of terminal set for a stabilizing centralized MPC decomposable in the form of a cross product of sets in each subsystem state space. An interesting idea on this direction was presented recently by the participants in this project.

8.3.2. Collaborations with Major European Organizations

Partner 1: University of L'Aquila, Department of Electrical and Information Engineering (Italy)

Sujet : study of nonlinear systems with delay, (notably differential equations interconnected with difference equations) via Lyapunov-Krasovskii functionals.

Partner 2: RWTH Aachen University, Germany

Mathematical systems theory, control theory, symbolic computation

Partner 3: Bilkent University, Turkey

Control of linear and nonlinear systems with delays, medical applications

Partner 4: Tel Aviv University, Israel

Stability analysis of nonlinear Partial Differential Equations

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- E. Acchab, University of El Jadida, Marocco, 01-15/11.
- M. Barakat, University of Kaiserslautern, Germany, 31/04-01/05.
- Y. Belikov, University of Tallinn, Estonia, 26-30/05.
- E. Fridman, University of Tel-Aviv, Israël, 22/09-22/10.
- U. Kotta, University of Tallinn, Estonia, 26-30/05.
- P. Laakkonen, University of Tampere, Finland, 09-17/06.
- G. Regensburger, RICAM, Linz, Austria, 06/03.
- D. Robertz, University of Plymouth, United Kingdom, 02-05/06.
- M. Tõnso, University of Tallinn, Estonia, 26-30/05, 17-21/11.
- Y. Yamamoto, University of Kyoto, Japan, 15-30/04.

National scientists who gave a talk at the seminar *Théorie Algébrique des Systèmes* (http://pages.saclay.inria.fr/alban.quadrat/Seminar.html): F. Boulier (University of Lille I, 27/05), Y. Bouzidi (Inria Nancy, VEGAS, 30/06), T. Cluzeau (University of Limoges, 19-20/11), J.-A. Weil (University of Limoges, 20/01, 03/02).

8.4.1.1. Internships

- Master thesis: W. Djema, *Etude de la stabilité d'un modèle de leucémie aiguë myëloblastique*, Ecole Nationale Polytechnique d'Alger (Algeria), 17/06/2014, C. Bonnet et F. Mazenc.
- Master thesis: K. Halturina, *Constructive study of differential flatness and its applications in control theory*, University of Tallinn (Estonia), grant of the French governement (3 months), 15/05/2014, Alban Quadrat.
- Master thesis: N. Ribard, *Etude constructive des théorèmes de Warfield sur l'équivalence des systèmes fonctionnels linéaires*, University of Versailles (France), 15/09/2014, Alban Quadrat.

8.4.2. Visits to International Teams

Alban Quadrat visited the department of mathematics of the University of SUNY Cortland, New York (USA), 09/2014.

8.5. International Initiatives

8.5.1. Inria International Partners

8.5.1.1. Informal International Partners

- UNICAMP, Sao Paulo, Brazil.

- Kyushu Institute of Technology, Iizuka, Fukuoka and University of Kyoto, Kyoto, Japan.

- Louisiana State University, Baton Rouge, USA.

DIVERSE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

We obtained a grant from the Britany region, within the plan of action SAD (for "Stratégie d'attractivité durable"). The VIP project (for "Visualisation Interactive de produits dans les configurateurs") aims to investigate software product line techniques. We have recruited Dr. Jin Kin (post-doc for a duration of 18 months, starting in december 2014) in collaboration with the ESTASYS team.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ANR GEMOC

- Coordinator: Inria (DIVERSE)
- Other partners: ENSTA Bretagne, Inria, IRIT, I3S, Obeo, Thales
- Dates: 2012-2016
- Abstract: GEMOC focuses on a generic framework for heterogeneous software model execution and dynamic analysis. This work has the ambition to propose an innovative environment for the design of complex software-intensive systems by providing: a formal framework that integrates state-of-the-art in model-driven engineering (MDE) to build domain-specific modeling languages (DSMLs), and models of computation (MoC) to reason over the composition of heterogeneous concerns; an open-source design and modeling environment associated to a well-defined method for the definition of DSMLs, MoCs and rigorous composition of all concerns for execution and analysis purposes.

  This requires addressing two major scientific issues: the design and verification of a formal framework to combine several different DSMLs relying on distinct MoCs; the design and validation of a methodology for DSMLs and MoC development. GEMOC aims at participating in the development of next generation MDE environments through a rigorous, tool-supported process for the definition of executable DSMLs and the simulation of heterogeneous models.

8.2.1.2. ANR INFRA-JVM

- Coordinator: Université Paris 6
- Other partners: Université Bordeaux 1, Université Rennes 1 (DIVERSE), Ecole des Mines de Nantes
- Dates: 2012-2015
- Abstract: INFRA-JVM is an ANR project whose goal is to design and provide a new Java Virtual Machine dedicated to pervasive environments. This project focuses on designing a Java Virtual Machine for embedded computing platform offering dynamic reconfiguration capabilities. In this context, DIVERSEaddresses the problem of efficiently identifying faulty software components running simultaneously in a virtual machine without isolation. Current solutions that perform permanent and extensive monitoring to detect anomalies induce very high overhead on the system, and can, by themselves, make the system unstable. Our main objective is to investigate an optimistic adaptive monitoring system using models@runtime to determine the faulty components of an application.

8.2.1.3. SOPRANO

- Coordinator: CEA
- CEA, University of Paris-Sud, Inria Rennes, OcamlPro, Adacore

- Dates: 2014-2017
- Abstract: Today most major verification approaches rely on automatic external solvers. However these solvers do not fill the current and future needs for verification: lack of satisfying model generation, lack of reasoning on difficult theories (e.g. floating-point arithmetic), lack of extensibility for specific or new needs. The SOPRANO project aims at solving these problems and prepare the next generation of verification-oriented solvers by gathering experts from academia and industry. We will design a new framework for the cooperation of solvers, focused on model generation and borrowing principles from SMT (current standard) and CP (well-known in optimisation). These ideas will be implemented in an open-source platform, with regular evaluations from the industrial partners.

8.2.2. BGLE / LEOC

8.2.2.1. BGLE2 CONNEXION

- Coordinator: EDF
- Other partners: Atos WorldGrid, Rolls-Royce Civil Nuclear, Corys TESS, Esterel Technologies, All4Tec, Predict, CEA, Inria, CNRS / CRAN, ENS Cachan, LIG, Telecom ParisTech
- Dates: 2012-2016
- Abstract: The cluster CONNEXION (*digital command CONntrol for Nuclear EXport and renovatION*) aims to propose and validate an innovative architecture platforms suitable control systems for nuclear power plants in France and abroad. In this project the Triskell team investigates methods and tools to (i) automatically analyze and compare regulatory requirements evolutions and geographical differences; (ii) automatically generate test cases for critical interactive systems.

8.2.2.2. LEOC CLARITY

- Coordinator: Obéo
- Other partners: AIRBUS, Airbus Defence and Space, All4tec, ALTRAN Technologies, AREVA, Artal, C.E.S.A.M.E.S., Eclipse Foundation Europe, Inria Sophia Antipolis Méditerranée, PRFC, Scilab Enterprises, Thales Global Services, Thales Alenia Space, Thales Research & Technology, Thales Systèmes Aéroportés, Université de Rennes 1.
- Dates: 2014-2017
- Abstract: The CLARITY project aims to establish an international dimension ecosystem around Melody/Capella modeling workbench for systems engineering (MBSE) and engineering architectures (system, software, hardware).

8.2.2.3. Occiware

- Coordinator: Open Wide
- Open Wide, ActiveEon SA, CSRT - Cloud Systèmes Réseaux et Télécoms, Institut Mines-Télécom/Télécom SudParis, Inria, Linagora, Obeo, OW2 Consortium, Pôle Numérique, Université Joseph Fourier,
- Dates: 2014-2017
- Abstract: The Occiware project aims to establish a formal and equipped framework for the management of all cloud resource based on the OCCI standard.

8.2.3. DGA

8.2.3.1. DGA-RAPID MOTIV

- Coordinator: InPixal
- Other partners: Bertin, DGA, Inria
- Dates: 2012-2014

- Abstract: This project investigates innovative software test generation and management solutions to handle the very high degrees of variability in video processing algorithmic chains. The objective is to provide systematic criteria to qualify the testing activity when developing video processing software and to tailor these criteria to the variability dimensions that emerge in the context of visible images.

8.2.3.2. DGA FPML

- Coordinator: DGA
- Partners: DGA MI, Inria
- Dates: 2014-2016
- Abstract: in the context of this project, DGA-MI and the Inria team DiverSE explore the existing approaches to ease the development of formal specifications of domain-Specific Languages (DSLs) dedicated to paquet filtering, while guaranteeing expressiveness, precision and safety. In the long term, this work is part of the trend to provide to DGA-MI and its partners a tooling to design and develop formal DSLs which ease the use while ensuring a high level of reasoning.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. FP7 FET STREP DIVERSIFY

- Coordinator: Inria (DIVERSE)
- Other partners: SINTEF, Université de Rennes 1, Trinity College Dublin
- Dates: 2013-2016
- Abstract: DIVERSIFY explores diversity as the foundation for a novel software design principle and increased adaptive capacities in CASs. Higher levels of diversity in the system provide a pool of software solutions that can eventually be used to adapt to unforeseen situations at design time. The scientific development of DIVERSIFY is based on a strong analogy with ecological systems, biodiversity, and evolutionary ecology. DIVERSIFY brings together researchers from the domains of software-intensive distributed systems and ecology in order to translate ecological concepts and processes into software design principles.

8.3.1.2. FP7 NoE NESSoS

- Coordinator: CNR - Consiglio Nazionale delle Ricerche (Italy)
- Others partners: ATOS (Spain), ETH (Switzerland), Katholieke Universiteit Leuven (Belgium), Ludwig-Maximilians-Universitaet Muenchen (Germany), IMDEA (Spain), Inria (France), University of Duisburg-Essen (Germany), University of Malaga (Spain), University of Trento (Italy), SIEMENS (Germany), SINTEF (Norway)
- Dates: 2010-2014
- Abstract: The Network of Excellence on Engineering Secure Future Internet Software Services and Systems (NESSoS) aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. In light of the unique security requirements the Future Internet will expose, new results will be achieved by means of an integrated research, as to improve the necessary assurance level and to address risk and cost during the software development cycle in order to prioritize and manage investments. NESSoS will also impact training and education activities in Europe to grow a new generation of skilled researchers and practitioners in the area. NESSoS will collaborate with industrial stakeholders to improve the industry best practices and support a rapid growth of software-based service systems in the Future Internet.

  Three Inria EPIs are involved in NeSSoS: ARLES, CASSIS and Triskell. Triskell leads the research workpackage on design and architecture for secured future internet applications.

8.3.1.3. FP7 Marie-Curie Relate

- Coordinator: Karlsruhe Institute of Technology
- Other partners: Université de Rennes, IRISA (France); King's College (UK); South East European Research Center, SEERC (Greece); Charles University (Czech Republic); CAS Software (Germany); Singular Logic (Greece)
- Dates: 2011-2015
- Abstract: The RELATE Initial Training Network aims to establish a network of international academic and industrial partners for a joint research training effort in the area of engineering and provisioning service-based cloud applications. The training is intended to not only shape high-level academic researchers, but also educate next generation experts and innovators in the European software industry. Through an integrative and multidisciplinary research approach, RELATE aims to promote the advancement of the state of the art in the related areas of model-driven engineering and formal methods, service-based mash-ups and application integration, security, performance, and trust in service-based cloud applications, and quality management and business model innovation.

8.3.1.4. FP7 STREP HEADS

- Coordinator: SINTEF
- Other partners: Inria, Software AG, ATC, Tellu, eZmonitoring
- Dates: 2013-2016
- Abstract: The idea of the HEADS project is to leverage model-driven software engineering and generative programming techniques to provide a new integrated software engineering approach which allow advanced exploitation the full range of diversity and specificity of the future computing continuum. The goal is to empower the software and services industry to better take advantage of the opportunities of the future computing continuum and to effectively provide new innovative services that are seamlessly integrated to the physical world making them more pervasive, more robust, more reactive and closer (physically, socially, emotionally, etc.) to their users. We denote such services HD-services. HD-services (Heterogeneous and Distributed services) characterize the class of services or applications within the Future Internet whose logic and value emerges from a set of communicating software components distributed on a heterogeneous computing continuum from clouds to mobile devices, sensors and/or smart-objects.

8.3.2. Collaborations in European Programs, except FP7 & H2020

8.3.2.1. ICT COST Action MPM4CPS (IC1404)

- Chair of the Action: Prof Hans Vangheluwe (BE)
- Dates: 2014-2018
- Abstract: Truly complex, designed systems, known as Cyber Physical Systems (CPS), are emerging that integrate physical, software, and network aspects. To date, no unifying theory nor systematic design methods, techniques and tools exist for such systems. Individual (mechanical, electrical, network or software) engineering disciplines only offer partial solutions. Multi-paradigm Modelling (MPM) proposes to model every part and aspect of a system explicitly, at the most appropriate level(s) of abstraction, using the most appropriate modelling formalism(s). Modelling languages' engineering, including model transformation, and the study of their semantics, are used to realize MPM. MPM is seen as an effective answer to the challenges of designing CPS. This COST Action promotes the sharing of foundations, techniques and tools, and provide educational resources, to both academia and industry. This is achieved by bringing together and disseminating knowledge and experiments on CPS problems and MPM solutions.

8.3.3. Industry-driven EU projects

8.3.3.1. ITEA MERGE

- Coordinator: Thales Research and Technology

- Other partners: Thales Global Services, Thales Communications and Security, OBEO, ALL4TEC, Onera, Inria, Université Paris VI, Codenomicon, STUK - Radiation and Nuclear Safety Authority, POHTOnSense Oy, University of Oulu, University of Jyvaskyla, Space Applications Services NV, Melexis, E2S, Katholieke Universiteit Leuven
- Dates: 2012-2015
- Abstract: MERgE stands for "Multi-Concerns Interactions System Engineering". Within the "Engineering support" theme of ITEA2 roadmap, the purpose of this project is to develop and demonstrate innovative concepts and design tools addressing in combination the "Safety" and "Security" concerns, targeting the elaboration of effective architectural solutions. MERgE will provide tools and solutions for combining safety and security concerns in systems development in a holistic way. It will provide academically solid and practice proven solutions and models for system developers and system owners to tackle the challenges of designing seamless optimal cost effective safe and secure solutions conformant to the model driven engineering paradigm. This will be done by tightly integrating the following paradigms: requirement engineering, safety, security and risk management in an over-all design process which is supported by adequate tools and methods. MERgE aims to bring a system engineering solution for Combined Safe & Secure system design. The main technical innovation of the project is the application of state of the art design tools tailorisation capabilities and "multi concern engineering" core technologies to the issue of interactions of "Safety" and "Security" concerns as well as other concerns like "Performance" or "Timing" in the design process.

8.3.4. Collaborations with Major European Organizations

SINTEF, ICT (Norway): Model-driven systems development for the construction of distributed, heterogeneous applications. We collaborate since 2008 and are currently in two FP7 projects together.

Université du Luxembourg, (Luxembourg): Models@runtime for dynamic adaptation and multi-objective elasticity in cloud management; model-driven development.

Open University (UK): models@runtime for the Internet of Things.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

8.4.1.1.1. Inria International Chair

Prof. Robert B. France [0] was granted by an Inria international chair for the period 2013-2017. Prof. France collaborate intensively with many members of DIVERSE on various joint work, e.g., the Familiar project and the GEMOC initiative. The Inria International Chair allows Prof. France to visit once a year the team along the period.

8.4.1.2. Informal International Partners

- Université de Montréal (Canada)
- McGill University (Canada)
- University of Alabama (USA)

8.4.2. International initiative GEMOC

The GEMOC initiative (cf. http://www.gemoc.org) is an open and international initiative launched in 2013 that coordinate research partners worldwide to develop breakthrough software language engineering (SLE) approaches that support global software engineering through the use of multiple domain-specific languages. GEMOC members aim to provide effective SLE solutions to problems associated with the design and implementation of collaborative, interoperable and composable modeling languages.

[0] Colorado State University, USA. See. http://www.cs.colostate.edu/~france/

The GEMOC initiative aims to provide a framework that facilitates collaborative work on the challenges of using of multiple domain-specific languages in software development projects. The framework consists of mechanisms for coordinating the work of members, and for disseminating research results and other related information on GEMOC activities. The framework also provides the required infrastructure for sharing artifacts produced by members, including publications, case studies, and tools.

The governance of the GEMOC initiative is ensured by the Advisory Board. The role of the Advisory Board is to coordinate the GEMOC work and to ensure proper dissemination of work products and information about GEMOC events (e.g., meetings, workshops).

Benoit Combemale is the co-founder and currently acts as principal coordinator of the GEMOC initiative. Benoit Combemale and Jean-Marc Jézéquel are part of the Advisory Board, and 9 DIVERSE members are part of the GEMOC initiative.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

- Victor Vranceanu: Inria, Intern, from Mar 2014 until Jul 2014
- Eric Manzi: Inria, Intern, from Jun 2014 until Aug 2014

DOLPHIN Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- PPF (Bioinformatics): This national program within the University of Lille 1 deals with solving bioinformatics and computational biology problems using combinatorial optimization techniques.
- PPF HPC (High performance computing).

8.2. National Initiatives

8.2.1. ANR

- ANR project Transports Terrestres Durable "RESPET - Gestion de réseaux de service porte-à-porte efficace pour le transport de marchandises", in collaboration with LAAS (Toulouse), DHL, JASSP, LIA (Univ. Avignon) (2011-2014).
- ANR project Modèles Numériques "NumBBO - Analysis, Improvement and Evaluation of Numerical Blackbox Optimizers" (2012-2016) in collaboration with Inria Saclay, TAO team, Ecole des Mines de St. Etienne, CROCUS team, and TU Dortmund University, Germany (2012-2016).
- ANR project TECSAN (Technologies pour la Santé) "ClinMine - Optimisation de la prise en Charge des Patients à l'Hôpital" in collaboration with University Lille 1, Université Lille 2, CHRU Lille, CHRU Montpelier, CHICL, Alicante (7 partners) (2014-2017) - Coordinator -
- PGMO project "Towards a Complexity Theory for Black-Box Optimization", together with Carola Doerr (CNRS, LIP6), Benjamin Doerr (Ecole Polytechnique), Anne Auger, Nikolaus Hansen (both Inria Saclay), Timo Koetzing (University of Jena, Germany), Johannes Lengler (ETH Zurich, Switzerland), and Jonathan Rowe (The University of Birmingham, UK)

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7 & H2020

Program: COST

Project acronym: cHiPSet

Project title: High-Performance Modelling and Simulation for Big Data Applications

Duration: 01 2015 - 01 2018

Coordinator: Joanna Kolodziej

Other partners: organisme, labo (pays): Spain, Poland, Germany, France, Luxembourg, italy, ...

Abstract: The Big Data era poses a critically difficult challenge and striking development opportunities in High-Performance Computing (HPC): how to efficiently turn massively large data into valuable information and meaningful knowledge. Computationally effective HPC is required in a rapidly-increasing number of data-intensive domains, such as Life and Physical Sciences, and Socio-economical Systems.

Modelling and Simulation (MS) offers suitable abstractions to manage the complexity of analysing Big Data in various scientific and engineering domains. Unfortunately, Big Data problems are not always easily amenable to efficient MS over HPC. Also, MS communities may lack the detailed expertise required to exploit the full potential of HPC solutions, and HPC architects may not be fully aware of specific MS requirements.

Therefore, there is an urgent need for European co-ordination to facilitate interactions among data-intensive MS and HPC experts, ensuring that the field, which is strategic and of long-standing interest in Europe, develops efficiently - from academic research to industrial practice. This Action will provide the integration to foster a novel, coordinated Big Data endeavour supported by HPC. It will strongly support information exchange, synergy and coordination of activities among leading European research groups and top global partner institutions, and will promote European software industry competitiveness

8.3.2. Collaborations with Major European Organizations

University of Luxembourg: organisme 1, labo 1 (Luxembourg)

Energy aware scheduling in Cloud computing systems

University of Tunis: LARODEC (Tunisia)

Multi-objective optimization under uncertainty using possibility theory

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. STEM

Title: deciSion Tools for Energy Management (STEM)

International Partner (Institution - Laboratory - Researcher):

Université de Montréal (CANADA)

Duration: 2012-2014

See also: http://dolphin.lille.inria.fr/Dolphin/STEM

The economic rise of developing countries, together with the need to meet ever more stringent pollution reduction targets, will increase the stress on the global energy system. Within this framework, the goal of the current project is to develop decision tools for energy management in a context of market deregulation. We will focus on two issues, namely demand management and production planning.

The first problem is concerned with the efficient management of consumption. More precisely, the short or long term behaviour of customers can be influenced through signals sent by a utility (or several utilities) to the end-users. These signals can take the form of an "optimal" pricing scheme, or yet of devices (timers, automatic switches, etc.) designed to induce an "optimal" behaviour from the users.

The second issue is concerned with efficient management of sustainable energy production . Indeed the development of renewable energy introduces new parameters in the supply/demand global equilibrium process. The issue is to achieve the right trade-off according to costs when determining the daily generation, usage and storage of renewable energy within an environment where grid prices and renewable energy level productions are stochastic.

The first problem is modeled as a bilevel program, the second one as a integer mutli-objective stochastic program. Efficient and effective solution methods are developed and implemented to solve these problems.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

- Memorandum of Understanding between Shinshu University (Nagano, Japan) and Inria, signed on March 2014

8.4.2.2. Informal International Partners

- University of Coimbra, Portugal.

- VUB, Brussels, Belgium.
- IRIDIA, Université Libre de Bruxelles.
- Cologne University of Applied Sciences, Germany.
- Leiden University, Netherlands.
- UMONS University and Tractebel company, Belgium.
- EMI - Univ. Rabat, Morocco.

8.4.3. Participation In other International Programs

- JSPS-MEXT project on Evolutionary multi-objective optimization, landscape analysis, and search performance, with Shinshu University, Nagano, Japan (2013—2016).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Prof. Hernan Aguirre, Shinshu University, Nagano, Japan
- Prof. Bernard Gendron, University of Montreal, Canada
- Prof. Kiyoshi Tanaka, Shinshu University, Nagano, Japan
- Fabio Daolio [PostDoc, Shinshu University, Nagano, Japan, from Sept 2014 to Sept 2015]
- Saúl Zapotecas-Martínez [PostDoc, Shinshu University, Nagano, Japan, from Nov 2014 to March 2015]
- Prof. Bernard Gendron, University of Montreal, Canada

8.5.1.1. Internships

- Martin Drozdik [PhD student, Shinshu University, Nagano, Japan, from Nov 2013 to Sept 2014]
- Miyako Sagawa [Master student, Shinshu University, Nagano, Japan, from Oct 2014 to Nov 2014]

8.5.2. Visits to International Teams

8.5.2.1. Explorer programme

Liefooghe Arnaud

Date: June 2014 - Jul 2014

Institution: Shinshu (Japan)

8.5.2.2. Research stays abroad

- A. Liefooghe, Oct 2014, IRIDIA, Univ. Libre de Bruxelles, Belgium
- D. Brockhoff, Research visit (invited) in China in October 2014 including East China Normal University, Shanghai, China (group of Aimin Zhou), Jiaotong University, Xi'An, China (group of Hui Li), and Xidian University, Xi'An, China (group of Maoguo Gong)
- L. Brotcorne, Sept 2014, Polytechnic School of Montreal
- L. Brotcorne, Oct 2014, Huhne Logisitc University, Hamburg
- E-G. Talbi, Mar 2014, Univ. Murcia, Spain
- E-G. Talbi, Juin 2014, EMI, Univ. Agdal Rabat, Morocco

DRACULA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

Projects coordination by a member of Dracula

- ANR (jeunes chercheurs) ProCell "Mathematical Methods for Erythropoiesis Modelling: from Proteins to Cell Populations", 2009-2014.
  Participants: Samuel Bernard, Fabien Crauste [Coordinator], Olivier Gandrillon, Thomas Lepoutre, Philippe Michel, Laurent Pujo-Menjouet, Vitaly Volpert.
- ANR BIMOD "Hybrid models of cell populations. Application to cancer modelling and treatment", 2010-2014.
  Participants: Mostafa Adimy, Fabien Crauste, Vitaly Volpert [Coordinator].
- ANR STOCHAGENE "Role of the chromatin dynamics on the stochasticity in gene expression in higher eukaryotic cells", 2011-2015.
  Participant: Olivier Gandrillon [Coordinator].

Collaboration in other projects

- ANR RPIB PrediVac "Innovative modeling tools for the prediction of CD8 T cell based vaccine efficacy", 2013-2015. Partners: U1111 Inserm (J. Marvel, coordinator), Dracula, Altrabio (small company), CoSMo (small company). For Dracula, the budget from 2013 to 2015 is 198 keuros, including three one-year post-doc positions (one post-doc has been recruited in April 2014 (Xuefeng Gao)), and the members are Fabien Crauste and Olivier Gandrillon.
- Thomas Lepoutre participates in the ANR (jeunes chercheurs) MODPOL (head Vincent Calvez (ENS Lyon)) "Cell polarization modeling", 2011-2015.
- Thomas Lepoutre is a member of the ANR KIBORD (head L. Desvillettes) dedicated to "kinetic and related models in biology". 2012-2016.
- Olivier Gandrillon participates in the ANR (Investissement d'Avenir) Iceberg (head Gregory Batt (Inria)) "From population models to model populations: single cell observation, modeling, and control of gene expression".

8.1.2. Other projects

- Inria ADT : SiMuScale "Simulations Multi-Échelles de Populations Cellulaires", 2014-2016.
  Participants: Samuel Bernard [Coordinator], Fabien Crauste, David Parsons.
- Association France Alzheimer Sciences Médicales 2014 : PAMELA "Prion et Alzheimer : Modélisation et Expérimentation d'une Liaison Agressive", 2014. Partners: UR0892 VIM (Virologie et Immunologie Moléculaires), INRA Domaine de Vilvert, Jouy-en-Josas.
  Participants: Mostafa Adimy, Samuel Bernard, Thomas Lepoutre, Laurent Pujo-Menjouet [Coordinator], Léon Tine.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

- Research program PHC POLONIUM (2014-2015) "Applications of reaction-diffusion equations in biology and medicine". Partners: Warsaw, Poland (Slawomir Bialecki, Jolanta Ciesielska, Bogdan Kazmierczak (coordinator), Marek Kochanczyk, Tomasz Lipniacki).
  Participants: Mostafa Adimy, Abdennasser Chekroun, Laurent Pujo-Menjouet [Coordinator], Alen Tosenberger, Vitaly Volpert.

8.2.2. Collaborations with Major European Organizations

- University of Valladolid (Spain). Collaboration with Oscar Angulo, Juan Carlos Lopez-Marcos and Miguel Ange Lopez-Marcos, on the analysis of an age-structured model describing erythropoiesis, and its numerical resolution.
- Karolinska University Hospital of Stockholm (Sweden). Collaboration with Peter Arner, Mats Eriksson, Erik Arner, Mikael Rydén and Kirsty L. Spalding, on the study of dynamics of human adipose lipid turnover in health and metabolic disease.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. Modelling leukemia

Title: Modeling quiescence and drug resistance in Chronic Myeloid Leukemia

International Partner (Institution - Laboratory - Researcher):

Center for Scientific Computation And Mathematical Modelling, University of Maryland (United States).

Duration: 2013 - 2015.

See also: http://dracula.univ-lyon1.fr/modelling_leukemia.php

Leukemia is the most famous disease of the blood cell formation process (hematopoiesis). Chronic myeloid leukemia results in a uncontrolled proliferation of abnormal blood cells. As the hematopoiesis involves stem cells (not accessible to observations), mathematical modeling is here a great tool to test hypothesis. We will join the expertise of Inria team DRACULA specialized on the modeling of blood cell formation and the Center for Scientific Computation and Applied Mathematical Modeling (CSCAMM, University of Maryland, College Park). The theoretical and modeling experience of team DRACULA and the numerical expertise combined with the links with experimentalists of members of CSCAMM will allow us to study deeply evolution of leukemia. We will especially focus on the behavior of leukemic stem cells and their possibility of becoming quiescent (dormant). Then we will study (using the knowledge obtained on leukemic stem cells) the phenomenon of drug resistance and its propagation over time and finally the mechanisms of multidrug resistance.

8.3.2. Participation In other International Programs

8.3.2.1. M3CD

Program: Euromediterranean 3+3

Title: Mathematical Models and Methods in Cell Dynamics

Inria principal investigator: Mostafa Adimy

International Partners (Institution - Laboratory - Researcher):

Institut Pasteur de Tunis (Tunisia) - Slimane Ben Miled

Consiglio Nazionale delle Ricerche- Istituto per le Applicazioni del Calcolo Mauro Picone (Italy) - Istituto per le Applicazioni del Calcolo Mauro Picone - Roberto Natalini

Cadi Ayyad University (Morocco) - Populations Dynamics Laboratory - Moulay Lhassan Hbid

Duration: Jan 2012 - Dec 2015

The aim of this project is to establish a network working on mathematical and computational models in cell dynamics. This network consists of five groups which have already established close bilateral relations. Those are the Inria teams Bang and Dracula in Paris and Lyon, France, the team IAC-CNR in Rome, Italy, the laboratory of Mathematical Population Dynamics (LMDP) from the university of Marrakech in Morocco, and the team of Mathematical Modelling and Computing in Biology (MoMinBi) from the Pasteur Institute in Tunis. Modelling cell dynamics and related processes is one of the main subjects of interest for the partners for many years. The issues addressed in the present project can be divided into five parts:

1) Analysis of structured models in cell population dynamics ;

2) Dynamics of normal and pathological haematopoiesis ;

3) Dynamics of Darwinian adaptation, in particular by drug resistance in competing cell or parasite populations, healthy and pathological / pathogenic (cancer, bacteria, parasites) ;

4) Dynamics of chemical and physical determinants of filament formation and intracellular spatial organisation of the cytoskeleton conformation ;

5) Coupling of the molecular mechanisms of control of the cell division cycle and cell proliferation.

The first part has been developed for many years by all the partners in this project. It tackles issues related to cell dynamics and biological mechanisms, physiological and chemical properties of cells and cell populations. The other four aspects of the project have been studied in the past by the Inria teams "Bang" and "Dracula" (**2**, **4**, **5**) and the IAC-CNR team (Rome), or are a rapidly emergent theme in Bang (**3**, cell Darwinism) with possible and natural connections with the other teams, in particular IAC-CNR and MoMinBi in Tunisia. Themes (**2**, **4**, **5**) have also been initiated (for their fundamental part) in a recent collaboration between Dracula and the teams from Morocco and Tunisia. The objectives of the present project are to pursue and deepen the study of cell proliferation dynamics and cellular mechanisms using structured models that take into account some new structure variables. The development of computer models will also be investigated in this project. Training and research activities related to these topics are currently underway between the Inria teams and the teams from Marrakech and Tunis, and between the Italian team and Bang. Two co-supervised theses are currently in progress, a Spring school on this subject will be organised by the partners in 2012. This program comes at the right time to give a new impetus to this collaboration. It will lead to the establishment of a multi-site laboratory expertise in population dynamics modelling, especially in cellular dynamics. This project will also allow the teams from Morocco and Tunisia to use their knowledge on mathematics applied to cell dynamics.

8.3.2.2. FCRF

Program: Fonds France Canada pour la recherche (FFCR)- France Canada research fund (FCRF) "New research collaboration" 2014-2015.

Title: Mathematical modelling of megakaryopoiesis and applications to platelet related diseases

Participants: Mostafa Adimy, Fabien Crauste, Laurent Pujo-Menjouet [Coordinator].

International Partners : Canada (Jiguo Cao, Nemanja Kosovalic, Jianhong Wu).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Anass Bouchnita

Subject: Numerical simulations of blood flows and blood coagulation

Date: from March 2014 until May 2014

Institution: École Mohammadia d'Ingénieurs (EMI), Rabat, Morocco

DREAM Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. PEPS: Pharmaco-epidemiology for Health Products

Participants: Thomas Guyet, René Quiniou, Véronique Masson, Alexandre Termier.

The PEPS project (Pharmaco-epidemiology des Produits de Santé) is funded by ANSM (national agency for health security). The project leader is E. Oger from the clinical investigation center CIC-1414 INSERM/CHU Rennes. The other partners located in Rennes are the Institute of Research and Technology (IRT) B<>Com, EHESP and the LTSI. The project will start in january 2015 and is funded for 4 years (3.6M€).

The PEPS project has two parts: the clinical studies and a research program dedicated to the development of innovative tools for pharmaco-epidemiological studies with medico-administrative databases. The pharmaco-epidemiology is the study of the uses, the effectiveness and the effects of health products (especially drugs) for the patients in a real live context, on a large population. Using medico-administrative databases – that contains information about the reimbursement of the medication, the medical visits and the cares – is a recent approach to enable studies on large cohortes and to reduce the response time to a pharmaco-epidemiology question.

Our contribution to this project will be the proposal of pattern mining algorithms and reasoning techniques to analyze typical care pathways of specific groups of insured patients.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

8.2.1.1.1. Monitoring cattle in big herds with multiple sensors

Participant: René Quiniou.

The state of Alberta produces a significant part of the beef meat in Canada. Big farms feeds up around 40.000 bull calves in feedlots grouping 200-300 animals. Diseases such as Bovine Respiratory Diseases (BRD) are frequent and may propagate quickly in such conditions. So, it is important to detect as soon as possible when an animal is sick. We are collaborating with the Department of Production Animal Health, University of Calgary for designing monitoring systems able to generate early alarms when an animal is sick. Precisely, we are studying the properties of new sensors and their aptitude to provide relevant data for BRD detectors. This year, we had a contract with the university of Calgary to fund a grant for a master student.

DREAMPAL Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

The CPER has financed the visit of Prof. Dorel Lucanu from Univ. Iasi (Romania) in July and August 2014.

7.2. International Initiatives

7.2.1. Participation In other International Programs

Wissem Chouchene is financed by the Euramus Mondus programme.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Prof. Dorel Lucanu from Univ. Iasi (Romania) visited us in July and August 2014. We continued work on language-independent program-verification techniques and on the formal definitions of the HiHope and HoMade assembler languages, as well as on the formally proved correctness of communication IPs.

DYLISS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Regional partnership with computer science laboratories in Nantes

Participants: Anne Siegel, Jérémie Bourdon, Damien Eveillard, François Coste, Jacques Nicolas, Vincent Picard, Santiago Videla.

Methodologies are developed in close collaboration with university of Nantes (LINA) and Ecole centrale Nantes (Irccyn). This is acted through the Biotempo and Idealg ANR projects and co-development of common software toolboxes within the Renabi-GO platform process. The Ph-D students V. Picard and J. Laniau are also co-supervised with members of the LINA laboratory.

7.1.2. Regional partnership in Marine Biology

Participants: Catherine Belleannée, Jérémie Bourdon, Jeanne Cambefort, Guillaume Collet, Jean Coquet, François Coste, Damien Eveillard, Olivier Dameron, Clovis Galiez, Gaëlle Garet, Yann Guitton, Julie Laniau, Jacques Nicolas, Vincent Picard, Sylvain Prigent, Anne Siegel.

A strong application domain of the Dyliss project is marine Biology. This application domain is co-developped with the station biologique de Roscoff and their three UMR and involves several contracts. The IDEALG consortium is a long term project (10 years, ANR Investissement avenir) aiming at the development of macro-algae biotechnology. Among the research activities, we are particularly interested in the analysis and reconstruction of metabolism and the characterization of key enzymes. Other research contracts concern the modeling of the initiation of sea-urchin translation (former PEPS program Quantoursin, Ligue contre le cancer and ANR Biotempo), the analysis of extremophile archebacteria genomes and their PPI networks (former ANR MODULOME and PhD thesis of P.-F. Pluchon) and the identification of key actors implied in competition for light in the ocean (PELICAN ANR project). In addition, the team participates to a collaboration program with the Biocore and Ange teams, together with Ifremer-Nantes, focused on the understanding on micro-algae (thesis of Julie Laniau).

7.1.3. Regional partnership in agriculture and bio-medical domains

Participants: Aymeric Antoine-Lorquin, Catherine Belleannée, Charles Bettembourg, François Coste, Jean Coquet, Olivier Dameron, Victorien Delannée, Jacques Nicolas, Anne Siegel, Valentin Wucher, Nathalie Théret.

We have a strong and long term collaboration with biologists of INRA in Rennes : PEGASE and IGEEP units. This partnership is acted by the co-supervision of one post-doctorant and the co-supervision of several PhD students. The Ph-D thesis of V. Wucher [13] was supported by collaborations with the IGEPP laboratory. The post-doc of Charles Bettembourg nows stregthens these collaborations. This collaboration is also reinforced by collaboration within ANR contracts (MirNadapt, FatInteger).

We also have a strong and long term collaboration in the bio-medical domain, namely with the IRSET laboratory at Univ. Rennes 1/Irset, acted by the co-supervised Ph-D theses of V. Delannée (Metagenotox project, funded by Anses) and J. Coquet. This partnership was reinforced in the former years by the ANR contract Biotempo ended at the end of 2014.

7.2. National Initiatives

7.2.1. Long-term contracts

7.2.1.1. "Omics"-Line of the Chilean CIRIC-Inria Center

Participants: Anne Siegel, Jérémie Bourdon, François Coste, Marie Chevallier, Damien Eveillard, Gaëlle Garet, Jacques Nicolas, Santiago Videla.

Cooperation with Univ. of Chile (MATHomics, A. Maass) on methods for the identification of biomarkers and software for biochip design. It aims at combining automatic reasoning on biological sequences and networks with probabilistic approaches to manage, explore and integrate large sets of heterogeneous omics data into networks of interactions allowing to produce biomarkers, with a main application to biomining bacteria. The program is co-funded by Inria and CORFO-chile from 2012 to 2022. In this context, IntegrativeBioChile is an Associate Team between Dyliss and the Laboratory of Bioinformatics and Mathematics of the Genome hosted at Univ. of Chile funded from 2011 to 2016.

7.2.1.2. ANR Idealg

Participants: Anne Siegel, Catherine Belleannée, Jérémie Bourdon, Jeanne Cambefort, François Coste, Olivier Dameron, Damien Eveillard, Jacques Nicolas, Guillaume Collet, Clovis Galiez, Gaëlle Garet, Yann Guitton, Sylvain Prigent.

IDEALG is one of the five laureates from the national call 2010 for Biotechnology and Bioresource and will run until 2020. It gathers 18 different partners from the academic field (CNRS, IFREMER, UEB, UBO, UBS, ENSCR, University of Nantes, INRA, AgroCampus), the industrial field (C-WEED, Bezhin Rosko, Aleor, France Haliotis, DuPont) as well as a technical center specialized in seaweeds (CEVA) in order to foster biotechnology applications within the seaweed field. It is organized in ten workpackages. We are participating to workpackages 1 (establishment of a virtual platform for integrating omics studies on seaweed) and 4 (Integrative analysis of seaweed metabolism) in cooperation with SBR Roscoff. Major objectives are the building of brown algae metabolic maps, flux analysis and the selection extraction of important parameters for the production of targeted compounds. We will also contribute to the prediction of specific enzymes (sulfatases) within workpackage 5 .[details]

7.2.2. Methodology: ANR Biotempo

Participants: Anne Siegel, Jérémie Bourdon, François Coste, Damien Eveillard, Jacques Nicolas, Olivier Dameron, Vincent Picard, Sylvain Prigent, Nathalie Théret, Santiago Videla.

The BioTempo projects aims at developing some original methods for studying biological systems. The goal is to introduce partial quantitative information either on time or on component observations to gain in the analysis and interpretation of biological data. Three biological applications are considered regulation systems used by biomining bacteria, TGF-$beta$ signaling and initiation of sea-urchin translation. It is funded by ANR Blanc (SIMI2) and coordinated by A. Siegel from 2011 to Nov. 2014. Teams involved include LINA (Nantes), I3S (Nice), DIMPP (Montpellier), Contraintes/Lifeware project team (Inria), IRSET (Rennes) and Station biologique de Roscoff [details]

7.2.3. Proof-of-concept on dedicated applications

7.2.3.1. ANR Fatinteger

Participants: Aymeric Antoine-Lorquin, Catherine Belleannée, Jacques Nicolas, Anne Siegel.

This project (ANR Blanc SVE7 "biodiversité, évolution, écologie et agronomie" from 2012 to 2015) is leaded by INRA UMR1348 PEGASE (F. Gondret). Its goal is the identification of key regulators of fatty acid plasticity in two lines of pigs and chickens. To reach these objectives, this project has for ambition to test some combination of statistics, bioinformatics and phylogenetics approaches to better analyze transcriptional data of high dimension. Data and methods integration is a key issue in this context. We work on the recognition of specific common cis-regulatory elements in a set of differentially expressed genes and on the regulation network associated to fatty acid metabolism with the aim of extracting some key regulators.

7.2.3.2. ANR Mirnadapt

Participants: Jacques Nicolas, Catherine Belleannée, Anne Siegel, Olivier Dameron, Valentin Wucher, Charles Bettembourg.

This ANR project is coordinated by UMR IGEPP, INRA Le Rheu (D. Tagu) and funded by ANR SVSE 6 "Génomique, génétique, bioinformatique, biologie systémique" from 2012 to 2014. This cooperation was strengthened by a co-tutored PhD thesis (V. Wucher) defended in Nov. 2014 [13]. It proposes an integrative study between bioinformatics, genomics and mathematical modeling focused on the transcriptional basis of the plasticity of the aphid reproduction mode in response to the modification of environment. An important set of differentially expressed mRNAs and microRNAs are available for the two modes, asexual parthenogenesis and sexual reproduction. Our work is to combine prediction methods for the detection of putative microRNA/mRNA interactions as well as transcription factor binding sites from the knowledge of genomic sequences and annotations available on this and other insects. The results will be integrated within a coherent putative interaction network and serve as a filter for the design of new targeted experiments with the hope to improve functional annotations of implied genes.

7.2.3.3. ANR Samosa

Participants: Jacques Nicolas, Catherine Belleannée, Anne Siegel, Aymeric Antoine-Lorquin, Jérémie Bourdon, François Coste.

Oceans are particularly affected by global change, which can cause e.g. increases in average sea temperature and in UV radiation fluxes onto ocean surface or a shrinkage of nutrient-rich areas. This raises the question of the capacity of marine photosynthetic microorganisms to cope with these environmental changes both at short term (physiological plasticity) and long term (e.g. gene alterations or acquisitions causing changes in fitness in a specific niche). Synechococcus cyanobacteria are among the most pertinent biological models to tackle this question, because of their ubiquity and wide abundance in the field, which allows them to be studied at all levels of organization from genes to the global ocean.

The SAMOSA project is funded by ANR from 2014 to 2018, coordinated by F. Gaczarek at the Station Biologique de Roscoff/UPMC/CNRS. The goal of the project is to develop a systems biology approach to characterize and model the main acclimation (i.e., physiological) and adaptation (i.e. evolutionary) mechanisms involved in the differential responses of Synechococcus clades/ecotypes to environmental fluctuations, with the goal to better predict their respective adaptability, and hence dynamics and distribution, in the context of global change. For this purpose, following intensive omics experimental protocol driven by our colleagues from « Station Biologique de Roscoff », we aim at constructing a gene network model sufficiently flexible to allow the integration of transcriptomic and physiological data.

7.2.4. Programs funded by research institutions

7.2.4.1. ADT Complex-biomarkers

Participants: Jeanne Cambefort, Guillaume Collet, Marie Chevallier, Anne Siegel.

This project started in Oct. 2014 and aims at designing a working environment based on workflows to assist molecular biologists to integrate large-scale omics data on non-classical species. The main goal of the workflows will be to facilitate the identification of set of regulators involved in the response of a species when challenged by an environmental stress. Applications target extremophile biotechnologies (biomining) and marine biology (micro-algae).

7.2.4.2. ANSES Mecagenotox

Participants: Victorien Delannée, Anne Siegel, Nathalie Théret.

The objective of Mecagenotox project is to characterize and model the human liver ability to bioactivate environmental contaminants during liver chronic diseases in order to assess individual susceptibility. Indeed, liver pathologies which result in the development of fibrosis are associated with a severe dysfunction of liver functions that may lead to increased susceptibility against contaminants. In this project funded by ANSES and coordinated by S. Langouet at IRSET/inserm (Univ. Rennes 1), we will combine cell biology approaches, biochemistry, biophysics, analytical chemistry and bioinformatics to 1) understand how the tension forces induced by the development of liver fibrosis alter the susceptibility of hepatocytes to certain genotoxic chemicals (especially Heterocyclic Aromatic Amines) and 2) model the behavior of xenobiotic metabolism during the liver fibrosis. Our main goal is to identify "sensitive" biomolecules in the network and to understand more comprehensively bioactivation of environmental contaminants involved in the onset of hepatocellular carcinoma.

7.2.4.3. PEPS VAG

Participants: François Coste, Jacques Nicolas, Clovis Galiez.

PEPS VAG started a collaboration between IMPMC UMR 7590, Institut de biologie de l'Ecole Normale Supérieure (IBENS) UMR8197, Atelier de Bioinformatique UPMC and Dyliss. It aims at defining the needs and means for a larger project about viruses in marine ecosystems. Indeed, we aim at developing new methods based on both sequential and structural information of proteins to improve the detection of viral sequences in marine metagenomes, to identify new viruses and to compare the viral populations specifically associated with different environment parameters (temperature, acidity, nutriments...) and ultimately to connect them with the potential hosts identified by population sequencing.

7.3. European Initiatives

7.3.1. Collaborations with Major European Organizations

Partner: EBI (Great-Britain)

Title: Modeling the logical response of a signalling network with constraints-programming.

Partner: Potsdam university (Germany)

Title: Constraint-based programming for the modelling and study of biological networks.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. INTEGRATIVEBIOCHILE

Title: Bioinformatics and mathematical methods for heterogeneous omics data

Inria principal investigator: Anne Siegel

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - Center for Mathematical Modeling - Alejandro Maass

Duration: 2011 - 2016

See also: http://www.irisa.fr/dyliss/public/EA/index.html

IntegrativeBioChile is an Associate Team between Inria project-team "Dyliss" and the "Laboratory of Bioinformatics and Mathematics of the Genome" hosted at CMM at University of Chile. The Associated team is funded from 2011 to 2016. The project aims at developing bioinformatics and mathematical methods for heterogeneous omics data. Within this program, we funded long and short stay visitings in France.

7.4.2. Inria International Labs

The Dyliss team is strongly involved in the Inria CIRIC center, and the research line "Omics integrative center": the associated team "IntegrativeBioChile", the post-doc of S. Thiele (2012) and the co-supervised of A. Aravena (2010-2013) contributed to reinforce the complementarity of both Chilean and French teams. In 2013, a workshop was organized in Chile to develop new French-Chilean collaboration within the framework of the CIRIC center. In 2014, Marie Chevallier joined the team as an engineer to reinforce software resulting from common collaborations.

7.4.3. Participation in other International Programs

7.4.3.1. International joint supervision of PhD

Title: Applying logic programming to the construction of robust predictive and multi-scale models of bioleaching bacteria [*S. Videla*]

Inria principal investigator: Anne Siegel

International Partner (Institution - Laboratory - Researcher):

University of Postdam (Germany). Department of computer science. T. Schaub.

Duration: October 2011 - September 2014

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- **Algeria**. Badji Mokhtar - Annaba University [M. Zekri]
- **Austria**. Graz university [M. Weltzer]
- **Chile**. Centro de Modelimiento Matematico, Santiago [A. Maass, P. Bordron, M.P. Cortez]
- **Germany**. Department of Computer Science, Potsdam [T. Schaub]
- **Germany**. Frei Universitat Berlin [A. Bockmayr]

7.5.1.1. Internships

Francisco Dorr

Date: Mar 2014 - Aug 2014

Institution: Universidad de Buenos Aires (Argentina)

7.5.2. Visits to International Teams

7.5.2.1. Shorts visits

- **Chile**. Centro de Modelimiento Matematico, Santiago. *Applications of ASP*. Nov. 2014 (1 to 2 weeks) [J. Bourdon, M. Chevallier, D. Eveillard, A. Siegel]

7.5.2.2. Explorer programme

Prigent Sylvain

Date: Mar 2014 - Apr 2014

Institution: FUB (Germany)

Videla Santiago

Date: Mar 2014 - May 2014

Institution: University of Potsdam (Germany)

Picard Vincent

Date: Sep 2014 - Nov 2014

Institution: The University of Tokyo, Japanese-French Laboratory for Informatics(Japan)

DYOGENE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. GdR GeoSto

Members of Dyogene participate in Research Group GeoSto (Groupement de recherche, GdR 3477) http://gdr-geostoch.math.cnrs.fr/ on Stochastic Geometry led by Pierre Calka [Université de Rouen]. This is a collaboration framework for all French research teams working in the domain of spatial stochastic modeling, both on theory development and in applications.

8.1.2. ANR

8.1.2.1. ANR GAP

Graphs, Algorithms and Probability - PI: Marc Lelarge; started in Jan 2012 - 48 months. http://www.di.ens.fr/~lelarge/ANR-GAP.html

Over the last few years, several research areas have witnessed important progress through the fruitful collaboration of mathematicians, theoretical physicists and computer scientists. One of them is the cavity method. Originating from the theory of mean field spin glasses, it is key to understanding the structure of Gibbs measures on diluted random graphs, which play a key role in many applications, ranging from statistical inference to optimization, coding and social sciences.

The objective of this project is to develop mathematical tools in order to contribute to a rigorous formalization of the cavity method:

- From local to global, the cavity method on diluted graphs. We will study the extent to which the global properties of a random process defined on some graph are determined by the local properties of interactions on this graph. To this end, we will relate the cavity method to the analysis of the complex zeros of the partition function, an approach that also comes from statistical mechanics. This will allow us to apply new techniques to the study of random processes on large diluted graphs and associated random matrices.
- Combinatorial optimization, network algorithms, statistical inference and social sciences. Motivated by combinatorial optimization problems, we will attack long-standing open questions in theoretical computer science with the new tools developed in the first project. We expect to design new distributed algorithms for communication networks and new algorithms for inference in graphical models. We will also analyze networks from an economic perspective by studying games on complex networks.

8.1.2.2. ANR MARMOTE

Markovian Modeling Tools and Environments - coordinator: Alain Jean-Marie (Inria Maestro); local coordinator (for partner Inria Paris-Rocquencourt): A. Bušić; Started: January 2013; Duration: 48 months; partners: Inria Paris-Rocquencourt (EPI DYOGENE), Inria Sophia Antipolis Méditerranée (EPI MAESTRO), Inria Grenoble Rhône-Alpes (EPI MESCAL), Université Versaillese-St Quentin, Telecom SudParis, Université Paris-Est Creteil, Université Pierre et Marie Curie.

The aim of the project is to realize a modeling environment dedicated to Markov models. One part will develop the Perfect Simulation techniques, which allow to sample from the stationary distribution of the process. A second one will develop parallelization techniques for Monte Carlo simulation. A third one will develop numerical computation techniques for a wide class of Markov models. All these developments will be integrated into a programming environment allowing the specification of models and their solution strategy. Several applications will be studied in various scientific disciplines: physics, biology, economics, network engineering.

8.1.2.3. ANR MAGNUM

A. Bušić was a participant (within partner LIP6) of the national project ANR MAGNUM (Methodes Algorithmiques pour la Generation aleatoire Non Uniforme: Modeles et applications) (2010–2014), partners: LIP6, LIAFA, IGM. http://www-apr.lip6.fr/anrMagnum/.

8.2. International Initiatives

8.2.1. Inria Associate Teams

IT-SG-WN is an Associate Team between the Inria project-team DYOGENE of Inria Paris-Rocquencourt, and the EECS department of UC Berkeley in the USA, funded from 2011 to 2014. This Associate Team participates in the Inria@SiliconValley initiative. The last visit within this program was the one month visit of Prof. Venkat Anantharam (EECS, UC Berkeley). The research work focused on network information theory, and more precisely on error exponents for Gaussian MAC Channels [38] and led to an ISIT submission lately.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Prof. Pawel Lorek from Wroclaw University (Poland) visited DYOGENE for one week.

Prof. Venkat Anantharam (EECS, UC Berkeley) visited DYOGENE in June 2014, within IT-SG-WN Inria Associate Team.

Prof. A. Rybko and Prof. A. Vladimirov (IITP RAS) visited DYOGNE in June - July 2014.

8.3.2. Visits to International Teams

Ana Bušić visited MIT (2 months) and University of Florida (4 months) from March to August 2014.

E-MOTION Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 Projects

European Project (Strep) Bambi (Bottom-up Approaches to Machines dedicated to Bayesian Inference). The Bambi project started January 1st 2014 for a period of three years. The participant to this project are CNRS, HUJI (ISRAEL), ULG (Belgique), ISR(Portugal) ProbaYes(France). We propose a theory and a hardware implementation of probabilistic computation inspired by biochemical cell signaling. We will study probabilistic computation following three axes: algebra, biology, and hardware. In each case, we will develop a bottom-up hierarchical approach starting from the elementary components, and study how to combine them to build more complex systems. We propose Bayesian gates operating on probability distributions on binary variables as the building blocks of our probabilistic algebra. These Bayesian gates can be seen as a generalization of logical operators in Boolean algebra. We propose to interpret elementary cell signalling pathways as biological implementation of these probabilistic gates. In turn, the key features of biochemical processes give new insights for new probabilistic hardware implementation. We propose to associate conventional electronics and novel stochastic nano-devices to build the required hardware elements. Combining them will lead to new artificial information processing systems, which could, in the future, outperform classical computers in tasks involving a direct interaction with the physical world. For this purpose, this project associates research in Bayesian probability theory, molecular biology, nanophysics, computer science and electronics. The e-motion team is mainly concerned by : The development of Stochastic temporal coding of probabilistic information and the adaptation and learning in probabilisitc machines

7.1.2. Collaborations with Major European Organizations

Department of Electrical & Computer Engineering: University of Thrace, Xanthi (GREECE)

Subject: 3D coverage based on Stochastic Optimization algorithms

BlueBotics: BlueBotics Company, Lausanne (Switzerland)

Subject: Implementation of self-calibration strategies for wheeled robots and SLAM algorithms for industrial purposes

Autonomous System laboratory: ETHZ, Zurich (Switzerland)

Subject: Vision and IMU data Fusion for 3D navigation in GPS denied environment.

Robotics and Perception Group: University of Zurich (Switzerland)

Subject: Vision and IMU data Fusion for 3D navigation in GPS denied environment.

Universidade de Aveiro (Portugal)

Subject: Leader following. Co-directed phD.

Centro De Automatica y Robotica, UPM-CSIC, Madrid (Spain)

Subject: Target interception.

Social Robotics Laboratory, Freiburg (Germany)

Subject: Human behavior understanding.

7.2. International Initiatives

7.2.1. "PRETIV"

[November 2011- October 2014]

Multimodal Perception and REasoning for Transnational Intelligent Vehicles" (PRETIV) is a three-year ANR project accepted in the framework of the Blanc International II Programme with participants from France (e-Motion of Inria, Heudiasyc of CNRS, PSA Peugeot Citroen DRIA in Velizy) and China (Peking University, PSA Peugeot Citroen Technical Center in Shanghai). The project aims at developing of an online multimodal perception system for a vehicle and offline reasoning methods, dealing with incompleteness and uncertainties in the models and sensor data, as well as at conducting experiments in typical traffic scenarios in France and China to create an open comparative dataset for traffic scene understanding. The perception system will incorporate vehicle localization, mapping of static environmental objects, detecting and tracking of dynamic objects in probabilistic frameworks through multimodal sensing data and knowledge fusion. The reasoning methods are based on sensor data to learn semantics, activity and interaction patterns (vehicle - other objects, vehicle - infrastructure) to be used as a priori information to devise effective online perception algorithms toward situation awareness. The comparative dataset will contain experimental data of typical traffic scenarios with ground-truth, which will be used to learn country-specific traffic semantics and it will be open to the public.

7.2.1.1. SAMPEN

Title: self adaptive mobile perception and navigation

International Partner (Institution - Laboratory - Researcher):

NTU (TAIWAN)

Duration: 2014 - 2016

See also: http://emotion.inrialpes.fr/people/spalanzani/HomeSAMPEN.html

The associate team project is a Robotic project. The aim of the project is to propose a self-adaptive system of perception combined with a system of autonomous navigation. Usually, systems of perception rely on a set of specific sensors and a calibration is done in a specific environment. We propose to develop some methods to make perception systems adaptive to the environmental context and to the set of sensors used. This perception, that can be embedded on the mobile robot as well as on home structures (wall, ceiling, floor), will be helpful to localize agents (people, robot) present in the scene. Moreover, it will give information to better understand social scenes. All information will be used by the navigation system to move with a behavior that fit the context.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Mario Garzon, PhD student at Universidade de Madrid was in our team from February 2014 until April 2014.
Yufeng Yu, PhD student at Peking University was in our team until February 2014.
Suryansh Kumar, IIIT-Hyderabad, was in our team from September 2013 to March 2014.

7.3.2. Visits to International Teams

7.3.2.1. Research stays abroad

Chiara Troiani

Date: 2013

Institution: University of Zürich (Switzerland)

ECUADOR Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. MAIDESC

Ecuador is coordinator of the ANR project MAIDESC, with Gamma team, University of Montpellier II, CEMEF-Ecole des Mines, Inria-Bordeaux, Lemma and Transvalor. MAIDESC concentrates on mesh adaptation and in particular meshes for interfaces, third-order accuracy, meshes for boundary layers, and curved meshes.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. AboutFlow

Type: PEOPLE

Instrument: Initial Training Network

Duration: 2012-2016

Coordinator: Jens-Dominik Mueller

Partner: Queen Mary University of London (UK)

Inria contact: Laurent Hascoët

Abstract: The aim of AboutFlow is to develop robust gradient-based optimisation methods using adjoint sensitivities for numerical optimisation of flows. http://aboutflow.sems.qmul.ac.uk/

8.2.1.2. UMRIDA

Type:AAT

Instrument:Aeronautics and Air Transport

Duration: 2013-2016

Coordinator: Charles Hirsch

Partner: Numeca S.A. (Belgium)

Inria contact: Alain Dervieux

Abstract: UMRIDA addresses major research challenges in Uncertainty Quantification and Robust Design: develop new methods that handle large numbers of simultaneous uncertainties and generalized geometrical uncertainties. The turn-around time must be acceptable for industrial readiness. UMRIDA will apply these methods to representative industrial configurations.

8.3. International Initiatives

8.3.1. Inria International Labs

Ecuador participates in the Joint Laboratory for Petascale Computing (JLPC) together with our colleagues at Argonne National Laboratory. In 2014, Ecuador was local organizer of the 11th workshop of the JLPC in Sophia-Antipolis, june 9-11, and of the PUF summer school on HPC systems, june 12-13.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Krishna Narayanan, from Argonne National Laboratory, visited Ecuador twice, on april 14-18 and on november 20-28
- Trond Steihaug, from University of Bergen (Norway), visited Ecuador from june 2 to june 27.
- Jan Hueckelheim, from Queen Mary University of London, did a secondment for the AboutFlow project with the Ecuador team from september 22 to november 21.

8.4.2. Visits to International Teams

- Laurent Hascoët visited Argonne National Laboratory from may 13 to may 23.
- Ala Taftaf did a secondment for the AboutFlow project with Queen Mary University of London from april 7 to june 6.

ESTASYS Exploratory Action

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. ESTASE

Participants: Axel Legay, Sean Sedwards.

ESTASE is a create project whose main objective was to initiate the creation of the plasma toolset as well as to propose new model checking algorithms for rare events.

7.1.2. Privacy

Participants: Axel Legay, Fabrizio Biondi, Jean Quilbeuf.

Privacy is a regional project whose objective is to quantify privacy of data. This includes, e.g., quantifying the anonymity of a voting protocol.

7.1.3. Variability

Participants: Axel Legay, Jin Hyun Kim, Louis-Marie Traonouez.

Variability is a regional project whose objective is to lift scheduling techniques to connected-objects. The main application of the project is Systems of Systems.

7.2. National Initiatives

7.2.1. ANR Malthy

Participants: Axel Legay, Rudolf Fahrenberg, Louis-Marie Traonouez.

The objective of this project is to study new models and techniques to reason on quantitative systems. We mainly focus on the composition of timed components in a dynamic setting.

7.2.2. BGLE SyS2Soft

Participants: Axel Legay, Thomas Given-Wilson, Cyrille Jegourel.

This national project studies various languages and techniques for quantitative systems.

7.3. European Initiatives

7.3.1. Danse

Program: FP7

Project acronym: DANSE

Project title: Designing for Adaptability and evolutioN in System of systems Engineering

Duration: mois année début - mois année fin

Coordinator: Offis

Abstract: Design and verification of Systems of Systems. We contributed by proposing the first verification engine for Heterogeneous SoS. For doing so, we have combined Plasma with Desyre that is a simulator for SoS described via the standardised FMI/FMU approach.

7.3.2. Meals

Program: Marie Curie

Project acronym: Meals

Project title: Mobility between Europe and Argentina applying Logics to Systems

Duration: Octobre 2012 – Octobre 2016

Coordinator: Germany (Saarbrucken) and Argentina ()

Abstract: Colaborative action on the topic of quantitative systems

7.3.3. Sensation

Program: Fet ProActif

Project acronym: Sensation

Project title: Self Energy-Supporting Autonomous Computation

Duration: Octobre 2012 – Octobre 2015

Coordinator: Aalborg University

Abstract: Development of new results for energy-centric systems. We contributed by proposing new algorithms for rare-event simulation.

7.3.4. DALI

Program: FP7

Project acronym: DALI

Project title: Devices for assisted living

Duration: Octobre 2011 - Octobre 2014

Coordinator: Trento University

Abstract: Development of a machine to guide a lady in a commercial center. We contributed by designing the cognitive algorithm. The machine is one example of a component of a large SoS that has its own objective but whose global behavior depends on those of other components. This is also a good illustration that our tool can be miniaturized to work in a small robot.

7.3.5. EMC2

Program: ARTEMIS

Project acronym: EMC2

Project title: Embedded Multi-Core systems for Mixed Criticality applications in dynamic and changeable real-time environments

Duration: mars 2014 – mars 2017

Coordinator: Infineon

Abstract: Large initiative on embadded systems and SoS. We will contribute with our expertise from DANSE and Sensation projects.

7.4. International Initiatives

Our team has strong collaboration with University of Namur, Carnegie Mellon University, University of Aalborg, Verimag Grenoble, and University of Waterloo. So far, those activities have not yet been funded.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

- Jan Kretinsky, PostDoc at IST Austria
- Karin Quaas, PostDoc at Leipzig University
- Kim Larsen, Professor at Aalborg University
- Zoltan Esik, Professor at University of Szeged

EXMO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Datalift

Program: ANR-ContInt

Project acronym: Datalift

Project title: DATALIFT

Instrument: platform

Duration: September 2010 - March 2014

Coordinator: Inria EXMO/François Scharffe

Participants: Jérôme Euzenat, Zhengjie Fan, Jérôme David

See also: http://www.datalift.org

Abstract: EXMO coordinates with LIRMM the DATALIFT project whose goal is to produce a platform for publishing governmental data as linked data. EXMO is particularly involved in the generation of links between datasets (see §6.3).

7.1.2. ANR Lindicle

Program: ANR-Blanc international 2

Project acronym: LINDICLE

Project title: Linking data in cross-lingual environment

Duration: January 2013 - December 2016

Coordinator: Inria EXMO/Jérôme David

Participants: Jérôme Euzenat, Manuel Atencia Arcas, Jérôme David, Tatiana Lesnikova, Adam Sanchez Ayte

Other partners: Tsinghua university (CN)

See also: http://lindicle.inrialpes.fr

Abstract: The LINDICLE project investigates multilingual data interlinking between French, English and Chinese data sources (see §6.3).

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. Ready4SmartCities

Type: CAPACITIES

Defi: ICT-2013.6.4 - Optimising Energy Systems in Smart Cities

Instrument: Coordination and Support Action

Project acronym: Ready4SmartCities

Project title: ICT Roadmap and Data Interoperability for Energy Systems in Smart Cities

Objectif: Optimising Energy Systems in Smart Cities

Duration: October 2013 - September 2015

Coordinator: D'appolonia Spa (Italy)

Other partners: D'appolonia (Italy) Universidad Politecnica de Madrid (Spain) CSTB (France), CERTH (Grèce), VTT (Finland), AIT (Austria), AEC3 (UK), Politecnico di Torino (Italy), Empirica (Germany)

Inria contact: Jérôme Euzenat

Participants: Jérôme Euzenat, Luz Maria Priego-Roche, Jérôme David, Adam Sanchez Ayte

See also: http://www.ready4smartcities.eu

Abstract: The Ready4SmartCities project aims at increasing awareness and interoperability for the adoption of OCT and semantic technologies in energy system to obtain a reduction of energy consumption and CO_2 emission at smart cities community level through innovative relying on RTF and innovation outcomes and ICT-based solutions.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- Giuseppe Pirrò (Free University of Bozen-Bolzano) visited EXMO in February 2014 working on web query languages.
- Juanzi Li and Zhigang Wang (Tsinghua university) visited EXMO in October 2014, working on multilingual data interlinking.
- Kate Revoredo and Frenanda Baião (Federal University of the State of Rio de Janeiro) visited EXMO in October, 2014, working on learning alignments.

FLOWERS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Comacina Capsule Creative

The artist community is a rich source of inspiration and can provide new perspectives to scientific and technological questions. This complementarity is a great opportunity that we want to enforce in the Poppy project by making the robot accessible to non-robotic-expert users. The first experimentation of the use of Poppy in an art project was an artist residency entitled "Étres et Numérique". Led by the artists [0] Amandine Braconnier (mixed media artist) and Marie-Aline Villard (dancer-researcher), supported by the Fabrik Pola and the Aquitaine Region, this contemporary art project focused on the way to express emotions through robotic body movement in physical interaction with a human dancer. This work took the form of a seven day art-science residency involving members of the Poppy project and the artists. During the residency, the ease of programming through the pypot library permitted to design a simple interface allowing the dancer to physically sculpt novel movements, which softness could be dynamically controlled. This residency took part in a French high school (Lycée Saintonge, Bordeaux) and was also an educational experiment where young students participated to workshops where they explored Poppy movements and physical interaction with the robot. The residency restitution was a contemporary art dance performance involving poetic choreography, alternating phases of autonomous robot movements and passive robot movements provoked by the dancer. A description of this experiment is available at: https://forum.poppy-project.org/t/artist-residency-etres-et-numerique/72.

8.1.2. Poppy at Saintonge Sainte-Famille highschool (Bordeaux)

After the artistic residency that took place in the chapel at the Saintonge Sainte Famille high school, some teachers have become interested in the educational potential of the Poppy project and would like to integrate it as a common thread into the school year.

Poppy was initially designed for research purposes and seems to be also adapted for higher education. Yet using Poppy in secondary education seems excessive as it is expensive and the use of high quality servo-actuators is not really justified. However, the experience with high-school students is still interesting and we accepted this opportunity to do a pilot experiment.

For the teachers, the main goal was to gain experience of using such tools in a project context and evaluate the potential and limitations for educational purposes. For us, we were interested in the reaction of young students to Poppy and in getting an opinion on the relevance of Poppy for education at this level. Also, it was a real crash test of our design (hardware and software) in non-experienced hands and outside the laboratory.

The experiment took place in the Saintonge Sainte Famille high school on May 26th & 27th, and involved near 40 *première STI2D* students (equivalent to UK Year 12) preparing a professional baccalaureate and three teachers (*"Energy and environment"*, *"Architecture and construction"*, and *"Digital information systems"*). It was organized as a workshop in three 4-hour sessions. The last two hours were dedicated to oral presentations in the lecture hall allowing students to share their experiences and work.

For this first pilot experiment, we decided to reduce the cost by using only a sub-part of the whole Poppy. For us the most relevant part for high-school students was the upper body (thorax, head and the two arms), because it avoids to work on complex sensory-motor behaviours such as balancing and walking while keeping the expressive potential of Poppy. The total cost of Robotis Dynamixel motors, electronics and 3D printing service was about €2500 (20 % tax included).

The student team managed to assemble a fully functional Poppy. Groups working on control were able to make a live demo of Poppy moving at the end of the workshop.

[0] Comacina Capsule Creative, http://www.comacina.org/

This experience was very instructive on several aspects relative to the usage of Poppy for education purpose. In particular, it raises some problems we would have never thought about without a "real world" experimentation in a school environement.

8.1.3. ENSAM

The orientation of a (high school) student, choosing a career, is often based on an imagined representation of a discipline, sector of activity or training. Moreover, higher education is sometimes for a college student or a student a self centered universe, with inaccessible teaching methodologies and level of competence.

The Arts and Métiers campus at Bordeaux-Talence in partnership with Inria wishes to contribute with its educational and scientific expertise to the development of new teaching methods and tools. The objective is to develop teaching sequences based on a project approach relying on an attractive multidisciplinary technological system: the humanoid Inria Poppy robot. These teaching sequences will be built and tailored to different levels of training, from high schools to Engineer schools.

The new formation "Bachelor of Technology", started in September 2014 at Ensam Bordeaux, is resolutely turned towards a project based pedagogy, outlining concepts from concrete situations. The humanoid Inria Poppy robot offers an open platform capable of providing an unifying thread for the different subjects covered during the 3-years of the Bachelor formation: mechanics, manufacturing (3D printing), electrical, mechatronics, computer sciences, design...

For the 1st and 2nd year of the ENSAM Engineer cursus, the Poppy robot can again be an interesting thread to support the teaching and to conduct further investigation.

8.1.4. DIGITEO

Alexander Gepperth is participating in two projects (PhD and PostDoc) financed by the local "Digiteo" initiative of the Plateau de Saclay.

8.2. National Initiatives

8.2.1. Hackathon at Universcience

On march 22th & 23th 2014, UniverSciences [0] organized a hackathon for the general public around the assembly of a Poppy robot. It involved 15 robotic enthusiasts, from children to adults. Participants were dispatched around several workshops during the two days. While a group was dedicated to the actual assembly of the different Poppy parts, others were exploring how to program the robot with the Python software or working on designing and 3D printing hardware improvements. Aside the workshops around Poppy, several presentations and conferences about robotics were set-up. In this context, participants are not only spectators of a scientific mediation act but also actors.

In two days, this group of new users, self-trained using online documentation have been able to build from scratch the whole robot and make it move using the Pypot library. They even designed a new original semi-passive solution for the ankle joint, as well as a robot helmet which was 3D printed and assembled within the time of the workshop. This experiment did not only show that the platform was easily usable in an educational context with users of all ages, and was rebuildable in two days by a little group, but it also showed high educational value as testified by users and educators (see https://forum.poppy-project.org/t/poppy-project-at-la-cite-des-sciences-et-de-lindustrie/)

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. 3rd HAND

Type: FP7

[0] Paris museum of sciences and technologies

Defi: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project

Objectif: Robotics, Cognitive Systems and Smart Spaces, Symbiotic Interaction

Duration: October 2013 - September 2016

Coordinator: Manuel Lopes

Partner: Universitaet Darmstadt, Germany

Partner: Stuttgart University, Germany

Partner: University of Innsbruck, Austria

Inria contact: Manuel Lopes

Abstract: Robots have been essential for keeping industrial manufacturing in Europe. Most factories have large numbers of robots in a fixed setup and few programs that produce the exact same product hundreds of thousands times. The only common interaction between the robot and the human worker has become the so-called ”emergency stop button”. As a result, re-programming robots for new or personalized products has become a key bottleneck for keeping manufacturing jobs in Europe. The core requirement to date has been the production in large numbers or at a high price. Robot-based small series production requires a major breakthrough in robotics: the development of a new class of semi-autonomous robots that can decrease this cost substantially. Such robots need to be aware of the human worker, alleviating him from the monotonous repetitive tasks while keeping him in the loop where his intelligence makes a substantial difference.

In this project, we pursue this breakthrough by developing a semi-autonomous robot assistant that acts as a third hand of a human worker. It will be straightforward to instruct even by an untrained layman worker, allow for efficient knowledge transfer between tasks and enable a effective collaboration between a human worker with a robot third hand. The main contributions of this project will be the scientific principles of semi-autonomous human-robot collaboration, a new semi-autonomous robotic system that is able to: i) learn cooperative tasks from demonstration; ii) learn from instruction; and iii) transfer knowledge between tasks and environments.

8.3.1.2. EXPLORERS

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Objectif: NC

Duration: December 2009 - November 2014

Coordinator: Pierre-Yves Oudeyer

Abstract: In spite of considerable and impressive work in artificial intelligence, machine learning, and pattern recognition in the past 50 years, we have no machine capable of adapting to the physical and social environment with the flexibility, robustness and versatility of a 6-months old human child. Instead of trying to simulate directly the adult's intelligence, EXPLORERS proposes to focus on the developmental processes that give rise to intelligence in infants by re-implementing them in machines. Framed in the developmental/epigenetic robotics research agenda, and grounded in research in human developmental psychology, its main target is to build robotic machines capable of autonomously learning and re-using a variety of skills and know-how that were not specified at design time, and with initially limited knowledge of the body and of the environment in which it will operate. This implies several fundamental issues: How can a robot discover its body and its relationships with the physical and social environment? How can it learn new skills without the intervention of an engineer? What internal motivations shall guide its exploration of vast spaces of skills? Can it learn through natural social interactions with humans? How to represent the learnt skills and how can they be re-used? EXPLORERS attacks directly those questions by proposing a

series of scientific and technological advances: 1) we will formalize and implement sophisticated systems of intrinsic motivation, responsible of organized spontaneous exploration in humans, for the regulation of the growth of complexity of learning situations; 2) intrinsic motivation systems will be used to drive the learning of forward/anticipative sensorimotor models in high-dimensional multimodal spaces, as well as the building of reusable behavioural macros; 3) intrinsically motivated exploration will be coupled with social guidance from non-engineer humans; 4) an information-theoretic framework will complement intrinsically motivated exploration to allow for the inference of body maps; 5) we will show how learnt basic sensorimotor skills can be re-used to learn the meaning of early concrete words, pushing forward human-robot mutual understanding. Furthermore, we will setup large scale experiments, in order to show how these advances can allow a high-dimensional multimodal robot to learn collections of skills continuously in a weeks-to-months time scale. This project not only addresses fundamental scientific questions, but also relates to important societal issues: personal home robots are bound to become part of everyday life in the 21st century, in particular as helpful social companions in an aging society. EXPLORERS' objectives converge to the challenges implied by this vision: robots will have to be able to adapt and learn new skills in the unknown homes of users who are not engineers.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. NEUROCURIOSITY

Title: NeuroCuriosity

International Partner (Institution - Laboratory - Researcher):

Columbia Neuroscience (ÉTATS-UNIS)

Duration: 2013 - 2015

One of the most striking aspects of human behavior is our enormous curiosity, drive for exploration. From a child feverishly examining a new toy with its hands and its eyes, to a tourist exploring a new city, to a scientist studying the brain, humans incessantly want to know. This exuberant curiosity shapes our private and social lives, and is arguably a key cognitive feature that allows our species to understand, control and alter our world. We aim to develop a novel unified biological and computational theory, which explains curiosity in the domain of visual exploration and attention as a deliberate decision motivated by learning progress. This theory will build and improve upon pioneer computational models of intrinsic motivation elaborated in developmental robotics, and be empirically evaluated in the context of visual exploration in monkeys through behavioral and brain imaging techniques. This will be the first attempt at a biological-computational framework of intrinsic motivation and perceptual exploration and their underlying cognitive mechanisms.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

Jonathan Grizou, Manuel Lopes, and Pierre-Yves Oudeyer collaborated with Inaki Itturate (EPFL) and Luis Montesano (Zaragoza University) on Calibration-Free Brain-Computer Interaction. This collaboration leaded to the following publications [45], [44] . Since then, more experiments have been performed and a journal paper will be submitted in January 2015.

Jonathan Grizou and Manuel Lopes collaborated with Sammuel Barret and Peter Stone (LARG groupd, University of Texas at Austin) on extending our work on adaptive interaction to the multi-agent domain in the adhoc team framework. Their collaboration is still active and a joint paper is in preparation for beginning of 2015.

Anna-Lisa Vollmer, Jonathan Grizou, Manuel Lopes, and Pierre-Yves Oudeyer collaborated with Katharina Rohlfing (Bielefeld University) for studying the co-construction of interaction protocol in collaborative tasks with humans. We devellopped a new experimental setup to investigate the processes used by humans to negotiate a protocol of interaction when they do not already share one. This collaboration leaded to the following publication [66].

Pierre-Yves Oudeyer worked with Linda Smith (Psychological and brain sciences department, Indiana Univ., Bloomington, US) on computational modeling of cognitive development, in particular on the role of curiosity driven processes on the evolution of language (see http://www.pyoudeyer.com/OudeyerSmithTopicsCogSci14.pdf).

Thibaut Munzer and Manuel Lopes worked with Bilal Piot (Supelec), Mathieu Geist (Supelec) and Olivier Pietquin (Lille University) to develop an Inverse Reinforcement Learning algorithm for Relational Domains.

Thibaut Munzer and Freek Stulp worked with Olivier Sigaud (ISIR, UPMC) to study regression algorithm for DMP and their impact on DMP optimization. From this collaboration resulted the publication [61].

Freek Stulp has started a cooperation with Michael Mistry at the University of Birmingham on learning inverse dynamics models. This has lead to a joint publication at the 2014 IEEE International Conference on Humanoid Robotics, where Freek Stulp and Michael Mistry presented a poster.

A cooperation with Laura Herlant of Carnegie Mellon University on discovering skill options lead to a joint publication at the 2014 IEEE/RSJ International Conference on Intelligent Robots and Systems, where Laura Herlant gave a presentation.

Gennaro Raiola and Freek Stulp presented a poster titled “Libraries of Motion Primitives as Active Virtual Fixtures for Co-manipulation” at the Forum STIC Paris-Saclay http://www.digiteo.fr/forum-stic-paris-saclay.

Egor Sattarov and Alexander Gepperth presented a poster entitled "MODALSENSE-multimodal perception architecture for intelligent vehicles" at the Forum STIC Paris-Saclay http://www.digiteo.fr/forum-stic-paris-saclay.

Alexander Gepperth and Mathieu Lefort are collaborating with the university of applied sciences of Bottrop (Germany) on the subject of multimodal hand gesture recognition. In the context of this collaboration, Alexander Gepperth supervises a PhD student, Thomas Kopinski.

Gennaro Raiola has started partially working at CEA LIST to integrate his work on virtual mechanism on the Alfred robot at CEA. This is done under the joint supervision of Freek Stulp and Xavier Lamy (CEA LIST), in the context of the DIGITEO-funded project “PrActIx”

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Luis Montesano, University of Zaragoza, Spain
- Jacqueline Gottlieb, Columbia University, USA
- Thomas Kopinski, University of Applied Sciences Bottrop, Germany
- Thomas Schultz, McGill University, Canada
- Gary Cottrell, Univ. California San Diego
- Minoru Asada, Osaka University, Japan.
- Anne Warlaumont, Univ. California at Merced, US.

8.5.2. Visits to International Teams

- Manuel Lopes visited Jan Peters at Technical University of Darmstadt
- Manuel Lopes visited Zachary Pardos at University of Berkeley
- Pierre-Yves Oudeyer visited the Center for Brain and Cognitive Development, Birbeck College, London

8.5.2.1. Explorer programme

Jonathan Grizou

Date: Aug 2014 - Sep 2014

Institution: University of Texas at Austin (USA)

Jonathan Grizou received a Inria explorer fellowship to visit the LARG groupd headed by Peter Stone at the university of Texas at Austin. He visited their lab for a month in September 2014 and worked on adhoc team problems with Sammuel Barret and Peter Stone.

FLUMINANCE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR SYSCOMM GeoFluids: Analyse et simulation d'écoulements fluides à partir de séquences d'images : application à l'étude d'écoulements géophysiques

Participants: Dominique Heitz, Etienne Mémin.

duration 48 months.

The project Geo-FLUIDS focuses on the specification of tools to analyze geophysical fluid flows from image sequences. Geo-FLUIDS aims at providing image-based methods using physically consistent models to extract meaningful features describing the observed flow and to unveil the dynamical properties of this flow. The main targeted application domains concern Oceanography and Meteorology. The project consortium gathers the Inria research groups: FLUMINANCE (leader), CLIME and MOISE. The group of the "Laboratoire de Météorologie Dynamique" located at the ENS Paris, the IFREMER-CERSAT group located at Brest and the METEOFRANCE GMAP group in Toulouse.

8.1.2. ANR JCJC GERONIMO : Advanced GEophysical Reduced-Order Model construction from IMage Observations

Participant: Cédric Herzet.

duration 48 months. The GERONIMO project which starts in March 2014 aims at devising new efficient and effective techniques for the design of geophysical reduced-order models from image data. The project both arises from the crucial need of accurate low-order descriptions of highly-complex geophysical phenomena and the recent numerical revolution which has supplied the geophysical scientists with an unprecedented volume of image data. The project is placed at the intersection of several fields of expertise (Bayesian inference, matrix factorization, sparse representations, etc.) which will be combined to handle the uncertainties associated to image measurements and to characterize the accurate reduced dynamical systems.

8.1.3. INSU-LEFE: Toward new methods for the estimation of sub-meso scale oceanic streams

Participant: Cédric Herzet.

duration 36 months. This project tackles the problem of deriving a precise submesoscale characterization of ocean currents from satellite data. The targeted methodologies should in particular enable the exploitation of data of different nature (for example sea surface temperature or height) and/or resolutions. This 36-month project benefits from a collaboration with the Laboratoire de Météorologie Dynamique, Ecole Normale Supérieure, Paris.

8.1.4. INSU-LEFE: MODELER

Participant: Etienne Mémin.

duration 24 months. This project with MeteoFrance aims at exploring error modeling and stochastic parameterization in geophysical flow dynamics. The theory explored in this context should enable the construction of unified image data assimilation strategies.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

Universidad de Buenos Aires (ARGENTINA) We have maintained academic exchanges with the group of Guillermo Artana.

Chico California State University (USA), We have pursue our collaboration with the group of Shane Mayor on the GPU implementation of wavelet based motion estimator for Lidar data. This code is developped in coproperty between Inria and Chico.

8.2.2. Participation In other International Programs

SticAMSUD project Voiceproduction leaded by Denisse Sciamarella (CNRS, LIMSI)

FOCUS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

- AEOLUS (Mastering the Cloud Complexity) is an ANR-ARPEGE project started on December 2010 that finished on December 2014. AEOLUS studies the problem of installation, maintenance and update of package-based software distributions in cloud-based distributed systems. The problem consists of representing the dependencies of packages and the inter-relationships among the services, in such a way that starting from a declarative description of the application to be deployed on the cloud, it is possible to automatically compute the resources (ie. virtual machines) to be acquired, and the allocation of such resources to the software services needed to run the application. Main persons involved: Gabbrielli, Lienhardt, Mauro, Zavattaro.
- REVER (Programming Reversible Recoverable Systems) is an ANR project that started on 1st December 2011 and with a 48-month duration. REVER aims to study the possibility of defining semantically well-founded and composable abstractions for dependable computing on the basis of a reversible programming language substrate, where reversibility means the ability to undo any distributed program execution, possibly step by step. The critical assumption behind REVER is that by adopting a reversible model of computation, and by combining it with appropriate notions of compensation and modularity, one can develop systematic and composable abstractions for recoverable and dependable systems. Main persons involved: Giachino, Lienhardt, Lanese, Laneve, Zavattaro.
- PACE (Processus non-standard: Analyse, Coinduction, et Expressivité) is an ANR project that started in 2013. The project targets three fundamental ingredients in theories of concurrent processes, namely coinduction, expressiveness, and analysis techniques. The project aims at processes that are beyond the realm of "traditional" processes. Specifically, the models studied exhibit one or more of the following features: probabilities, higher-order, quantum, constraints, knowledge, and confidentiality. These models are becoming increasingly more important for today's applications. Coinduction is intended to play a pivotal role. Indeed, the approaches to expressiveness and the analysis techniques considered in the project are based on coinductive equalities. Main persons involved: Hirschkoff (project coordinator), Dal Lago, Lanese, Sangiorgi, Zavattaro.
- ELICA (Expanding Logical Ideas for Complexity Analysis) is an ANR project which started on October 2014 and that we will finish on September 2018. ELICA is a project about methodologies for the static analysis of programs as for their resource consumption. The project's aim is to further improve on logical methodologies for complexity analysis (type systems, rewriting, etc.). More specifically, one would like to have more powerful techniques with less false negatives, being able at the same time to deal with nonstandard programming paradigms (concurrent, probabilistic, etc.). Main persons involved: Avanzini, Cappai, Dal Lago, Hirschkoff, Martini, Sangiorgi.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

- ENVISAGE (Engineering Virtualized Services) is a EU FP7 project, with starting date October 1st, 2013, and with a 3-year duration. The project is about model-based development of virtualized services, including tool support for resource analysis. Most Focus members are involved.

7.2.2. Collaborations in European Programs, except FP7

- The ICT COST Action BETTY (Behavioural Types for Reliable Large-Scale Software Systems), initiated in October 2012 and with a four-year duration, uses behavioural type theory as the basis for new foundations, programming languages, and software development methods for communication-intensive distributed systems. Behavioural type theory encompasses concepts such as interfaces, communication protocols, contracts, and choreography. Main persons involved: Bravetti, Giachino, Hirschkoff, Lanese, Laneve, Mauro, Sangiorgi, Zavattaro.

7.2.3. Collaborations with Major European Organizations

Simone Martini is a member of the Executive Board of EQANIE (European Quality Assurance Network for Informatics Education), from October 2014.

We list here the cooperations and contacts with other groups, without repeating those already listed in previous sections.

- ENS Lyon (on concurrency models and resource control). Contact person(s) in Focus: Dal Lago, Martini, Sangiorgi, Vignudelli. Some visit exchanges during the year, in both directions. One joint PhD supervision (J.-M. Madiot).
- Inria EPI Spades (on models and languages for components, reversibility). Contact person(s) in Focus: Lanese. Some visit exchanges during the year, in both directions.
- Laboratoire d'Informatique, Université Paris Nord, Villetaneuse (on implicit computational complexity). Contact person(s) in Focus: Dal Lago, Martini. An Italian PhD student (Marco Solieri) is working on his PhD thesis with joint supervision (Martini, Guerrini).
- Institut de Mathématiques de Luminy, Marseille (on lambda-calculi, linear logic and semantics). Contact person(s) in Focus: Dal Lago, Martini. One joint PhD supervision (Michele Alberti).
- Team PPS, University of Paris-Diderot Paris 7 (on logics for processes, resource control). Contact person(s) in Focus: Dal Lago, Martini, Sangiorgi. Some short visits in both directions during the year.
- IRILL Lab, Paris (on models for the representation of dependencies in distributed package based software distributions). Contact person(s) in Focus: Mauro, Zavattaro. Some short visits in both directions during the year.
- EPI Carte, Inria-Nancy Grand Est and LORIA (on implicit computational complexity). Contact person(s) in Focus: Dal Lago.
- LMU Munich (M. Hofmann) (on Implicit computational complexity and IntML). Contact person(s) in Focus: Dal Lago.
- IMDEA Software, Madrid (G. Barthe) (on Implicit computational complexity for cryptography). Contact person(s) in Focus: Dal Lago,Sangiorgi. Some visits during 2014.
- Facultad de Informatica, Universidad Complutense de Madrid (on web services). Contact person(s) in Focus: Bravetti. Bravetti is an external collaborator in the project "ESTuDIo: ESpecificacion y Testing de sistemas altamente DIstribuidos" (Specification and Testing of Highly Distributed Systems) January 1, 2013 - December 31, 2015 (3 years), funded by the Spanish Ministerio de Economia y Competitividad.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

The following researchers have visited Focus for short periods; we list them together with the title of the talk they have given during their stay, or the topic discussed during their stay.

- Luca Padovani (Turin) "Deadlock and lock freedom in the linear pi-calculus".
- Jean-Bernard Stefani (Inria Grenoble), "Strong isolation in actor systems".
- Mauro Caporuscio (Milan): "Prime: A middleware support for fluid distributed systems".

- Fabrizio Montesi (Copenhagen): "Choreographic Programming".
- Marco Carbone (Copenhagen): "Behavioural types for adaptable service composition".
- Sandro Etalle (Eindhoven), "Signature-Less Network Intrusion Detection: from the research table to the production environments."
- Wolf Zimmermann (Halle, Germany), "Automatic Protocol Conformance Checking in Component-Based and Service-Oriented Systems."
- Lars Kotthoff (Cork, Ireland), "Towards an algorithm selection standard: data format and tools."
- Herbert Wiklicky (London), "Quantitative Aspects in Program Synthesis."
- Naoki Kobayashi (Tokyo), "Model checking higher-order programs".
- Benoit Valiron and Claudia Faggian (Paris), "Geometry of Synchronization"
- Marc Bagnol (Marseille), "On the Resolution Semiring"
- Irek Ulidowski (Leicester), on the topic of reversibility.

7.3.1.1. Internships

Raphaelle Crubille, from ENS Lyon, has begun a stage in Focus during 2014, under the supervision of Ugo Dal Lago.

FUN Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Tracaverre

Participants: Nathalie Mitton [correspondant], Gabriele Sabatino.

Title: Tracaverre

Type: FUI

Duration: November 2012 - Avril 2015

Coordinator: Saver Glass

Others partners: Inria FUN IEMN Courbon Camus La Grande Marque LIRIS DISP

Abstract: Tracaverre studies the use of RFID for traceability of prestigious bottles. Tracaverre has yielded to the implementation of the T-Scan software.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. RESCUE

Participants: Nathalie Mitton, Karen Miranda, Tahiry Razafindralambo [correspondant].

Title: Reseau Coordonne de substitution mobile

Type: VERSO

Duration: December 2010 - April 2014

Coordinator: Inria FUN

Other partners: LAAS UPMC France Telecom ENS Lyon

See also: http://rescue.lille.inria.fr/

Abstract: In RESCUE, we propose to exploit the controlled mobility of mobile routers to help a base network in trouble provide a better service. The base network may be any access network or metropolitan network (including wired and wireless technologies). Troubles may come from an increase of unplanned traffic, a failure of an equipment, or a power outage.

When no backup networks are available, it would be interesting to deploy, for a limited time corresponding to the period of the problem (i.e., failure or traffic overload), a substitution network to help the base network keep providing services to users. In the RESCUE project, we will investigate both the underlying mechanisms and the deployment of a substitution network composed of a fleet of dirigible wireless mobile routers. Unlike many projects and other scientific works that consider mobility as a drawback, in RESCUE we use the controlled mobility of the substitution network to help the base network reduce contention or to create an alternative network in case of failure.

7.2.1.2. BinThatThinks

Participant: Nathalie Mitton [correspondant].

Title: BinThatThinks

Type: ECOTECH

Duration: November 2010 - March 2014

Coordinator: Inria ACES (Rennes)

Other partners: Etineo Veolia

See also: http://binthatthink.inria.fr/

Abstract: Efficient dust sorting is a main challenge for the current society. BinThatThinks is a research project that aims to propose a system that makes the collect and sorting easier through the use of RFID and sensors. Publications in 2014 in the framework of this project are: [12], [13].

7.2.2. ADT

7.2.2.1. MiAOU

Participants: Ibrahim Amadou, Rim Driss, Nathalie Mitton [correspondant], Loic Schmidt, Julien Vandaele.

Title: Middleware Application to Optimal Use (MiAOU)

Type: ADT

Duration: December 2012 - November 2014

Coordinator: Inria FUN

Abstract: Miaou is an ADT that aims to promote the AspireRFID middleware to a new level of manageability and usability. Miaou has yielded to a software module.

7.2.2.2. ARUNTA

Participants: Emilio Compagnone, Valeria Loscri [correspondant], Julien Vandaele, Sonja Nienaber.

Title: Arduino-based Robots for Ubiquitous Network (ARUNTA)

Type: ADT

Duration: September 2014 - August 2016

Coordinator: Inria FUN

Abstract: This ADT focuses on the use of Arduino, an open-source electronics prototyping platform, really flexible and easy-to-use [1] to allow a fleet of robots to perform specific tasks. The goal of the ADT is to make experiments on Arduino-based robotic platforms, by implementing two robot cooperation algorithms that have been already tested through simulation tools. In order to extend the users' community and to allow more people to benefit from this research on robot cooperation, this ADT will output a tutorial and a test-bed will be developed. Moreover, the final project will be shared with the Arduino community and every interested user.

7.2.3. Equipements d'Excellence

7.2.3.1. FIT

Participants: Raymond Borenstein, Nathalie Mitton [correspondant], Anne-Sophie Tonneau, Julien Vandaele, Roberto Quilez.

Title: Future Internet of Things

Type: EquipEx

Duration: March 2010 - December 2019

Coordinator: UPMC

See also: http://fit-equipex.fr/

Abstract: FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet.

FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's "Equipements d'Excellence" (Equipex) research grant program. Coordinated by Professor Serge Fdida of UPMC Sorbonne Universités and running over a nine-year period, the project will benefit from a 5.8 million euro grant from the French government.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

7.3.1.1. VITAL

Participants: Nathalie Mitton [correspondant], Valeria Loscri, Riccardo Petrolo.

Type: FP7
Defi: Pervasive and Trusted Network and Service Infrastructure
Instrument: Specific Targeted Research Project
Objectif: A reliable, smart and secure Internet of Things for Smart Cities
Duration: September 2013 - August 2016
Coordinator: DERI
Partner: National University of Ireland (NUI), Inria, Reply (Italy), Silo (Greece), Atos (Spain), AIT (Greece), IMAGES (UK), Camden Town Unlimited (UK), ITU (Turkey), Istanbul Metropolitan Municipality (Turkey)
Inria contact: Nathalie Mitton
Abstract: Internet-of-Things (IoT) applications are currently based on multiple architectures, standards and platforms, which have led to a highly fragmented IoT landscape. This fragmentation is evident in the area of smart cities, which typically comprise several technological silos (i.e. IoT systems that have been developed and deployed independently). Nowadays there is a pressing need to remove these silos in order to allow cities to share data across systems and coordinate processes across domains, thereby essentially improving sustainability and quality of life. In response to this need, VITAL will realize a radical shift in the development, deployment and operation of IoT applications, through introducing an abstract virtualized digital layer that will operate across multiple IoT architectures, platforms and business contexts. Specifically, VITAL will provide platform and business context agnostic access to Internet-Connected-Objects (ICO). Moreover, it will research virtualized filtering, complex event processing (CEP) and business process management mechanisms, which will be operational over a variety of IoT architectures/ecosystems. The mechanisms will compromise the diverse characteristics of the underlying ecosystems, thereby boosting interoperability at the technical and business levels. VITAL will also provide development and governance tools, which will leverage the project's interfaces for virtualized access to ICOs. VITAL will allow solution providers to (re)use a wider range of data steams, thereby increasing the scope of potential applications. It will also enable a more connected/integrated approach to smart city applications development, which will be validated in realistic deployments in London and Istanbul. The partners will contribute and adapt a host of readily available urban infrastructures, IoT platforms and novel IoT applications, which will ease the accomplishment of the project's goals based on an optimal value for EC money.

Publications in 2014 in the framework of this project are: [6], [7], [11], [21], [22].

7.4. International Initiatives

7.4.1. Inria International Labs

7.4.1.1. PREDNET

Participants: Nathalie Mitton [correspondant], Viktor Toldov, Julien Vandaele, Cesar Marchal.

Title: Predator network
Type: LIRIMA
Duration: January 2013 - December 2016
See also: https://iww.inria.fr/prednet/en/
Abstract: PREDNET (PREDator adhoc NETwork) proposes to do research on the most suitable topology and subsequent deployment of a wireless sensor network for sparsely populated outlying rural and wilderness areas, for effective monitoring and protection of resources and ecosystems. This collaboration gave birth to joint project submission, joint conference organization and several publications, among them for 2014: [36]

7.4.1.2. CIRIC Chile

Participant: Tahiry Razafindralambo.

Tahiry Razafindralambo is in leave at Inria Chile since August 2013 until April 2014. Tahiry's project within Inria Chile is linked to a project developed by NIC research Labs - Chile (Dr. Javier Bustos, Ms. Carolina Sandoval, Mr. Felipe Lema and Ms. Karina Ventura) regarding Quality of Experience, the Universidad de Chile (Pr. Nelson Baloian and Pr. Gustavo Zurita Alarcon) regarding data display, Psicomedica regarding the clinical aspect regarding the wireless sensor networks aspect. The proposed project tries to evaluate the user perception regarding a wearable monitoring system. The Wearable monitoring system will be installed on patients with mental diseases to monitor their body temperatures, heart rate, ...

7.4.1.3. Declared Inria International Partners

Title: Palmares

International Partner (Institution - Laboratory - Researcher):

Université Mediterranea di Reggio Calabria (UNIC) (Italy)

Duration: 2014 - 2016

See also: http://www.palmares.unirc.it

Objective of this collaboration is the design of an innovative architecture that enables autonomic and decentralized fruition of the services offered by the network of smart objects in many heterogeneous and dynamic environments, in a way that is independent of the network topology, reliable and flexible. The result is an 'ecosystem' of objects, self-organized and self-sustained, capable of making data and services available to the users wherever and whenever required, thus supporting the fruition of an 'augmented' reality thanks to a new environmental and social awareness. This collaboration gave birth to the PALMARES project (see section International programs), students and researchers exchanges (see section international visits) and joint publications, among them for 2014: [1], [2], [28], [29], [23], [13].

7.4.1.4. Informal International Partners

Southern University, China

The purpose of this collaboration is to study the green (or energy-efficient) communication problem in vehicular ad hoc networks (VANETs) and the application of vehicular network communication in green transportation. It gave birth to joint project submission, joint conference organization and several publications, among them for 2014: [26], [27].

7.4.1.5. PhD co-supervision

PhD co-supervision with Sfax University

Since January 2013, Nathalie Mitton co-supervises Mouna Rekik as a PhD student with Pr Zied Chtourou from Université de Sfax, Tunisia. Her topic is about swarm intelligence based multi-path geographic routing for wireless sensor and actuator networks.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

Several researchers have visited our group in 2014, mainly from our partner universities but not only:

- Marthinus Johannes Booysen, Univ. Stellenbosch, South Africa, July 2014
- Zied Chtourou, Univ. Sfax, Tunisia, June and December 2014
- Riaan Wolhuter, Univ. Stellenbosch, South Africa, March and June 2014
- Willem Smit, Univ. Stellenbosch, South Africa, July 2014
- OP Vyas, Indian Institute of Information Technology, India July 2014

In addition, 2 ERCIM fellows have visited us for a week : Andrea Hess and Matthew Orlinski.

7.5.1.1. Internships

We have hosted and supervised several master students. Some came to run their master internship in our lab, like

Christos Katsikiotis from Athenes University, Greece (6 months), Abdoul-Aziz Mbacke from Université Anta Diop in Senegal (6 months), Siavash Mohamadabadi from UPMC (4 months), Basile Mona from Université Jules Vernes (4 months)/.

Other students have visited us from our partner universities in the framework of the joint project we run together. This is the case for Sonja Nienaber (4 months) and Adriaan Zeeman (4 months) who came from Stellenbosch university, South Africa, in the framework of the Prednet program and Nicola Zema from our International partner University of Reggio Calabria, Italy (6 months).

7.5.2. Visits to International Teams

- Roudy Dagher visited University of Brno, Czech Republic a week in May 2014.
- Roudy Dagher visited University of Santanders, Spain in July 2014.
- Viktor Toldov visited Stellenbosch University, South Africa for 2 months (Oct-dec 2014).

7.5.2.1. Research stays abroad

Tahiry Razafindralambo spent 20 months in Chile (See other section).

GALAAD2 Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. GEOLMI

GEOLMI - Geometry and Algebra of Linear Matrix Inequalities with Systems Control Applications - is an ANR project working on topics related to the Geometry of determinantal varieties, positive polynomials, computational algebraic geometry, semidefinite programming and systems control applications.

The partners are LAAS-CNRS, Univ. de Toulouse (coordinator), LJK-CNRS, Univ. Joseph Fourier de Grenoble; Inria Sophia Antipolis Méditerranée; LIP6-CNRS Univ. Pierre et Marie Curie; Univ. de Pau et des Pays de l'Adour; IRMAR-CNRS, Univ. de Rennes.

More information available at http://homepages.laas.fr/henrion/geolmi.

8.1.2. ANEMOS

ANEMOS - Advanced Numeric for ELMs (Edge Localized Mode) : Modeling and Optimized Schemes - is an ANR project devoted to the numerical modelling study of such ELM control methods as Resonant Magnetic Perturbations (RMPs) and pellet ELM pacing both foreseen in ITER. The goals of the project are to improve understanding of the related physics and propose possible new strategies to improve effectiveness of ELM control techniques. The study of spline spaces for isogemetric finite element methods is proposed in this context.

The partners are IRFM, CEA, Cadarache; JAD, University of Nice - Sophia Antipolis; Inria, Bacchus; Maison de la Simulation CEA-CNRS-Inria-University of Orsay- University of Versailles St Quentin.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. TERRIFIC

Title: Towards Enhanced Integration of Design and Production in the Factory of the Future through Isogeometric Technologies

Type: COOPERATION (ICT)

Defi: PPP FoF: Digital factories: Manufactoring design and product lifecycle manage

Instrument: Specific Targeted Research Project (STREP)

Duration: September 2011 - August 2014

Coordinator: SINTEF, Oslo (Norway)

Others partners:

Alenia Aeronautica (Italy); Inria Méditerranée (France); Jozef Kepler universitet, Linz (Austria); JOTNE, Oslo (Norway); MAGNA, Steyr (Austria); Missler Software (France); Siemens AG (Germany); Technische Universität Kaiserslautern (Germany); University of Pavia (Italy).

See also: http://terrific-project.eu

Abstract: The project aims at significant improvement of the interoperability of computational tools for the design, analysis and optimization of functional products. An isogeometric approach is applied for selected manufacturing application areas (cars, trains, aircrafts) and for computer-aided machining. Computer Aided Design (CAD) and numerical simulation algorithms are vital technologies in modern product development, yet they are today far from being seamlessly integrated. Their interoperability is severely disturbed by inconsistencies in the mathematical approaches used. Efficient feedback from analysis to CAD and iterative refinement of the analysis model is a feature of isogeometric analysis, and would be an essential improvement for computer-based design optimization and virtual product development. Our vision is to provide and disseminate tangible evidence of the performance of the isogeometric approach in comparison to traditional ones in four important application areas as well as addressing interoperability and other issues that necessarily arise in a large-scale industrial introduction of isogeometry.

8.3. International Initiatives

8.3.1. Participation In other International Programs

We have a bilateral collaboration between Galaad and the University of Athens-DIT team ERGA, headed by Ioannis Emiris for the period August 2013-August 2014. It is supported by both Inria and the University of Athens.

Title: Algebraic algorithms in optimization

Abstract: In the past decade, algebraic approaches to optimization problems defined in terms of multivariate polynomials have been intensively explored and studied in several directions. One example is the work on semidefinite optimization and, more recently, convex algebraic geometry. This project aims to focus on algebraic approaches for optimization applications in the wide sense. We concentrate on specific tools, namely root counting techniques, the resultant, the discriminant and non-negative polynomials, on which the two teams have extensive collaboration and expertise. We examine applications in convex algebraic geometry as well as to a newer topic for the two teams, namely game theory. A common thread to these approaches is to exploit any (sparse) structure.

We participate to a bilateral collaboration between France and Spain which is supported as a PICS from CNRS. The Spanish partner is the University of Barcelona (J. Burgos, C. D'Andrea, Martin Sombra) and the French partners are The university of Caen (F. Amoroso, M. Weimann), the University of Paris 6 (M. Chardin, P. Philippon) and GALAAD (L. Busé).

Title: Diophantine Geometry and Computer Algebra

Abstract: This project aims at exploring interactions between diophantine geometry and computer algebra by stimulating collaborations between experts in both domains. The research program focus on five particular topics : toric varieties and height, equidistribution, Diophantine geometry and complexity, Factorization of multivariate polynomials by means of toric geometry and study of singularities of toric parameterizations.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Chandrajit Bajaj, professor at University of Austin, Texas, USA, September 14-28.

Nicolàs Botbol, researcher CONICET, University of Buenos Aires, Argentina, March 10-23.

Philippe Trébuchet, LIP6, University of Paris 6, France, May 4-11.

Nelly Villamizar, researcher at RICAM, University of Linz, Austria, February 19-26.

8.4.2. Visits to International Teams

8.4.2.1. Research stays abroad

Evelyne Hubert was invited to participate to the program on *Inverse Moment Problems: the Crossroads of Analysis, Algebra, Discrete Geometry and Combinatorics* at the Institute for Mathematical Science at the National University of Singapore (December 1013 - January 2014).

GALEN Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Excellence Clusters

- Program: DIGITEO (Chair)

  Project acronym: SubSample

  Project title: Identification and prediction of Salient brain States through probabilistic structure learning towards fusion of imaging and genomic date

  Duration: 01/2012-12/2015

  Coordinator: ECP - FR
- Program: DIGITEO (OMTE)

  Project acronym: Curator

  Project title: Real-time 2D/3D Deformable Fusion Towards Computer Assisted Surgery

  Duration: 01/2013-01/2015

  Coordinator: ECP - FR
- Program: DIGITEO
  - Project acronym: SOPRANO
  - Project title: Structured Output Prediction on Large Scale Neuroscience Data
  - Duration: 3/2013-3/2016
  - Coordinator: Ecole Centrale Paris - FR
- Program: MEDICEN

  Project acronym: ADOC

  Project title: ADOC – Diagnostic peropératoire numérique en chirurgie du cancer

  Duration: 11/2011-09/2015

  Coordinator: LLTECH - FR

8.2. National Initiatives

8.2.1. ANR

- Program: ANR Blanc International

  Project acronym: ADAMANTIUS

  Project title: Automatic Detection And characterization of residual Masses in pAtients with lymphomas through fusioN of whole-body diffusion-weighTed mrI on 3T and 18F-flUorodeoxyglucoSe pet/ct

  Duration: 9/2012-8/2015

  Coordinator: CHU Henri Mondor - FR
- Program: ANR JCJC

  Project acronym: HICORE

  Project title: HIerarchical COmpositional REpresentations for Computer Vision

  Duration: 10/2010-9/2014

Coordinator: ECP - FR

- Program: ANR JCJC

  Project acronym: LearnCost

  Project title: Learning Model Constraints for Structured Prediction

  Duration: 2014-2018

  Coordinator: Inria Saclay - FR

- Program: ITMOs Cancer & Technologies pour la santé d'Aviesan / INCa

  Project acronym: CURATOR

  Project title: Slice-to-Image Deformable Registration towards Image-based Surgery Navigation & Guidance

  Duration: 12/2013-11/2015

  Coordinator: ECP - FR

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. DIOCLES

Type: FP7

Instrument: European Research Council

Duration: September 2011 - August 2016

Coordinator: Nikos Paragios

Partner: Ecole Centrale de Paris (FR)

Inria contact: Nikos Paragios

8.3.1.2. MOBOT

Type: FP7

Defi: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project

Objectif: Cognitive Systems and Robotics

Duration: February 2013 - January 2016

Coordinator: Angelika Peer

Partner: University of Bristol (UK)

Inria contact: Iasonas Kokkinos

8.3.1.3. I-SUPPORT

Type: H2020

Defi: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project

Objectif: Cognitive Systems and Robotics

Duration: March 2015 - February 2018

Coordinator: Rafa Lopez

Partner: Robotnik Automation (Spain)

Inria contact: Iasonas Kokkinos

8.3.1.4. RECONFIG

Type: FP7

Defi: Cognitive Systems and Robotics
Instrument: Specific Targeted Research Project
Objectif: Cognitive Systems and Robotics
Duration: February 2013 - January 2016
Coordinator: Dimos Dimarogonas
Partner: KTH (SE)
Inria contact: Iasonas Kokkinos

8.3.1.5. Strategie

Type: FP7
Instrument: Career Integration Grant
Duration: January 2014 - December 2017
Coordinator: Inria
Inria contact: Matthew Blaschko

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. SPLENDID

Title: Self-Paced Learning for Exploiting Noisy, Diverse or Incomplete Data
International Partner (Institution - Laboratory - Researcher):
Stanford University (ÉTATS-UNIS)
Duration: 2012 - 2014
See also: http://cvn.ecp.fr/personnel/pawan/research/splendid.html

The goal of the project is to develop methods for learning accurate probabilistic models using diverse (consisting of fully and weakly supervised samples), incomplete (consisting of partially labeled samples) and noisy (consisting of mislabeled samples) data. To this end, we will build on the intuitions gained from self-paced human learning, where a child is first taught simple concepts using simple examples, and gradually increasing the complexity of the concepts and the examples. In the context of machine learning, we aim to impart the learner with the ability to iteratively adapt the model complexity and process the training data in a meaningful order. The efficacy of the developed methods will be tested on several real world computer vision and medical imaging applications using large, inexpensively assembled datasets.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

Europe

- Technical University of Munich (DE) – Collaborative research with the Chair for Computer Aided Medical Procedures& Augmented Reality at the department of Computer Science. Collaboration Topic: Graph-based methods for linear/deformable registration, segmentation, and tracking.
- University College London (UK) – Collaborative research with the Gatsby Computational Neuroscience Unit. Collaboration Topic: Kernel measures of dependence.
- University of Oxford (UK) – Collaborative research with the Visual Geometry Group of the Department of Engineering Science. Collaboration Topic: Structured prediction and parts-based models.
- University of Oulu (Finland) – Collaborative research with the Machine Vision Group at the department of Electrical Engineering. Collaboration Topic: Ranking based learning algorithms for cascaded object detection.

Americas

- University of California at Los Angeles (US) – Collaborative research with the UCLA Vision Lab and the UCLA Center for Cognition, Vision, and Learning Lab at the Departments of Computer Science and Statistics. Collaboration Topic: Action Recognition & Object Detection Parsing.
- University of Pensylvania (USA) – Collaborative research with the section of Biomedical Imaging of the Department of Radiology. Collaboration Topic: Graph-based methods for linear/deformable registration.
- StonyBrook University, Computer Science Department (USA) – Collaborative research with the image analysis lab in the context of the SubSample DIGITEO Chair. Collaboration Topic: Higher Order Graph-based methods in graph-matching, cocaine addiction analysis with sparse graph models, object detection and implicit 3D pose estimation
- Ecole Polytechnique de Montreal (CA) – Collaborative research with the Canada Research Chair in Medical Imaging and Assisted Interventions. Collaboration Topic: Higher Order Graph-based methods in Spine Imaging
- University of Colorado, Department of Computer Science (USA) - Research with the Autonomous Robotics & Perception Group. Collaboration topic: Large scale video segmentation using efficient approximations to a graph Laplacian.

Asia

- International Institute of Information Technology, Hyderabad (India) – Collaborative research with Center for Visual Information Technology. Collaboration Topic: Average precision with weak supervision and self-paced learning for deep convolutional neural networks.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Professor Maragos, Petros: Technical University of Athens, GR (October 2014)

8.5.1.1. Internships

- Gastounioti, Aimilia: Technical University of Athens, GR (from February until June 2014)
- Trulls, Eduard: Universitat Politècnica de Catalunya, ES (from June until October 2014)
- Vedantam, Shanmukha Ramakrishna: Virginia Tech, USA (from June 2014 until August 2014)]

8.5.2. Visits to International Teams

- Ferrante, Enzo: Stanford University, USA (from June to September 2014)

8.5.2.1. Research stays abroad

- Boussaid, Haithem: University of Pennsylvania, USA (from June to September 2014)
- Togkas, Stavros: Oxford University, UK (from August to November 2014)

GALLIUM Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR projects

8.1.1.1. BWare

Participants: Damien Doligez, Fabrice Le Fessant.

The "BWare" project (2012-2016) is coordinated by David Delahaye at Conservatoire National des Arts et Métiers and funded by the *Ingénierie Numérique et Sécurité* programme of *Agence Nationale de la Recherche*. BWare is an industrial research project that aims to provide a mechanized framework to support the automated verification of proof obligations coming from the development of industrial applications using the B method and requiring high guarantees of confidence.

8.1.1.2. Paral-ITP

Participant: Damien Doligez.

The "Paral-ITP" project (2011-2014) is coordinated by Burkhart Wolff at Université Paris Sud and funded by the *Ingénierie Numérique et Sécurité* programme of *Agence Nationale de la Recherche*. The objective of Paral-ITP is to investigate the parallelization of interactive theorem provers such as Coq and Isabelle.

8.1.1.3. Verasco

Participants: Jacques-Henri Jourdan, Xavier Leroy.

The "Verasco" project (2012-2015) is coordinated by Xavier Leroy and funded by the *Ingéniérie Numérique et Sécurité* programme of *Agence Nationale de la Recherche*. The objective of this 4-year project is to develop and formally verify a static analyzer based on abstract interpretation, and interface it with the CompCert C verified compiler.

8.1.2. FSN projects

8.1.2.1. ADN4SE

Participants: Damien Doligez, Jael Kriener.

The "ADN4SE" project (2012-2016) is coordinated by the Sherpa Engineering company and funded by the *Briques Génériques du Logiciel Embarqué* programme of *Fonds national pour la Société Numérique*. The aim of this project is to develop a process and a set of tools to support the rapid development of embedded software with strong safety constraints. Gallium is involved in this project to provide tools and help for the formal verification in TLA+ of some important aspects of the PharOS real-time kernel, on which the whole project is based.

8.1.2.2. CEEC

Participants: Thomas Braibant, Maxime Dénès, Xavier Leroy.

The "CEEC" project (2011-2014) is coordinated by the Prove & Run company and also involves Esterel Technologies and Trusted Labs. It is funded by the *Briques Génériques du Logiciel Embarqué* programme of *Fonds national pour la Société Numérique*. The CEEC project develops an environment for the development and certification of high-security software, centered on a new domain-specific language designed by Prove & Run. Our involvement in this project focuses on the formal verification of a C code generator for this domain-specific language, and its interface with the CompCert C verified compiler.

8.1.3. FUI projects

8.1.3.1. Richelieu

Participants: Michael Laporte, Fabrice Le Fessant.

The "Richelieu" project (2012-2014) is funded by the *Fonds unique interministériel* (FUI). It involves Scilab Enterprises, U. Pierre et Marie Curie, Dassault Aviation, ArcelorMittal, CNES, Silkan, OCamlPro, and Inria. The objective of the project is to improve the performance of scientific programming languages such as Scilab's through the use of VMKit and LLVM.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. DEEPSEA

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Objectif: NC

Duration: June 2013 - May 2018

Coordinator: Umut Acar

Partner: Inria

Inria contact: Umut Acar

Abstract: the objective of project DEEPSEA is to develop abstractions, algorithms and languages for parallelism and dynamic parallelism, with applications to problems on large data sets.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

- Princeton University: interactions between the CompCert verified C compiler and the Verified Software Toolchain developed at Princeton.
- Cambridge University and Microsoft Research Cambridge: formal modeling and testing of weak memory models.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Sigurd Schneider, Ph.D. student at Saarlandes University in Saarbrucken, visited Gallium from Mar 2014 to May 2014. As part of his Ph.D., Sigurd Schneider develops an intermediate representation that unifies static single assignment form (SSA) and functional intermediate representations. During his internship, he considered the addition of GC support to this intermediate representation. He also developed a program logic to verify the correctness of a class of optimizations, including constant subexpression elimination (CSE) and global value numbering.

8.4.1.2. Research stays abroad

Since November 2014, Damien Doligez is on a sabbatical at Jane Street (New York, USA), a financial company (member of the Caml Consortium) that invests considerable R&D in the OCaml language and system.

GAMMA3 Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

F. Alauzet, N. Barral, V. Menier and A. Loseille are part of the MAIDESC ANR (2013-2015) on mesh adaptation for moving interfaces in CFD.

6.2. European Initiatives

6.2.1. FP7 & H2020 Projects

P. Laug participates in the GEOPRISM (GEOlogical resources PRotection and exploitation using Innovative Simulation Methods - Towards new generations of simulation technologies) project, submitted to H2020-FETOPEN-2014-2015-RIA. This project involves several Inria teams (Sage, Gamma3, Pomdapi, Coffee) and several European research centers and universities.

6.3. International Initiatives

6.3.1. Inria Associate Teams

6.3.1.1. AM2NS

Title: Advanced Meshing Methods for Numerical Simulations

International Partner (Institution - Laboratory - Researcher):

Mississippi State University (ÉTATS-UNIS)

Duration: 2014 - 2016

See also: https://www.rocq.inria.fr/gamma/gamma/Membres/CIPD/Frederic.Alauzet/AssociateTeam_AM2NS/AT_am2ns.html

Numerical simulation is now mature and has become an integral part of design in science and engineering applications. Meshing, i.e., discretizing the computational domain, is at the core of the computational pipeline and a key element to significant improvements. The AM2NS Associate Team focus on developing the next generation of automated meshing methods to improve their robustness and the mesh quality to solve the ever increasing complexity of numerical simulations. Four major meshing issues are targeted: (i) more robustness for mesh generation methods in recovering a given data set, (ii) higher quality for anisotropic adapted meshes via constraint alignment, (iii) higher quality for boundary layer meshes near geometry singularities, and (iv) more robustness in handling complex displacement for moving mesh methods. The impact of this collaborative research will be to provide more reliable solution output predictions in an automated manner by using these new meshing methods.

6.4. International Research Visitors

6.4.1. Visits to International Teams

6.4.1.1. Sabbatical programme

Laug Patrick

Date: Sep 2014 - Aug 2015

Institution: Polytechnique Montréal (Canada)

The main scientific objectives are twofold: the reconstruction of a 3D space or scene from multiple images, and the parallelization of the mesh generation of multiface models on multicore processors.

GANG Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Displexity

Participants: Carole Gallet Delporte, Hugues Fauconnier, Pierre Fraigniaud, Amos Korman, Adrian Kosowski, Laurent Viennot.

Managed by University Paris Diderot, C. Delporte and H. Fauconnier lead this project that grants 1 Ph. D.

Distributed computation keep raising new questions concerning computability and complexity. For instance, as far as fault-tolerant distributed computing is concerned, impossibility results do not depend on the computational power of the processes, demonstrating a form of undecidability which is significantly different from the one encountered in sequential computing. In the same way, as far as network computing is concerned, the impossibility of solving certain tasks locally does not depend on the computational power of the individual processes.

The main goal of DISPLEXITY (for DIStributed computing: computability and ComPLEXITY) is to establish the scientific foundations for building up a consistent theory of computability and complexity for distributed computing.

One difficulty to be faced by DISPLEXITY is to reconcile the different sub-communities corresponding to a variety of classes of distributed computing models. The current distributed computing community may indeed be viewed as two not necessarily disjoint sub-communities, one focusing on the impact of temporal issues, while the other focusing on the impact of spatial issues. The different working frameworks tackled by these two communities induce different objectives: computability is the main concern of the former, while complexity is the main concern of the latter.

Within DISPLEXITY, the reconciliation between the two communities will be achieved by focusing on the same class of problems, those for which the distributed outputs are interpreted as a single binary output: yes or no. Those are known as the yes/no-problems. The strength of DISPLEXITY is to gather specialists of the two main streams of distributed computing. Hence, DISPLEXITY will take advantage of the experience gained over the last decade by both communities concerning the challenges to be faced when building up a complexity theory encompassing more than a fragment of the field.

In order to reach its objectives, DISPLEXITY aims at achieving the following tasks:

- Formalizing yes/no-problems (decision problems) in the context of distributed computing. Such problems are expected to play an analogous role in the field of distributed computing as that played by decision problems in the context of sequential computing.
- Formalizing decision problems (yes/no-problems) in the context of distributed computing. Such problems are expected to play an analogous role in the field of distributed computing as that played by decision problems in the context of sequential computing.
- Revisiting the various explicit (e.g., failure-detectors) or implicit (e.g., a priori information) notions of oracles used in the context of distributed computing allowing us to express them in terms of decidability/complexity classes based on oracles.
- Identifying the impact of non-determinism on complexity in distributed computing. In particular, DISPLEXITY aims at a better understanding of the apparent lack of impact of non-determinism in the context of fault-tolerant computing, to be contrasted with the apparent huge impact of non-determinism in the context of network computing. Also, it is foreseen that non-determinism will enable the comparison of complexity classes defined in the context of fault-tolerance with complexity classes defined in the context of network computing.

- Last but not least, DISPLEXITY will focus on new computational paradigms and frameworks, including, but not limited to distributed quantum computing and algorithmic game theory (e.g., network formation games).

The project will have to face and solve a number of challenging problems. Hence, we have built the DISPLEXITY consortium so as to coordinate the efforts of those worldwide leaders in Distributed Computing who are working in our country. A successful execution of the project will result in a tremendous increase in the current knowledge and understanding of decentralized computing and place us in a unique position in the field.

7.1.2. Laboratory of Information, Networking and Communication Sciences (LINCS)

Participants: François Durand, The-Dang Huynh, Leonardo Linguaglossa, Laurent Viennot.

Gang is participating to the LINCS, a research centre co-founded by Inria, Institut Mines-Télécom, UPMC and Alcatel-Lucent Bell Labs, dedicated to research and innovation in the domains of future information and communication networks, systems and services. Gang contributes to work on online social networks, content centric networking and forwarding information verification.

7.2. International Initiatives

7.2.1. Inria International Partners

7.2.1.1. Informal International Partners

- Carole Delporte and Hugues Fauconnier collaborate with Sam Toueg (Univ. of Toronto) and Rachid Guerraoui (EPFL) on distributed computing and synchronization.
- Carole Delporte, Hugues Fauconnier and Pierre Fraigniaud collaborate on distributed computing with Eli Gafni (UCLA) and Sergio Rajsbaum (Univ. of Mexico).
- Pierre Fraigniaud collaborates with Zvi Lotker (Ben-Gurion Univ.) on social networks.
- Amos Korman collaborates with Ofer Feinerman (Weizmann Institute) on the application of distributed algorithm analysis to ant behaviors.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- Eli Gafni, UCLA, June - July 2014
- Sergio Rajsbaum, Univ. of Mexico, June - July 2014
- Zvi Lotker, Ben-Gurion Univ., September 2014 - July 2015 (Junior chair of the FSMP)

GCG Team

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Inria International Partners

8.1.1.1. Informal International Partners

- P. Sadayappan, OSU, Columbus, Ohio, USA: Collaboration on automatic analysis of I/O complexity (several co-publications); collaboration on code optimization (one join paper + one submitted paper)
- Fernando Pereira, UFMG, Bello Horizonte, Brazil: Collaboration on static analysis (on join paper); collaboration on hybrid analysis (one submitted paper)

8.2. International Research Visitors

8.2.1. Visits of International Scientists

- Prof. Fernando Magno Pereira, 1 months 1/2, UFMG Brazil

8.2.2. Visits to International Teams

8.2.2.1. Research stays abroad

- Fabrice Rastello: 2 months at OSU, Columbus, Ohio with the team of P. Sadayappan.

GECO Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- Project *Stabilité des systèmes à excitation persistante*, Program MathIng, Labex LMH, 2013-2016. This project is about different stability properties for systems whose damping is intermittently activated. The coordinator is Mario Sigalotti. The other members are Yacine Chitour and Guilherme Mazanti.
- **Digitéo project 2012-061D SSyCoDyC.** SSyCoDyC (2013–2014) is financed by Digitéo in the framework of the DIM *Hybrid Systems and Sensing Systems*. It focuses on the application of techniques of hybrid systems to the analysis of retarded equations with time-varying delays. SSyCoDyC has financed the post-doc fellowship of Ihab Haidar and was coordinated by Paolo Mason and Mario Sigalotti.
- iCODE is the Institute for Control and Decision of the Idex Paris Saclay. It was launched in March 2014 for two years until June 2016. iCODE's aims are fostering research, spin-offs creation, training and diffusion of Control and Decision in Paris-Saclay. To those aims, iCODE has received a budget of 980Keuros, supported by *investissements d'avenir*. The scientific topics addressed by iCODE are organized in four research initiatives:
  - Control & Neuroscience
  - Large-scale systems & Smart grids
  - Behavioral Economics
  - White research initiative.

  iCODE is coordinated by Yacine Chitour (L2S-Univ. Paris Sud), associated member and collaborator of GECO. Mario Sigalotti is member of the Steering Committee.

7.2. European Initiatives

7.2.1. FP7 Projects

Program: ERC Starting Grant

Project acronym: GeCoMethods

Project title: Geometric Control Methods for the Heat and Schroedinger Equations

Duration: 1/5/2010 - 1/5/2015

Coordinator: Ugo Boscain

Abstract: The aim of this project is to study certain PDEs for which geometric control techniques open new horizons. More precisely we plan to exploit the relation between the sub-Riemannian distance and the properties of the kernel of the corresponding hypoelliptic heat equation and to study controllability properties of the Schroedinger equation.

All subjects studied in this project are applications-driven: the problem of controllability of the Schroedinger equation has direct applications in Laser spectroscopy and in Nuclear Magnetic Resonance; the problem of nonisotropic diffusion has applications in cognitive neuroscience (in particular for models of human vision).

Participants. Main collaborator: Mario Sigalotti. Other members of the team: Andrei Agrachev, Riccardo Adami, Thomas Chambrion, Grégoire Charlot, Yacine Chitour, Jean-Paul Gauthier, Frédéric Jean.

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. Informal International Partners

SISSA (Scuola Internazionale Superiore di Studi Avanzati), Trieste, Italy.

Sector of Functional Analysis and Applications, Geometric Control group. Coordinator: Andrei A. Agrachev.

We collaborate with the Geometric Control group at SISSA mainly on subjects related with sub-Riemannian geometry. Thanks partly to our collaboration, SISSA has established an official research partnership with École Polytechnique.

7.3.2. Participation In other International Programs

- Laboratoire Euro Maghrébin de Mathématiques et de leurs Interactions (LEM2I)
  http://www.lem2i.cnrs.fr/
- GDRE Control of Partial Differential Equations (CONEDP)
  http://www.ceremade.dauphine.fr/~glass/GDRE/

GENSCALE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. DGASP: Discrete Geometry Problem solve with ASP

Participants: Douglas Goncalves, Antonio Mucherino.

This project was funded by Région Bretagne in the framework of the SAD call (Stratégie Attractivité Durable), from April 2013 to March 2014 and coordinated by A. Mucherino. It enabled to hire Douglas Goncalves as a postdoctoral student for 12 months for working on a discretizable class of distance geometry problems. The project is in collaboration with Carlile Lavor (IMECC-UNICAMP, Brazil) and Jacques Nicolas (Dyliss team, IRISA).

8.1.2. KoriKlast2: Intensive Sequence comparison

Participants: Sébastien Brillet, Erwan Drezen, Dominique Lavenier, Ivaylo Petrov.

This is a collaborative project funded by Région Bretagne (18 months, from June 2014) with 3 partners: the Korilog Company, the bioinformatics computing center of Roscoff and the GenScale team. The purpose is (1) to improve the KLAST software with new alignment methods developed by GenScale; (2) to extend the capabilities of KLAST toward metagenomic processing; (3) to develop a cloud version targeting huge sequence comparison processing.

8.1.3. Collaboration with IGDR (Insitute of Genetic and Development of Rennes)

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo, Guillaume Rizk.

We collaborate with several teams of the IGDR: Genetics of dog (detection of long non coding RNAs in collaboration with Thomas Derrien and Christophe Hitte) and Integrated Functional Genomics and Biomarkers (NGS analyses of glioblastoma cancer, project funded by INCa in collaboration with Marie de Tayrac and Jean Mosser).

8.1.4. Partnership with INRA

Participants: Susete Alves Carvalho, Anaïs Gouin, Dominique Lavenier, Fabrice Legeai, Claire Lemaitre, Pierre Peterlongo, François Moreews.

The GenScale team has a strong and long term collaboration with biologists of INRA in Rennes: IGEPP and PEGASE units. This partnership concerns both service and research activities and is acted by the hosting three INRA engineers (F. Legeai, F. Moreews, S. Alves Carvalho). In particular, the collaboration with the IGEPP team includes several research projects in which Genscale is a formal partner: PEAPOL and SPECIAPHID projects.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. Project FATINTEGER

Participants: Dominique Lavenier, François Moreews.

Coordinateur: F. Gondret
Duration: 36 months (Mar. 2012 - feb. 2015)
Partners: PEGASE Inra Rennes, CNRS IRISA Rennes, AgroCampus Ouest LMA-IRMAR Rennes

The FatInteger project aims to identify some of the transcriptional key players of animal lipid metabolism plasticity, combining high throughput data with statistical approaches, bioinformatics and phylogenetic. GenScale is involved in the design of the workflow for processing the genomic data.

8.2.1.2. Project SPECIAPHID: Speciation of pea aphids

Participants: Claire Lemaitre, Anaïs Gouin, Fabrice Legeai.

Coordinator: J-C. Simon (Inra)
Duration: 36 months (Jan. 2012 – Dec 2014)
Partners: IGEPP Inra Rennes, CBGP Inra Montpellier, BF2I Inra Lyon.

The SPECIAPHID project aims to understand the adaptation and speciation of pea aphids by re-sequencing and comparing the genomes of numerous aphid individuals. The role of Genscale is to apply and develop new methods to detect variation between re-sequenced genomes, and in particular complex variants such as structural ones.

8.2.1.3. Project ADA-SPODO: Genetic variation of Spodoptera Frugiperda

Participants: Claire Lemaitre, Fabrice Legeai, Anaïs Gouin, Dominique Lavenier, Pierre Peterlongo.

Coordinator: E. D'Alençon (Inra, Montpellier)
Duration: 39 months (Oct. 2012 – Dec 2015)
Partners: DGIMI Inra Montpellier, CBGP Inra Montpellier, URGI Inra Versailles, Genscale Inria/IRISA Rennes.

The ADA-SPODO project aims at identifying all sources of genetic variation between two strains of an insect pest: Lepidoptera Spodoptera Frugiperda in order to correlate them with host-plant adaptation and speciation. GenScale's task is to develop new efficient methods to compare complete genomes along with their postgenomic and regulatory data.

8.2.1.4. Project COLIB'READ: Advanced algorithms for NGS data

Participants: Pierre Peterlongo, Claire Lemaitre, Dominique Lavenier, Fabrice Legeai, Guillaume Rizk, Chloé Riou.

Coordinator: P. Peterlongo (Inria, GenScale, Rennes)
Duration: 36 months (Mar. 2013 – Feb. 2016)
Partners: LIRMM Montpellier, Bamboo Inria Lyon, Genscale Inria/IRISA Rennes.

The main goal of the Colib'Read project is to design new algorithms dedicated to the extraction of biological knowledge from raw data produced by High Throughput Sequencers (HTS). The project proposes an original way of extracting information from such data. The goal is to avoid the assembly step that often leads to a significant loss of information, or generates chimerical results due to complex heuristics. Instead, the strategy proposes a set of innovative approaches that bypass the assembly phase, and that does not require the availability of a reference genome. https://colibread.inria.fr/

8.2.1.5. Project GATB: Genome Analysis Tool Box

Participants: Dominique Lavenier, Erwan Drezen, Pierre Peterlongo, Claire Lemaitre, Guillaume Rizk, Charles Deltel.

Coordinator: D. Lavenier (Inria/Irisa, GenScale, Rennes)
Duration: 24 months (Feb. 2013 – Jan. 2015)
Partners: GenScale Inria/IRISA, Rennes – DTI Inria, Rennes.

This project aims to develop algorithms and tools for genome analysis based on an compact data structure having a very low memory footprint allowing end-users to process huge volume of genomic data on a simple desktop computer. The GATB is structured around a C++ library from which many efficient NGS tools can be developed. GATB has been published and used outside Genscale (LIRMM, Inria Bamboo team). http://gatb.inria.fr

8.2.1.6. Project HydroGen: Metagenomic applied to ocean life study

Participants: Dominique Lavenier, Pierre Peterlongo, Claire Lemaitre, Guillaume Rizk, Gaëtan Benoit.

Coordinator: D. Lavenier (Inria/Irisa, GenScale, Rennes)
Duration: 42 months (Nov. 2014 – Apr. 2018)
Partners: CEA (GenosScope, Evry), INRA (AgroParisTech, Paris – MIG, Jouy-en-Jossas).

The HydroGen project aims to design new statistical and computational tools to measure and analyze biodiversity through comparative metagenomic approaches. The support application is the study of ocean biodiversity based on the analysis of seawater samples available from the Tara Oceans expedition.

8.2.2. PIA: Programme Investissement d'Avenir

8.2.2.1. RAPSODYN: Optimization of the rapeseed oil content and yield under low nitrogen

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

Coordinator: N. Nessi (Inra, IGEPP, Rennes)
The objective of the Rapsodyn project is the optimization of the rapeseed oil content and yield under low nitrogen input. GenScale is involved in the bioinformatics work package to elaborate advanced tools dedicated to polymorphism and application to the rapeseed plant.

8.2.2.2. France Génomique: Bio-informatics and Genomic Analysis

Participants: Laurent Bouri, Dominique Lavenier.

Coordinator: J. Weissenbach (Genoscope, Evry)
France Génomique gathers resources from the main French platforms in genomic and bio-informatics. It offers to the scientific community an access to these resources, a high level of expertise and the possibilities to participate in ambitious national and international projects. The GenScale team is involved in the work package "assembly" to provide expertise and to design new assembly tools for the 3rd generation sequencing.

8.2.3. Programs from research institutions

8.2.3.1. Inria ADT Mapsembler

Participants: Alexan Andrieux, Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

The Mapsembler project aims at finalizing and at distributing the Mapsembler tool. It is funded by Inria ADT call (2012) and coordinated by P. Peterlongo from oct. 2012 to sept. 2014. http://alcovna.genouest.org/mapsembler/

8.2.3.2. Mastodons CNRS Program SéPhHaDé: Computational Challenge of High Throughput Sequencing and Phenotyping in Life Science

Participants: Dominique Lavenier, Erwan Drezen, Ba Diep Nguyen.

Coordinator: E. Rivals (Lirmm, Montpellier)
Duration: 3 years (2012-2014)
Partners: Lirmm et Inria Montpellier, GenScale IRISA/Inria Rennes, Bamboo LIFL, Lille, INRA Montpellier , ISEM, IPMC Nice, CIRAD Montpellier, LSIS Aix Marseille, Tela Botanica Montpellier, UPMC Banyuls/Mer, CEA Evry, LITIS Rouen

This project deals with the management of huge volume of data generated (1) by the new sequencing technologies (2) by the collection of information for phenotyping living organisms. In 2014, GenScale has developed a methodology to compare metagenomic datasets to protein databanks.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

- Brazil
  - IMECC, UNICAMP, Campinas
  - COPPE, Federal University of Rio de Janeiro
  - University federal of Minas Gerais
- USA
  - Information Sciences Group (CCS-3), Los Alamos National Laboratory (LANL), Los Alamos.
  - Baylor College of Medicine, Houston
- China
  - StateKey Laboratory of Silkworm Genome Biology at the SouthWest University, Chongqing, China
- Vietnam
  - University of Cantho
- Europe
  - Bulgarian Academy of Science (BAS), Sofia, Bulgaria
  - The Genome Analysis Center, Norwich, UK
  - University of Sheffield, UK
  - University of York, UK

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Stephen Richards, Assistant Professor, Baylor College of Medicine, Houston, USA, June 2014. Stephen Richards is responsible for the sequencing and bioinformatics analysis of the genomes of arthropods. During his visit, he worked on the improvement of the pea aphid genome assembly.
- Ba Diep Nguyen, Assistant Professor, Cantho University, Vietnam Nov. 2014 to Jan. 2015 During his visit, Ba Diep Nguyen worked on the design of a new methodology for comparing metagenomic samples to protein databank.

8.4.2. Visits to International Teams

8.4.2.1. Research stays abroad

- Rumen Andonov, Professor, Information Sciences Group (CCS-3) from Los Alamos National Laboratory (LANL), Los Alamos, USA. Jan. 2014 to Aug. 2014. R. Andonov collaborates with LANL on various research projects related to solving hard combinatorial optimization problems on very large graphs and their applications in Bioinformatics. Two applications were on the focus of this cooperation during 2014: the scaffolding problem in NGS and structural classification of proteins.

GEOMETRICA Project-Team

8. Partnerships and Cooperations

8.1. Technological Development Actions

8.1.1. ADT PH

Participants: Jean-Daniel Boissonnat, Frédéric Chazal, David Cohen-Steiner, Sonali Digambar Patil, Marc Glisse, Steve Oudot, Clément Maria, Mariette Yvinec.

- Title: Persistent Homology

- Coordinator: Mariette Yvinec (GEOMETRICA)

- Duration: 1 year renewable once, starting date December 2012. Renewed for 1 year from January 1st 2014 to December 31t 2014
- Others Partners: Inria team ABS, Gipsa Lab (UMR 5216, Grenoble, http://www.gipsa-lab.inpg.fr/)

- Abstract: Geometric Inference is a rapidly emerging field that aims to analyse the structural, geometric and topological, properties of point cloud data in high dimensional spaces. The goal of the ADT PH is to make available, a robust and comprehensive set of algorithmic tools resulting from recent advances in Geometric Inference. The software will include:

tools to extract from the data sets, families of simplicial complexes,

data structures to handle those simplicial complexes,

algorithmic modules to compute the persistent homology of those complexes,

applications to clustering, segmentation and analysis of scalar fields such as the energy landscape of macromolecular systems.

8.1.2. ADT OrbiCGAL

Participants: Aymeric Pellé, Monique Teillaud.

- Title: OrbiCGAL

- Coordinator: Monique Teillaud (GEOMETRICA)

- Duration: 1 year renewable once, starting date September 2013.
- Abstract: OrbiCGAL is a software project supported by Inria as a Technological Development Action (ADT). It is motivated by applications ranging from infinitely small (nano-structures) to infinitely large (astronomy), through material engineering, physics of condensed matter, solid chemistry, etc

The project consists in developing or improving software packages to compute triangulations and meshes in several types of non-Euclidean spaces: sphere, 3D closed flat manifolds, hyperbolic plane.

8.2. Regional Initiatives

8.2.1. Digiteo project TOPERA

Participants: Frédéric Chazal, Marc Glisse, Anaïs Vergne.

TOPERA is a project that aims at developing methods from Topological Data Analysis to study covering properties and quality of cellular networks. It also involves L. Decreusefond and P. Martins from Telecom Paris.

- Starting date: December 2013

- Duration: 18 months

8.3. National Initiatives

8.3.1. ANR Présage

Participants: Olivier Devillers, Marc Glisse, Ross Hemsley, Monique Teillaud, Rémy Thomasse.

- Acronym: Presage.

- Type: ANR blanc.

- Title: *méthodes PRobabilistes pour l'Éfficacité des Structures et Algorithmes GÉométriques*.

- Coordinator: Xavier Goaoc.

- Duration: 31 december 2011 - 31 december 2015.

- Other partners: Inria VEGAS team, University of Rouen.

- Abstract: This project brings together computational and probabilistic geometers to tackle new probabilistic geometry problems arising from the design and analysis of geometric algorithms and data structures. We focus on properties of discrete structures induced by or underlying random continuous geometric objects. This raises questions such as:

- What does a random geometric structure (convex hulls, tessellations, visibility regions...) look like?
- How to analyze and optimize the behavior of classical geometric algorithms on *usual* inputs?
- How can we generate randomly *interesting* discrete geometric structures?

- Year publications: [56], [33], [48], [52], [62], [61], [12]

8.3.2. ANR TOPDATA

Participants: Jean-Daniel Boissonnat, Frédéric Chazal, David Cohen-Steiner, Mariette Yvinec, Steve Oudot, Marc Glisse, Clément Levrard.

- Acronym : TopData.

- Title : Topological Data Analysis: Statistical Methods and Inference.

- Type : ANR blanc

- Coordinator : Frédéric Chazal (GEOMETRICA)

- Duration : 4 years starting October 2013.
- Others Partners: Département de Mathématiques (Université Paris Sud), Institut de Mathḿatiques (Université de Bourgogne), LPMA (Université Paris Diderot), LSTA (Université Pierre et Marie Curie)

- Abstract: TopData aims at designing new mathematical frameworks, models and algorithmic tools to infer and analyze the topological and geometric structure of data in different statistical settings. Its goal is to set up the mathematical and algorithmic foundations of Statistical Topological and Geometric Data Analysis and to provide robust and efficient tools to explore, infer and exploit the underlying geometric structure of various data.

Our conviction, at the root of this project, is that there is a real need to combine statistical and topological/geometric approaches in a common framework, in order to face the challenges raised by the inference and the study of topological and geometric properties of the wide variety of larger and larger available data. We are also convinced that these challenges need to be addressed both from the mathematical side and the algorithmic and application sides. Our project brings together in a unique way experts in Statistics, Geometric Inference and Computational Topology and Geometry. Our common objective is to design new theoretical frameworks and algorithmic tools and thus to contribute to the emergence of a new field at the crossroads of these domains. Beyond the purely scientific aspects we hope this project will help to give birth to an active interdisciplinary community. With these goals in mind we intend to promote, disseminate and make our tools available and useful for a broad audience, including people from other fields.

- See also: http://geometrica.saclay.inria.fr/collaborations/TopData/Home.html

8.4. European Initiatives

8.4.1. FP7 & H2020 Projects

8.4.1.1. GUDHI

Type: FP7

Instrument: ERC Advanced Grant

Duration: February 2014 - January 2019

Coordinator: Jean-Daniel Boissonnat

Inria contact: Jean-Daniel Boissonnat

Abstract: The central goal of this project is to settle the algorithmic foundations of geometry understanding in dimensions higher than 3. Geometry understanding encompasses a collection of tasks including the approximation and computer representation of geometric structures, and the inference of geometric or topological properties of sampled shapes.

See also https://project.inria.fr/gudhi/

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Pedro Machado Manhães de Castro (Universidade Federal de Pernambuco)

Arijit Ghosh (MPII, Saarbrucken), april, november-december

Antoine Vigneron (KAUST), may

Ramsay Dyer (Johann Bernouilli Institute, University of Groningen), octobre

Kira Vyatkina (Saint Petersburg Academic University), october

Vissarion Fisikopoulos (Université Libre de Bruxelles), november

GEOSTAT Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- Project VAD-MMF with Conseil Régional Aquitaine: *Voice Activity Detection using the Multiscale Microcanonical Formalism*, 2012-2015.
- Project CAVERNOM with Conseil Régional Aquitaine: *Cardiac Arrhythmia Complexity and Variability by means of Robust Nonlinear Methods*, 2015.

7.2. National Initiatives

- ICARODE [2013-2016]. Participants : Hussein Yahia, Oriol Pont, Véronique Garçon, Joel Sudre, Antonio Turiel, Christine Provost [LOCEAN]. 4-year contract, CNES-NASA funding, started 2013. Title: *ICARODE: Integration and cascading for high resolution ocean dynamics*. Project leader: H. Yahia.
- IHU LIRYC and CRA DIAFIL project [2012-2014]. Post-doctoral fellow: B. Xu. Project leaders H. Yahia and O. Bernus.
- REGION AQUITAINE PROJECT "OPTAD". Participants : H. Yahia, S. Kumar Maji. Project leader: H. Yahia.

GEOSTAT is a member of the GDRs ISIS and PHENIX.

7.3. European Initiatives

7.3.1. Collaborations in European Programs, except FP7 & H2020

Program: ESA (European Spatial Agency) Support to Science Element.

Project acronym: OceanFlux.

Project title: High resolution mapping of GHGs exchange fluxes.

Duration: 09/2011 - 09/2014.

Coordinator: C. Garbe.

Other partners: : IWR (University of Heidelberg), LEGOS (CNRS DR-14), GEOSTAT (Inria), KIT (Karlsruher Institut fur Technologie, Frankfurt), IRD, Université Paul Sabatier.

Abstract: The EBUS (Eastern Boundary Upwelling Systems) and OMZs (Oxygen Minimum Zone) contribute very significantly to the gas exchange between the ocean and the atmosphere, notably with respect to the greenhouse gases (hereafter GHG). Invasion or outgasing fluxes of radiatively-active gases at the air-sea interface result in coupled or decoupled sink and source configurations. From in-situ ocean measurements, the uncertainty of the net global ocean-atmosphere CO2 fluxes is between 20 and 30%, and could be much higher in the EBUS-OMZ. Off Peru, very few in-situ data are available presently, which justifies alternative approaches for assessing the fluxes. GHG vertical column densities (VCD) can be extracted from satellite spectrometers. The accuracy of these VCDs need to be very high in order to make extraction of sources feasible. To achieve this accuracy is extremely challenging, particularly above water bodies, as water strongly absorbs infra-red (IR) radiation. To increase the amount of reflected light, specular reflections (sun glint) can be used on some instruments such as GOSAT. Also, denoising techniques from image processing may be used for improving the signal-to-noise ratio (SNR). GHG air-sea fluxes determination can be inferred from inverse modeling applied to VCDs, using state of the art modeling, at low spatial resolution. For accurately linking sources of GHGs to EBUS and OMZs, the resolution of the source regions

needs to be increased. This task develops on new non-linear and multiscale processing methods for complex signals to infer a higher spatial resolution mapping of the fluxes and the associated sinks and sources between the atmosphere and the ocean. Such an inference takes into account the cascading properties of physical variables across the scales in complex signals. The use of coupled satellite data (e.g. SST and/or Ocean colour) that carry turbulence information associated to ocean dynamics is taken into account at unprecedented detail level to incorporate turbulence effects in the evaluation of the air-sea fluxes. We will present a framework as described above for determining sources and sinks of GHG from satellite remote sensing. The approach includes resolutions enhancements from nonlinear and multiscale processing methods. The applicability is validated against ground truth observations and numerical model studies.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. OPTIC

Title: Optimal inference in Complex and Turbulent data

International Partner (Institution - Laboratory - Researcher):

IITR (INDE)

Duration: 2014 - 2017.

See also: https://optic.bordeaux.inria.fr/. The associated team is supported by Inria and IFCAM.

The OptIC associated team targets the extension and development of a strong collaboration between Inria GEOSTAT team and INDIAN INSTITUTE OF TECHNOLOGY ROORKEE Dept of Electronics and Computer Engineering (Prof. D. Singh's group) on non-linear Signal Processing for Universe Sciences, with a strong emphasis on data fusion in Earth Observation and monitoring. Non-linear Physics puts strong evidence of the fundamental role played by multiscale hierarchies in complex and turbulent data: in these data, the information content is statistically localized in geometrical arrangements in the signal's domain, while such geometrical organization is not attainable by classical methods in linear signal processing. This is one of the major drawbacks in the classical analysis of complex and turbulent signals. The goal of this associated team is to show that inference of physical variables along the scales of complex and turbulent signals can be performed through optimal multiresolution analysis performed on non-linear features and data extracted from the signals, resulting in novel and powerful approaches for data fusion between different acquisitions (in temporal/spatial/spectral resolutions). This program needs both strong expertise in the physical processes beyond the acquisitions and the application of non-linear physics ideas on the behavior of the acquired physical phenomena. The proposal will focus on specific applications in Earth Observation and monitoring for which the Indian partner has developed a very strong expertise, notably in its knowledge and use of the physical processes in remote sensing acquisitions. This partnership is an extremely interesting and high potential collaboration between two teams which focus separately either on the acquisition of the physical processes or their analysis by Complex Systems and non-linear physics methodologies. The recent results obtained in super-resolution by GEOSTAT promises strong applications to a much wider range of Universe Sciences problems, notably with a strong emphasis on data fusion between the physical variables acquired on related but different acquisitions. OptiC builds on a collaboration between Inria and IIT ROORKEE teams, added with partners in Universe Sciences and earth observation (ONERA, CNRS) already involved in research actions with GEOSTAT.

7.4.2. Participation In other International Programs

- IFCAM (India), in cooperation with OPTIC associated team (7.4.1): Indo-French Centre for Applied Mathematics (IFCAM) project [2014-2017]. Title: Optimal inference in complex and turbulent data. 3-year contract, IFCAM funding, started 2014. Partners: GEOSTAT and IIT ROORKEE (INDIA).

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Professor Dharmendra Singh, IIT Roorkee, in the framework of the OPTIC associated team, visited GEOSTAT in June 2014.

7.5.1.1. Internships

- Ashwini Jaya Kular. Master 2 intern from Apr to Oct 2014.
- Jiri Mekyska, PhD student at Brno university (Czech republic), spent the month of June at GEOSTAT. His internship was funded by the Joseph Fourier grant.

7.5.2. Visits to International Teams

H. Yahia (2 weeks) and N. Brodu (2 weeks) visited IIT Roorkee in 2014, to work in the framework of the OPTIC associated team.

GRACE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. PEPS PAIP

From late 2012 through 2013, D. Augot was heavily involved in the preparation of the *Institut de la société du numérique* (Digital Society Institute) proposal within IDEX Paris-Saclay. Led by N. Boujemaa, this proposal aims to be a catalyst for interdisciplinary research (involving computer scientists and researchers from the humanities) on societal challenges inherent to eLife/life digitization. The proposal has initial funding from the IDEX, and will hopefully be self-funding within three years. Two kick-off projects were defined: joint human & machine interaction, and privacy and digital identity.

Within IDEX Paris-Saclay, the PAIP (Pour une Approche Interdisciplinaire de la Privacy) project was proposed and accepted in September 2013, with a small budget (30 keuros) for all the partners of the privacy group.

D. Augot engaged in monthly brainstorming meetings with researchers from Inria Paris–Rocquencourt (project-team SMIS), Université Jean Monnet's ADIS and CERDI labs (A. Rallet, A. Bensamoun), and Télécom ParisTech (C. Levallois-Barth). Topics under discussion include terms of service of various cloud storage providers; SMIS's *TrustedCell* secure token initiative for helding private and secure personal data; privacy leaks; and measurements on smartphones.

A one-day conference was held in Paris in December 2014.

8.1.2. PEPS Aije-Bitcoin

Within the group PAIP (Pour une Approche Interdisciplinaire de la Privacy), D. Augot presented the cryptographic and peer-to-peer principles at the heart of the Bitcoin protocol (electronic signature, hash functions, and so on). Most of the information is publicly available: the history of all transactions, evolution of the source code, developers' mailing lists, and the Bitcoin exchange rate. It was recognized by the economists in our group that such an amount of data is very rare for an economic phenomenon, and it was decided to start research on the history of Bitcoin, to study the interplay between the development of protocol and the development of the economical phenomenon.

The project **Aije-Bitcoin** (analyse informatique, juridique et économique de Bitcoin) was accepted as interdisciplinary research for a PEPS (Projet exploratoire Premier Soutien) cofunded by the CNRS and Université de Paris-Saclay. This one-year preliminary program will enable the group to master the understanding of Bitcoin from various angles, allowing more advanced research in the following years.

8.1.3. IDEALCODES

Idealcodes is a two-year Digiteo research project, started in October 2014. The partners involved are the École Polytechnique (X) and the Université de Versailles–Saint-Quentin-en-Yvelines (Luca de Feo, UVSQ). It funds one two-year post-doc, J. Nielsen, working at the boundary between coding theory, cryptography, and computer algebra.

Idealcodes spans the three research areas of algebraic coding theory, cryptography, and computer algebra, by investigating the problem of lattice reduction (and root-finding). In algebraic coding theory this is found in Guruswami and Sudan's list decoding of algebraic geometry codes and Reed–Solomon codes. In cryptography, it is found in Coppersmith's method for finding small roots of integer equations. These topics were unified and generalised by H. Cohn and N. Heninger [36], by considering algebraic geometry codes and number field codes under the deep analogy between polynomials and integers. Sophisticated results in coding theory could be then carried over to cryptanalysis, and vice-versa. The generalized view raises problems of computing efficiently, which is one of the main research topics of Idealcodes.

8.2. National Initiatives

8.2.1. ANR

- CATREL (accepted June 2012, Kickoff December 14, 2012, Starting January 1st, 2013): "Cribles: Améliorations Théoriques et Résolution Effective du Logarithme" (Sieve Algorithms: Theoretical Advances and Effective Resolution of the Discrete Logarithm Problem). This project aims to make effective "attacks" on reduced-size instances of the discrete logarithm problem (DLP). This is a key ingredient for the assessment of the security of cryptosystems relying on the hardness of the DLP in finite fields, and for deciding on relevant key sizes.

8.2.2. DGA

- DIFMAT-3: this one-year project aims to find matrices with good diffusion properties over small finite fields, in the spirit of [17]. The principle is to find non-maximal matrices, but with better coefficients and implementation properties. The relevant cryptographic properties to be studied correspond to the weight distribution of the associated code. Since we use Algebraic-Geometry codes, much more powerful techniques can be used for computing these weight distribution, using and improving Duursma's ideas [37].
- Cybersecurity. Inria and DGA contracted for three PhD topics at the national level, one of them involving Grace. Grace started a new PhD, and hired P. Karpman. The topic of this PhD is complementary to the above DIFMAT-3: while DIFMAT-3 provides fundamental methods for dealing with AG codes, in application for diffusion layers in block ciphers, the topic here is to make concrete propositions of block ciphers using these matrices. P. Karpman is coadvised by T. Peyrin (Nanyang Technological University, Singapore), by P.-A. Fouque (Université de de Rennes), and D. Augot.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

PQCRYPTO (Post-Quantum Cryptography) is a proposal which was submitted in 2014 by Tanja Langa (Tu/E), with Inria as a partner. We received in September 2014 the notification that it was accepted. Inria's Secret and Grace project-teams are part of this proposal, whose starting date is March 2015.

8.3.2. Collaborations in European Programs, except FP7 & H2020

Program: COST

Project acronym: COST 4175/11

Project title: Random Network Coding and Designs over GF(q) http://www.network-coding.eu/index.html

Duration: 04/2012 - 04/2016

Coordinator: Marcus Greferath

Other partners: Camilla Hollanti, Aalto University, Finland Simon R. Blackburn, Royal Holloway, University of London, UK Tuvi Etzion, Technion, Israel Ángeles Vázquez-Castro, Autonomous University of Barcelona, Spain Joachim Rosenthal, University of Zurich, Switzerland (Chairs of the five working groups).

Abstract: Random network coding emerged through an award-winning paper by R. Koetter and F. Kschischang in 2008 and has since then opened many new directions in networking, internet, wireless communication systems, and cloud computing. This COST Action will set up a European research network and establish network coding as a European core area in communication technology. Its aim is to bring together experts from pure and applied mathematics, computer science, and electrical engineering, who are working in the areas of discrete mathematics, coding theory, information theory, and related fields.

8.4. International Initiatives

8.4.1. Informal International Partners

- M. Bossert, Institute of Communications Engineering, Ulm Universität.
- S. Galbraith, Department of Mathematics, University of Auckland.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Ruud Pellikaan (Department of Mathematics and Computing Science Eindhoven University of Technology) visited us from April 24th to May 21st.

GRAPHIK Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. ASPIQ

Participants: Jean-François Baget, Fabien Garreau, Marie-Laure Mugnier, Jérôme Fortin, Michel Leclère.

ASPIQ (ASP technologIes for Querying large scale multisource heterogeneous web information), is an ANR white project (duration: 4 years) that started in Oct. 2012. It involves partners from CRIL, LERIA and LSIS. The project coordinator is Odile Papini (LSIS). http://aspiq.lsis.org/

The main objective of this project is to propose:

- extensions of standard ASP for representing OWL2 tractable sublanguages;
- new operations for merging conflicting information in this extended ASP;
- the identification of subclasses of this extended ASP allowing for efficient query answering mechanisms;
- an implementation of a prototype reasoning system.
- *See Section 6.2 for this year's results (Extensions of the Framework).*

8.1.1.2. Pagoda

Participants: Jean-François Baget, Marie-Laure Mugnier, Mélanie König, Swan Rocher, Michaël Thomazo.

Pagoda (Practical Algorithms for Ontology-based Data Access)is an ANR JCJC (young researchers) project that started in Jan. 2013 (duration: 4 years). The project coordinator is Meghyn Bienvenu (LRI). It involves partners from the EPI LEO, the LIG, and the Anatomy Laboratory of Grenoble. http://pagoda.lri.fr/

The primary aim of this project is to address challenges brought by scalability and the handling of data inconsistencies by developing novel OBDA (Ontology Based Data Access) query answering algorithms and practical methods for handling inconsistent data.

- *See Section 6.2 for this year's results.*

8.1.1.3. Qualinca

Participants: Michel Leclère, Michel Chein, Madalina Croitoru, Léa Guizol, Rallou Thomopoulos, Alain Gutierrez, Swan Rocher, Marie-Laure Mugnier.

Qualinca is an ANR Contint project that started in Apr. 2012 (duration: 4 years). The project coordinator is Michel Leclère (GraphIK). It involves partners from LRI, LIG, ABES and INA. http://www.lirmm.fr/qualinca/index8ece.html?q=en/en/home

The main objective is to elaborate mechanisms allowing to:

- evaluate the quality of an existing document base;
- maintain a given level of quality by controlling updating operations;
- increase the quality of a given base;
- develop generic methods that take into account the quality of a given base (for instance for searching documents or interconnecting bases).
- *See Section 6.4 for this year's results.*

8.1.1.4. Dur-Dur

Participants: Abdallah Arioua, Patrice Buche, Madalina Croitoru, Jérôme Fortin, Rallou Thomopoulos.

Dur-Dur (Innovations agronomiques, techniques et organisationnelles pour accroître la DURabilité de la filière blé DUR) is an ANR project that started in 2014 (duration: 3 years). It is led by IATE Laboratory. http://umr-iate.cirad.fr/projets/dur-dur

The Dur-Dur project develops a systematic approach to investigate the questions related to the management of the nitrogen, energy and contaminants, to guarantee a global quality of products throughout the production and the processing chain. The knowledge representation task of Dur-Dur proposes to map the stakeholders' objectives into a multicriteria cartography, as well as possible means to reach them, and computes the compatibility / incompatibility of these objectives on the basis of argumentation methods. The research methods used are qualitative and based both on argumentation theory and on Social Multi- Criteria Evaluation (SMCE) theory. They will be extended and adapted to the needs of the project to provide a formal framework of assessment of the various orientations considered for the durum wheat chain.

8.1.2. Competitivity Clusters

We are taking part in the Laboratory of Excellence ("labex") *NUMEV* (Digital and Hardware Solutions, Modelling for the Environment and Life Sciences), led by University of Montpellier 2 in partnership with CNRS, University of Montpellier 1 and Inria. This project aims at developping information and communication technologies for environmental and life sciences. We are participating to one of the four axis, namely "Scientific Data: processing, integration and security".

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. EcoBioCap

Participants: Patrice Buche, Madalina Croitoru, Jérôme Fortin, Patricio Mosse.

EcoBiocap is a FP7-KBEE project that started in March 2011 (duration: 4 years). It is led by INRA (and scientifically managed by Montpellier IATE laboratory). It involves sixteen partners among which Cork University (Ireland), CSIC (Spain), Roma University La Sapienza (Italy), SIK (Sweden). The objective of EcoBioCAP is to "provide the EU food industry with customizable, ecoefficient, biodegradable packaging solutions with direct benefits both for the environment and EU consumers in terms of food quality and safety". The budget is managed by IATE team.

- *See Section 6.3 for this year's results.*

8.2.2. Collaborations with Major European Organizations

Richard Booth: University of Luxembourg, Interdisciplinary Centre for Security, Reliability and Trust (Luxembourg)

Souhila Kaci collaborates with Richard Booth on abstract argumentation. Madalina Croitoru collaborates with Richard Booth on argumentation labelling distances.

Leon van der Torre: University of Luxembourg, Computer Science and Communications Research Unit (Luxembourg)

Souhila Kaci collaborates with Leon van der Torre on argumentation aspects. They co-supervised a PhD student (Tjitze Rienstra) from 2010 to 2014.

Sebastian Rudolph and Michaël Thomazo: TU Dresden (Germany)

Jean-François Baget and Marie-Laure Mugnier collaborate with Sebastian Rudolph and Michaël Thomazo on existential rules.

Markus Krötzsch: TU Dresden (Germany)

Jean-François Baget, Marie-Laure Mugnier and Clément Sipieter collaborate with Markus Krötzsch who is associated with the ADT QUASAR (Section 5.2), as an expert in the Semantic Web.

Ricardo Rodriguez: University of Buenos-Aires(Argentina)

Madalina Croitoru collaborates with Ricardo Rodriguez on axiomatization of consistent query answering semantics inspired from axiomatization of belief revision operators.

Milos Stoiakovitch: University of Novi Sad (Serbia)

Madalina Croitoru collaborates with Milos Stoiakovitch on properties of positional games in argumentation.

8.3. International Research Visitors

8.3.1. Visits to the GraphIK team

- January 2014: Camille Pradel, IRIT. He gave a talk presenting his PhD results *D'un langage de haut niveau à des requêtes graphes permettant d'interroger le web sémantique*. http://thesesups.ups-tlse.fr/2237/1/2013TOU30261.pdf
- January 2014: Florent Domenach, Nicosia University, Chypre. He gave a talk *Analyse formelle de concepts, application à l'analyse d'annotations sémantiques*.
- February 2014: Aymeric Ledorze, LERIA Aymeric Ledorze (LERIA). He gave a talk presenting his PhD results *Validation, synthèse et paramétrage des cartes cognitives*. https://tel.archives-ouvertes.fr/tel-00956983/document
- February 2014: Pierre Bisquert, IRIT. He gave a talk presenting his PhD results on *Étude du changement en argumentation*. http://thesesups.ups-tlse.fr/2272/1/2013TOU30302.pdf
- February 2014: Lakhdar Saïs, CRIL. He gave a talk on *Approches déclaratives pour la fouille de données*. http://www.cril.univ-artois.fr/decMining/pdf/slidesSeminaireLirmm.pdf
- April 2014: Meghyn Bienvenu, LRI, One week work on query rewriting as part of the Pagoda project (see 8.1).
- April 2014: Federico Ulliana, Inria Grenoble. He gave a talk on *Deductive RDF Triplestores : domain-specific applications and bounded-size module extraction*.
- June 2014: Slawek Staworko, Inria Lille. He gave a talk on *Prioritized Repairing and Consistent Query Answering in Relational Database*. http://researchers.lille.inria.fr/~staworko/research/talk-montpellier14.pdf
- September 2014: Jérôme Lang, LAMSADE. He gave a talk on *Introduction au choix social computationnel*. http://www.afia.asso.fr/tiki-download_wiki_attachment.php?attId=83
- October 2014: Bernardo Cuenca Grau, Department of Computer Science, Oxford. Work on algorithms for reasoning with existential rules.
- October 2014: Meghyn Bienvenu, LRI, One week work on query rewriting as part of the Pagoda project (see 8.1).

8.3.2. Visits to International Teams

- January 2014: Madalina Croitoru was invited by the Universitat Autonònoma de Barcelona (UAB). Work with Lluís Godo Lacasa (Artificial Intelligence Research Institute, IIIA) and Ricardo Rodriguez (University of Buenos Aires) on the axiomatisation of consistent query answering via belief revision (see 6.2).

HEPHAISTOS Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. SyRreMuse project: recommender for museum and exhibit visitors

Participant: Bernard Senach [correspondant].

The goal of the SyReMuse Project is to design and implement a recommender system for Museum and exhibits visitors. The project brings together a cluster of research labs from Inria and from University of Avignon mixing computer scientists and Human Science researchers (Laboratoire d'informatique d'Avignon, -Centre Norbert Elias, Wimmics, Hephaistos, ICT usage labs) . The project has been submitted to an ANR Call and, though not successful is still going on with a restricted objective focusing on modeling visitor's expectations and experience (individual and group).

7.1.2. Gnothi Seauton project : Evaluation of communicating objects

Participants: Yves Papegay, Bernard Senach [correspondant], Jean-Pierre Merlet.

In collaboration with a rehabilitation center, we are setting up an experiment of self-quantification devices based on actimetrics (measurement and analysis of motor activities of a subject). The goal of the study is to assess utility and usability of these devices in the context of mobility rehabilitation. The study will take place at Vallauris' Centre Heliomarin with physical therapists and patients with mobility impairments.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. CABLEBOT

- Type: COOPERATION
- Instrument: Specific Targeted Research Project
- Objective: to develop a new generation of modular and reconfigurable robots able to perform many different steps in the post-production of large-scale structures.
- Duration: November 2011 - October 2014
- Coordinator: Ms. Mariola Rodríguez (TECNALIA, Spain)
- Partner: TECNALIA (Spain), CNRS-LIRMM, FRAUNHOFFER-IPA, UDE, Inria, EADS, ACCIONA, VICINAY
- Inria contact: Jean-Pierre Merlet
- Abstract: The CABLEBOT project [0] deals with a novel methodology for designing, developing and evaluating cable robots customized for the automation in large-scale auxiliary processes. Parallel cable robots extend the payloads and workspace of conventional industrial robots by more than two orders of magnitude. The main objective is to develop a new generation of modular and reconfigurable robots able to perform many different steps in the post-production of large-scale structures. Three key technologies will be developed: a) Design of Cable Robot: Software tools to design the layout and geometry of cable robots, b) Industrial Process Planning: Simulation of cable robots to verify the operation of cable robots in environments with large-scale structures c) Control Algorithms and Systems: Distributed control and kinematic transformation to operate modular cable

[0] http://www.cablebot.eu/

robots. Two application examples are targeted in close cooperation to industry: aeronautical applications of maintenance and the handling of construction beams. In both cases existing automation can hardly be used due to maneuverability of heavy and big parts and the risk associated. The results are feasible for many other fields including large-workspace movements of products, with impact in logistics, transport, and warehousing. The exploitation and commercialization of CABLEBOT are driven by VICINAY CEMVISA, the application of industrial scenarios, two end-users of different sectors - EADS and ACCIONA - will automate their currently manual post-production. TECNALIA provides the technology for simulation in terms of productivity, cost, safety and robustness, whereas the design of the robots is in charge of LIRMM and Inria. IPA and UDE are in charge of the control algorithms, on distributed and force control of redundant systems. Benefits include an increase of production efficiency, a wider range of products, light and reconfigurable structure mechanisms and adaptable and more flexible operator assistance systems.

7.2.1.2. RAPP

Type: COOPERATION

Instrument: Specific Targeted Research Project

Objective: Robotic Applications for Delivering Smart User Empowering Applications

Duration: December 2013-December 2016

Coordinator: CERTH/ITI

Partner: CERTH/ITI(Greece), Inria, WUT (Poland), ORTELIO (UK), ORMYLIA (Greece), INGEMA (Spain)

Inria contact: David Daney, Jean-Pierre Merlet, Manuel Serrano

Abstract: s our societies are affected by a dramatic demographic change, in the near future elderly and people requiring support in their daily life will increase and caregivers will not be enough to assist and support them. Socially interactive robots can help to confront this situation not only by physically assisting people but also functioning as a companion. The increasing sales figures of robots are pointing that we are in front of a trend break for robotics. To lower the cost for developers and to increase their interest on developing robotic applications, the RAPP introduces the idea of robots as platforms. RAPP (Robotic Applications for Delivering Smart User Empowering Applications) will provide a software platform in order to support the creation and delivery of robotics applications (RAPPs) targeted to people at risk of exclusion, especially older people. The open-source software platform will provide an API that contains the functionalities for implementing RAPPs and accessing the robot's sensors and actuators using higher level commands, by adding a middleware stack with added functionalities suitable for different kinds of robots. RAPP will expand the computational and storage capabilities of robots and enable machine learning operations, distributed data collection and processing, and knowledge sharing among robots in order to provide personalized applications based on adaptation to individuals. The use of a common API will assist developers is creating improved applications for different types of robots that target to people with different needs, capabilities and expectations, while at the same time respect their privacy and autonomy, thus the proposed RAPP Store will have a profound effect in the robotic application market. The results of RAPP will be evaluated through the development and benchmarking of social assistive RAPPs, which exploit the innovative features (RAPP API, RAPP Store, knowledge reuse, etc.) introduced by the proposed paradigm.

7.2.2. Collaborations with Major European Organizations

Our collaboration are described in the figure 1 .

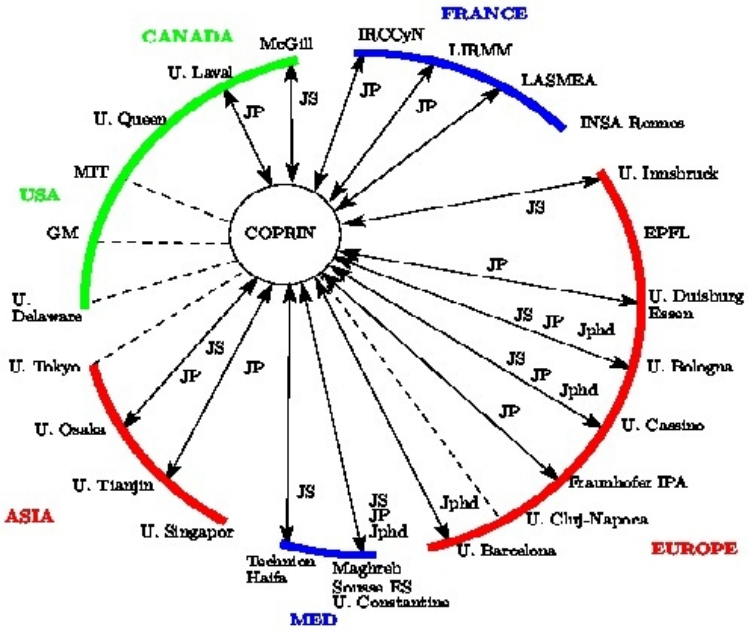

Figure 1. COPRIN collaboration. JP:joint project, JS: joint stay, Jphd: joint PhD students

HIEPACS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Innovative simulation methods for large scale numeric prototypes on emerging architectures computers

Participants: Emmanuel Agullo, Olivier Coulaud, Aurélien Esnard, Mathieu Faverge, Luc Giraud, Abdou Guermouche, Pierre Ramet, Jean Roman.

Grant: Regional council
Dates: 2013 – 2015
Partners: EPIs REALOPT, RUNTIME from Inria Bordeaux Sud-Ouest, CEA-CESTA and l'Institut pluridisciplinaire de recherche sur l'environnement et les matériaux (IPREM) .
Overview: Numerical simulation is now integrated into all the design levels and the scientific studies for both academic and industrial contexts. Given the increasing size and sophistication of the simulations carried out, the use of parallel computing is inescapable. The complexity of such achievements requires collaboration of multidisciplinary teams capable of mastering all the necessary scientific skills for each component constituting the chain of expertise. In this project we consider each of these elements as well as efficient methods for parallel codes coupling. All these works are intended to contribute to the design of large scale parallel multi-physics simulations. In addition to this research human activities the regional council also support some innovative computing equipment that will be embedded in the PlaFRIM experimental plateform, project led by O. Coulaud.

8.2. National Initiatives

8.2.1. Inria Project Lab

8.2.1.1. C2S@Exa - Computer and Computational Sciences at Exascale

Since January 2013, the team is participating to the C2S@EXA Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@EXA is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

8.2.2. ANR

8.2.2.1. SOLHAR: SOLvers for Heterogeneous Architectures over Runtime systems

Participants: Emmanuel Agullo, Mathieu Faverge, Andra Hugo, Abdou Guermouche, Xavier Lacoste, Pierre Ramet, Jean Roman, Guillaume Sylvand.

Grant: ANR-MONU

Dates: 2013 – 2017
Partners: Inria (REALOPT, RUNTIME Bordeaux Sud-Ouest et ROMA Rhone-Alpes), IRIT/INPT, CEA-CESTA et Airbus Group Innovations.
Overview:

During the last five years, the interest of the scientific computing community towards accelerating devices has been rapidly growing. The reason for this interest lies in the massive computational power delivered by these devices. Several software libraries for dense linear algebra have been produced; the related algorithms are extremely rich in computation and exhibit a very regular pattern of access to data which makes them extremely good candidates for GPU execution. On the contrary, methods for the direct solution of sparse linear systems have irregular, indirect memory access patterns that adversely interact with typical GPU throughput optimizations.

This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computer equipped with accelerators. The ultimate aim of this project is to achieve the implementation of a software package providing a solver based on direct methods for sparse linear systems of equations. To date, the approaches proposed to achieve this objective are mostly based on a simple offloading of some computational tasks to the accelerators and rely on fine hand-tuning of the code and accurate performance modeling to achieve efficiency. This project proposes an innovative approach which relies on the efficiency and portability of runtime systems. The development of a production-quality, sparse direct solver requires a considerable research effort along three distinct axes:

- linear algebra: algorithms have to be adapted or redesigned in order to exhibit properties that make their implementation and execution on heterogeneous computing platforms efficient and reliable. This may require the development of novel methods for defining data access patterns that are more suitable for the dynamic scheduling of computational tasks on processing units with considerably different capabilities as well as techniques for guaranteeing a reliable and robust behavior and accurate solutions. In addition, it will be necessary to develop novel and efficient accelerator implementations of the specific dense linear algebra kernels that are used within sparse, direct solvers;
- runtime systems: tools such as the StarPU runtime system proved to be extremely efficient and robust for the implementation of dense linear algebra algorithms. Sparse linear algebra algorithms, however, are commonly characterized by complicated data access patterns, computational tasks with extremely variable granularity and complex dependencies. Therefore, a substantial research effort is necessary to design and implement features as well as interfaces to comply with the needs formalized by the research activity on direct methods;
- scheduling: executing a heterogeneous workload with complex dependencies on a heterogeneous architecture is a very challenging problem that demands the development of effective scheduling algorithms. These will be confronted with possibly limited views of dependencies among tasks and multiple, and potentially conflicting objectives, such as minimizing the makespan, maximizing the locality of data or, where it applies, minimizing the memory consumption.

Given the wide availability of computing platforms equipped with accelerators and the numerical robustness of direct solution methods for sparse linear systems, it is reasonable to expect that the outcome of this project will have a considerable impact on both academic and industrial scientific computing. This project will moreover provide a substantial contribution to the computational science and high-performance computing communities, as it will deliver an unprecedented example of a complex numerical code whose parallelization completely relies on runtime scheduling systems and which is, therefore, extremely portable, maintainable and evolvable towards future computing architectures.

8.2.2.2. SONGS: Simulation Of Next Generation Systems

Participant: Abdou Guermouche.

Grant: ANR 11 INFRA 13
Dates: 2011 – 2015

Partners: Inria (Bordeaux Sud-Ouest, Nancy - Grand Est, Rhone-Alpes, Sophia Antipolis - Méditerranée), I3S, LSIIT
Overview:

The last decade has brought tremendous changes to the characteristics of large scale distributed computing platforms. Large grids processing terabytes of information a day and the peer-to-peer technology have become common even though understanding how to efficiently exploit such platforms still raises many challenges. As demonstrated by the USS SimGrid project funded by the ANR in 2008, simulation has proved to be a very effective approach for studying such platforms. Although even more challenging, we think the issues raised by petaflop/exaflop computers and emerging cloud infrastructures can be addressed using similar simulation methodology.

The goal of the SONGS project is to extend the applicability of the SimGrid simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area.

Any sound study of such systems through simulations relies on the following pillars of simulation methodology: Efficient simulation kernel; Sound and validated models; Simulation analysis tools; Campaign simulation management.

8.2.2.3. ANEMOS: Advanced Numeric for ELMs : Modeling and Optimized Schemes
Participants: Xavier Lacoste, Guillaume Latu, Pierre Ramet.

Grant: ANR-MN
Dates: 2012 – 2016
Partners: Univ. Nice, CEA/IRFM, CNRS/MDS.
Overview: The main goal of the project is to make a significant progress in understanding of active control methods of plasma edge MHD instabilities Edge Localized Modes (ELMs) wich represent particular danger with respect to heat and particle loads for Plasma Facing Components (PFC) in ITER. The project is focused in particular on the numerical modelling study of such ELM control methods as Resonant Magnetic Perturbations (RMPs) and pellet ELM pacing both foreseen in ITER. The goals of the project are to improve understanding of the related physics and propose possible new strategies to improve effectiveness of ELM control techniques. The tool for the non-linear MHD modeling is the JOREK code which was essentially developed within previous ANR ASTER. JOREK will be largerly developed within the present project to include corresponding new physical models in conjunction with new developments in mathematics and computer science strategy. The present project will put the non-linear MHD modeling of ELMs and ELM control on the solid ground theoretically, computationally, and applications-wise in order to progress in urgently needed solutions for ITER.

Regarding our contributions, the JOREK code is mainly composed of numerical computations on 3D data. The toroidal dimension of the tokamak is treated in Fourier space, while the poloidal plane is decomposed in Bezier patches. The numerical scheme used involves a direct solver on a large sparse matrix as a main computation of one time step. Two main costs are clearly identified: the assembly of the sparse matrix, and the direct factorization and solve of the system that includes communications between all processors. The efficient parallelization of JOREK is one of our main goals, to do so we will reconsider: data distribution, computation distribution or GMRES implementation. The quality of the sparse solver is also crucial, both in term of performance and accuracy. In the current release of JOREK, the memory scaling is not satisfactory to solve problems listed above , since at present as one increases the number of processes for a given problem size, the memory footprint on each process does not reduce as much as one can expect. In order to access finer meshes on available supercomputers, memory savings have to be done in the whole code. Another key point for improving parallelization is to carefully profile the application to understand the regions of the code that do not scale well. Depending on the timings obtained, strategies to diminish communication overheads will be evaluated and schemes that improve load balancing will be initiated. JOREK uses PaStiX sparse matrix library for matrix inversion. However, large number of toroidal harmonics and particular thin structures to resolve for realistic plasma parameters and ITER machine size still require more aggressive optimisation in numeric

dealing with numerical stability, adaptive meshes etc. However many possible applications of JOREK code we proposed here which represent urgent ITER relevant issues related to ELM control by RMPs and pellets remain to be solved.

8.2.2.4. OPTIDIS: OPTImisation d'un code de dynamique des DISlocations

Participants: Olivier Coulaud, Aurélien Esnard, Arnaud Etcheverry, Luc Giraud.

Grant: ANR-COSINUS
Dates: 2010 – 2014
Partners: CEA/DEN/DMN/SRMA (leader), SIMaP Grenoble INP and ICMPE / Paris-Est.
Overview: Plastic deformation is mainly accommodated by dislocations glide in the case of crystalline materials. The behavior of a single dislocation segment is perfectly understood since 1960 and analytical formulations are available in the literature. However, to understand the behavior of a large population of dislocations (inducing complex dislocations interactions) and its effect on plastic deformation, massive numerical computation is necessary. Since 1990, simulation codes have been developed by French researchers. Among these codes, the code TRIDIS developed by the SIMAP laboratory in Grenoble is the pioneer dynamic dislocation code. In 2007, the project called NUMODIS had been set up as team collaboration between the SIMAP and the SRMA CEA Saclay in order to develop a new dynamics dislocation code using modern computer architecture and advanced numerical methods. The objective was to overcome the numerical and physical limits of the previous code TRIDIS. The version NUMODIS 1.0 came out in December 2009, which confirms the feasibility of the project. The project OPTIDIS is initiated when the code NUMODIS is mature enough to consider parallel computation. The objective of the project is to develop and validate the algorithms in order to optimize the numerical and performance efficiency of the NUMODIS code. We are aiming at developing a code able to tackle realistic material problems such as the interaction between dislocations and irradiation defects in a grain plastic deformation after irradiation. These kinds of studies where "local mechanisms" are correlated with macroscopic behavior is a key issue for nuclear industry in order to understand material aging under irradiation, and hence predict power plant secured service life. To carry out such studies, massive numerical optimizations of NUMODIS are required. They involve complex algorithms lying on advanced computational science methods. The project OPTIDIS will develop through joint collaborative studies involving researchers specialized in dynamics dislocations and in numerical methods. This project is divided in 8 tasks over 4 years. Two PhD theses will be directly funded by the project. One will be dedicated to numerical development, validation of complex algorithms and comparison with the performance of existing dynamics dislocation codes. The objective of the second is to carry out large scale simulations to validate the performance of the numerical developments made in OPTIDIS. In both cases, these simulations will be compared with experimental data obtained by experimentalists.

8.2.2.5. RESCUE: RÉsilience des applications SCientifiqUEs

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Mawussi Zounon.

Grant: ANR-Blanc (computer science theme)
Dates: 2010 – 2015
Partners: Inria EPI ROMA (leader) and GRAND LARGE.
Overview: The advent of exascale machines will help solve new scientific challenges only if the resilience of large scientific applications deployed on these machines can be guaranteed. With 10,000,000 core processors, or more, the time interval between two consecutive failures is anticipated to be smaller than the typical duration of a checkpoint, i.e., the time needed to save all necessary application and system data. No actual progress can then be expected for a large-scale parallel application. Current fault-tolerant techniques and tools can no longer be used. The main objective of the RESCUE project is to develop new algorithmic techniques and software tools to solve the exascale resilience problem. Solving this problem implies a departure from current approaches, and calls for yet-to-be-discovered algorithms, protocols and software tools.

This proposed research follows three main research thrusts. The first thrust deals with novel checkpoint protocols. This thrust will include the classification of relevant fault categories and the development of a software package for fault injection into application execution at runtime. The main research activity will be the design and development of scalable and light-weight checkpoint and migration protocols, with on-the-fly storing of key data, distributed but coordinated decisions, etc. These protocols will be validated via a prototype implementation integrated with the public-domain MPICH project. The second thrust entails the development of novel execution models, i.e., accurate stochastic models to predict (and, in turn, optimize) the expected performance (execution time or throughput) of large-scale parallel scientific applications. In the third thrust, we will develop novel parallel algorithms for scientific numerical kernels. We will profile a representative set of key large-scale applications to assess their resilience characteristics (e.g., identify specific patterns to reduce checkpoint overhead). We will also analyze execution trade-offs based on the replication of crucial kernels and on decentralized ABFT (Algorithm-Based Fault Tolerant) techniques. Finally, we will develop new numerical methods and robust algorithms that still converge in the presence of multiple failures. These algorithms will be implemented as part of a software prototype, which will be evaluated when confronted with realistic faults generated via our fault injection techniques.

We firmly believe that only the combination of these three thrusts (new checkpoint protocols, new execution models, and new parallel algorithms) can solve the exascale resilience problem. We hope to contribute to the solution of this critical problem by providing the community with new protocols, models and algorithms, as well as with a set of freely available public-domain software prototypes.

8.2.2.6. BOOST: Building the future Of numerical methOdS for iTer

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman.

Grant: ANR-Blanc (applied math theme)
Dates: 2010 – 2014
Partners: Institut de Mathématiques de Toulouse (leader); Laboratoire d'Analyse, Topologie, Probabilités in Marseilles; Institut de Recherche sur la Fusion Magnétique, CEA/IRFM and HIEPACS.
Overview: This project regards the study and the development of a new class of numerical methods to simulate natural or laboratory plasmas and in particular magnetic fusion processes. In this context, we aim at giving a contribution, from the mathematical, physical and algorithmic point of view, to the ITER project.

The core of this project consists in the development, the analysis, the implementation and the testing on real physical problems of the so-called Asymptotic-Preserving methods which allow simulations over a large range of scales with the same model and numerical method. These methods represent a breakthrough with respect to the state-of-the art. They will be developed specifically to handle the various challenges related to the simulation of the ITER plasma. In parallel with this class of methodologies, we intend to design appropriate coupling techniques between macroscopic and microscopic models for all the cases in which a net distinction between different regimes can be done. This will permit to describe different regimes in different regions of the machine with a strong gain in term of computational efficiency, without losing accuracy in the description of the problem. We will develop full 3-D solver for the asymptotic preserving fluid as well as kinetic model. The Asymptotic-Preserving (AP) numerical strategy allows us to perform numerical simulations with very large time and mesh steps and leads to impressive computational saving. These advantages will be combined with the utilization of the last generation preconditioned fast linear solvers to produce a software with very high performance for plasma simulation. For HIEPACS this project provides in particular a testbed for our expertise in parallel solution of large linear systems.

8.2.2.7. DEDALES: Algebraic and Geometric Domain Decomposition for Subsurface/Groundwater Flows

Participants: Emmanuel Agullo, Luc Giraud, Mathieu Faverge, Louis Poirel.

Grant: ANR-14-CE23-0005
Dates: 2014 – 2018
Partners: Inria EPI POMDAPI (leader); Université Paris 13 - Laboratoire Analyse, Géométrie et Applications; Maison de la Simulation; Andra.

Overview: Project DEDALES aims at developing high performance software for the simulation of two phase flow in porous media. The project will specifically target parallel computers where each node is itself composed of a large number of processing cores, such as are found in new generation many-core architectures. The project will be driven by an application to radioactive waste deep geological disposal. Its main feature is phenomenological complexity: water-gas flow in highly heterogeneous medium, with widely varying space and time scales. The assessment of large scale model is of major importance and issue for this application, and realistic geological models have several million grid cells. Few, if at all, software codes provide the necessary physical features with massively parallel simulation capabilities. The aim of the DEDALES project is to study, and experiment with, new approaches to develop effective simulation tools with the capability to take advantage of modern computer architectures and their hierarchical structure. To achieve this goal, we will explore two complementary software approaches that both match the hierarchical hardware architecture: on the one hand, we will integrate a hybrid parallel linear solver into an existing flow and transport code, and on the other hand, we will explore a two level approach with the outer level using (space time) domain decomposition, parallelized with a distributed memory approach, and the inner level as a subdomain solver that will exploit thread level parallelism. Linear solvers have always been, and will continue to be, at the center of simulation codes. However, parallelizing implicit methods on unstructured meshes, such as are required to accurately represent the fine geological details of the heterogeneous media considered, is notoriously difficult. It has also been suggested that time level parallelism could be a useful avenue to provide an extra degree of parallelism, so as to exploit the very large number of computing elements that will be part of these next generation computers. Project DEDALES will show that space-time DD methods can provide this extra level, and can usefully be combined with parallel linear solvers at the subdomain level. For all tasks, realistic test cases will be used to show the validity and the parallel scalability of the chosen approach. The most demanding models will be at the frontier of what is currently feasible for the size of models.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. EXA2CT

Type: FP7

Defi: Special action

Instrument: Specific Targeted Research Project

Objectif: Exascale computing platforms, software and applications

Duration: September 2013 - August 2016

Coordinator: IMEC, Belgium

Partner: Particular specializations and experience of the partners are:

- Applications:
  - NAG - long experience in consultancy for HPC applications
  - Intel France - collaboration with industry on the migration of software for future HPC systems
  - TS-SFR - long experience in consultancy for HPC applications in Aerospace and Oil & Gas
- Algorithms – primarily numerical:
  - UA - broad experience in numerical solvers, with some taken up by the PETSc numerical library and other work published in high-ranking journals such as Science.
  - USI - expertise in parallel many-core algorithms for real-world applications on emerging architectures
  - Inria - expertise on large scale parallel numerical algorithms

  - IT4I - experience in the development of scalable solvers for large HPC systems (e.g. PRACE)
- Programming Models & Runtime Environments:
  - Imec - leads the programming model research within the Flanders ExaScience Lab
  - UVSQ - specialized in code optimization and performance evaluation in the area of HPC
  - TS-SFR - leading the BMBF funded GASPI project
  - Fraunhofer - developed a GASPI runtime environment used in industrial applications
- Hardware Optimization:
  - Intel France - investigates workloads for new hardware architectures within the context of the Exascale Computing Research centre

Inria contact: Luc Giraud

Abstract: The EXA2CT project brings together experts at the cutting edge of the development of solvers, related algorithmic techniques, and HPC software architects for programming models and communication. We will produce modular open source proto-applications that demonstrate the algorithms and programming techniques developed in the project, to help boot-strap the creation of genuine exascale codes.

Numerical simulation is a crucial part of science and industry in Europe. The advancement of simulation as a discipline relies on increasingly compute intensive models that require more computational resources to run. This is the driver for the evolution to exascale. Due to limits in the increase in single processor performance, exascale machines will rely on massive parallelism on and off chip, with a complex hierarchy of resources. The large number of components and the machine complexity introduce severe problems for reliability and programmability.

8.4. International Initiatives

8.4.1. Inria International Labs

We are involved in the Inria@SiliconValley initiative through the associate team FASTLA described below.

8.4.2. Inria Associate Teams

8.4.2.1. MORSE

Title: Matrices Over Runtime Systems @ Exascale

International Partner (Institution - Laboratory - Researcher):

KAUST Supercomputing Laboratory (ÉTATS-UNIS)

Duration: 2014 - 2016

See also: http://icl.cs.utk.edu/projectsdev/morse/index.html

The goal of Matrices Over Runtime Systems at Exascale (MORSE) project is to design dense and sparse linear algebra methods that achieve the fastest possible time to an accurate solution on large-scale multicore systems with GPU accelerators, using all the processing power that future high end systems can make available. To develop software that will perform well on petascale and exascale systems with thousands of nodes and millions of cores, several daunting challenges have to be overcome, both by the numerical linear algebra and the runtime system communities. By designing a research framework for describing linear algebra algorithms at a high level of abstraction,the MORSE team will enable the strong collaboration between research groups in linear algebra, runtime systems and scheduling needed to develop methods and libraries that fully benefit from the potential of future large-scale machines. Our project will take a pioneering step in the effort to bridge the immense software gap that has opened up in front of the High-Performance Computing (HPC) community.

8.4.2.2. FASTLA

Title: Fast and Scalable Hierarchical Algorithms for Computational Linear Algebra

International Partner (Institution - Laboratory - Researcher):

Stanford University (ÉTATS-UNIS)

Lawrence Berkeley National Laboratory (ÉTATS-UNIS)

Duration: 2014 - 2016

See also: http://people.bordeaux.inria.fr/coulaud/projets/FastLA_Website/

In this project, we propose to study fast and scalable hierarchical numerical kernels and their implementations on heterogeneous manycore platforms for two major computational kernels in intensive challenging applications. Namely, fast multipole methods (FMM) and sparse hybrid linear solvers, that appear in many intensive numerical simulations in computational sciences. Regarding the FMM we plan to study novel generic formulations based on $\mathcal{H}$-matrices techniques, that will be eventually validated in the field of material physics: the dislocation dynamics. For the hybrid solvers, new parallel preconditioning approaches will be designed and the use of $\mathcal{H}$-matrices techniques will be first investigated in the framework of fast and monitored approximations on central components. Finally, the innovative algorithmic design will be essentially focused on heterogeneous manycore platforms. The partners, Inria HiePACS, Lawrence Berkeley Nat. Lab and Stanford University, have strong, complementary and recognized experiences and backgrounds in these fields.

8.4.3. Participation In other International Programs

8.4.3.1. HOSCAR

We are involved in the Inria-CNPq HOSCAR project led by Stéphane Lanteri.

The general objective of the project is to setup a multidisciplinary Brazil-France collaborative effort for taking full benefits of future high-performance massively parallel architectures. The targets are the very large-scale datasets and numerical simulations relevant to a selected set of applications in natural sciences: (i) resource prospection, (ii) reservoir simulation, (iii) ecological modeling, (iv) astronomy data management, and (v) simulation data management. The project involves computer scientists and numerical mathematicians divided in 3 fundamental research groups: (i) numerical schemes for PDE models (Group 1), (ii) scientific data management (Group 2), and (iii) high-performance software systems (Group 3).

An annual meeting has been organized in Gramado, Brazil on September, 2014.

8.4.3.2. G8-ECS

Title: Enabling Climate Simulations at Extreme Scale

Inria principal investigator: Luc Giraud

International Partners (Institution - Researcher):

Univ. Illinois at Urbanna Champaign & Argonne National Lab. - Franck Cappello,

Univ. Tennessee at Knoxville - George Bosilca,

German Research School for Simulation Sciences - Felix Wolf,

Univ. Victoria - Andrew Weaver,

Titech - Satoshi Matsuoka,

Univ. Tsukuba - Mitsuhisa Sato,

NCAR - Rich Loft,

Barcelona Supercomputing Center - Jesus Labarta.

Duration: 2011 - 2014

See also: G8 ESC-Enabling Climate Simulations at Extreme Scale

Exascale systems will allow unprecedented reduction of the uncertainties in climate change predictions via ultra-high resolution models, fewer simplifying assumptions, large climate ensembles and simulation at a scale needed to predict local effects. This is essential given the cost and consequences of inaction or wrong actions about climate change. To achieve this, we need careful co-design of future exascale systems and climate codes, to handle lower reliability, increased heterogeneity, and increased importance of locality. Our effort will initiate an international collaboration of climate and computer scientists that will identify the main roadblocks and analyze and test initial solutions for the execution of climate codes at extreme scale. This work will provide guidance to the future evolution of climate codes. We will pursue research projects to handle known roadblocks on resilience, scalability, and use of accelerators and organize international, interdisciplinary workshops to gather and disseminate information. The global nature of the climate challenge and the magnitude of the task strongly favor an international collaboration. The consortium gathers senior and early career researchers from USA, France, Germany, Spain, Japan and Canada and involves teams working on four major climate codes (CESM1, EC-EARTH, ECSM, NICAM).

HIPERCOM2 Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. GETRF

Participants: Paul Muhlethaler, Pascale Minet, Cédric Adjih, Emmanuel Baccelli, Philippe Jacquet.

Period: 2012 - 2014.

Partners: DGA/MI, Inria (coordinator), Alcatel-Lucent.

The GETRF project aims at improving the effectiveness of communications mechanisms and technologies capable of functioning in extreme conditions and GETRF also aims at opening ways for solutions that are close to the optimum. The following areas will be addressed:

- Compromise time / maximum efficiency for coloring (TDMA), which can be used to take into account the asymmetry of traffic delays to optimize routing.
- Significant energy savings for opportunistic routing (in power saving mode) even where traffic control is limited and where the nodes are idle most of the time ("low-duty cycle")
- From a completely different point of view, the finding optimal network capacity for opportunistic routing variants when designed for mobile networks
- Robustness to mobility and to changes in network conditions (difficult connectivity, foes, ...) extreme network coding - which is moreover an innovative technology in itself applied here in MANETs, at the network and/or application layer, rather than at the physical/or theoretical level as in other proposals.

The project focuses on four technical approaches which are:

- Coloring for the development of a TDMA system for energy saving and delay control,
- Cross-layer (MAC/routing) mechanism for "low-duty-cycle" mode
- Network coding,
- Opportunistic routing and mobile mobility to use relays to minimize retransmissions of packets with a target time.

The first two approaches are intended to provide energy efficient sensor networks. The second two approaches try to provide mechanisms for building ad hoc networks capable of handling high node mobility.

In this last year of the project we finalize our studies on the four main mechanism of the GETRF project:

- energy saving mechanisms using synchronous techniques,
- energy saving mechanisms using asynchronous techniques,
- network coding,
- mobile routing.

In the last deliverable of the project, we study how these techniques can be combined. We also present how to improve asynchronous techniques for energy saving and how to adapt mobile routing to other assumptions.

8.1.2. Competitivity Clusters

8.1.2.1. SAHARA

Participants: Pascale Minet, Ridha Soua, Erwan Livolant.

Period: 2011 - 2014.

Partners: EADS (coordinator), Astrium, BeanAir, CNES, ECE, EPMI, Eurocopter, GlobalSys, Inria, LIMOS, Oktal SE, Reflex CES, Safran Engineering Systems.

SAHARA is a FUI project, labelled by ASTECH and PEGASE, which aims at designing a wireless sensor network embedded in an aircraft. The proposed solution should improve the embedded mass, the end-to-end delays, the cost and performance in the transfers of non critical data.

During year 2014, we provided support to the SMEs in the SAHARA project for the implementation of network algorithms and protocols.

8.1.2.2. CONNEXION

Participants: Pascale Minet, Ines Khoufi, Erwan Livolant.

Period: 2012 - 2016.

Partners: EDF (coordinator), All4Tec, ALSTOM, AREVA, Atos WorldGrid, CEA, CNRS / CRAN, Corys TESS, ENS Cachan, Esterel Technologies, Inria, LIG, Predict, Rolls-Royce Civil Nuclear, Telecom ParisTech.

The Cluster CONNEXION (Digital Command Control for Nuclear EXport and renovation) project aims to propose and validate an innovative architecture platforms suitable control systems for nuclear power plants in France and abroad. This architecture integrates a set of technological components developed by the academic partners (CEA, Inria, CNRS / CRAN, ENS Cachan, LIG, Telecom ParisTech) and based on collaborations between major integrators such as ALSTOM and AREVA, the operator EDF in France and "techno-providers" of embedded software (Atos WorldGrid, Rolls-Royce Civil Nuclear, Corys TESS, Esterel Technologies, All4Tec, Predict). With the support of the competitiveness clusters System@tic, Minalogic and Burgundy Nuclear Partnership,the project started in April 2012. The key deliverables of the project covered several topics related demonstration concern-driven engineering models for the design and validation of large technical systems, design environments and evaluation of HMI, the implementation of Wireless Sensor Network context-nuclear, buses business object or real-time middleware facilitating the exchange of heterogeneous data and distributed data models standardized to ensure consistency of digital systems.

The HIPERCOM2 team is focuses more particularly on the interconnection of the OCARI wireless sensor network with the industrial facility backbone and deployment algorithms of wireless sensors. In November 2014, we contributed with our Connexion partners to a demonstration showing that OCARI:

- supports wireless sensors of various types (e.g. temperature sensor PT100, smoke detector produced by CEA, fire alarm produced by ADWAVE);
- can be interconnected via a gateway to the industrial facility backbone OPC/UA ROSA developed by Telecom ParisTech to reach the KASEM system in charge of predictive maintenance developed by Predict.

All the chain ranging from the physical sensors, the OCARI wireless network, the OPC/UA bus to the KASEM software was integrated to allow information originated from wireless sensor nodes to be displayed on the KASEM console.

We also focus on deployment algorithms for mobile wireless sensor networks in a temporary worksite or after a disaster. These deployments must ensure coverage and network connectivity. In 2013 we studied solutions to ensure full coverage of the area to monitor as well as network connectivity. We proposed solutions in a first step for autonomous mobile wireless sensor nodes and in a second step for static ones. In May 2014, we showed in a Connexion demonstration a tool displaying the deployment of wireless static sensor nodes in an indoor environment. Since these static nodes are deployed by a mobile robot, we studied how to optimize the exposition duration of a robot in an hostile environment. We also focused on network connectivity, more particularly on how to ensure a reliable connectivity to the sink of sensor nodes located at some points of interest. Our goal is to find the best trade-off between the number of relay nodes deployed and the length of the paths connecting each PoI to the sink.

8.1.2.3. SWAN

Participants: Cédric Adjih, Claudio Greco.

Period: 2011 - 2014

Partners: CNRS, Supélec, Université Paris-Sud (L2S), LTCI, LRI, Inria and IEF.

SWAN, Source-aWAre Network coding, is a DIMLSC DIGITEO project. It deals with network coding for multimedia.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

Paul Muhlethaler was reviewer of the projects:

- E3NETWORK (Energy Efficient E-band transceiver for backhaul of the future networks)
- TROPIC (Distributed computing, storage and radio resource allocation over cooperative femtocells)

8.3. International Initiatives

8.3.1. Participation In other International Programs

8.3.1.1. AWSN 2014

Program: Euromediterranean 3+3

Title: Auto-adaptivity in Wireless Sensor Networks

Inria principal investigator: Pascale Minet

International Partners (Institution - Laboratory - Researcher):

University of Catania (Italy) - DIEEI - Lucia Lo Bello

Ecole Nationale Supérieure d'Informatique et d'Analyse des Systèmes (Morocco) - ND-SRG - Mohamed Erradi

Ecole Nationale des Sciences de l'Informatique (Tunisia) - CRISTAL - Leila Azouz Saidane

Duration: Jan 2012 - Dec 2015

See the Web site: http://hipercom.inria.fr/euromed/

Wireless sensor networks (WSNs) allow the development of numerous applications in various domains, such as security and surveillance, environment protection, precision agriculture, intelligent transportation, homecare of elderly and disabled people...

Communication in such WSNs has to cope with limited capacity resources, energy depletion of sensor nodes, important fluctuations of traffic in the network, changes in the network topology (radio link breakage, interferences ...) or new application requirements. In the AWSN project, we focus on the different techniques to be introduced in the WSNs to make them auto-adaptive with regard to these various changes, while meeting the application requirements. Thus, we address:

- network deployment and redeployment in order to fulfill the application requirements,
- QoS (Quality of Service) optimization taking into account real-time traffic and dynamic bandwidth allocation,
- energy efficiency and replacement of failed sensor node,
- component generation and dynamic adaptation of the application.

In 2014, the AWSN project organized two workshops reserved to AWSN teams:

- Workshop in Rabat in October 2014.
- Workshop in Rocquencourt in December 2014.

The AWSN project organized also open workshops and conferences:

- the RAWSN 2014 workshop in Marrakech in May 2014 organized by the Moroccan team: see the program on http://www.netys.net/rawsn2014/, workshop held in conjunction with NETYS 2014.
- the PEMWN 2014 conference in Sousse in November 2014, organized by the Tunisian and French teams, see the program on https://sites.google.com/site/pemwn2014/final-program

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- **Leila Saidane**, ENSI, Tunis, Tunisia, February and September 2013,
- **Mohammed Erradi**, ENSIAS, Rabat, Morocco, September 2013,
- **Abdellatif Kobbane**, ENSIAS, Rabat, Morocco, September 2013.

HYBRID Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Labex S3PM

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Guillaume Claude.

S3PM is a 3-year project (2013-2016) funded by Labex CominLabs. It involves 3 academic research teams: Medicis (LTSI/Inserm), S4 and Hybrid (IRISA/Inria). S3PM aims at providing specific models, tools and software to create a collaborative virtual environment dedicated to neurosurgery processes using observations of real processes.

8.1.2. Labex HEMISFER

Participant: Anatole Lécuyer [contact].

HEMISFER is a 3-year project (2013-2016) funded by Labex CominLabs. It involves 4 Inria/IRISA teams (Hybrid, Visages (lead), Panama, Athena) and 2 medical centers: the Rennes Psychiatric Hospital (CHGR) and the Reeducation Department of Rennes Hospital (CHU Pontchaillou). The goal of HEMISFER is to make full use of neurofeedback paradigm in the context of rehabilitation and psychiatric disorders. The major breakthrough will come from the use of a coupling model associating functional and metabolic information from Magnetic Resonance Imaging (fMRI) to Electro-encephalography (EEG) to “enhance” the neurofeedback protocol. Clinical applications concern motor, neurological and psychiatric disorders (stroke, attention-deficit disorder, treatment-resistant mood disorders, etc).

8.1.3. Labex SABRE

Participants: Anatole Lécuyer [contact], Jussi Lindgren.

SABRE is a 3-year project (2014-2017) funded by Labex CominLabs. It involves 1 Inria/IRISA team (Hybrid) and 2 groups from TELECOM BREST engineering school. The goal of SABRE is to improve computational functionnalities and power of current real-time EEG processing pipelines. The project will investigate innovative EEG solution methods empowered and speeded-up by ad-hoc, transistor-level, implementations of their key algorithmic operations. A completely new family of fully-hardware-integrated, new computational EEG imaging methods will be developed that are expected to speed up the imaging process of an EEG device of several orders of magnitude in real case scenarios.

8.1.4. CNPAO Project

Participants: Valérie Gouranton [contact], Jean-Baptiste Barreau, Quentin Petit.

CNPAO ("Conservatoire Numérique du Patrimoine Archéologique de l’Ouest") is an on-going research project partially funded by the Université Européenne de Bretagne (UEB). It involves IRISA/Hybrid and CReAAH. The main objectives are: (i) a sustainable and centralized archiving of 2D/3D data produced by the archaeological community, (ii) a free access to metadata, (iii) a secure access to data for the different actors involved in scientific projects, and (iv) the support and advice for these actors in the 3D data production and exploration through the latest digital technologies, modeling tools and virtual reality systems.

8.1.5. IRT b<>com

Participants: Bruno Arnaldi [contact], Valérie Gouranton, Maud Marchal.

b<>com is a French Institute of Research and Technology (IRT). The main goal of this IRT is to fasten the development and marketing of tools, products and services in the field of digital technologies. Our team collaborate with b<>com within two 3-year projects: ImData (on "Immersive Interaction") and GestChir (on "Augmented Healthcare").

8.2. National Initiatives

8.2.1. ANR CORVETTE

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Florian Nouviale, Thomas Lopez, Rozenn Bouville Berthelot, Thomas Boggini, Quentin Petit.

CORVETTE (COllaboRative Virtual Environment Technical Training and Experiment) is a 4-year ANR project (2011-2014) led by Bruno Arnaldi. It involves 3 Academic partners (INSA Rennes, ENIB, CEA-List) and 4 Industrial partners (AFPA, Nexter Training, Virtualys, Golaem). CORVETTE aims at designing novel approaches for industrial training (maintenance, complex procedures, security, diagnosis, etc) exploiting virtual reality technologies. The project has three main research axes: collaborative work, virtual human, communication and evaluation. The project seeks to put in synergy: 1) Virtual Human for its ability to embody the user as an avatar and acting as a collaborator during trainingj; 2) Natural communication between users and virtual humans for task-oriented dialogues; and 3) Methodologies in cognitive psychology for the assessment of the effectiveness of the collaboration of users and virtual humans to perform complex cooperative tasks in VR. All these components have been integrated into a unified environment based on an industrial scenario. Several evaluations regarding the different technologies developed in the project have also been achieved.

8.2.2. ANR MANDARIN

Participants: Merwan Achibet, Adrien Girard, Anatole Lécuyer, Maud Marchal [contact].

MANDARIN ("MANipulation Dextre hAptique pour opéRations INdustrielles en RV") is a 4-year ANR project (2012-2015). MANDARIN partners are CEA-List (coordinator), Inria/Hybrid, UTC, Haption and Renault. It aims at designing new hardware and software solutions to achieve natural and intuitive mono and bi-manual dextrous interactions, suitable for virtual environments. The objective of Hybrid in MANDARIN is to design novel multimodal 3D interaction techniques and metaphors allowing to deal with haptic gloves limitations (portability, under-actuation) and to assist the user in virtual reality applications requiring dexterous manipulation. The results will be evaluated with a representative industrial application which is not feasible with currently existing technologies: the bi-manual manipulation of complex rigid objects and cables bundles.

8.2.3. ANR HOMO-TEXTILUS

Participants: Anatole Lécuyer [contact], Maud Marchal, Jonathan Mercier-Ganady.

HOMO-TEXTILUS is a 4-year ANR project (2012-2015). Partners of the project are : Inria/Hybrid, CHART, LIP6, TOMORROW LAND, RCP and potential end-user is Hussein Chalayan fashion designer. The objective of HOMO TEXTILUS is to study what could be the next generation of smart and augmented clothes, and their influence and potential impact on behavior and habits of their users. The project is strongly oriented towards human science, with both user studies and sociological studies. The involvement of Hybrid team in the project consists in studying the design of next-gen prototypes of clothes embedding novel kinds of sensors and actuators. Envisionned sensors relate to physiological measurements such as with EEG (electroencephalograpohy and Brain-Computer Interfaces), EMG (muscular activity), GSR (galvanic skin response) or Heart Rate (HR). Envisionned actuators relate to new sensory stimulations such as vibrotactile displays or novel visual (eg LED) displays. These prototypes will thus be used in the various experiments planned in the project.

8.2.4. FUI SIFORAS

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Thomas Lopez.

SIFORAS (Simulation for training and assistance) is a 3-year project (2011-2014) funded by the competitive cluster "Images et Réseaux". SIFORAS involves 4 academic partners (INSA Rennes, ENIB, CEA-List, ENISE) and 9 Industrial partners (Nexter Training, Delta CAD, Virtualys, DAF Conseils, Nexter Systems, DCNS, Renault, SNCF, Alstom). This project consists in developing a pedagogical system for technical training in industrial procedures. It aims at proposing Instructional Systems Design to answer the new objectives of training (Intelligent Tutorial System, mobility, augmented reality, high productivity). The Hybrid implication in the project shares some common means and goals with the Corvette project, in particular concerning its global architecture based on STORM and LORA models, and exploiting GVT software.

8.2.5. FUI Previz

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Rozenn Bouville Berthelot, Emmanuel Badier, Thomas Boggini.

Previz is a 3-year project (2013-2016) funded by the competitive cluster "Images et Réseaux". Previz involves 4 Academic partners (Hybrid/INSA Rennes, ENS Louis-Lumière, LIRIS, Gipsa-Lab) and 9 Industrial partners (Technicolor, Ubisoft, SolidAnim, loumasystem, Polymorph). Previz aims at proposing new previsualization tools for movie directors. The goal of Hybrid in Previz is to introduce new interactions between real and virtual actors so that the actor's actions, no matter his/her real or virtual nature, impact both the real and the virtual environment. The project will end up with a new production pipeline in order to automatically adapt and synchronize the visual effects (VFX), in space and time, to the real performance of an actor.

8.2.6. ADT MAN-IP

Participant: Valérie Gouranton [contact].

The ADT MAN-IP is a 2-year project (2013-2015) funded by Inria for software support and development. MAN-IP involves two Inria teams: Hybrid and MimeTIC. MAN-IP aims at proposing a common software pipeline for both teams to facilitate the production of populated virtual environments. The resulting software should include functionalities for motion capture, automatic aquisition and modification, and high-level authoring tools.

8.2.7. ADT OpenViBE-NT

Participants: Anatole Lécuyer [contact], Jussi Lindgren [contact], Jozef Legény.

The ADT OpenViBE-NT is a 3-year project (2012-2015) funded by Inria for support and development of the OpenViBE software (section 5.1). OpenViBE-NT involves four Inria teams: Hybrid, Potioc, Athena, Neurosys - all being extensive users of OpenViBE. OpenViBE-NT aims at improving the current functionalities of OpenViBE platform, and helping in supporting its active and ever growing community of users.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. FP7 VISIONAIR

Participants: Valérie Gouranton, Thierry Duval.

- Program: FP7-INFRA
- Project acronym: VISIONAIR
- Project title: VISION Advanced Infrastructure for Research
- Duration: Feb 2011 - Feb 2015
- Coordinator: INPG
- Other partners: INPG France, University Patras Greece, Cranfield University United Kingdom, Universiteit Twente Netherlands, Universitaet Stuttgart Germany, ICBPP Poland, Univ. Méditerranée France, CNR Italy, Inria France, KTH Sweden, Technion Israel, RWTH Germany, PUT Poland, AMPT France, TUK Germany, University Salford United Kingdom, Fraunhofer Germany, I2CAT Spain, University Essex United Kingdom, MTASEAKI Hungary, ECN France, UCL United Kingdom, Polimi Italy, European Manufacturing and Innovation Research Association
- Abstract: Visionair calls for the creation of a European infrastructure for high level visualisation facilities that are open to research communities across Europe and around the world. By integrating existing facilities, Visionair aims to create a world-class research infrastructure for conducting state-of-the-art research in visualisation, thus significantly enhancing the attractiveness and visibility of the European Research Area. Hybrid team is mainly involved in Work Package 9 (Advanced methods for interaction and collaboration) led and supervised by Prof. Georges Dumont (MimeTIC Inria team).

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. Associate Team SIMS

Participant: Maud Marchal [contact].

SIMS is an Inria Associate Team involving Mimetic and Hybrid Inria teams in Rennes and the GAMMA Research Group of the University of North Carolina in the United States. SIMS focuses on realistic and effective simulation of highly complex systems based on human movement and interaction. The Associate Team has three main axes of research: crowd simulation, movement planning for autonomous virtual humans and real-time physical simulation for interactive environments. The latter axis is supervised by Maud Marchal. In this context, one Master student spent 8 months in the GAMMA Research Group, starting in November 2013.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Dr. Gerd Bruder, Postdoc at the Universität Hamburg, Germany, spent a half month stay in our group in Rennes in February 2014 to work on locomotion and distance perception in virtual environments, in the frame of EU FP7 "VISIONAIR" project.
- Mr. Michael Pereira, PhD student at EPFL, Switzerland, spent a half month stay in our group in Rennes in October 2014 to work on BCI and virtual environments, in the frame of EU FP7 "VISIONAIR" project.

8.5.2. Visits to International Teams

8.5.2.1. Explorer programme

Merwan Achibet

Date: Sep 2014 - Dec 2014

Institution: School of Electro-Communication Tokyo, (UEC), Pr. Kajimoto, Japan

HYCOMES Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- Ayman Aljarbouh's PhD is partially funded by an ARED grant of the Brittany Regional Council. His doctoral work takes place in the context of the Modrio and Sys2Soft projects on hybrid systems modeling — see sections 7.3.1 and 7.2 . Ayman Aljarbouh is working on accelerated simulation techniques for hybrid systems. In particular, he is focusing on the regularisation, at runtime, of chattering behaviour and the approximation of Zeno behaviour.
- Benoît Caillaud is participating to the S3PM project of the CominLabs excellence laboratory [0]. This project focuses on the computation of surgical procedural knowledge models from recordings of individual procedures, and their execution [24]. The objective is to develop an enabling technology for procedural knowledge based computer assistance of surgery. In this project, we demonstrate its potential added value in nurse and surgeon training.

7.2. National Initiatives

Program:« Briques génériques du logiciel embarqué » (Embedded Software Generic Building-Blocks)

Project acronym: Sys2soft

Project title: Physics Aware Software

Duration: June 2012 – April 2016

Coordinator: Dassault Systèmes (France)

Other partners: Thales TGS / TRT / TAS, Alstom Transport, Airbus, DPS, Obeo, Soyatec

Abstract: The Sys2soft project aims at developping methods and tools supporting the design of embedded software interacting with a complex physical environment. The project advocates a methodology where both physics and software are co-modeled and co-simulated early in the design process and embedded code is generated automatically from the joint physics and software models. Extensions of the Modelica language with synchronous programming features are being investigated, as a unified framework where interacting physical and software artifacts can be modeled.

7.3. European Initiatives

7.3.1. Collaborations in European Programs, except FP7 & H2020

Program: ITEA2

Project acronym: Modrio

Project title: Model Driven Physical Systems Operation

Duration: September 2012 – November 2015

Coordinator: EDF (France)

[0] http://www.cominlabs.ueb.eu/themes/project/

Other partners: ABB (Sweden), Ampère Laboratory / CNRS (France), Bielefeld University (Germany), Dassault Systèmes (Sweden), Dassault Aviation (France), DLR (Germany), DPS (France), EADS (France), Equa Simulation (Sweden), IFP (France), ITI (Germany), Ilmenau University (Germany), Katholic University of Leuven (Belgium), Knorr-Bremse (Germany), LMS (France and Belgium), Linköping University (Sweden), MathCore (Sweden), Modelon (Sweden), Pöry (Finland), Qtronic (Germany), SICS (Sweden), Scania (Sweden), Semantum (Finland), Sherpa Engineering (France), Siemens (Germany and Sweden), Simpack (Germany), SKF (Sweden), Supmeca (France), Triphase (Belgium), University of Calabria (Italy), VTT (Finland), Vattenfall (Sweden), Wapice (Finland).

Abstract: Modelling and simulation are efficient and widely used tools for system design. But they are seldom used for systems operation. However, most functionalities for system design are beneficial for system operation, provided that they are enhanced to deal with real operating situations. Through open standards the benefits of sharing compatible information and data become obvious: improved cooperation between the design and the operation communities, easier adaptation of operation procedures wrt. design evolutions. Open standards also foster general purpose technology. The objective of the ITEA 2 MODRIO project is to extend modelling and simulation tools based on open standards from system design to system operation.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Informal International Partners

Extending beyond the context of the Modrio project (see section 7.3.1 , the Hycomes team is collaborating with the team of Dassault Systems, located in Lund (Sweden), in charge of developping Dymola, one of the major software tools in the Modelica community.

I4S Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. FONDEOL2

Participants: Dominique Siegert, Ivan Guéguen.

Type: Region

Objectif: wind turbines SHM

Duration: June 2011 to June 2014

Coordinator: STX France

Partners: IFSTTAR, Central School of Nantes and EGIS

Inria contact: Ivan Guéguen

Abstract: The project involves innovation supports and foundations for offshore wind around 5 lots representing the issues of the project:

- Lot 1: The design methodology
- Lot 2: Design, calculation, execution and control of offshore foundations
- Lot 3: Structural supports remote monitoring of wind
- Lot 4: Eco-design of supports and foundations for wind jacket and gravity
- Lot 5: Integration of noise reduction during pile installation in foundation design jacket

We are interested in the problem of Lot 3, structural monitoring of wind turbine supports. This lot covers an area of research in full expansion, commonly known as Structural Health Monitoring (SHM).

8.1.2. MAG2C-Pont Tabarly

Participant: Ivan Guéguen.

Type: GIS

Objectif: bridge instrumentation

Duration: Since 2014

Coordinator : LIRGEC

Partners: IFSTTAR, CSTB, Nantes Métropole, Université de Nantes

Inria contact: Ivan Guéguen

Abstract: The project deals with the instrumentation of the Tabarly Bridge.

The instrumentation auscultates globally the structure, a structural defect in a given location changes its modal parameters and thus the vibration behavior. Then it can be detected on any part of the structure with an accelerometer. These measures coupled with a wireless data transmission system type or wifi 3g will allow remote monitoring of the evolution of the structure. And where appropriate, to deploy when necessary, for maintenance. The different objectives are

- Experimentation on a bridge
- Equipment qualification in real conditions over the long term
- Apply different vibration processing algorithms
- Surveillance and Detection
- Measurement database

The instrument proposed is based on an accelerometer-based distributed network on the structure. This assembly is connected to a data acquisition system and a modem 3g for continuous measurements and remotely. The vibration will be collectable on the internet.

8.2. National Initiatives

8.2.1. High speed rail track Instrumentation

Participant: Ivan Guéguen.

Type: IRT

Objectif: bridge SHM

Duration: 11/2014 to 11/2018

Coordinator: RAILENIUM

Partners : IFSTTAR, EIFFAGE, RFF, LGCgE

Inria contact: Ivan Guéguen

Abstract: This project aims to orchestrate multiple sections of a high-speed route (classical section with granular layer, transition zone). The proposed instrumentation concerns all the different layers of the structure, and is designed to allow monitoring of the overall track behavior

The instrumentation will include: A Weather station measures environmental conditions (temperature, precipitation on the site). Accelerometers, to monitor the dynamic behavior of the track, with measures at several levels: the hammer beams on top of the grave-bitumen layer, on top of the soil. These measures will include acceleration compare the dynamic response of a section with and without GB. Instrumentation of severe bitumen strain gauges for measuring the longitudinal and transverse tensile strains at the base of the UK, and temperature probes (top and bottom layer). This instrumentation will estimate the fatigue life of the GB, temperature changes in this layer, and will calculate a temperature equivalent to the layer of GB. Instrumentation subgrade by means of measurement gauges at the top of the vertical deformation of the soil, and TDR probes to measure changes in water content. Its objective is to measure the levels of distortion in the upper part of the soil, and their variations, in conjunction with the seasonal variations in water content. An anchored sensor, measuring the total deflection between the top of the GB and a reference point that is 4 m deep. This sensor will measure the total displacement of the structure beneath the ballast (GB + layer of granular soil leveling + support). These will also serve as a reference for comparison with the movements deducted from accelerometer measurements. Continuous optical fiber, to measure static permanent deformation in the transverse direction over the entire width of the structure at the base of the sub-layer. These optical fibers used to monitor deformation obtained following the transverse profile in the game with underlay in the UK (in ballast) and the part with underlay GNT (Differential settlement, appearance of a crack ...).

8.2.2. REPTILES

Participant: Jean Dumoulin.

Type: FUI

Objectif: Innovation for rehabilitation of potable water tubes

Duration: Since 11/2012

Coordinator: FREYSSINET

Inria contact: J. Dumoulin

Since 2012, within FUI Reptiles, J. Dumoulin was coordinator of the conception, study and development of a thermoplastic composite assembly system for water tubes reenforcement. Moreover, infrared thermography was used for active control.

8.2.3. SIPRIS

Participants: Laurent Mevel, Dominique Siegert, Ivan Guéguen, Vincent Le Cam, Mathieu Le Pen, Michael Doehler.

contract 6841.

Type: FUI

Objectif: Systèmes d'Instrumentation pour la prévention des risques

Duration: June 2013 to June 2014

Coordinator: ADVITAM

Inria contact: L. Mevel

Abstract: The project concerns the behavior of a prestressed concrete beam, a series of vibration and displacement measurement was carried out in line with internal stresses due to the cables. This followed an experimental modal analysis and study of the variations of modal parameters on the beam. As part of the project, the laboratory signaling gantry of IFSTTAR Nantes was instrumented to perform an experimental system for automatic damage detection based on monitoring the natural modes of vibration. The gantry was also modeled by the finite element method to predict the variations of the first natural frequencies of vibration for a damage event catalog. The gantry is a metallic structure of 8x12 m, formed by the assembly of profiled aluminum alloy welded. This portico was installed there thirty years on the site. Each pillar is fixed in a massive concrete anchor with threaded rods 10, which are critical for the stability of the gantry. CAD geometric model made with Solidworks that was used for the mesh structure with shell elements. The FE mesh consists of 59231 triangular elements at 6 knots, the model has a total of 143,831 nodes. The thicknesses of the shells of the parts constituting the structure are between 3 and 25 mm. The mechanical properties of the aluminum alloy are reported in the table below. The boundary conditions applied to the model consisted of blocking the degrees of freedom of movement and rotation on the edges of holes arranged to pass the threaded rods. The mesh is refined in the vicinity of the holes. The results give an excellent correlation between simulation and experiment on the relative value for the third mode. The correlation is smaller for the first and the second mode. An update of the numerical model can refine the correlation between simulation and experiment, especially the absolute value of frequencies. As shown in the simulation and experimentation, modes with greater frequency of changes generally important in their relative value.

Tests were performed on laboratory test slabs SII Nantes

Very good progresses has also been validated compared to the problems encountered on PEGASE 1 due to memory limitations (few memory, no MMU, reduced Linux...). A global method is currently tested: transcoding SSI algorithms from Matlab sources to C codes using the Matlab-coder toolbox. Thus code execution is compared to the results got from Matlab from a common benchmark of data files

8.2.4. Collaboration with ISAE

Participants: Laurent Mevel, Ahmed Jhinaoui.

Ahmed Jhinaoui has finished his thesis on helicopter instability. This thesis was co-directed by professor Morlier from ISAE, France. This thesis is funded by FP7-NMP Large Scale Integrated Project IRIS.

8.2.5. Collaboration with GEM

Participants: Laurent Mevel, Michael Doehler, Md Delwar Hossain Bhuyan.

Md Delwar Hossain Bhuyan has started a PhD on Damage localisation on offshore platforms, The thesis is co-directed by L. Mevel and F. Schoefs from GEM, Nantes, with supervision shared with M. Doehler and Y. Lecieux from GEM. It is funded by the Brittany region for 3 years.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. ISMS

Participants: Michael Doehler, Laurent Mevel.

Type: FP7

Defi: Internet-Based Structural Monitoring System

Instrument: Industry-Academia Partnerships and Pathway

Objectif: Develop damage detection framework for SHM

Duration: September 2010 - August 2014

Coordinator: Palle Andersen

Partner: Structural Vibration Solutions (Denmark), University of British Columbia (Canada)

Inria contact: Laurent Mevel

Abstract:

ISMS aimed to address the significant commercial opportunity and rapidly emerging technological potential of improved Damage Detection or Structural Health Monitoring (SHM) technologies for large-scale civil infrastructure by challenging significant and non-trivial, inter-disciplinary and intersectoral barriers currently preventing industrial application and take-up of these technologies. The principal strategic objective of ISMS was joint design and development of a fully automated internet-based damage detection procedure robust to environmental changes with application to fully instrumented large-scale civil infrastructures, primarily bridges [50].

8.3.2. Collaborations in European Programs, except FP7 & H2020

8.3.2.1. European Research Network on System Identification (ERNSI)

Participants: Qinghua Zhang, Michael Doehler, Laurent Mevel.

The I4S project-team is involved in the activities of the European Research Network on System Identification (ERNSI) federating major European research teams on system identification, currently teams from 8 countries. Modeling of dynamical systems is fundamental in almost all disciplines of science and engineering, ranging from life science to process control. System identification concerns the construction, estimation and validation of mathematical models of dynamical physical or engineering phenomena from experimental data.

8.3.2.2. MODRIO

Participants: Qinghua Zhang, Liangquan Zhang.

Type: ITEA2

Defi: Model Driven Physical Systems Operation

Objectif: To meet the evermore stringent safety and environmental regulations for power plants and transportation vehicles, system operators need new techniques to improve system diagnosis and operation.

Duration: June 2012 to November 2015

Coordinator: Daniel Bouskela (EDF)

Inria teams PARKAS, HYCOMS, I4S

Inria contact: B. Caillaud

Abstract: Open standards are necessary for different teams to cooperate by sharing compatible information and data. The objective of the MODRIO project is to extend modeling and simulation tools based on open standards from system design to system diagnosis and operation. This project joined by partners from Austria, Belgium, Finland, France, Germany, Italy and Sweden has been selected by the board of Information Technology for European Advancement (ITEA 2).

8.3.2.3. COST Action TU 1402

Participants: Michael Doehler, Laurent Mevel.

L. Mevel is member of the management committee of the COST Action.

M. Doehler is co-leader of working group 2 "SHM technologies and structural performance".

Type: COST

Objectif: Quantifying the value of structural health monitoring

Duration: 11/2014 - 11/2018

Coordinator: S. Thoens (DTU Denmark)

Partner: 23 countries, see http://www.cost.eu/COST_Actions/tud/Actions/TU1402

Inria contact: Laurent Mevel

Abstract: This COST Action enhances the benefit of Structural Health Monitoring (SHM) by novel utilization of applied decision analysis on how to assess the value of SHM - even before it is implemented. This improves decision basis for design, operation and life-cycle integrity management of structures and facilitates more cost efficient, reliable and safe strategies for maintaining and developing the built environment to the benefit of society. SHM is increasingly applied for collecting information on loads and aggressive environments acting on structures, structural performances, deterioration processes and changes in the use of structures. However, there is an urgent need to establish a better understanding of the value of SHM before its implementation, together with practically applicable methods and tools for its quantification. This Action thus aims to develop and describe a theoretical framework, together with methods, tools, guidelines, examples and educational activities, for the quantification of the value of SHM. The COST Action will be conducted with the support of the Joint Committee on Structural Safety (JCSS). The networks of researchers and industries established during COST Actions TU0601, C26, E55 and E24, the EU FP7 project IRIS, the Marie Curie Network SmartEn and the JCSS will ensure visibility, impact and dissemination.

8.3.2.4. EBONSI

Participant: Qinghua Zhang.

Type: ANR-NSFC

Objectif: Extended Block-Oriented Nonlinear System Identification

Duration: from April 2011 to March 2014.

Coordinator: Qinghua Zhang

Partner: CRAN, Laboratory of Industrial Process Monitoring and Optimization of Peking University.

Inria contact: Qinghua Zhang

Abstract: The main idea of block-oriented nonlinear system identification is to model a complex system with interconnected simple blocks. Such models can cover a large number of industrial applications, and are yet simple enough for theoretic studies. The objectives of the EBONSI project are to extend classical block-oriented nonlinear models to new model structures motivated by industrial applications, and to relax some traditional restrictions on experimental conditions. This is an international project jointly funded by the French Agence Nationale de la Recherche (ANR) and the Chinese National Natural Science Foundation (NSFC) .

IBIS Project-Team

7. Partnerships and Cooperations

7.1. National initiatives

Project name	AlgeaInSilico: Prédire et optimiser la productivité des microalgues en fonction de leur milieu de croissance
Coordinator IBIS participants Type	O. Bernard H. de Jong Inria Project Lab (2013-)

Project name	GeMCo – Model reduction, experimental validation, and control for the gene expression machinery in *E. coli*
Coordinator IBIS participants Type Web page	M. Chaves E. Cinquemani, J. Geiselmann, C. Gomez Balderas-Barillot, E. Grac, H. de Jong, S. Lacour, C. Pinel, D. Ropers ANR Blanc (2010-2014) http://www-sop.inria.fr/members/Madalena.Chaves/ANR-GeMCo/main.html

Project name	RESET – Arrest and restart of the gene expression machinery in bacteria: from mathematical models to biotechnological applications
Coordinator IBIS participants Type Web page	H. de Jong E. Cinquemani, J. Geiselmann, C. Gomez Balderas-Barillot, E. Grac, H. de Jong, S. Lacour, Y. Markowicz, C. Pinel, D. Ropers Bioinformatics call, Investissements d'Avenir program (2012-2016) https://project.inria.fr/reset/

Project name	Fonction du système de régulation post-transcriptionnel CSR dans la dynamique de l'adaptation métabolique chez la bactérie modèle Escherichia coli
Coordinators IBIS participants Type Web page	M. Cocaign-Bousquet (Inra, LISBP), B. Enjalbert (INSA, LISBP), D. Ropers M. Morin, D. Ropers Contrat Jeune Scientifique Inra-Inria (2012-2016) http://www.inra.fr/les_hommes_et_les_femmes/rejoignez_nous/completer_sa_formation/le_recrutement_de_doctorants/cjs__1/inra_inria

7.2. International collaborations

IBIS has strong collaborations with the group of Giancarlo Ferrari-Trecate at the Computer Engineering & Systems Science Department of the University of Pavia (Italy) and the group of John Lygeros at the Automatic

Control Lab at ETH Zürich (Switzerland). This collaboration started with the FP6 project Hygeia, in which the above groups and IBIS (then HELIX) participated. Over the years, it has resulted in a dozen of co-authored papers and the co-supervision of a PhD thesis by Hidde de Jong and Giancarlo Ferrari-Trecate. Eugenio Cinquemani was a post-doctoral fellow at ETH in the framework of the Hygeia project, and joined the IBIS group as a research scientist in the fall of 2009. Andres Gonzales-Vargas, PhD student of Giancarlo Ferrari-Trecate, will spend six months in IBIS in 2014.

7.3. International research visitors

Visiting PhD student	Andres Gonzalez Vargas (University of Pavia, Italy)
Subject	Stochastic modeling and identification of regulatory networks

Invited professor	Alberto Soria-Lopéz (Centro de Investigación y de Estudios Avanzados (Cinestav) of Instituto Politécnico Nacional (IPN), Mexico)
Subject	Development of an automatically-controlled system of multiplexed mini-bioreactors

IMAGINE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Scenoptique (12/2012 - 03/2014)

Participant: Rémi Ronfard.

In October 2011, we started a collaboration with Theatre des Celestins in Lyon on the topic of interactive editing of rehearsals. This research program is funded by the Region Rhone Alpes as part of their CIBLE project, with a budget for a doctoral thesis (Vineet Gandhi) and three large sensor video cameras. Theatre des Celestins is interested in novel tools for capturing, editing and browsing video recordings of their rehearsals, with applications in reviewing and simulating staging decisions. We are interested in building such tools as a direct application and test of our computational model of film editing, and also for building the world's first publicly available video resource on the creative process of theatre rehearsal. Using state-of-the-art video analysis methods, this corpus is expected to be useful in our future work on procedural animation of virtual actors and narrative design. The corpus is also expected to be shared with the LEAR team as a test bed for video-based action recognition.

8.1.2. Labex Persyval

Participants: Rémi Ronfard, Olivier Palombi, Armelle Bauer.

We received a doctoral grant from LABEX PERSYVAL, as part of the research program on authoring augmented reality (AAR) for PhD student Adela Barbelescu. Her thesis is entitled *directing virtual actors by imitation and mutual interaction - technological and cognitive challenges*. Her advisors are Rémi Ronfard and Gérard Bailly (GIPSA-LAB).

Additionally, this project funds the PhD thesis of Armelle Bauer which has started in October, co-advised by François Faure, Olivier Palombi, and Jocelyne Troccaz from TIMC-GMCAO. The goal is to tackle the scientific challenges of visualizing one's self anatomy in motion using Augmented Reality techniques.

8.1.3. TAPIOCA, Persyval Grant (11/2013 - 11/2015)

Participants: Damien Rohmer, Jean-Claude Léon, Marie-Paule Cani.

Tapioca (Tangibilité Physiologique Instrumentée: Outil mixte redimensionnable pour la conception d'artefact) is a *projet exploratoire* of the Persyval Grant. This project aim to study the use of resizable interactive interface to ease the generation of virtual models. This project is in collaboration with LIG, Gipsa-lab and GSCOP.

8.2. National Initiatives

8.2.1. ANR SOHUSIM (10/2010-09/2014)

Participants: Ali Hamadi Dicko, François Faure.

Sohusim (Soft Human Simulation) is a ANR Project which started on October 1st 2010. It is done in collaboration between: EVASION (Inria), Fatronik France (TECNALIA), DEMAR (Inria), HPC PROJECT and the CHU de Montpellier.

This project deals with the problem of modeling and simulation of soft interactions between humans and objects. At the moment, there is no software capable of modeling the physical behavior of human soft tissues (muscles, fat, skin) in mechanical interaction with the environment. The existing software such as LifeMod or OpenSim, models muscles as links of variable length and applying a force to an articulated stiff skeleton. The management of soft tissues is not taken into account and does not constitute the main objective of this software.

A first axis of this project aims at the simple modeling and simulation of a passive human manipulated by a mecatronics device with for objective the study and the systems design of patient's manipulation with very low mobility (clinic bed). The second axis concentrates on the detailed modeling and the simulation of the interaction of an active lower limb with objects like orthesis, exoskeleton, clothes or shoes. The objective being there also to obtain a tool for design of devices in permanent contact with the human who allows determining the adequate ergonomics in terms of forms, location, materials, according to the aimed use.

8.2.2. ANR CORPUS SPECTABLE EN LIGNES (01/2013-01/2015)

Participant: Rémi Ronfard.

Spectacle En Ligne(s) amplifies our collaboration with the Theatre des Celetins in Lyon, which was started with the Scenoptique project in 2011. Scenoptique investigates novel techniques for recording ultra-high definition video, reframing them and editing them into interactive movies. Spectacle En Ligne(s), is targeted on the creation and diffusion of an original data set of integral vídeo recordings of theatre and opera rehearsals. The data set is naturally suited to researchers interested in the creation process and the genetic analysis of dramatic art and mise en scene. To support research in this area, we are extending the audio and visual analysis tools developed in the Scenoptique project.

8.2.3. FUI Dynam'it (01/2012 - 02/2014)

Participant: Francois Faure.

2-year contract with two industrial partners: TeamTo (production of animated series for television) and Artefacts Studio (video games). The goal is to adapt some technologies created in SOFA, and especially the frame-based deformable objects [43], [42] to practical animation tools. This contract provides us with the funding of two engineers and one graphical artist during two years.

8.2.4. FUI Collodi (October 2013 - October 2016)

Participants: Francois Faure, Romain Testylier.

This 3-year contract with two industrial partners: TeamTo and Mercenaries Engineering (software for production rendering), is a follow-up and a generalization of Dynamit. The goal is to propose an integrated software for the animation and final rendering of high-quality movies, as an alternative to the ever-ageing Maya. It will include dynamics similarly to Dynamit, as well as innovative sketch-based kinematic animation techniques invented a Imagine by Martin Guay and Rémi Ronfard. This contract, started in October, funds 2 engineers for 3 years.

8.2.5. ANR CHROME (01/2012 - 08/2015)

Participant: Rémi Ronfard.

Chrome is a national project funded by the French Research Agency (ANR). The project is coordinated by Julien Pettré, member of MimeTIC. Partners are: Inria-Grenoble IMAGINE team (Remi Ronfard), Golaem SAS (Stephane Donikian), and Archivideo (Francois Gruson). The project has been launched in september 2012. The Chrome project develops new and original techniques to massively populate huge environments. The key idea is to base our approach on the crowd patch paradigm that enables populating environments from sets of pre-computed portions of crowd animation. These portions undergo specific conditions to be assembled into large scenes. The question of visual exploration of these complex scenes is also raised in the project. We develop original camera control techniques to explore the most relevant part of the animations without suffering occlusions due to the constantly moving content. A long-term goal of the project is to enable populating a large digital mockup of the whole France (Territoire 3D, provided by Archivideo). Dedicated efficient human animation techniques are required (Golaem). A strong originality of the project is to address the problem of crowded scene visualisation through the scope of virtual camera control, as task which is coordinated by Imagine team-member Rémi Ronfard.

Three phd students are funded by the project. Kevin Jordao is working on interactive design and animation of digital populations and crowds for very large environments. His advisors are Julien Pettré and Marie-Paule Cani. Quentin Galvanne is working on automatic creation of virtual animation in crowded environments. His advisors are Rémi Ronfard and March Christie (Mimetic team, Inria Bretagne). Julien Pettre. Chen-Kin Lim is working on crowd simulation and rendering of the behaviours of various populations using crowd patches. Her advisors are Rémi Ronfard and March Christie (Mimetic team, Inria Bretagne). Julien Pettre.

8.2.6. Action3DS (Caisse des dépôts) (10/2011 - 09/2014)

Participant: Rémi Ronfard.

Action3DS is a national project funded by Caisse des Dépots, as part of the *projet Investissements d'avenir ACTION3DS* research program entitled *Technologies de numérisation et de valorisation des contenus culturels, scientifiques et éducatifs*.

The project is coordinated by Thales Angénieux (Patrick Defay). Partners are Inria (Rémi Ronfard), Lutin Userlab (Charles Tijus), LIP6 (Bernadette Bouchon-Meunier), GREYC (David Tschumperlé), École nationale supérieure Louis Lumière (Pascal Martin), Binocle (Yves Pupulin), E2V Semiconductors and Device-Alab.

The goal of the project is the developpement of a compact professional stereoscopic camera for 3D broadcast and associated software. Rémi Ronfard is leading a work-package on real-time stereoscopic previsualization, gaze-based camera control and stereoscopic image quality.

The project is funding our new postdoc researcher Christophe Lino who is working on learning-based camera control for stereoscopic 3D cinematography with Rémi Ronfard.

8.2.7. AEN MorphoGenetics (10/2012 - 09/2015)

Participant: François Faure.

3-year collaboration with Inria teams Virtual Plants and Demar, as well as INRA (Agricultural research) and the Physics department of ENS Lyon. The goal is to better understand the coupling of genes and mechanical constraints in the morphogenesis (creation of shape) of plants. Our contribution is to create mechanical models of vegetal cells based on microscopy images. This project funds the Ph.D. thesis of Richard Malgat, who started in October, co-advised by François Faure (IMAGINE) and Arezki Boudaoud (ENS Lyon).

8.2.8. PEPS SEMYO (10/2012 - 09/2014)

Participant: François Faure.

2-year collaboration with Inria team DEMAR (Montpellier) and Institut de Myologie (Paris) to simulate 3D models of pathological muscles, for which no standard model exist. The main idea is to use our mesh-less frame-based model to easily create mechanical models based on segmented MRI images.

8.3. European & International Initiatives

8.3.1. ERC Grant Expressive (04/2012-03/2017)

Participants: Marie-Paule Cani, Stefanie Hahmann, Jean-Claude Léon.

To make expressive and creative design possible in virtual environments, the goal is to totally move away from conventional 3D techniques, where sophisticated interfaces are used to edit the degrees of freedom of pre-existing geometric or physical models: this paradigm has failed, since even trained digital artists still create on traditional media and only use the computer to reproduce already designed content. To allow creative design in virtual environments, from early draft to progressive refinement and finalization of an idea, both interaction tools and models for shape and motion need to be revisited from a user-centred perspective. The challenge is to develop reactive 3D shapes – a new paradigm for high-level, animated 3D content – that will take form, refine, move and deform based on user intent, expressed through intuitive interaction gestures inserted in a user-knowledge context. Anchored in Computer Graphics, this work reaches the frontier of other domains, from Geometry, Conceptual Design and Simulation to Human Computer Interaction.

8.3.2. Piper (2013-2017)

The main objective of this European FP7 project is to develop new tools to position and personalize advanced human body models for injury prediction in car crashes. Our partners are automobile constructors and biomechanics research labs. Our main task is to provide tools for the interactive positioning of the models in the cockpits prior to the crash simulation, using our real-time simulation software SOFA. This 42-month contract funds one engineer in Imagine, and we plan to hire post-doc students next year.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Bob Sumner: Character depiction, posing and synthesis, Disney Research (Zurich) (13/11/2014).
- Tamy Boubekeur: Spatial, Statistical and Morphological Analysis for 3D Shape Modeling, Telecom ParisTech (23/10/2014)
- Jacob Wenzel: Capturing and simulating the interaction of light with the world around us, ETH Zurich (09/10/2014)
- Mariët Theune: Nicolas Szilas, Ulrike Spierling, Paolo Petta, Remi Ronfard. Storytelling seminar (21/07/2014)
- Mark Finlayson: Learning Narrative Structure from Annotated Stories, MIT (03/07/2014)
- Matthias Teschner: Particle-based Fluid Simulation, University of Freiburg (17/06/2014)
- Melina Skouras. Design and Fabrication of Deformable Objects, ETH Zurich (05/06/2014)
- Boris Thibert. Flat torus and smooth fractals, LJK Grenoble (15/05/2014)
- Olga Sorkine. Reality-inspired constraints for shape modeling and editing, ETH Zurich (28/03/2014)
- Jernej Barbic: Model reduction for elasticity problems in computer graphics and animation, University of Southern California (02/27/2014)
- Chris Wojtan: Compensating for Defects in Geometric Models and Liquid Surfaces, IST Austria (02/20/2014)

IN-SITU Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

DigiPods - Remote Collaborative Interaction mong Heterogeneos Visualization Platforms, Région Île-de-France (2012-2015), Coordinator: Stéphane Huot. Partners: Digiteo/FCS Campus Paris-Saclay, Univ. Paris-Sud, Inria, CNRS, CEA, Telecom ParisTech.

The goal of DIGIPODS is to design new interactive equipments and devices for collaborative interaction in immersive and high-resolution visualization platforms, connected through a high-end telepresence infrastructure. Beyond the usual interactive devices of such platforms (motion capture, interactive surfaces, haptic devices, audio and video systems), all the platforms will be augmented with new devices to facilitate co-located or remote interaction and collaboration: telepresence robots and the Digicarts, a new kind of interaction devices specifically designed for these needs. These equipments will be used by researchers in Human-Computer Interaction to explore the visualization and manipulation of large datasets, interaction in virtual reality, remote collaboration among heterogeneous platforms; but also by researchers from other fields and by professionals in order to explore and manipulate their complex data.

DigiCarts - Post-doctoral fellow position funded by Digiteo, Coordinator: Stéphane Huot. Partners: Univ. Paris-Sud, Inria, CNRS, CEA, Telecom ParisTech.

Complements the DigiPods project with funding for a 18 months post-doctoral position focused on the design, implementation and evaluation of the Digicart devices.

DigiZoom - Funding by DIGICOSME Labex, Coordinator: Olivier Chapuis. Partners: U. Paris-Sud, Inria, Institut Mines-Telecom.

Design, modeling and empirical evaluation of multi-scale navigation techniques depending on the input channels and output characteristics of the devices, in particular their size, in single-user and collaborative contexts. This project funds a joint PhD student between InSitu and the VIA group at Institut Mines-Telecom.

MultiVis - Funding by DIGICOSME Labex, Coordinator: James Eagan (Institut Mines Telecom). Partners: U. Paris-Sud, Inria, Institut Mines-Telecom.

Design, evaluate, and implement novel interaction models to help users appropriate multiple computational surfaces in the sense-making process. Our initial approach is to operationalize and extend the instrumental interaction model to specifically accommodate the specific needs of the sense-making process for information visualization. This project funds a joint PhD student between the VIA group at Institut Mines-Telecom and InSitu.

7.2. National Initiatives

Digiscope - Collaborative Interaction with Complex Data and Computation (2011-2020) http://digiscope.fr. “Equipment of Excellence” project funded by the “Invesissements d’Avenir” program of the French government. 10 academic partners: FCS Paris-Saclay (coordinator), Université Paris-Sud, CNRS, CEA, Inria, Institut Telecom ParisTech, Ecole Centrale Paris, Université Versailles - Saint-Quentin, ENS Cachan, Maison de la Simulation. Overall budget: 22.5 Meuros, including 6.7 Meuros public funding from ANR. Michel Beaudouin-Lafon: coordinator and principal investigator for the whole project.

The goal of Digiscope is to create nine high-end interactive rooms interconnected by high-speed networks and audio-video facilities to study remote collaboration across interactive visualization environments. The equipment will be open to outside users and targets four main application areas: scientific discovery, product lifetime management, decision support for crisis management, and education and training. In Situ contributes the existing WILD room, a second room called WILDER funded by the project, and its expertise in the design and evaluation of advanced interaction techniques and the development of distributed software architectures for interactive systems.

MDGest - Interacting with Multi-Dimensional Gestures (2011-2014). InSitu is the only academic partner. Funded by the French National Research Agency (ANR), Programme JCJC (Junior researchers): 88 Keuros. Caroline Appert (coordinator) and Theophanis Tsandilas.

This project investigates new interactions for small devices equipped with a touchscreen. Complementing the standard point-and-click interaction paradigm, the MDGest project explores an alternative way of interacting with a user interface: tracing gestures with the finger. According to previous work, this form of interaction has several benefits, as it is faster and more natural for certain contexts of use. The originality of the approach lies in considering new gesture characteristics (dimensions) to avoid complex shapes that can be hard for users to memorize and activate. Dimensions of interest include drawing speed (local or global), movement direction, device orientation or inclination, and distinctive drawing patterns in a movement.

DRAO – Adrien Bousseau (Inria, Sophia Antipolis) submitted a successful ANR grant with InSitu members Theophanis Tsandilas and Wendy Mackay, and Prof. Maneesh Agrawala (Berkeley).

The goal of the project is to create interactive graphics tools to support sketching. The kickoff meeting was held in Nov. 2012 and included interviews with designers from Toyota.

7.3. European Initiatives

7.3.1. CREATIV

Type: IDEAS
Instrument: ERC Advanced Grant
Duration: June 2013 - May 2018
Coordinator: Wendy Mackay
Partner: Inria (France)
Inria contact: Wendy Mackay
Abstract: CREATIV explores how the concept of co-adaptation can revolutionize the design and use of interactive software. Co-adaptation is the parallel phenomenon in which users both adapt their behavior to the system's constraints, learning its power and idiosyncrasies, and appropriate the system for their own needs, often using it in ways unintended by the system designer. The initial goal of the CREATIV project is to fundamentally improve the learning and expressive capabilities of advanced users of creative software, offering significantly enhanced methods for expressing and exploring their ideas. The ultimate goal is to radically transform interactive systems for everyone by creating a powerful and flexible partnership between human users and interactive technology.

7.3.2. Social Privacy

Type: PEOPLE
Instrument: Marie Curie International Outgoing Fellowships for Career Development
Duration: September 2012 - August 2015
Coordinator: Wendy Mackay
Partner: Inria (France) and Massachusets Institute of Technology (USA)
Inria contact: Ilaria Liccardi
Abstract: Although users' right to privacy has long been protected, the rapid adoption of social media has surpassed society's ability to effectively regulate it. Today's users lack informed consent: they must make all-or-nothing decisions about on-line privacy regardless of context. The Social Privacy project will first diagnose the problem, exploring privacy issues associated with social media at the level of the individual, the enterprise and society, and then generate effective solutions, from providing users with technical safeguards and informed consent, to establishing corporate guidelines for protecting privacy, to developing and testing recommendations for public policy.

7.3.3. Collaborations in European Programs, except FP7 & H2020

EIT ICT Labs Master School, European Institute of Technology. Coordinator: M. Beaudouin-Lafon. Partners: KTH (Sweden), U. Paris-Sud (France), U. Aalto (Finland), Technical University Berlin (Germany), Technical University Delft (Netherlands), U. College London (UK), U. Trento (Italy).

InSitu participates in the Human-Computer Interaction and Design (HCID) major of the EIT ICT Labs European Master School. Paris-Sud is one the sites for the first year of this Master Program, and host one of the specialties for second-year students. Students in this program receive a double degree after studying in two countries. https://www.dep-informatique.u-psud.fr/en/formation/lmd/M1_HCID.

7.3.4. Collaborations with Major European Organizations

VCoRE - Next-Generation Visual Computing Platform (ADT Inria, 2011-2014), Coordinator for InSitu: Stéphane Huot. Partners: Inria (Grenoble, Lille, Rennes, Saclay, Sophia Antipolis), IGD Fraunhofer Institute.

Collaboration between Inria and IGD Fraunhofer Institute for the specification and development of a software framework dedicated to mixed/augmented/virtual reality and advanced visualization platforms (distributed computer graphics, simulation and interaction).

7.4. International Initiatives

7.4.1. Inria International Labs

7.4.1.1. Massive Data

A former member of InSitu, Emmanuel Pietriga, has spent two years at the Inria Chile/CIRIC lab as head of the Massive Data team. The team focuses on the design, development and empirical evaluation of novel interactive visualization techniques that help users understand and manipulate massive amounts of data on different types of platforms: mobile devices, workstations, control rooms (ALMA radio-telescope), ultra-high-resolution wall-sized displays such as ANDES, the lab's wall-sized display similar to InSitu's WILD and WILDER rooms. During his stay, he continued to collaborate with InSitu members.

- ALMA: http://almaobservatory.org
- ANDES: http://www.inria.cl/?page_id=2727&lang=en

7.4.2. Inria Associate Teams

7.4.2.1. MIDWAY

Title: Musical Interaction Design Workbench And technologY

International Partner:

McGill University & CIRMMT, Montréal (CA), Marcelo Wanderley

Duration: 2014 -

See also: http://insitu.lri.fr/MIDWAY

The MIDWAY associated team involves two partners: the InSitu group, and the Input Devices and Music Interaction Laboratory (IDMIL) from the Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT) – McGill University. Our goal is to design and implement MIDWAY, a musical interaction design workbench, to facilitate the exploration and design of new interactive technologies for both musical creation and performance. Each laboratory has extensive experience developing new interactive technologies and studying interactive phenomena from complementary points of view. The two groups share multiple, complementary research interests that the MIDWAY joint team will help them to explore together: In|Situ|'s experience working with composers to develop novel tools, toolkits and interaction models will complement IDMIL/CIRMMT's knowledge and experience designing new musical instruments and their studies of the musical creative process. Both partners have organized workshops to initiate and to plan the research program for the upcoming months (joint developments, publication and visits/exchanges).

7.4.3. Inria International Partners

7.4.3.1. Informal International Partners

- Stu Card and Sara Goldhaber-Fiebert, Stanford University, on improving the use of emergency manuals in operating rooms.

- Wendy Ju, Stanford University, and Steven Dow, Carnegie Mellon University, on the issues of Research Through Design.
- James Hollan, U.C. San Diego, on video analysis tools.
- Bjorn Hartmann, U.C. Berkeley, on multi-surface interaction.
- Shumin Zhai, Google Mountain View, on gesture-based interaction.
- Clemens Klokmose, University of Aarhus (Denmark), on ubiquitous instrumental interaction.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Marcelo Wanderlay, Professor at McGill University, Canada, May 2014.
- Shumin Zhai, Senior Staff Research Scientist at Google, USA, July 2014.
- Chat Wacharamanotham, Ph.D. candidate at RWTH Aachen, Germany, June 2014.

7.5.1.1. Internships

- Ignacio Avellino Martinez, Master Student from Univ. Trento and Univ. Aachen, was an intern at InSitu from Apr 2014 until Sep 2014 to work on telepresence systems for large interactive spaces. He was then granted an Inria CORDI grant pursue a Ph.D. at InSitu.

INDES Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR DEFIS PWD

The PWD project (Programmation du Web diffus) has been funded by the ANR Défis programme for 4 years, starting November 2009. The partners of this project are the teams INDES (coordinator), LIP6 at University Pierre et Marie Curie and PPS at University Denis Diderot. The PWD project has been elected as one the projects "phare" by the ANR.

7.1.2. ANR AJACS

The AJACS project (Analyses of JavaScript Applications: Certification & Security) has been funded by the ANR for 42 months, starting December 2014. The goal of AJACS project is to provide strong security and privacy guarantees on the client side for web application scripts. The Indes members are involved in the tasks WP2 Certified Analyses and WP3 Security of JavaScript Applications. The partners of this project include Inria teams Celtique (coordinator), Toccata, and Prosecco.

7.1.3. FUI X-Data

Broadly available big and open data open new perspectives in terms of use and applications. The X-Data project aims at validating this claim by using actual data sets for building realistic applications. The goal is to combine a large variety of data sets coming from different partners (Data Publica, Orange, EDF, La Poste, social networks, ...) to build innovative applications. The Indes team designs and implements new programming language constructs that help programming these applications. Our contribution to this project ended in November 2014.

7.1.4. FUI UCF

The 3 years long UCF project aims at developing a reactive Web platforms for delivering multimedia contents. The partners of the project are the startups Alterway, OCamlPro, and XWiki, and the academic research laboratories of University Pierre et Marie Curie and Denis Diderot.

7.2. European Initiatives

7.2.1. FP7

7.2.1.1. RAPP

Program: http://rapp-project.eu

Title: Robot App Store

Collaborator: Inria Hephaistos

Abstract: RAPP is a 36 months pan-european FP7 project, started in December 2013. Hop is used in the development of prototypes of the Coprin Ang rollator transfer device, for mobility assistance and activity monitoring.

7.2.1.2. MEALS

Type: FP7

Title: Mobility between Europe and Argentina applying Logics to Systems

Instrument: International Research Staff Exchange Scheme

Duration: October 2011 - September 2015

Coordinator: Pedro D'Argenio

Partner: University of Córdoba, University of Buenos Aires, University of Twente

Inria contact: Castuscia Palamidessi

Abstract:The MEALS project (Mobility between Europe and Argentina applying Logics to Systems) goals cover three aspects of formal methods: specification (of both requirement properties and system behavior), verification, and synthesis. The Indes members are involved in the task of Security and Information Flow Properties (WP3). The partners in this task include University of Buenos Aires, University of Córdoba, Inria (together with Catuscia Palamidessi, Kostas Chatzikokolakis, Miguel Andrés) and University of Twente. The web page of the project can be found at http://www.meals-project.eu.

7.2.2. Collaborations in European Programs, except FP7 & H2020

Program: **ICT Cost Action IC1201**

Project acronym: BETTY

Project title: Behavioural Types for Reliable Large-Scale Software Systems

Duration: October 2012 - October 2016

Coordinator: Simon Gay, University of Glasgow

Other partners: Several research groups, belonging to 22 european countries

Abstract: The aim of BETTY is to investigate and promote behavioural type theory as the basis for new foundations, programming languages, and software development methods for communication-intensive distributed systems. Behavioural type theory encompasses concepts such as interfaces, communication protocols, contracts, and choreography.

Program: **ICT Cost Action IC1405**

Project title: Reversible computation - extending horizons of computing

Duration: November 2014 - November 2018

Coordinator: Irek Ulidowski, University of Leicester

Abstract: Reversible computation is an emerging paradigm that extends the standard forwards mode of computation with the ability to execute in reverse. It aims to deliver novel computing devices and software, and to enhance traditional systems. The potential benefits include the design of reversible logic gates and circuits - leading to low-power computing and innovative hardware for green ICT, new conceptual frameworks and language abstractions, and software tools for reliable and recovery-oriented distributed systems.

This Action is the first European network of excellence aimed at coordinating research on reversible computation.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

7.3.1.1. Internships

Vineet Rajani

Date: 10/12/2014 - 10/03/2015

Institution: Max Planck Institute (MPI), Germany

Collaborator: Tamara Rezk

7.3.1.2. Research stays abroad

Atuya Okudaira

Date: 1/1/2014 - 31/08/2014

Institution: International University of Kagoshima, Japan

Collaborator: Manuel Serrano

INFINE Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Equipex FIT

Participants: Cedric Adjih, Emmanuel Baccelli, Ichrak Amdouni, Alaeddine Weslati, Vincent Ladeveze.

Partners: Inria (Lille, Sophia-Antipolis, Grenoble), INSA, UPMC, Institut Télécom Paris, Institut Télécom Evry, LSIIT Strasbourg.

FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It provides this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project gives french internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the future internet. FIT was one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's "Équipements d'Excellence" (Equipex) research grant program, in 2011.

One component of the FIT platform is the sets of IoT-LAB testbeds (voir le site IoT-LAB). These were motivated by the observation that the world is moving towards an "Internet of Things", in which most communication over networks will be between objects rather than people.

The Infine team is now managing the FIT IoT-LAB site currently at Rocquencourt whose development has been started in 2010 (in the Hipercom team).

8.2. European Initiatives

8.2.1. EU CHIST-ERA MACACO

Participants: Aline Carneiro Viana, Emmanuel Baccelli, Eduardo Mucelli.

Program: EU CHIST-ERA, topic Context- and Content-Adaptive Communication Networks

Project acronym: MACACO

Project title: Mobile context-Adaptive CAching for COntent-centric networking

Duration: 2013-2016

Coordinator: Aline Carneiro Viana

Other partners: INPT-ENSEEIHT at University of Toulouse, University of Birmingham (UK), SUPSI (Switzerland), CNR (Italy) and Federal University of Minas Gerais (Brazil)

Abstract:

MACACO (Mobile context-Adaptive CAching for COntent-centric networking) is a 3-year CHIST-ERA European Project addressing the topic Context- and Content-Adaptive Communication Networks. It is funded by ANR in France, SNSF in Switzerland, and ESPRC in UK. It focus on data offloading mechanisms that take advantage of context and content information. Our intuition is that if it is possible to extract and forecast the behaviour of mobile network users in the threedimensional space of time, location and interest (i.e. 'what', 'when' and 'where' users are pulling data from the network), it is possible to derive efficient data offloading protocols. Such protocols would pre-fetch the identified data and cache it at the network edge at an earlier time, preferably when the mobile network is less charged, or offers better quality of service. This project has officially started in November 2013. The first annual report will be delivered before January 25, 2015.

8.2.2. Collaborations in European Programs, except FP7 & H2020

Participants: Emmanuel Baccelli, Cedric Adjih, Oliver Hahm.

Program: ANR/BMBF French-German partnership within CSOSG Framework

Project acronym: SAFEST

Project title: Social Area Framework for Early Security Triggers

Duration: 2012-2015

Coordinators: Emmanuel Baccelli (France), Jochen Schiller (Germany)

Other partners: Freie Universitat Berlin, Fraunhofer, Hamburg University, Sagem, Daviko, FOS

Abstract: Public spaces, such as airports, railway stations, or stadiums bring together large numbers of people on limited space to use security-sensitive infrastructure. These spaces pose two distinct challenges to public security: (a) detecting unauthorized intrusions and (b) monitoring large crowds in order to provide guidance in case of unexpected events (e.g., mass panic). To ensure the safety of the general public as well as individuals, we thus require a flexible and intelligent method for area surveillance. One example in which current monitoring systems proved to be dangerously inefficient is the Love Parade music festival in Duisburg, Germany, July 2010. Crowd control failed to provide guidance to a large crowd, resulting in a mass panic with 21 deaths and several hundred injured. In this particular case, overloaded communication infrastructure led to a lack of information about the density and the movement of the crowd, which in turn resulted in misjudgments on appropriate strategies to resolve the situation. This incident highlights the need for more sophisticated and reliable methods for area surveillance. The SAFEST project aims to analyse the social context of area surveillance and to develop a system that can fulfill this task, both in terms of technology as well as acceptance by the general public. The system will operate in distributed way, collect anonymised data, securely transfer this data to a central location for evaluation, and if necessary notify the operator and/or issue alerts directly to the general public. SAFEST addresses the following topics: (i) it proposes a solution for crisis management, addressing social, technical, and economic issues, (ii) it enhances the protection of the population against risks and dangers, including the evaluation of acceptance of said solution, and (iii) it addresses the protection of critical infrastructures by the means of a comprehensive technical solution.

8.3. International Initiatives

8.3.1. Participation In other International Programs

8.3.1.1. STIC AmSud UCOOL

Participants: Aline Carneiro Viana, Eduardo Mucelli.

Program: STIC AmSud

Project acronym: UCOOL

Project title: Understanding and predicting human demanded COntent and mObiLity

Duration: 2013-2015

Coordinator: Aline Carneiro Viana

Other partners: National Laboratory for Scientific Computing (Brazil), Facultad de Ingeniería, Universidad de Buenos Aires (Argentina), Universidad Tecnica Federico Santa Maria (Chile), Telecom Sud Paris, and Inria (with INFINE at Saclay and DANTE at Rhone-Alpes)

Abstract: The UCOOL (Understanding and predicting human demanded COntent and mObiLity, https://macaco.inria.fr/) project is granted by STIC-AmSUD, it is a 2-year project, and has officially started in January 2014. The main goal of this project is to define solutions for the identification and modelling of correlations between the user mobility – describing changes in the user positioning and the current environment he/she is in – and the traffic demand he/she generates.

8.3.1.2. STIC Asie URSA

Participant: Aline Carneiro Viana.

Program: STIC Asie

Project acronym: URSA

Project title: Urban Sensing for Ads Networks

Duration: 2012-2014

Coordinator: Stephane MAag (Telecom SudParis)

Other partners: Telecom SudParis, Inria, Fu Jen Catholic University (Taiwan), Institute for Infocomm Research (Singapore), and IFI (Vietnam).

Abstract: The URSA (Urban Sensing for Ads Networks, http://www-public.tem-tsp.eu/ maag/URSA/) project was granted by STIC-Asie. It was a 2-year project which has started in January 2013 and has just finished. URSA aims at defining an urban sensing network based on the mobility of users and the diffusion of advertisings by fixed elements.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Artur Ziviani, National Laboratory for Scientific Computing (LNCC), Brazil, October 2014.

José Ignacio Alvarez-Hamelin, Facultad de Ingeniería, Universidad de Buenos Aires, Argentina, October 2014.

Jorge Brea, GranData and Universidad de Buenos Aires, Argentina, October 2014.

Anelise Munaretto, Federal Technological University of the Parana (UTFPR), Brazil, October 2014.

Carlos Sarraute, GranData, Argentina, October 2014.

Don Towsley, University of Massachusetts - Amherst, USA, June 2014.

8.4.1.1. Internships

Lavanya Addepalli, Universidad Politecnica de Valencia, Spain, from Jun 2014 to Nov 2014.

8.4.2. Visits to International Teams

8.4.2.1. Research stays abroad

Emmanuel Baccelli has been visiting Freie Universitaet (FU) Berlin in 2014, within the context of the SAFEST project. The closer collaboration enabled by this stay allowed the initial development of the RIOT community http://www.riot-os.org, and the development of new activities around Information-centric networking in the Internet of Things. During his stay, Emmanuel Baccelli also taught a course on Computer Networking for graduate level. More details in the corresponding sections of this document.

IPSO Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR Programme blanc international (BLAN) LODIQUAS 2012-2015

Participants: Philippe Chartier, Florian Méhats, Francois Castella, Mohammed Lemou.

The project, entitled "LODIQUAS" (for: Low DImensional QUANtum Systems), received fundings for 4 postdocs (48 months) and one pre-doc (36 months). The whole project involves the following researchers : Norbert Mauser (Vienna), Erich Gornik (Vienna), Mechthild Thalhammer (Innsbruck), Christoph Naegerl (Innsbruck), Jörg Schmiedmayer (Vienna), Hans-Peter Stimming (Vienna),Francis Nier (Rennes), Raymond El Hajj (Rennes), Claudia Negulescu (Toulouse), Fanny Delebecque (Toulouse), Stéphane Descombes (Nice), Christophe Besse (Lille).
Quantum technology as the application of quantum effects in macroscopic devices has an increasing importance, not only for far future goals like the quantum computer, but already now or in the near future. The present project is mainly concerned with the mathematical and numerical analysis of these objects, in conjunction with experimental physicists.

6.1.2. ANR MOONRISE: 2015-2019

Participants: Nicolas Crouseilles, Philippe Chartier, Florian Méhats, Francois Castella, Mohammed Lemou.

The project *Moonrise* submitted by F. Méhats has been funded by the ANR for 4 years, for the period 2015-2019. This project aims at exploring modeling, mathematical and numerical issues originating from the presence of high-oscillations in nonlinear PDEs from the physics of nanotechnologies (quantum transport) and from the physics of plasmas (magnetized transport in tokamaks). The partners of the project are the IRMAR (Rennes), the IMT (Toulouse) and the CEA Cadarache. In the IPSO team, F. Castella, P. Chartier, N. Crouseilles and M. Lemou are members of the project Moonrise.

6.1.3. ANR Programme blanc GYPSI: 2010-2014

Participant: Nicolas Crouseilles.

Leader: Ph. Gendrih.

The full description is available at https://sites.google.com/site/anrgypsi/

6.1.4. ANR Programme blanc E2T2: 2010-2014

Participant: Nicolas Crouseilles.

Leader: P. Beyer

6.2. European Initiatives

6.2.1. FP7 & H2020 Projects

6.2.1.1. Geopardi

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Objectif: NC

Duration: September 2011 - August 2016

Coordinator: E. Faou

Inria contact: E. Faou

6.2.2. Collaborations in European Programs, except FP7 & H2020

6.2.2.1. Verification of global gyrokinetic codes and development of new algorithms for gyrokinetic and kinetic codes

Project acronym: EUROFusion CfP-WP14-ER-01/IPP-03: 2014

Project title: verification of global gyrokinetic codes and development of new algorithms for gyrokinetic and kinetic codes

Duration: 2013-2014

Participants: N. Crouseilles and M. Lemou

Coordinator:E. Sonnendrücker

6.2.2.2. Enabling Research Project for the implementation of the fusion roadmap

Project acronym: EUROFusion

Project title: Enabling Research Project for the implementation of the fusion roadmap

Duration: 2015-2017

Participants: N. Crouseilles and M. Lemou

Coordinator:E. Sonnendrücker

6.3. International Research Visitors

6.3.1. Visits of International Scientists

- L. Einkemmer, University of Innsbruck, two weeks, november 2014.
- Y. Zhang, WPI, Vienna, 3 months.

6.3.2. Visits to International Teams

6.3.2.1. Research stays abroad

- N. Crouseilles visited the group of P. Coelho (Universitad tecnico de Lisboa, Portugal), one week (november 2014).
- M. Lemou and N. Crouseilles visited the India Institute of Science at Bangalore (India): from december 2d to december 17th, 2013. Visited team: around Raghurama Rao.
- M. Lemou visited the Wisconsin university, Madison (USA): from February 1st to February 16th, 2014. Visited team: around Shi Jin.
- P. Chartier, M. Lemou and F. Méhats visited the university of San Sebastien, Pays Basque (Spain): from June 8th to June 13th 2014.

KALIFFE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

Our group participates to the following ANR projects with different colleagues of us in Lyon

- ANR STAB on stability for the asymptotic behavior of PDEs, stochastic processes and their discretization. The Principal Investigator is I. Gentil (UCB Lyon) and F. Filbet is a participant.
- ANR BOND on boundaries, numerics and dispersion. The Principal Investigator is S. Benzoni (UCB Lyon) and L. M. Rodrigues is a participant.
- ANR de groupe "*Highly-Efficient ATmospheric modelling*" (HEAT), 2014–2018. The Principal Investigator is Th. Dubos and D. Le Roux is a participant.

On the other hand, we have submitted a projet on the call 2015 on adapted dynamic and multi-scale methods. F. Filbet, M. Bergot are participants.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

This is the last year of the ERC Project Nusikimo devoted to the mathematical and numerical analysis in statistical physics with a special interest to applications in Plasma Physics (CEA-CELIA laboratory in Bordeaux, where the Mega-Joule Laser is built) and micro-technology with MEMS (university of Catania). Our project gathers young researchers in applied mathematics from the group in Mathematical Modelling and Scientific Computing in Lyon.

7.2.2. Collaborations in European Programs, except FP7 & H2020

Program: Eurofusion - Enabling Research Project for the implementation of the fusion roadmap

Project acronym: Verification of global gyrokinetic code.

Project title: Verification of global gyrokinetic codes and development of new algorithms for gyrokinetic and kinetic codes.

Duration: 1 year.

Coordinator: E. Sonnendrücker.

Other partners: Max Planck Intitute (Garching, Germany).

Abstract: The aim of this proposal the improvement of the numerical methods for gyrokinetic models and to investigate new ideas towards fully kinetic simulations of tokamaks and stellarators. It consists of three main parts: the first is devoted to the definition of verification models that enable to verify that the implemented codes are a good approximation to a given continuous model and that contain the most challenging numerical problems in the most simple possible setting. New benchmarks of the codes will also be performed. The second part is devoted to the improvement of each category of codes and the third to experimenting new ideas that can lead to better codes in the longer term

7.3. International Initiatives

7.3.1. Inria International Partners

Our team is a partner on the CoKLyCo project. It is the acronym of the project COffee-Kyoto-LYon-COperation. The project if funded by Inria, through its International Affairs programs and the Japan Society for the Promotion of Science (JSPS), through the cooperation program AYAME (Wink: Ayame means iris. . .).

Kinetic theory plays a central role in many areas of mathematical physics, from nanoscales to continuum mechanics. It is an indispensable tool in the mathematical description of applications in physical science from its origin in dilute gases, to wide applications such as semiconductors, polymers, cells, plasma, galaxies, traffic networking, and swarming. Many challenges remain in both the analysis and efficient computational techniques for such problems. The project is concerned with the modeling of rarefied gas dynamics for Micro-Electro-Mechanical Systems. The design of such devices with tiny scales leads to new questions related to the intricate particles/structures interactions. Strongly motivated by the specific technological content, we wish to develop original computational tools, based on rigorous mathematical basis. This project is therefore concerned with the mathematical analysis and the numerical simulation of systems of PDEs of kinetic type, or their hydrodynamic counter-part, set in a moving domain. In 2014, we started working on several aspects of these questions, owing to a couple of visits and meetings during conferences, like the one in CIRM, Nov, 2014.

7.3.1.1. Informal International Partners

- F. Filbet collaborates with J. M. Qiu from the University of Houston on positive method for Vlasov type models.
- F. Filbet collaborates with G. Russo and S. Boscarino at University of Catania (Italy) on high order numerical schemes for time evolution equation and with L. Pareschi at the University of Ferrara (Italy) on spectral methods for Boltzmann equations [7].
- L. M. Rodrigues collaborates with M. Johnson (Kansas University) and K. Zumbrun (Indiana University) and their group on stability issues and asymptotic model reduction.

KerData Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

MapReduce (2010–2014). An ANR project (ARPEGE 2010) with international partners, which focuses on optimized Map-Reduce data processing on cloud platforms. This project started in October 2010 in collaboration with Argonne National Lab, the University of Illinois at Urbana Champaign, the UIUC/Inria Joint Lab on Petascale Computing, IBM, IBCP, MEDIT and the GRAAL Inria Project-Team. URL: http://mapreduce.inria.fr/.

8.1.2. ADT

ADT BlobSeer (2013–2014). To support the development of the BlobSeer software for ongoing cooperations, Inria provided support for a research engineer. Loïc Cloatre has been hired as a senior engineer for the second year of this project, starting in February 2014.

8.1.3. Other National projects

HEMERA (2010–2014). An Inria Large Wingspan Project, started in 2010. Within Hemera, G. Antoniu (KerData Inria Team) and Gilles Fedak (GRAAL Inria Project-Team) co-lead the Map-Reduce scientific challenge.

KerData also co-initiated a working group called *Efficient management of very large volumes of information for data-intensive applications*, co-led by G. Antoniu and Jean-Marc Pierson (IRIT, Toulouse).

Grid'5000. We are members of the Grid'5000 community: we make experiments on the Grid'5000 platform on a daily basis.

8.2. European Initiatives

8.2.1. FP7 and H2020 Projects

BigStorage (2015–2018)

Program: European Training Network (ETN).

Coordinator: María S. Pérez.

Partners: Universidad Politécnica de Madrid (UPM), Barcelona Supercomputing Center (PSC), Johannes Gutenberg Universität Mainz, Foundation for Research and Technology - Hellas (FORTH), Xyratex Technology Limited, Deutsches Klimarechenzentrum, CA Technologies, Fujitsu Technology Solutions GmbH, French Atomic Agency CEA, IBM Research Ireland, Bull SAS, and Informatica El Corte Ingles.

Abstract: The consortium of this Marie-Curie Innovative Training Networks (ITN) *BigStorage: Storage-based Convergence between HPC and Cloud to handle Big Data* aims at training future data scientists in order to enable them and us to apply holistic and interdisciplinary approaches for taking advantage of a data-overwhelmed world, which requires HPC and Cloud infrastructures with a redefinition of storage architectures underpinning them — focusing on meeting highly ambitious performance and energy usage objectives. KerData mainly collaborates with UPM and PSC 2 co-advised PhD theses).

8.2.2. Collaborations in European Programs, except FP7 and H2020

Program: EIT ICT Labs.
Project acronym: EUROPA Activity - Future Cloud Action Line.
Project title: Big Data Analytics with Apache Flink for Real Business Use-Cases.
Duration: May 2014–December 2014.
Coordinator: Gabriel Antoniu, Alexandru Costan.
Participants: Anirvan Basu, Camelia Ciolac.
Other partners: TU Berlin (Germany), VTT (Finland), F-Secure (Finland).
Abstract: In this project, we study the requirements with respect to Big Data analytics today, following several interviews with representative companies from various domains ranging from online mobile gaming to security and logistics. The goal is to identify those requirements that could be addressed by the Apache Flink (formerly known as Stratosphere) platform and apply them in some real-life business scenarios. We first present the state-of-the-art in the field of Big Data analytics, then validate the novel features of Flink. Finally we study how some of the requirements needed by the industry could be addressed by the latter, and illustrate them with 2 real use-cases. To this end, Camelia Ciolac and Anirvan Basu were hired and implemented two demos showing the use of Flink to solve Big Data problems from 2 companies: a mobile games developer (Tribeflame) and a security company (F-Secure), respectively.

8.3. International Initiatives

8.3.1. Inria International Labs

JLESC: Joint Laboratory on Extreme-Scale Computing. This laboratory is jointly run by Inria, UIUC, ANL and BSC. It has ben created in 2014 as a follow-up of the Inria-UIUC JLPC to collaborate on concurrency-optimized I/O for Extreme-scale platforms (see details in Section 4.3). This project is an extension of the Joint Inria-UIUC Laboratory for Petascale Computing (JLPC) which was used as the basis of the Data@Exascale Associate Team with ANL and UIUC (2013–2015).

8.3.2. Inria Associate Teams

Data@Exascale

Title: Ulta-scalable I/O and storage for Exascale systems
Inria principal investigator: Gabriel Antoniu
International Partners:

Argonne National Laboratory (United States) - Mathematics and Computer Science Division - Rob Ross
University of Illinois at Urbana Champaign (United States) - Marc Snir

Duration: 2013–2015
See also: http://www.irisa.fr/kerdata/data-at-Exascale/
Description: as the computational power used by large-scale scientific applications increases, the amount of data manipulated for subsequent analysis increases as well. Rapidly storing this data, protecting it from loss and analyzing it to understand the results are significant challenges, made more difficult by decades of improvements in computation capabilities that have been unmatched in storage. For many applications, the overall performance and scalability becomes clearly driven by the performance of the I/O subsystem. As we anticipate Exascale systems in 2020, there is a growing consensus in the scientific community that revolutionary new approaches are needed in computational science storage. These challenges are at the center of the activities of the Joint Inria-UIUC Lab for Petascale Computing, recently extended to Argonne National Lab. This project gathers researchers from Inria, Argonne National Lab and the University of Illinois at Urbana Champaign to address 3 goals: 1) investigate new storage architectures for Exascale systems; 2) investigate new approaches to the design of I/O middleware for Exascale systems to optimize data processing and visualization, leveraging dedicated I/O cores and I/O forwarding techniques; 3) explore techniques enabling adaptive cloud data services for HPC.

8.3.3. Participation In other International Programs

FP3C ANR-JST project (2010–2014). This project co-funded by ANR and by JST (Japan Science and Technology Agency) started in October 2010 for 42 months. It focuses on programming issues for Post-Petascale architectures. In this framework, KerData collaborates with the University of Tsukuba on data management issues. Rohit Saxena was hired as an engineer until February 2014.

8.3.4. Inria International Partners

8.3.4.1. Declared Inria International Partners

Politehnica University of Bucharest. This status was established since January 2013, right after the end of our former DataCloud@work Associate Team.

8.3.4.2. Informal International Partners

Huazhong University of Science and Technology (HUST), China. We collaborate on optimizing Map-Reduce in virtualized environments.

Nanyang Technological University (NTU). We collaborate on optimizing Big Data applications in the Cloud and HPC systems.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Robert Ross (Argonne National Lab) visited the KerData team for one week (June 2014) within the framework of the Data@Exascale Associate Team, as an Invited Professor funded by the University of Rennes 1.

8.4.2. Internships

Stefan Ene

Subject: Overlapping cloud data transfers and computation for incremental Map-Reduce.

Date: April–September 2014.

Institution: Master student from Politehnica University of Bucharest (Romania). Co-funded by the Inria Internships Program.

Andreea Pintilie

Subject: Bio-informatics inspired algorithms for fast cloud data transfers.

Date:April–September 2014.

Institution: Master student from Politehnica University of Bucharest (Romania). Co-funded by the Inria Internships Program.

Anh-Phuong Tran

Subject: Failure-aware job scheduling in Hadoop cloud data centers.

Date: February–June 2014.

Institution: Master student enrolled in the European Master in Distributed Computing (EMDC) program, a joint program between KTH Royal Institute of Technology in Sweden and Instituto Superior Tecnico in Portugal.

Tien Dat Phan

Subject: A simulation approach to evaluate Map-Reduce performance under failure.

Date: February 2014–June 2014.

Institution: Master student from University Rennes 1, Rennes (France)

Orçun Yildiz

Subject: (In-)Efficiency in energy consumption of data management on Petascale supercomputers.

Date: February–July 2014.

Institution: Master student enrolled in the European Master in Distributed Computing (EMDC) program, a joint program between KTH Royal Institute of Technology in Sweden and Instituto Superior Tecnico in Portugal.

Thomas Bouguet

Subject: Development of a web platform for the analysis of Darshan I/O log files.

Date: May–July 2014.

Institution: Master student from University Rennes 1, Rennes (France).

8.4.3. Visits to International Teams

Lokman Rahmani visited ANL (Rob Ross, Tom Peterka) for 2 months, funded by the PUF NextGen project in the context of the Joint Laboratory for Extreme-Scale Computing (JLESC).

LAGADIC Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Oseo Apash project

Participants: François Pasteau, Marie Babel.

no Insa Rennes 2012-230, duration: 24 months.

Started in September 2012 and finished in July 2014, the Apash project was supported by the Images & Réseaux cluster. It involved three laboratories connected to INSA Rennes, namely Irisa/Inria, IETR and LGCGM. One industrial partner took part into this project: Ergovie. This project aimed at designing a driving assistance for electrical wheelchair towards the autonomy and security of disabled people. The work realized within this project is described in Section 6.2.1 .

8.1.2. HandiViz project - SATT Ouest Valorisation

Participants: François Pasteau, Marie Babel.

duration: 12 months.

This project strated in June 2014. Thanks to a strong collaboration with Ergovie Company and the rehabilitation center Pôle Saint Hélier (Rennes), the semi-autonomous navigation solution designed for wheelchair systems (see Section 6.2.1) has been medically validated and tested by patients. The resulting technology is currently under transfer towards Ergovie (SATT/INSA funding). This technology, compliant with any off-the-shelf electrical wheelchair, is expected to be commercialized at mid 2015. We expect that this technology should be helpfull for many handicapped people. In particular, clinical trials have shown that such a system can lift the medical interdiction to drive wheelchairs for people who suffer from severe handicap such as hemispatial neglect or cerebral palsy.

8.1.3. ARED NavRob

Participants: Suman Raj Bista, Paolo Robuffo Giordano, François Chaumette.

no Inria Rennes 8033, duration: 36 months.

This project funded by the Brittany council started in October 2013. It supports in part Suman Raj Bista's Ph.D. about visual navigation of a humanoid robot (see Section 8.2.4).

8.1.4. "Equipement mi-lourd Rennes Metropoles"

Participant: Paolo Robuffo Giordano.

no Irisa CNRS Rennes 14C0481, duration: 36 months.

A grant from "Rennes Métropole" has been obtained in June 2014 and will support the activities related to the use of drones (quadrotor UAVs). The platform described in Section 5.4.5 has been purchased thanks to this grant.

8.2. National Initiatives

8.2.1. ANR P2N Nanorobust

Participants: Le Cui, Eric Marchand.

no. UR1 11FA310-06D, duration: 48 months.

This project started in November 2011. It is composed of a consortium managed by Femto-ST in Besançon with LPN and Isir in Paris, Thalès and Lagadic group through the "Université de Rennes 1". Nanorobust deals with the development of micro- and nano-manipulation within SEM (Scanning Electron Microscope). Our goal is to provide visual servoing techniques for positioning and manipulation tasks with a nanometer precision.

8.2.2. ANR Contint Visioland

Participants: Noël Mériaux, Patrick Rives, François Chaumette.

duration: 48 months.

This project started in November 2013. It is composed of a consortium managed by Onera in Toulouse with Airbus, Spikenet Technology, IRCCyN, and Lagadic. Its aim is to develop vision-based localization and navigation techniques for autonomous landing on a runway.

8.2.3. PEA Decsa

Participants: Aurélien Yol, Eric Marchand.

no Inria Rennes 6630, duration: 36 months.

This project started in November 2011. It is composed of a consortium managed by Astrium/Airbus with the Novadem, Sirehna, Spot Image and Magellium companies, and with the Inria Lagadic and Steep groups (Peter Sturm). It is devoted to the development of navigation and perception algorithms for small drones in urban environment.

8.2.4. Oseo Romeo 2

Participants: Nicolas Cazy, Suman Raj Bista, Fabien Spindler, Paolo Robuffo Giordano, François Chaumette.

no Inria Rennes 7114, duration: 48 months.

This project started in November 2012. It is composed of a large consortium managed by Aldebaran Robotics. It aims to develop advanced control and perception functionalities to a humanoid robot. It supports in part Suman Raj Bista's Ph.D. about visual navigation of a humanoid robot, as well as Nicolas Cazy's Ph.D. about model-based predictive control for visual servoing.

8.2.5. Equipex Robotex

Participants: Fabien Spindler, François Chaumette.

no Inria Rennes 6388, duration: 10 years.

Lagadic is one of the 15 French partners involved in the Equipex Robotex network. It is devoted to get significative equipments in the main robotics labs in France. In a near future, we plan to buy a humanoid robot, Romeo, by Aldebaran Robotics.

8.2.6. Inria large scale initiative action PAL

Participants: Panagiotis Papadakis, François Pasteau, Vishnu Karakkat Narayanan, Erwan Demairy, Marie Babel, Patrick Rives, François Chaumette.

Lagadic participates in the large-scale initiative action PAL (Personally Assisted Living) to develop technologies and services to improve the autonomy and quality of life for elderly and fragile persons. PAL started in September 2009 for 5 years. The purpose of PAL is to provide an experimental infrastructure, in order to facilitate the development of models, tools, technologies and concept demonstrations. Using the skills and objectives of the involved teams, four research themes have been defined: a) assessing the degree of frailty of the elderly, b) mobility of people, c) rehabilitation, transfer and assistance in walking, and d) social interaction. Lagadic is currently involved in the themes "mobility of people" and "assistance in walking" through collaborations with the EPI e-Motion (Grenoble), EPI Coprin (Sophia-Antipolis), and Handibio (Toulon). See Sections 6.2.1 , 6.2.2 and 6.1.4 , as well as [55].

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. FP7 Space RemoveDEBRIS

Participants: Eric Marchand, Fabien Spindler, François Chaumette.

Instrument: Specific Targeted Research Project

Duration: from October 2013 till September 2016

Coordinator: University of Surrey (United Kingdom)

Partner: Surrey Satellite Technology (United Kingdom), Astrium (Toulouse, France and Bremen, Germany), Isis (Delft, The Netherlands), CSEM (Neuchâtel, Switzerland), Stellenbosch University (South Africa).

Inria contact: François Chaumette

Abstract: The goal of this project is to validate the model-based tracking algorithms developped during Antoine Petit's Ph.D. (see Section 6.3.1) on images acquired during an actual space debris removal mission.

8.3.1.2. FP7 Regpot Across

Participant: François Chaumette.

Program: Regpot

Project acronym: Across

Project title: Center of Research Excellence for Advanced Cooperative Systems

Duration: from September 2011 till March 2015

Coordinator: Prof. Ivan Petrovic from University of Zagreb (Croatia)

Other partners: KTH (Sweden), ETHZ (Switzerland), TUM (Germany), University of Manchester (UK), Vienna University of Technology (Austria), Politecnico di Milano (Italy), University of Sevilla (Spain), Eindhoven University of Technology (The Netherlands), University of Athens (Greece), etc.

Abstract: the goal of this project is to enhance collaborations with the University of Zagreb.

8.4. International Initiatives

8.4.1. Inria Associate Teams

Participant: Marie Babel.

Sampen (Self Adaptive Mobile Perception and Navigation) is an Inria associated team with the Iceira Lab supervised by Prof Ren C. Luo at the National University of Taiwan. It has been accepted in 2014 for 2 years. The coordinator of the team for Inria is Anne Spalanzani from UPMF University at Grenoble. The other French participants are Marie Babel, Daney David (Phoenix group in Bordeaux) and Christian Laugier (e-Motion group in Grenoble).

The aim of the project is to propose a self-adaptive system of perception combined with a system of autonomous navigation. Usually, systems of perception rely on a set of specific sensors and a calibration is done in a specific environment. We propose to develop some methods to make perception systems adaptive to the environmental context and to the set of sensors used. This perception, that can be embedded on the mobile robot as well as on home structures (wall, ceiling, floor), will be helpful to localize agents (people, robot) present in the scene. Moreover, it will give information to better understand social scenes.

8.4.1.1. Informal International Partners

- As a follow up to the long term collaboration with the "Centro de Tecnologia da Informação Renato Archer" (CTI) in Campinas (Brazil), a new Ph.D. student, Renato José Martins, joined the team in Sophia Antipolis thanks to a grant from the CNPq (2013-2017). He is co-directed by Patrick Rives and Samuel Siqueira Bueno from "Divisão de Robótica e Visão Computacional" at CTI.
- Alexandre Krupa has a collaboration with Nassir Navab from the Technische Universität München concerning the joint supervision of Pierre Chatelain's Ph.D.
- Patrick Rives has a collaboration with Javier Gonzales-Jimenez from the University of Malaga (Spain). Eduardo Fernandez-Moral who received his PhD in Malaga by September 2014, is currently on a Postdoctoral position in Sophia Antipolis.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Hideaki Uchiyama, associate professor at Kyushu University, Japan, visited the group in Rennes for 3 weeks in December 2014 to work on augmented reality.
- Ivan Markovic, postdoctoral researcher at the University of Zagreb, spent a three-month visit in Rennes in the scope of the FP7 Regpot Across project (see Section 8.3.1.2 and 6.2.4).

8.5.2. Visits to International Teams

- Pierre Chatelain spent 2 one-week visits in Nassir Navab's lab at TUM, Germany, in the scope of his Ph.D.

LEAR Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Project Qcompere

Participants: Guillaume Fortier, Cordelia Schmid, Jakob Verbeek.

This three-and-a-half year project started in November 2010. It is aimed at identifying people in video using both audio (using speech and speaker recognition) and visual data in challenging footage such as news broadcasts, or movies. The partners of this project are the CNRS laboratories LIMSI and LIG, the university of Caen, Inria's LEAR team, as well as two industrial partners Yacast and Vecsys Research.

8.1.2. ANR Project Physionomie

Participants: Frédéric Jurie [University of Caen], Jakob Verbeek, Shreyas Saxena.

Face recognition is nowadays an important technology in many applications ranging from tagging people in photo albums, to surveillance, and law enforcement. In this 3-year project (2013–2016) the goal is to broaden the scope of usefulness of face recognition to situations where high quality images are available in a dataset of known individuals, which have to be identified in relatively poor quality surveillance footage. To this end we will develop methods that can compare faces despite an asymmetry in the imaging conditions, as well as methods that can help searching for people based on facial attributes (old/young, male/female, etc.). The tools will be evaluated by law-enforcement professionals. The participants of this project are: Morpho, SensorIT, Université de Caen, Université de Strasbourg, Fondation pour la Recherche Stratégique, Préfecture de Police, Service des Technologies et des Systèmes d'Information de la Sécurité Intérieure, and LEAR.

8.1.3. ANR Project Macaron

Participants: Julien Mairal, Zaid Harchaoui, Laurent Jacob [CNRS, LBBE Laboratory], Michael Blum [CNRS, TIMC Laboratory], Joseph Salmon [Telecom ParisTech].

The project MACARON is an endeavor to develop new mathematical and algorithmic tools for making machine learning more scalable. Our ultimate goal is to use data for solving scientific problems and automatically converting data into scientific knowledge by using machine learning techniques. Therefore, our project has two different axes, a methodological one, and an applied one driven by explicit problems. The methodological axis addresses the limitations of current machine learning for simultaneously dealing with large-scale data and huge models. The second axis addresses open scientific problems in bioinformatics, computer vision, image processing, and neuroscience, where a massive amount of data is currently produced, and where huge-dimensional models yield similar computational problems.

This is a 3 years and half project, funded by ANR under the program "Jeunes chercheurs, jeunes chercheuses", which started in October 2014. The principal investigator is Julien Mairal.

8.1.4. PEPS CNRS BMI (Biology - Mathematics - Computer Science), Project FlipFlop

Participants: Elsa Bernard [Institut Curie, Ecoles des Mines-ParisTech], Laurent Jacob [CNRS, LBBE Laboratory], Julien Mairal, Jean-Philippe Vert [Institut Curie, Ecoles des Mines-ParisTech], Anne-Hélène Monsoro-Burq [Institut Curie].

The project is concerned with large-scale sparse estimation techniques for processing RNA-Seq data. It led to a joint publication [4] with partners from Inria Grenoble, Institut Curie in Paris, and the LBBE laboratory in Lyon. The principal investigator was Laurent Jacob (CNRS, LBBE laboratory). The project started in Jun 2012 and ended in Dec 2014.

8.1.5. MASTODONS Program CNRS - Project Gargantua

Participants: Zaid Harchaoui, Julien Mairal.

The project is concerned with machine learning and mathematical optimization for big data. The partners are from LJK (Grenoble), LIG (Grenoble), LIENS (ENS, Paris), Lab. P. Painleve (Lille). Principal investigator/leader: Zaid Harchaoui. Dates: May 2013-Dec. 2014

8.1.6. Equipe-action ADM du Labex Persyval (Grenoble) "Khronos"

Participants: Zaid Harchaoui, Massih-Reza Amini [LIG].

The partners of this project are from the laboratories LJK, LIG, GIPSA, TIMC, CEA. The principal investigators/leaders are Zaid Harchaoui (Inria and LJK), Massih-Reza Amini (LIG). The project started in Jan. 2014 and ends in Dec. 2016.

8.2. European Initiatives

8.2.1. AXES

Participants: Ramazan Cinbis, Matthijs Douze, Zaid Harchaoui, Dan Oneata, Danila Potapov, Cordelia Schmid, Jakob Verbeek, Clement Leray, Anoop Cherian.

This 4-year project started in January 2011 and ends in March 2015. Its goal is to develop and evaluate tools to analyze and navigate large video archives, eg. from broadcasting services. The partners of the project are ERCIM, Univ. of Leuven, Univ. of Oxford, LEAR, Dublin City Univ., Fraunhofer Institute, Univ. of Twente, BBC, Netherlands Institute of Sound and Vision, Deutsche Welle, Technicolor, EADS, Univ. of Rotterdam. See http://www.axes-project.eu/ for more information.

8.2.2. ERC Advanced grant Allegro

Participants: Cordelia Schmid, Karteek Alahari, Jerome Revaud, Pavel Tokmakov, Nicolas Chesneau.

The ERC advanced grant ALLEGRO started in April 2013 for a duration of five years. The aim of ALLEGRO is to automatically learn from large quantities of data with weak labels. A massive and ever growing amount of digital image and video content is available today. It often comes with additional information, such as text, audio or other meta-data, that forms a rather sparse and noisy, yet rich and diverse source of annotation, ideally suited to emerging weakly supervised and active machine learning technology. The ALLEGRO project will take visual recognition to the next level by using this largely untapped source of data to automatically learn visual models. We will develop approaches capable of autonomously exploring evolving data collections, selecting the relevant information, and determining the visual models most appropriate for different object, scene, and activity categories. An emphasis will be put on learning visual models from video, a particularly rich source of information, and on the representation of human activities, one of today's most challenging problems in computer vision.

8.3. International Initiatives

8.3.1. Inria Associate Teams

- **HYPERION: Large-scale statistical learning for visual recognition:** Zaid Harchaoui and Cordelia Schmid have an ongoing collaboration resp. with Pr. Jitendra Malik (EECS) and Pr. Nourredine El Karoui (Stat. dpt.) of UC Berkeley in the fall 2011. This collaboration has been supported by the *associated team "Hyperion"* and the *France-Berkeley Fund* (dates: June 2012-Dec. 2013). The collaboration is focusing on *large-scale statistical learning for computer vision*, ranging from the high-dimensional statistics aspects to real-world applications on large image and video datasets. Several visits of members of each institution and co-supervision of students happened in 2012, 2013, 2014. As part of the "Hyperion" associated team, two papers were published resp. in CVPR'14 and ICML'14, and one paper is currently in revision.

8.3.2. Inria International Partners

- **UC Berkeley:** This collaboration between Bin Yu, Jack Gallant, Yuval Benjamini, Adam Bloniarz (UC Berkeley), Ben Willmore (Oxford University) and Julien Mairal (Inria LEAR) aims to discover the functionalities of areas of the visual cortex. We have introduced an image representation for area V4, adapting tools from computer vision to neuroscience data. The collaboration started when Julien Mairal was a post-doctoral researcher at UC Berkeley and is still ongoing. We are planning to welcome one student from UC Berkeley during the summer 2015 to work on this project.
- **University of Edinburgh:** C. Schmid collaborates with V. Ferrari, associate professor at university of Edinburgh. Vicky Kalogeiton started a co-supervised PhD in September 2013; she is bi-localized between Uni. Edinburgh and Inria. Her subject is the automatic learning of object representations in videos.
- **MPI Tübingen:** C. Schmid collaborates with M. Black, a research director at MPI. In 2013, she spent one month at MPI and worked with a PhD student, S. Zuffi, and a postdoctoral researcher, H. Jhuang. C. Schmid has continued this collaboration in 2014 and spent also one month there.

8.3.3. Participation in Other International Programs

- **France-Berkeley fund:** The LEAR team was awarded in 2014 a grant from the France-Berkeley fund for a project between Julien Mairal and Pr. Bin Yu (statistics department, UC Berkeley) on "Invariant image representations and high dimensional sparse estimation for neurosciences". The award amounts to 10,000 USD for a period of one year, from November 2014 to November 2015. The funds are meant to support scientific and scholarly exchanges and collaboration between the two teams.

8.4. International Research Visitors

8.4.1. Visits to International Teams

- **Sabbatical program** Zaid Harchaoui is currently on sabbatical at New-York university, from October 2014 to September 2015.

LEMON Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

Fabien MARCHE is member of the ANR project BonD (PI Sylvie Benzoni), 2013-2017.

Fabien MARCHE is member of the ANR project ACHYLLES (PI Rodolphe Turpault), 2014-2017

8.2. International Initiatives

8.2.1. Inria International Labs

Antoine ROUSSEAU visited Inria Chile in April, 2014 (2 weeks, see Associate Teams below) in order to prepare an application for a research center on marine energies in Chile.
This application is coordinated by DCNS Energies Marines and also involves Inria Chile and PUC University (Santiago).

8.2.2. Inria Associate Teams

Antoine ROUSSEAU collaborates with the ANESTOC partners (TOSCA at Inria Sophia and Rolando Rebolledo at PUC, Santiago, Chile) on the stochastic analysis of renewable energies. Together with Mireille Bossy (TOSCA), AR supervises the research of two engineers in Chile: Jacques Morice and Cristián Paris.

Antoine ROUSSEAU collaborates with the DYNECOS2 partners (MODEMIC at Inria Sophia and Hector Ramirez at CMM, Santiago, Chile) on the bioremediation of natural resources.

In the framework for these two collaborations, AR visited Inria Chile in April, 2014 (2 weeks). See the TOSCA (resp. MODEMIC) project team activity report for more information on the ANESTOC (resp. DYNECOS) associate team.

8.2.3. Inria International Partners

8.2.3.1. Informal International Partners

Vincent GUINOT collaborates with B.F. Sanders (Irvine University, Californie, USA)

Vincent GUINOT collaborates with S. Soares-Frazao (Unité de Génie Civil, Université catholique de Louvain, Belgium)

Fabien MARCHE and Antoine ROUSSEAU collaborate with R. Cienfuegos (PUC University, Santiago, Chile)

LFANT Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANRPeace – Parameter spaces for Efficient Arithmetic and Curve security Evaluation

Participants: Bill Allombert, Karim Belabas, Jean-Marc Couveignes, Andreas Enge, Hamish Ivey-Law, Nicolas Mascot, Enea Milio, Aurel Page, Damien Robert.

http://chic2.gforge.inria.fr/

The PEACE project is joint between the research teams of Institut de Recherche en Mathématiques de Rennes (IRMAR), LFANT and Institut Mathématiques de Luminy (IML).

The project aims at constituting a comprehensive and coherent approach towards a better understanding of theoretical and algorithmic aspects of the discrete logarithm problem on algebraic curves of small genus. On the theoretical side, this includes an effective description of moduli spaces of curves and of abelian varieties, the maps that link these spaces and the objects they classify. The effective manipulation of moduli objects will allow us to develop a better understanding of the algorithmic difficulty of the discrete logarithm problem on curves, which may have dramatic consequences on the security and efficiency of already deployed cryptographic devices.

One of the anticipated outcomes of this proposal is a new set of general criteria for selecting and validating cryptographically secure curves (or families of curves) suitable for use in cryptography. Instead of publishing fixed curves, as is done in most standards, we aim at proposing generating rationales along with explicit theoretical and algorithmic criteria for their validation.

The ANR organised the conference “Effective moduli spaces and applications to cryptography” in June 2014 as a part of the Centre Henri Lebesgue’s Thematic Semester 2014 “Around moduli spaces”.

6.1.2. ANRSimpatic – SIM and PAiring Theory for Information and Communications security

Participants: Guilhem Castagnos, Damien Robert.

The SIMPATIC project is an industrial research project, formed by academic research teams and industrial partners: Orange Labs, École Normale Supérieure, INVIA, Oberthur Technologies, ST-Ericsson France, Université de Bordeaux 1, Université de Caen Basse-Normandie, Université de Paris 8.

The aim of the SIMPATIC project is to provide the most efficient and secure hardware/software implementation of a bilinear pairing in a SIM card. This implementation will then be used to improve and develop new cryptographic algorithms and protocols in the context of mobile phones and SIM cards. The project will more precisely focus on e-ticketing and e-cash, on cloud storage and on the security of contactless and of remote payment systems.

D. Robert is a participant in the Task 2 whose role is to give state of the art algorithms for pairing computations, adapted to the specific hardware requirements of the Simpatic Project.

6.2. European Initiatives

6.2.1. FP7 & H2020 Projects

6.2.1.1. ANTICS

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Objectif: NC

Duration: January 2012 - December 2016

Coordinator: Inria (France)

Inria contact: Andreas Enge

Abstract: Data security and privacy protection are major challenges in the digital world. Cryptology contributes to solutions, and one of the goals of ANTICS (Algorithmic Number Theory in Cryptology) is to develop the next generation public key cryptosystem, based on algebraic curves and abelian varieties. Challenges to be tackled are the complexity of computations, certification of the computed results and parallelisation, addressed by introducing more informatics into algorithmic number theory.

6.3. International Initiatives

6.3.1. Inria International Labs

The *MACISA* project-team (Mathematics Applied to Cryptology and Information Security in Africa) is one of the new teams of LIRIMA. Researchers from Inria and the universities of Bamenda, Bordeaux, Dakar, Franceville, Maroua, Ngaoundéré, Rennes, Yaoundé cooperate in this team.

The project is concerned with public key cryptology and more specifically the role played by algebraic maps in this context. The team focus on two themes:

- Theme 1 : Rings, primality, factoring and discrete logarithms;
- Theme 2 : Elliptic and hyperelliptic curve cryptography.

The project is managed by a team of five permanent researchers: G. Nkiet, J.-M. Couveignes, T. Ezome, D. Robert and A. Enge. Since Sep. 2014 the coordinator is T. Ezome and the vice-coordinator is D. Robert. The managing team organises the cooperation, schedules meetings, prepares reports, controls expenses, reports to the LIRIMA managing team and administrative staff.

A non-exhaustive list of activities organised or sponsored by Macisa includes

- The Summer school in M'Bour in Senegal with the International Center for Pure and Applied Mathematics (ICPAM/CIMPA), June 2014;
- The Annual Cameroonian workshop on Cryptography, Algebra and Geometry (CRAG), July 2014;
- The visit of Thierry Mefenza (Cameroun), to École Normale Supérieure de Paris for a PhD Thesis with Damien Vergnault, November 2013 and September–November 2014;
- The visit of Hortense Boudjou (Maroua) to work with Abdoul Aziz Ciss (École Polytechnique de Thièse, Sénégal), May – July 2014;
- The visit of Abdoul Aziz Ciss (Dakar) and Tony Ezome (Franceville) to Bordeaux, September 2014.
- Kodjo Kpognon Egadédé defended his PhD thesis in december 2014 under the supervision of Julien Sebag.

The team was evaluated in September 2014 as part of the general LIRIMA evaluation seminar.

6.3.2. Inria International Partners

6.3.2.1. Informal International Partners

The team is used to collaborate with Leiden University through the ALGANT program for PhD joint supervision.

Eduardo Friedman (U. of Chile), long term collaborator of K. Belabas and H. Cohen is a regular visitor in Bordeaux (about 1 month every year).

6.4. International Research Visitors

6.4.1. Visits of International Scientists

- Hartmut Monien, Universität Bonn, Germany. 01/2014;
- Eduardo Friedman, Universidad de Chile, 02/2014;
- Amalia Pizarro-Madariaga, Universidad de Valparaiso, Chile, 04/2014;
- Tony Ezome Mintsa, University of Franceville, Gabon, 04/2014 and 09/2014;
- Alina Dudeanu, École polytechnique fédérale de Lausanne, Switzerland, 05/2014;
- Kamal Khuri-Makdisi, American University of Beirut, Lebanon, 07/2014;
- Abdoul-Aziz Ciss, University of Dakar, 09/2014;
- Dimitar Jetchev, École polytechnique fédérale de Lausanne, Switzerland, 10/2014;

6.4.1.1. Internships

- Ilaria Chillotti (with D. Robert), Université Joseph Fourier, 02/2014–07/2014]
- Gregor Seiler (with A. Enge), Technische Universität Berlin, Germany, 10/2013–03/2014

LIFEWARE Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Projects

- ANR Blanc Hyclock (2014-2018) on "Hybrid modeling of time for Circadian Clock Biology and Chronopharmacology", coordinated by F. Delaunay (CNRS, Nice), F. Lévi (INSERM Paris-Sud), G. Bernot (CNRS I3S, Nice), O. Roux (Ecle Centrale Nantes).
- ANR Blanc STOCH-MC (2014-2018) on "Stochastic Models: Scalable Model Checking", coordinated by Blaise Genest (Inria Rennes), with Grégory Batt, Wieslaw Zielonka (LIAFA), and Hugo Gimbert (LaBRI).
- ANR Investissement Avenir ICEBERG project (2011-2016) "From population models to model populations", coordinated by Grégory Batt, with Pascal Hersen (MSC lab, Paris Diderot Univ./CNRS), Reiner Veitia (Institut Jacques Monod, Paris Diderot Univ./CNRS), Olivier Gandrillon (BM2A lab, Lyon Univ./CNRS), Cédric Lhoussaine (LIFL/CNRS), and Jean Krivine (PPS lab, Paris Diderot Univ./CNRS).
- ANR Cosinus Syne2arti project (2010-2014) "From synthetic gene networks to artificial tissues" coordinated by Grégory Batt, with Oded Maler (CNRS Verimag), Dirk Drasdo (EPI Mamba), and Ron Weiss (MIT).
- ANR Blanc BIOTEMPO project (2010-2014) coordinated by Anne Siegel (EPI DYLISS), with Ovidiu Radulescu (U. Montpellier), O. Roux (Ecole Centrale de Nantes), Irina Rusu (U. Nantes).
- ANR Blanc NET-WMS-2 (2011-2015) on "constraint optimization in Wharehouse Management Systems", coordinated by F. Fages, with N. Beldiceanu (Ecole des Mines de Nantes, EPI TASC), and Abder Aggoun (KLS optim).

8.1.2. BPI-OSEO BioIntelligence Project

- OSEO-BPI Biointelligence project (2009-2014) coordinated by Dassault-Systèmes, with Sobios, Aureus pharma, Ipsen, Pierre Fabre, Sanofi-Aventis, Servier, Bayer CropScience, INSERM, Genopole Evry, EPI Orpailleur.

8.1.3. GENCI Contract

- GENCI (2009-) attribution of 300000 computation hours per year on the Jade cluster of 10000 cores of GENCI at CINES, Montpellier. Used for hardest parameter search problems in BIOCHAM-parallel.

8.2. International Initiatives

8.2.1. Inria Associate Teams

8.2.1.1. TISHOM

Title: Artificial tissue homeostasis: combining synthetic and computational biology approaches
Inria principal investigator: Grégory Batt
International Partner (Institution - Laboratory - Researcher):
Massachusetts Institute of Technology (United States) - Weiss Lab
Duration: 2012 - 2014

Cell-based gene therapy aims at creating and transplanting genetically-modified cells into a patient in order to treat an illness. Ideally, actively-growing cells are used to form a self-maintaining tissue in the patient, thus permanently curing the disease. Still, before any real therapeutic use, many important issues need to be addressed. In particular, one should guarantee tissue homeostasis, that is, that the size of the newly-introduced tissue remains within admissible bounds. The TISHOM project focused on developing methods and tools to facilitate the design and effective construction of artificial tissues.

In the context of his PhD, Xavier Duportet worked on three projects on engineering human cells. The first one, dealing with developing tools to facilitate the engineering of mammalian cells, has been published [7]. The two others deal with the development of communication systems and still need to be finalized. This experimental work raised a number of more theoretical questions, that were investigated by François Bertaux, together with Szymon Stoma. Two problems have been investigated. The first one dealt with accounting for protein fluctuations for the analysis of signal transduction systems over long time scales and has been published [4]. The second one dealt with the multiscale simulation of tissues and is still under way. During the course of the project, a third line of research emerged, to assist the design of a patterning system currently developed by the Weiss lab. On the computational side, the major issues have been addressed. On the experimental side, additional constructions and characterizations are still needed.

Lastly, the associated team also helped to organize the workshop Design, optimization and control in systems and synthetic biology. Nearly 200 researchers and students attended this event. Although of relatively modest size, this event was attended by a number of leaders of the field and had a significant international visibility.

8.2.2. Inria International Partners

8.2.2.1. Collaboration with National Taiwan University

Since 2012, we have a collaboration with Prof. Jie-Hong Jiang, National Taiwan University first on hybrid simulations of biochemical reaction systems and now on the design of a compiler of digital programs and analog circuits in biochemical reactions. Our preliminary results and common publications on this topic [15], [16] are encouraging but a lot of work is needed to minimize the number of necessary species and reactions. Our aim, in partnership with Franck Molina (CNRS, Sysdiag, Montpellier) is to design a biosensor using our biochemical programming compiler, implement the generated code in a liposome using a microfluidic device, and test its efficacy *in vitro*.

8.3. International Research Visitors

8.3.1. Invited Professors

Prof. Alexander Bockmayr from Freie Universitat, Berlin, Germany, visited us from January to March 2014 for common work on constraint-based methods in computational systems biology, and teaching in our MPRI Master C2.19 course on computational methods for systems and synthetic biology.

LINKMEDIA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CominLabs Project CominWeb

Participants: Vincent Claveau, Sébastien Le Maguer.

Duration: 1 year
Partners: Univ. Nantes
URL: http://www.cominweb.cominlabs.ueb.eu

In the framework of the CominWeb projet, a 50kE contract was granted by the Labex CominLabs to the team to carry a preliminary study about text similarity models in different contexts: information retrieval, content based recommendation, etc.

8.1.2. CominLabs Project Linking Media in Acceptable Hypergraphs (LIMAH)

Participants: Rémi Bois, Sébastien Campion, Vincent Claveau, Guillaume Gravier, Patrick Gros, Pascale Sébillot.

Duration: 4 years, started in April 2014
Partners: Telecom Bretagne (IODE), Univ. Rennes II (CRPCC, PREFics), Univ. Nantes (LINA/TAL)
URL: http://limah.irisa.fr

LIMAH aims at exploring hypergraph structures for multimedia collections, instantiating actual links reflecting particular content-based proximity—similar content, thematic proximity, opinion expressed, answer to a question, etc. Exploiting and developing further techniques targeting pairwise comparison of multimedia contents from an NLP perspective, LIMAH addresses two key issues of content-based graph-oriented multimedia collection structuring: How to automatically build from a collection of documents an hypergraph, i.e., graph combining edges of different natures, which provides exploitable links in selected use cases? How collections with explicit links modify usage of multimedia data in all aspects, from a technology point of view as well as from a user point of view? LIMAH studies hypergraph authoring and acceptability taking a multidisciplinary approach mixing ICT, law, information and communication science as well as cognitive and ergonomy psychology.

8.2. National Initiatives

8.2.1. ANR Project FIRE-ID

Participants: Sébastien Campion, Philippe-Henri Gosselin, Patrick Gros, Hervé Jégou.

Duration: 3 years, started in May 2012
Partner: Xerox Research Center Europe

The FIRE-ID project considers the semantic annotation of visual content, such as photos or videos shared on social networks, or images captured by video surveillance devices or scanned documents. More specifically, the project considers the fine-grained recognition problem, where the number of classes is large and where classes are visually similar, for instance animals, products, vehicles or document forms. We also assumed that the amount of annotated data available per class for the learning stage is limited.

8.2.2. ANR Project Secular

Participants: Laurent Amsaleg, Teddy Furon, Hervé Jégou, Ewa Kijak.

Duration: 3 years, started in September 2012

Partners: Morpho, Univ. Caen GREYC, Telecom ParisTech

Content-based retrieval systems (CBRS) are becoming the main multimedia security technology to enforce copyright laws or to spot illegal contents over the Internet. However, CBRS were not designed with privacy, confidentiality and security in mind. This comes in serious conflict with their use in these new security-oriented applications. Privacy is endangered due to information leaks when correlating users, queries and the contents stored-in- the-clear in the database. This is especially the case of images containing faces which are so popular in social networks. Biometrics systems have long relied on protection techniques and anonymization processes that have never been used in the context of CBRS. The project seeks to a better understanding of how biometrics related techniques can help increasing the security levels of CBRS while not degrading their performance.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. VIAMASS

Type: FP7

Instrument: ERC Starting Grant

Duration: 04/2014 – 03/2019

Coordinator: Hervé Jégou

Inria contact: Hervé Jégou

Abstract: VIAMASS is a ERC Starting grant project coordinated by Hervé Jégou and with Teddy Furon as co-investigator. The goal of the project is to automatically discover visual links within a very large collection of images. These “visual hyper-links” will connect the objects across the images of the collection. This raises a major obstacle with respect to scalability: cross matching all the images is of quadratic complexity when performed with a brute-force approach. To this end, VIAMASS addresses issues at the frontier of the current state of the art in computer vision and signal processing.

8.3.1.2. Forensic Image Identifier and Analyzer

Program: Eurostars

Duration: 03/2011 – 07/2014

Coordinator: Videntifier Technologies

Other partners: Videntifier Technologies (Iceland), Forensic Pathways (UK)

Abstract: FIIA is an innovative software service for the Forensic market that automatically identifies and analyzes the content of images on web sites and seized computers. The service saves time and money, gathers better evidence, and builds stronger court cases. We are in charge of helping with the technology needed to identify the logos from terrorist organizations that are inserted in images or videos. Challenges are related to the poor resolution and small size of logos as well as to the very strict efficiency constraints that the logo detector must match.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. MOTIF

Title: Unsupervised motif discovery in multimedia content

International Partner (Institution - Laboratory - Researcher):

Pontifícia Universidade Católica de Minas Gerais - VIPLAB - Silvio Jamil Guimãraes

Universidade Federal Minas Gerais - NPDI - Arnaldo Albuquerque de Araújo

Duration: 2014 - 2017
See also: http://www.icei.pucminas.br/projetos/viplab/projects/associate-team/index.html
MOTIF aims at studying various approaches to unsupervised motif discovery in multimedia sequences, i.e., to the discovery of repeated sequences with no prior knowledge on the sequences. On the one hand, we will develop symbolic approaches inspired from work on bioinformatics to motif discovery in the multimedia context, investigating symbolic representations of multimedia data and adaptation of existing symbolic motif discovery algorithms. On the other hand, we will further develop cross modal clustering approaches to repeated sequence discovery in video data, building upon previous work.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

- National Institute for Informatics, Japan
- Berkeley University, USA
- University of Amsterdam, The Netherlands
- Katholieke Universiteit Leuven, Belgium
- National Technical University of Athens, Greece
- Czech Technical University, Czech Republic

8.4.3. Other International Programs

- PICS CNRS MM-Analytics
  - Title: Fouille, visualisation et exploration multidimensionnelle de contenus multimédia ; Multi-Dimensional Multimedia Browsing, Mining, Analytics (num 6382).
  - International Partner (Institution - Laboratory - Researcher):
    Reykjavík University, Iceland - Björn Þór Jónsson
  - Jan. 2014 – Dec. 2016
- STIC AmSud MAXIMUM Unsupervised Multimedia Content Mining
  - International coordinator: Guillaume Gravier, CNRS – IRISA, France
  - Scientific coordinators : Arnaldo de Albuquerque Araújo (Universidade Federal de Minas Gerais, Computer Science Department, NPDI); Benjamin Bustos (Universidad de Chile, Department of Computer Science, PRISMA); Silvio Jamil F. Guimarães (Pontifícia Universidade Católica de Minas Gerais, VIPLAB)
  - Jan. 2014 - Dec. 2015

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Yannis Avrithis
Dates: October 2014 (2 weeks)
Institution: National Technical University of Athens (Greece)

8.5.2. Internships

Miaojing Shi
Dates: February 2014–January 2015 (1 year)
Subject: Large scale visual search
Institution: Pekin University (China)

8.5.3. Visits to International Teams

8.5.3.1. Research stays abroad

Petra Bosilj
Date: Sep. – Nov., 2014
Institution: Johann Bernoulli institute, Groningen, The Netherlands
Anca-Roxana Simon
Date: Apr. – June, 2014
Institution: Katholieke Universiteit Leuven, Belgium

LINKS Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. FUI Région AAP 14 Hermes(2013-2015)

Participants: Angela Bonifati [correspondent], Joachim Niehren, Iovka Boneva Denis Debarbieux

The Hermes projecton "Relation Client Personalisée et Contextualisée" is coordinated by Bonifati from Links. Our partners are the Université Lille 1, Logos Keyneosoft, Cylande, Norsys, Numsight, Leroy Merlin, Kiabi and Auchan. The project addresses the problem of enriching the client communication within the marketing process. Starting from heterogeneous data sources (connected devices, social networks and traditional marketing channels), one has to extract the necessary information at hand. The data sources can be seen in a streaming fashion as they produce continuous data.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. ANR Aggreg

Particpants: Joachim Niehren [correspondent], Pierre Bourhis, Aurelien Lemay, Adrien Boiret This project has been accepted this year and it is in collaboration with University Paris 7, University of Marseille and University of Caen. The main goal of the Aggreg project is to develop efficient algorithms for answering aggregate queries for databases and data streams of various kinds.

7.2.2. Competitivity Clusters

We participate to the following http://www.picom.fr/ (Pôle de compétitivité PICOM - regional research cluster on commerce industries). In particular, the Hermes project has been conceived within the cluster.

7.3. European Initiatives

7.3.1. Collaborations with Major European Organizations

Partner 1: University of Oxford, Departement of Computer Science Database Group.

This collaboration is related the Inria North-European Lab Lille-Oxford. It is related to managing linked data and its exchange. If the Database Group has deep roots with Joachim Niehren and Angela Bonifati, new topics have been recently developped by younger researchers as Slawek Staworko and Pierre Bourhis.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Declared Inria International Partners

Links is in Inria North-European Lab team with University of Oxford. The main people involved are Joachim Niehren [correspondent] , Pierre Bourhis and Angela Bonifati, but the cooperation is equally relevant for Iovka Boneva, Aurélien Lemay, Slawek Staworko, Sophie Tison, Radu Ciucanu (PhD student). The Oxford database group (http://www.cs.ox.ac.uk/isg/db) is one of the top database groups world wide. The main persons involved will be Michael Benedikt [correspondent], Dan Olteanu, Andreas Pieris (postdoc). Further promising cooperation opportunities are to be explored with members of Georg Gottlob's ERCproject DiaDem(http://www.cs.ox.ac.uk/projects/DIADEM/index.html) on semantics-based information extraction.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

Martin Musicante from Universidade Federal do Rio Grande do Norte has been an invited Professor since December 2014.

7.5.2. Visits to International Teams

7.5.2.1. Sabbatical programme

Slawomir Stawork has been in sabbatical at University of Edinburg for a year.

7.5.2.2. Research stays abroad

Pierre Bourhis has visited University of Oxford for more than a month in different visits over the year.

M3DISIM Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

The team is part of the Mechanics and Living Systems Initiative (Opération Mécanique et Systèmes du Vivant), a joint operation – focused on biomechanical modeling – between the LadHyx and LMS labs (CNRS and Ecole Polytechnique), and Inria-M3DISIM.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. VPH-Share

Type: FP7

Defi: Towards sustainable and personalised healthcare

Instrument: Integrated Project

Objectif: Virtual Physiological Human

Duration: March 2011 - February 2015

Coordinator: Univ. Sheffield (UK)

Other partners: Cyfronet (Cracow), University College London, Istituto Ortopedico Rizzoli (Bologna), NHS, IBM Israel, Univ. Auckland, Agència d'Informació, Avaluació i Qualitat en Salut (Barcelona), Biocomputing Competence Centre (Milano), Universitat Pompeu Fabra (Barcelona), Philips Research, TUE (Eindhoven), Sheffield Teaching Hospitals, Atos Origin (Madrid), the Open University (UK), Univ. Vienna, King's College London, Empirica (Bonn), Fundació Clínic (Barcelona), Univ. Amsterdam

See also: http://vph-share.org/

Abstract: VPH-Share aims at developing the organisational fabric (the infostructure) and integrating the optimised services to expose and share data and knowledge, to jointly develop multiscale models for the composition of new VPH workflows, and to facilitate collaborations within the VPH community. Within this project, the M3DISIM team is in charge of developing some high-performance data assimilation software tools.

7.2.1.2. VP2HF

Type: FP7

Defi: ICT for Health, Ageing Well, Inclusion and Governance

Instrument: Specific Targeted Research Project

Objectif: Virtual Physiological Human

Duration: October 2013 - September 2016

Coordinator: King's College London (UK)

See also: http://vp2hf.eu/

Abstract: Heart failure (HF) is one of the major health issues in Europe affecting 6 million patients and growing substantially because of the aging population and improving survival following myocardial infarction. The poor short to medium term prognosis of these patients means that treatments such as cardiac re-synchronisation therapy and mitral valve repair can have substantial impact. However, these therapies are ineffective in up to 50% of the treated patients and involve significant morbidity and substantial cost. The primary aim of VP2HF is to bring together image and data processing tools with statistical and integrated biophysical models mainly developed in previous VPH projects, into a single clinical workflow to improve therapy selection and treatment optimisation in HF.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

7.3.1.1. Internships

Alexendre Laurin [Simon Fraser Univ., Canada] Sébastien Imperiale [correspondant] Philippe Moireau Dominique Chapelle

In the context of an ongoing collaboration between the Aerospace Physiology lab (Simon Fraser University, Vancouver, Canada) and Inria (M3DISIM and Reo teams), Alexandre Laurin (PhD student) has been awarded some funding for a 2 months internship in the M3DISIM team, with the objective of initiating the modelling of seismocardiography (SCG) measurements. SCG consists in measuring displacements of the sternum and ribs generated by a heart beat using accelerometers placed on the thorax. In this context, linear elastodynamics equations are applicable to account for the transient propagation of motion from the heart to the sternum via the highly heterogeneous underlying materials (cartilage and bone). Specific care has been taken to solve the aforementioned equation in a realistic 3D geometry including the complete thoracic cage. Fully coupled simulations (beating heart with thorax deformation) are planned at the final stage of this modelling work in 2015.

MADYNES Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Satelor AME Lorraine regional project

Participants: Mandar Harshe, Bernardetta Addis, Evangelia Tsiontsiou, Ye-Qiong Song [contact].

MADYNES is involved in Satelor, a regional research and development project funded by the AME (Agence de Mobilisation Economique) of Lorraine (October 2013 – September 2016). The consortium includes academic (Univ. of Lorraine, Inria), medical (OHS) and industrial (Diatelic-Pharmagest, ACS, Kapelse, Salendra, Neolinks) partners. It aims at developing innovative and easily deployable ambient assisted living solutions for their effective use in the tele-homecare systems. Madynes team is mainly involved in the data collection system development based on wireless sensors networks and IoT technology. The first topic consists in defining the basic functions of the future SATEBOX – a gateway box for interconnecting in-home sensors to the medical datacenter, based on our previously developed MPIGate software. A first specification for achieving a beta-version prototype of the future Satebox gateway has been made. It is intentionally limited to only using Zigbee wireless sensors for providing a low-cost and easily deployable solution for the daily activity monitoring. Its first real-world deployment at a OHS hospital room has also bee carried out.Through this deployment, a lot of important lessons have been learn that enable us to improve the reliability, robustness and the accuracy of our system. The second topic is related to improving the data transfer reliability while still keeping minimum energy consumption. This has led us to focus on the multi-hop mesh network topology with multi-constrained QoS routing problem (PhD thesis of Evangelia Tsiontsiou). A state of the art study has shown the need to look for new routing algorithms and the interest of the newly developed operator calculus approach.

8.1.2. Hydradrone R&D Lorraine UL project

Participants: Adrien Guenard, Laurent Ciarletta [contact].

Funded by the Region Lorraine under the R&D program.

The Madynes team has been working on the Hydradrone project since July 2014. It is starting as a collaborative R&D regional research and development project, funded by Region Lorraine. This project is a joint work between Madynes and PEMA (Pedon Environnement et Milieux aquatiques), an SME/VSE (small and medium size Entreprise, PEM/TPE). The company is providing the use cases and terrain (and business) validation.

It consists in developing a new solution for the surveillance of aquatic environment, the Hydradrone :

- based on an hybrid UxV (Unmanned Air, Surface, Ground Vehicle),
- some Cyber Physical bricks in coherence with the Alerion concept
- and an integration in the Information System of the company

The first year is dedicated to the development of a couple hydradrone proofs of concept (the UxV) for both hardware and software (embedded / remote) and for the sensor payload "cyber physical" bricks.

The Alerion spinoff will join the consortium upon creation.

8.1.3. 6PO Research Region Lorraine and UL project

Participants: Emmanuel Nataf, Ye-Qiong Song, Yael Kolasa, Laurent Ciarletta [contact].

Funded by Region Lorraine and Université de Lorraine since 2013. Vincent Chevrier is the point of contact for the dep. 5 at Loria. Adel Belkadi (CRAN & LORIA) is co-directed by L. Ciarletta and Didier Theilliol (CRAN correspondant).

6PO (“Systèmes Cyber-Physiques et Commande Coopérative Sûre de Fonctionnement pour une Flotte de Véhicules sans Pilote”) is a joint research project between the Loria and CRAN laboratories. It aims at researching solutions for safe formation flying of collaborative UAVs seen as part of a collection of Cyber Physical Systems. This led to a common publication and the organisation of a workshop in 09/2014. It is reinforced by a PhD grant from the Federation Charles Hermite that started in october 2014. Efforts will be pursued in 2015.

The project provides common use cases and scientific challenges that serve as catalysts for collaboration between teams from different research topics :

- Cyber Physical Systems, Real Time, Quality of service, Performance and Energy in Wireless Sensors and Activator Networks
- Collaborative, communicating autonomous systems and Unmanned Vehicles
- Safety, Dependabilty, Reliability, Diagnosis, Fault-Tolerance

8.2. National Initiatives

8.2.1. Quasimodo

Participants: François Despaux, Abdelkader Lahmadi, Ye-Qiong Song [contact].

The QUASIMODO ANR Blanc international project (http://quasimodo.loria.fr/) is a fundamental research project coordinated by Prof. Ye-Qiong SONG at LORIA - University of Lorraine in France and by Prof. Youxian SUN at SKLICT of Zhejiang University in China. The project started on March 2011 and will be completed at the end of 2014. It is funded by ANR grant (ANR 2010 INTB 0206 01) and NSFC grant (NSFC 61061130563). The main objective of the project is to specify, develop and evaluate algorithms and mechanisms to provide the self-adaptive QoS support for real-time applications using wireless sensor networks (WSN). This year, the iQueue-MAC has been extended (see section 6.5.2) and we presented a method to estimate the e2e delay for a multi-hop scenario (section 6.5.2)

8.2.2. ANR Doctor

Participants: Thomas Silverston [contact], Thibault Cholez [contact], Elian Aubry, Jérôme François, Abdelkader Lahmadi, Olivier Festor.

The DOCTOR project is an applied research project funded by the French National Research Agency (ANR), grant <ANR-14-CE28-000>, and supported by the french Systematic cluster. The project officially started on October 2014 with a effective beginning of the scientific work on December 2014. It involves five partners specialized in network architectures, network monitoring and network security: three industrial partners (Orange Labs, Thales and Montimage) and two academic partners (Université de technologie de Troyes, LORIA).

Information-Centric Networking (ICN), a novel promising networking paradigm that allows adapting networks to current content-centric usage patterns, raises many deployment issues. The DOCTOR project advocates the use of virtualized network equipment (Network Functions Virtualization), enabling the co-existence of such IP and ICN stacks and the progressive migration of traffic from one stack to the other while guaranteeing the good security and manageability of the network that are primary operator requirements that need to be assured before deploying new solutions. Therefore in DOCTOR, the main goals of the project are: (1) the efficient deployment of emerging networks functions or protocols in a virtualized networking environment; (2) the monitoring and security of virtually deployed networking architectures.

This year, we mainly prepared the kickoff meeting that took place the 10th of December in Orange Labs, Issy-les-Moulineaux. We also started a joint work with UTT to write a survey on Named-Data Networking with an emphasis on the deployment and security questions.

8.2.3. ANR LAR

Participants: Kévin Roussel, Ye-Qiong Song [contact].

LAR (Living Assistant Robot) is a national project getting together Inria (MAIA and MADYNES teams), Credit Agricole, Diatelic and Robotsoft. The aim is to develop an ambient assisted living system for elderly including both sensors and assistant robots. The task of our team is the development of a WSN based system integrating both sensors of the environment and sensors and actuators embedded on a mobile robot. The research issues include the QoS, energy and mobility management. This year we identified RIOT OS as our software platform for developing both protocols and IoT applications. We also evaluated and fixed three hardware platforms (Zolertia MSP430 Z1, AVR ATmega256RFR2 and Arduino DUE) for the development of the project. We have improved the robustness of the existing ports of RIOT OS on MSP430-based motes. Two MAC protocols (S-CoSenS and iQueue-MAC) have been implemented on RIOT-OS (see section 6.5.2).

8.2.4. PEPS Humain - CNRS Project TrustSourcing

Participants: Thomas Silverston [contact], Vassili Rivron, Isabelle Chrisment.

Crowdsourcing relies on the participation of users collecting information in order to perform complex tasks. The participating users and the collected data should be of high quality for offering a trustable service to all the users. In the Trustsourcing project, we propose to design a Trust mechanism adapted to the crowdsourcing paradigm. Based on the current work initiated by the Metroscope/PRACTIC initiative, whose main goal is to study the usage of smartphone by measuring users' activity, we will propose to classify smartphone users and deduce some categories of trustable users. According to their "fingerprint" usage of their smartphone (time spent with phone, number of applications, messages etc.), we could estimate if an user will more probably belong to a category of trustable users or not. Our predictive mechanism will rely on the measurement of realistic users' activity and could help limiting drastically the impact of malicious users and the deterioration of the crowdsourcing service.

8.2.5. Action de Développement Technologique

8.2.5.1. ADT Métroscope

This ADT is linked to the consortium Metroscope [0], whose goal is to understand the behavior of the Internet and its uses within a mobile environment. Through this ADT, funded by Inria, an engineer (Mohammad-Irfan Khan) was hired for 2 years (2013-2015). He is participating in the design and deployment of a distributed platform. This platform is composed of a services providing measurement tools that collect a set of data and interact with probes located at various points of the network.

8.2.5.2. ADT SEA

The goal of this ADT is to provide an novel security solution for Android platforms where the users will be able to evaluate the security level of their devices. The solution relies on the analysis and collection of logs and network activities of running Android applications to detect malicious activities and also the detection of vulnerable configurations of the device using an OVAL-based approach. Through, this ADT, funded by Inria, an engineer (Eric Finickel) was hired for 2 years (2013-2015). He is working on the development of Android devices embedded probes to export logs and network activities. He will also design and setup the collector and the analysis applications using a Hadoop based framework. It is currently deployed in the High Security Lab.

8.2.5.3. ADT R2D2

The goal of this ADT is to provide assistance in developing the Aetournos platform. Through this ADT, funded by Inria, an engineer (Ceilidh Hoffmann) was hired for the year (2014). She has been helping maintaining the Aetournos platform, coordinating students work on the platform and tutoring the Aetournos team for the Outback Joe Search and Rescue Challenge. She is also developing tools for UAV localization using visual cues.

[0] http://metroscope.eu/

8.2.6. Inria Project Lab PAL

The Inria Large-scale initiative action IPL PAL project (http://pal.inria.fr) aims at providing technologies and services for improving the autonomy and quality of life for elderly and fragile persons. Communication is one of the key components for ensuring real-time data gathering and exchange between heterogeneous sensors and actuators (robots). Within PAL project and using LORIA's smart apartment platform (http://infositu.loria.fr), we extended MPIGate (http://mpigate.loria.fr) functionalities by adding EnOcean sensors and defining a unified data format in JSON to ease the exchange with other data servers. The adoption of ROS (Robotic Operating System) as middleware also facilitates the interoperability of our services with the services of the other PAL partners since the new PALGate is based on ROS.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. FI-WARE

Type: COOPERATION Future Internet Core Platform

Instrument: Integrated Project

Objective/Topic: PPP FI - Technology Foundation: Future Internet Core Platform

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Partners: Thales, SAP, Inria

Inria contact: Olivier Festor

See also: http://www.fi-ware.eu

Abstract: FI-WARE will deliver a novel service infrastructure, building upon elements (called Generic Enablers) which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability and production costs linked to Internet Applications, building a true foundation for the Future Internet.

The goal of the FI-WARE project is to advance the global competitiveness of the EU economy by introducing an innovative infrastructure for cost-effective creation and delivery of services, providing high QoS and security guarantees. The key deliverables of FI-WARE will be an open architecture and a reference implementation of a novel service infrastructure, building upon generic and reusable building blocks developed earlier.

The MADYNES contributions to the FI-WARE project are:

- Sicslowfuzzer, a fuzzing framework for the Internet of Things, that allows to assess the robustness of IoT OSes and applications, networkwise.
- Flowoid, a netflow probe for Android-based devices, which also provides a netflow location template to convey location information of the device;
- XOvaldi4Android, an OVAL interpreter for Android-based devices, that is able to retrieve OVAL definitions using a web service, use them to check the current status of the system, and publish a result, using a second web service;
- the coordination between the Security Work Package and the Inria teams involved in it. This includes the attending to weekly audio conferences, face to face meetings, and making sure deliverables and tasks were addressed in a timely manner.

During 2014, all the contributions of the Madynes team including the developed tools and their respective documentation have been delivered and validated by the Work Package leader.

8.3.1.2. Flamingo

Type: FP7

Instrument: Network of Excellence

Objective/Topic: Management of the Future Internet

Duration: November 2012 - October 2016

Coordinator: University of Twente (Netherlands)

Partners: University of Twente, Inria, University of Zurich, Jacobs University of Bremen, University des Bundeswehr Munich, Polytechnic University of Catalonia, Interdisciplinary Institute for Broadband Technology, University of Ghent, University College London

Inria contact: Olivier Festor

See also: http://www.fp7-flamingo.eu

Abstract: The FP7 FLAMINGO Network of Excellence is composed of 8 partner universities, with complementary knowledge and strong ties to industry. It covers the entire spectrum of network management core functions and application domains, which are required for building, integrating, and disseminating the knowledge of the management plane for the Future Internet.

The objectives of FLAMINGO are (a) to strongly integrate the research of leading European research groups in the area of network and service management, (b) to strengthen the European and worldwide research in this area, and (c) to bridge the gap between scientific research and industrial application. To achieve these goals, FLAMINGO performs a broad range of activities, such as to develop open source software, establish joint labs, exchange researchers, jointly supervise Ph.D. students, develop educational and training material, interact with academia and industry, organize event, and strongly contribute to (IETF and IRTF) standardization.

Our work on network and service monitoring has focused on security for mobile and low power networks. We have proposed a strategy for addressing DODAG-based attacks [25], jointly with Jacobs University of Bremen. We have also designed a distributed monitoring architecture in the context of advanced measurement infrastructures. These results are presented in section 6.3.5 . In addition, we have continued efforts with University of Twente on extending IP flow-based network monitoring with location information. These ones have been centered on additional use cases, applicability of associating IP Flows with metering processes location, and implementation guidelines from both metering process and collector sides.

We have also pursued activities on automated configuration and repair, with a particular focus on safe configuration and service orchestration issues, which are covered in section 6.3.1 .

8.4. International Initiatives

8.4.1. Inria International Labs

- LIRIMA (Laboratoire international de recherche en informatique et mathématiques appliquées): MADYNES is associated with the MASECNESS research team of the Yaoundé University in Cameroun. The collaboration is about wireless sensors networks and was the support for funding student mobility (3 months this year). The LIRIMA has also supported the purchase of thirty sensors used in our common work.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

- JFLI (CNRS UMI 3527) in Tokyo: Thomas Silverston is currently in this lab (délégation) in Tokyo. The main goal of his research work is to anticipate the evolution of the Internet and to focus on the design of new architectures for the Future Internet. His research program at the JFLI (CNRS, UMI 3527) focus on the use of SDN to allow deploying new network architecture and functionalities in virtualized environment (e.g., ICN) as well as providing a management plane to help network operators monitoring novel network architecture for the Future Internet.

- University of Luxembourg: we have several active cooperations with the university of Luxembourg around network security, Information Centric Networking and Software Defined Networking. Especially, we have one ongoing Ph.D. candidate (Samuel Marchal) and Jérôme François is a Fellow at SnT (Interdisciplinary Center for Security, Reliability and Trust) to empower these collaborations. Besides S. Marchal, we are working particularly with Radu State, Thomas Engel and Salvatore Signorello.

8.4.2.2. Informal International Partners

- University of Twente, The Netherlands, joint work with Professor Aiko Pras on large scale network monitoring and attack detection
- Jacobs University Bremen, joint PhD. with Professor Schoenwaelder on security management in wireless sensor networks
- Federal University of Rio Grande do Sul (UFRGS), joint work with Professor Granville on autonomic management systems
- University of the Federal Armed Forces, Munich Germany, joint work with Professor Gabi Dreo on cloud and mobile cloud security management
- Politecnico di Milano, Italy, joint work with Professor Antonio Capone and Giuliana Carello on energy-aware network management and cloud infrastructures
- Polytecnique de Montrèal, Canada, joint work with Professor Brunilde Sansò on energy-aware network management
- IASI-CNR (National Italian Center of Research), Italy, joint work with Sara Mattia on optimization methods for energy-aware survivable networks
- Zhejiang University (China), joint ANR-NSFC Quasimodo project with professors Youxian Sun, Jiming Chen and Zhi Wang on the adaptive QoS in WSN and multi-target tracking.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

Pedro Paulo Martins Dos Santos

Subject: Flow-based malware signatures

Date: from Jun 2014 to Aug 2014

Institution: Universidade de Brasília, Brazil

8.5.1.2. Scientific visits

Participant: Raouf Boutaba.

Visiting Professor

Network and cloud managements

Date: from Jul to Aug 2014

University of Waterloo, Canada

Participant: Lamia Fourati-Chaari.

Visiting Assistant Professor

Content Centric Networks

Date: from mid-June to end June 2014

Institut d'Informatique et de Multimédia de Sfax (Tunisie)

Participant: Celia Ouanteur.

Visiting PhD student

Markov modeling of Low Latency Deterministic Networks (LLDN) of IEEE802.15.4e

Date: from May to June 2014

University A/Mira of Bejaia, Algeria

Participant: Xiufang Shi.

Visiting PhD student

ANR-NSFC Quasimodo joint project: multi-target location algorithm design

Date: from March to June 2014

Zhejiang University, China

Participant: Shuguo Zhuo.

Visiting PhD student

ANR-NSFC Quasimodo joint project: implementation of iQueue-MAC protocol on RIOT OS

Date: from May to August 2014

Zhejiang University, China

MAESTRO Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Marmote

Participants: Alain Jean-Marie, Issam Rabhi.

ANR Program: Modèles Numériques (MN) 2012, number ANR-12-MONU-0019

Project title: MARkovian MOdeling Tools and Environments

Duration: January 2013 - December 2016

Coordinator: Alain Jean Marie (Inria)

Partners: Inria (project-teams DYOGENE, MAESTRO and MESCAL), Univ. Versailles-Saint-Quentin (PRiSM lab.), Telecom SudParis (SAMOVAR lab.), Univ. Paris-Est Créteil (LACL), and Univ. Pierre-et-Marie-Curie (LIP6)

Abstract: ANRMARMOTE aims at realizing the prototype of a software environment dedicated to modeling with Markov chains. It brings together seven partner teams, expert in Markovian analysis, who will develop advanced solution algorithms and applications in different scientific domains: reliability, distributed systems, biology, physics and economics.

https://wiki.inria.fr/MARMOTE/Welcome

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. CONGAS

Participants: Eitan Altman, Konstantin Avrachenkov, Ilaria Brunetti, Yonathan Portilla, Alexandre Reiffers, Vikas Singh.

Project title: Dynamics and coevolution in multi level strategic interaction games

Type: FP7

Challenge: Future and Emerging Technologies

Instrument: Specific Targeted Research Project

Objective: FET Proactive: Dynamics of Multi-Level Complex Systems (DyM-CS)

Duration: October 2012 - September 2015

Coordinator: Francesco De Pellegrini (CREATE-NET)

Scientific Coordinator: Eitan Altman (Inria)

Other partners: Center for Research and Telecommunication Experimentation for Network Communities (Italy), Univ. d'Avignon et des Pays de Vaucluse (France), Technische Univ. Delft (The Netherlands), Imperial College of Science, Technology and Medicine (United Kingdom), Univ. di Pisa (Italy) and Technion - Israel Institute of Techonology (Israel)

Inria contact: Konstantin Avrachenkov

Abstract: CONGAS will develop new mathematical models and tools, rooted in game theory, for the analysis, prediction and control of dynamical processes in complex systems. It will provide a coherent theoretical framework for understanding the emergence of structure and patterns in these systems, accounting for interactions spanning various scales in time and space, and acting at different structural and aggregation levels.

MAESTRO's task is to develop game theoretic models to model (a) the formation of technological and social network; (b) the routing for competing agents; and (c) the competition of information in social networks.

http://www.congas-project.eu/

8.2.2. Collaborations in European Programs, except FP7 & H2020

Program: COST
Project acronym: ACROSS
Project title: Autonomous Control for a Reliable Internet of Services
Duration: November 2013 - November 2017
Coordinator: Rob Van Der Mei (CWI) and J.L. Van Den Berg (TNO), The Netherlands
Abstract: Currently, we are witnessing a paradigm shift from the traditional information-oriented Internet into an Internet of Services (IoS). This transition opens up virtually unbounded possibilities for creating and deploying new services. Eventually, the ICT landscape will migrate into a global system where new services are essentially large-scale service chains, combining and integrating the functionality of (possibly huge) numbers of other services offered by third parties, including cloud services. At the same time, as our modern society is becoming more and more dependent on ICT, these developments raise the need for effective means to ensure quality and reliability of the services running in such a complex environment. Motivated by this, the aim of this Action is to create a European network of experts, from both academia and industry, aiming at the development of autonomous control methods and algorithms for a reliable and quality-aware IoS.
Keywords: Service oriented internet, cloud services, autonomous control, reliability, pricing.
Website: http://www.cost-across.nl/

8.2.3. Collaborations with Major European Organizations

European Space Operations Centre: European Space Agency, Darmstadt (Germany)
Application of a BitTorrent-like data distribution model to mission operations. In the framework of this project with ESA we cooperate with Thales-Alenia Space (France) and with Teletel S.A. (Greece).

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. THANES

Participants: Eitan Altman, Konstantin Avrachenkov, Jithin Kazhuthuveettil Sreedharan, Philippe Nain, Giovanni Neglia, Alexandre Reiffers.

Title: THeory and Application of NEtwork Science
Inria principal investigator: Giovanni Neglia
International Partner (Institution - Laboratory - Researcher):

Univ. Federal do Rio de Janeiro (Brazil) - Department of Computer and Systems Engineering - Daniel Ratton Figueiredo

Duration: 2014 - 2016
See also: https://team.inria.fr/thanes/
Our goal is to study how services in Online Social Networks (OSN) can be efficiently designed and managed. This research requires to answer 3 main questions: 1) How can the topology of an OSN be discovered? Many services need or can take advantage of some knowledge of the network structure that is usually not globally available and in any case changes continuously due to structural dynamics. 2) How does services adoption spread across the OSN? On the one hand the popularity of a service is determined by word-of-mouth through the links of the OSN and, on the other end, the service may contribute to reshape the structure of the OSN (e.g. by creating new connections). 3) How do different services compete for the finite attention and money of OSN users? In particular our purpose is to provide analytical models (corroborated by simulations and experiments on real networks) to understand such complex interactions.

8.3.1.2. GANESH

Participants: Eitan Altman, Konstantin Avrachenkov.

Title: GAmes, OptimizatioN and Analysis of NEtworkS THeory and Applications

Inria principal investigator: Eitan Altman

International Partners (Institution - Laboratory - Researcher):

IISc Bangalore (India) - Electrical Communication Engineering - Anurag Kumar

IIT Mumbai (India) - Department of Electrical Engineering - Vivek Borkar

IIT Madras (India) - Electrical Engineering - Venkatesh Ramaiyan

Duration: 2012 - 2014

See also: http://www-sop.inria.fr/members/Eitan.Altman/Ganesh/Home.html

This project aims at producing outstanding contributions to the foundations of the theory of networks, in game theory, team theory, optimization and analysis. Three areas in networking will be used to apply these: (i) economy of networks and network neutrality, (2) scheduling in wireless networks, and (3) distributed optimization issues in ad-hoc networks.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

MAESTRO has continued collaborations with researchers from GERAD, Univ. Montreal (Canada), Flinders Univ. (Australia), National Univ. of Rosario (Argentina), Technion - Israel Institute of Technology (Israel), Univ. of Arizona (USA), Univ. of Illinois at Urbana-Champaign (USA), Univ. of Liverpool (UK), Univ. of Massachusetts at Amherst (USA), Univ. of Palermo (Italy), and Univ. of Twente (The Netherlands); Petrozavodsk State Univ. (Russia); Ghent Univ. (Belgium); see Sections 8.4.1.1 and 8.4.2 .

8.3.3. Participation In other International Programs

E. Altman, I. Brunetti, M. Haddad, G. Neglia, A. Reiffers and J. K. Sreedharan participated in the CEFIPRA workshop on “New Avenues for Network Models” (13-15 January 2014) and the IFCAM workshop on Social Networks (16 January 2014). CEFIPRA and IFCAM organized these workshops to celebrate 6 years of successful collaboration between Inria and Indian institutions. The travel and accommodation expenses were supported by CEFIPRA and IFCAM.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Professors / Researchers

Vivek Borkar

Date: 17 November 2014 - 6 December 2014

Institution: IIT Bombay (India)

Pavel Chebotarev

Date: 19-26 September 2014

Institution: RAS Institute of Control Problems (Russia)

Mohamed Shaheen ElGamel

Date: 7-10 October 2014

Institution: AAST Alexandria (Egypt)

Fabio Fagnani

Date: 28-31 January 2014

Institution: Politecnico di Torino (Italy)

Daniel Figueiredo

Date: 20-29 November 2014

Institution: Univ. Federal do Rio de Janeiro (Brasil)

Anurag Kumar

Date: 27 May 2014 - 4 June 2014

Institution: IISc Bangalore (India)

Joy Kuri

Date: 18-24 May 2014

Institution: IISc Bangalore (India)

Evsey Morozov

Date: 20-24 October 2014

Institution: Petrozavodsk State Univ. (Russia)

Alexey Piunovskiy

Date: 19-24 May 2014

Institution: Univ. of Liverpool (UK)

Shanmugasundaram Ravikumar

Date: 25-30 April 2014

Institution: Google (USA)

Bruno Ribeiro

Date: 6-15 July 2014, 24-28 November 2014

Institution: Carneggie Mellon Univ. (USA)

Rajesh Sundaresan

Date: 17 November 2014 - 6 December 2014

Institution: IISc Bangalore (India)

Don Towsley

Date: 18-21 February 2014

Institution: Univ. of Massachusetts, Amherst (USA)

Sulan Wong

Date: 9 December 2013 - 15 January 2014

Institution: Univ. of A Coruña (Spain)

Uri Yechiali

Date: 21 April 2014 - 4 May 2014

Institution: Tel Aviv Univ. (Israel)

Yi Zhang

Date: 19-24 May 2014

Institution: Univ. of Liverpool (UK)

8.4.1.2. Ph.D. students

Giuseppe Di Bella

Date: 1 May 2014 - 30 September 2014

Institution: Univ. of Palermo (Italy)

Arnob Ghosh

Date: 1 June 2014 - 31 August 2014

Institution: Univ. of Pennsylvania (USA)

Cristina Rottondi

Date: 1 April 2014 - 30 May 2014

Institution: Politecnico di Milano (Italy)

8.4.1.3. Internships

Aditya Aradhye

Date: 9 June 2014 - 11 July 2014

Institution: Madras Univ. (India)

Dalel Khalladi

Date: 1 March 2014 - 31 August 2014

Institution: Univ. Avignon (France)

Najmeddine Majed

Date: 1 May 2014 - 31 october 2014

Institution: SupCom Tunis (Tunisia)

Nedko Nedkov

Date: 1 April 2014 - 31 July 2014

Institution: National and Kapodistrian Univ. of Athens (Greece)

Shanay Shah

Date: 15 May 2014 - 14 July 2014

Institution: IIT Bombay (India)

Anastasiia Varava

Date: 1 March 2014 - 31 August 2014

Institution: Univ. of Nice Sophia Antipolis (France)

8.4.2. Visits to International Teams

8.4.2.1. Research stays abroad

MAESTRO members have visited (the)

- Create-Net, Italy in the period 14-19 April 2014 (**A. Reiffers**);
- Eurandom, The Netherlands in the period 20-24 January 2014 (**K. Avrachenkov**);
- Federal Univ. Of Rio de Janeiro, Brazil in the periods 30 July - 5 August 2014 (**E. Altman**) and 21-31 August 2014 (**G. Neglia** and **A. Reiffers**);
- Ghent Univ., Belgium in the period 15-16 December 2014 (**K. Avrachenkov**);
- Indian Institute of Science and Indian Institute of Technology (Mumbai), India in the period 11-23 January 2014 (**E. Altman**);
- National Univ. of Rosario, Argentina in the period 29 November - 16 December 2014 (**A. Jean-Marie**);
- Technion - Israel Institute of Technology, Tel Aviv, Israel in the periods 2-16 February 2014, 19 April - 3 May 2014 and 15-24 October 2014 (**E. Altman**) and 20 October - 17 December 2014 (**A. Reiffers**);
- Univ. of Bamberg, Germany in the period 19-21 March 2014 (**K. Avrachenkov**);
- Univ. of Delft, The Netherlands in the period 12-14 October 2014 (**E. Altman**);
- Univ. of Florence, Italy in the periods 14-18 July 2014 and 10-13 November 2014 (**G. Neglia**);
- Univ. of Illinois at Urbana-Champaign, USA in the period 1 October 2013 - 31 January 2014 (**M. El Chamie**);
- Univ. of Liverpool, UK in the period 30 March - 3 April 2014 (**K. Avrachenkov**);
- Univ. of Massachusetts at Amherst, USA in the periods 15 April – 16 May 2014 (**P. Nain**);
- Univ. of Waterloo, Canada in the period 16-19 July 2014 (**E. Altman**).

MAGIQUE-3D Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The PhD fellowship of Vanessa Mattesi is partially (50%) funded by the Conseil Régional d'Aquitaine.

The Post-Doctoral fellowship of Ángel Rodríguez Rozas is partially (50%) funded by the Conseil Régional d'Aquitaine.

8.2. National Initiatives

8.2.1. Depth Imaging Partnership

Magique-3D maintains active collaborations with Total. In the context of Depth Imaging, Magique-3D coordinates research activities dealing with the development of high-performance numerical methods for solving wave equations in complex media. This project involves 2 other Inria Team-Projects (Hiepacs and Nachos) which have complementary skills in mathematics, computing and in geophysics. DIP is fully funded by Total by the way of an outline agreement wit Inria .

Since its beginning (2009), eight PhD students have been funded and Magique 3D has hired six of them, one being shared with the project team Nachos (http://www-sop.inria.fr/nachos/). Moreover, several internships have been realized. In 2014 the second phase of DIP has begun. Lionel Boillot has been hired as engineer to work on the DIP platform.

8.2.2. Micro-local analysis of wave equations

The numerical solution of wave equations most often requires to truncate the propagation domain to define a computational domain limited by an artificial boundary. Magique-3D is very involved in the construction and mathematical validation of boundary conditions which are set on the artificial boundary. Different techniques can be used for the design of such conditions and Magique-3D maintains a collaboration with Prof. Olivier Lafitte from the University of Paris 13 on the mathematical analysis of the Dirichlet-to-Neumann (DtN) operator for acoustic waves. This issue is addressed by applying micro-local analysis which enables us to consider the full DtN operator in the whole space of frequencies.

8.2.3. Partnership with the department DMAE of ONERA

title: Modeling of multiperforated plates

Coordinator: Sébastien Tordeux

Other partners: Department DMAE of ONERA

Abstract: In the aeronautic industry, there is a need of numerical models for the design of turboreactors of new generation. Magique-3D is cooperating with the department DMAE of ONERA to develop acoustic models of multiperforated plates which is an important component of the turboreactors.

This project is interdisciplinary, since it involves the experimental expertise of Estelle Piot (acoustician engineer of ONERA working on acoustic bench), the competences in mathematical modeling of Magique 3D. In parallel to the obtention of new theoretical results we are jointly developing a new numerical library based on the discontinuous Galerkin approximation which aims in interpreting experimental data.

This cooperation is formalized thanks to the common supervision of the PhD of Vincent Popie funded by ONERA and DGA and is a follow-up of the ANR APAM (2008-2011).

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. HPC-GA

Title: High Performance Computing for Geophysics Applications

Type: PEOPLE

Instrument: International Research Staff Exchange Scheme (IRSES)

Duration: January 2012 - December 2014

Coordinator: Inria (France)

Others partners: BCAM (Basque Center of Applied Mathematics), Spain; BRGM (Bureau de Recherches Géologiques et Minières), France; ISTerre (Institut des Sciences de la Terre, France; UFRGS (Federal University of Rio Grande do Sul), Institute of Informatics, Brazil; UNAM (National Autonomous University of Mexico) , Institute of Geophysics, Mexico;

See also: https://project.inria.fr/HPC-GA/en

Abstract: Simulating large-scale geophysics phenomenon represents, more than ever, a major concern for our society. Recent seismic activity worldwide has shown how crucial it is to enhance our understanding of the impact of earthquakes. Numerical modeling of seismic 3D waves obviously requires highly specific research efforts in geophysics and applied mathematics, leveraging a mix of various schemes such as spectral elements, high-order finite differences or finite elements.

But designing and porting geophysics applications on top of nowadays supercomputers also requires a strong expertise in parallel programming and the use of appropriate runtime systems able to efficiently deal with heterogeneous architectures featuring many-core nodes typically equipped with GPU accelerators. The HPC-GA project aims at evaluating the functionalities provided by current runtime systems in order to point out their limitations. It also aims at designing new methods and mechanisms for an efficient scheduling of processes/threads and a clever data distribution on such platforms.

The HPC-GA project is unique in gathering an international, multidisciplinary consortium of leading European and South American researchers featuring complementary expertise to face the challenge of designing high performance geophysics simulations for parallel architectures: UFRGS, Inria, BCAM and UNAM. Results of this project will be validated using data collected from real sensor networks. Results will be widely disseminated through high-quality publications, workshops and summer-schools.

Two members of MAGIQUE-3D (Julien Diaz and Victor Péron) participated to the last Workshop of HPC-GA in Grenoble on October 2014.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. MAGIC

Program: Inria International Partner

Title: Advance Modelling in Geophysics

Inria principal investigator: Hélène Barucq

International Partner (Institution - Laboratory - Researcher):

California State University at Northridge (United States) - Department of Mathematics - Rabia Djellouli

The Associated Team MAGIC was created in January 2006 and renewed in January 2009. At the end of the program in December 2011, the two partners, MAGIQUE-3D and the California State University at Northridge (CSUN) decided to continue their collaboration and obtained the "Inria International Partner" label in 2013.

See also: https://project.inria.fr/magic/

The ultimate objective of this research collaboration is to develop efficient solution methodologies for solving inverse problems arising in various applications such as geophysical exploration, underwater acoustics, and electromagnetics. To this end, the research program will be based upon the following three pillars that are the key ingredients for successfully solving inverse obstacle problems: 1) The design of efficient methods for solving high-frequency wave problems. 2) The sensitivity analysis of the scattered field to the shape and parameters of heterogeneities/scatterers. 3) The construction of higher-order Absorbing Boundary Conditions.

In this framework, Rabia Djellouli visited Magique 3D in December 2014

8.4.2. Participation In other International Programs

8.4.2.1. HOSCAR

Program: Inria-CNPq

Title: High performance cOmputing and SCientific dAta management dRiven by highly demanding applications

Inria principal investigator: Stéphane Lanteri (Nachos, Inria Sophia Antipolis-Méditerranée

International Partners:

LNCC (Laboratório Nacional de Computaçäo Científica), Brazil;

COPPE/UFRJ (Instituto Alberto Luiz Coimbra de Pós-Graduaçäo e Pesquisa de Engenharia/Alberto Luiz Coimbra Institute for Graduate Studies and Research in Engineering, Universidade Federal do Rio de Janeiro), Brazil;

INF/UFRGS (Instituto de Informática, Universidade Federal do Rio Grande do Sul);

LIA/UFC (Laboratórios de Pesquisa em Ciência da Computaçäo Departamento de Computaçäo, Universidade Federal do Ceará).

Inria Teams :

NACHOS, Inria Sophia Antipolis - Méditerranée;

ZENITH, Inria Sophia Antipolis - Méditerranée;

MOAIS, Inria Grenoble - Rhone-Alpes;

HIEPACS, Inria Bordeaux - Sud-Ouest;

MOAIS, Inria Bordeaux - Sud-Ouest;

MAGIQUE 3D, Inria Bordeaux - Sud-Ouest;

Duration: 2012-2015

See also: http://www-sop.inria.fr/hoscar/

HOSCAR is a CNPq - Inria collaborative project between Brazilian and French researchers, in the field of computational sciences, also sponsored by the French Embassy in Brazil. It is coordinated by the team-project Nachos

The general objective of the project is to setup a multidisciplinary Brazil-France collaborative effort for taking full benefits of future high-performance massively parallel architectures. The targets are the very large-scale datasets and numerical simulations relevant to a selected set of applications in natural sciences: (i) resource prospection, (ii) reservoir simulation, (iii) ecological modeling, (iv) astronomy data management, and (v) simulation data management. The project involves computer scientists and numerical mathematicians divided in 3 fundamental research groups: (i) numerical schemes for PDE models, (ii) scientific data management,

and (iii) high-performance software systems. Several Brazilian institutions are participating to the project among which: LNCC (Laboratório Nacional de Computação Científica), COPPE/UFRJ (Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia/Alberto Luiz Coimbra Institute for Graduate Studies and Research in Engineering, Universidade Federal do Rio de Janeiro), INF/UFRGS (Instituto de Informática, Universidade Federal do Rio Grande do Sul) and LIA/UFC (Laboratórios de Pesquisa em Ciência da Computação Departamento de Computação, Universidade Federal do Ceará). The French partners are research teams from several Inria research centers.

8.4.2.2. GEO3D

Program: Inria-Russia

Title: Models and numerical simulations in Geosciences: wave propagation in complex media

Inria principal investigator: Sébastien Tordeux

International Partner (Institution - Laboratory - Researcher):

Novosibirsk State University (Russia (Russian Federation)) - Institute of Numerical Mathematics and Mathematical Geophysics - Sébastien Tordeux

Duration: January 2012 - December 2014

See also: http://uppa-inria.univ-pau.fr/m3d/ConfFR/participants.html

GEO3D is a collaborative project between Magique 3D team-project (Inria Bordeaux Sud-Ouest) and the Institute of Numerical Mathematics and Mathematical Geophysics (Novosibirsk State University) and the Institute of Petroleum Geology and Geophysics, in the context of geosciences.

We are mainly interested in the derivation of numerical methods (discontinuous Galerkin approximation, space-time refinement), the design of direct and inverse high performance solver, and the modeling of complex media.

More precisely, we are actually interested in

1. the computation of truncated Singular Value decomposition of very large matrix to analyze the inverse problem;
2. the coupling of a discontinuous Galerkin method with a finite differences method for the direct problem;
3. a spectral time stepping method for the direct problem;
4. an algorithm to determine an impedance coefficient using indirect measurement.

An international workshop on “Computational Geophysics” gathering around 50 participants has been organized in Novosibirsk in the framework of GEO3D in September 2014

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Serguey Solovyev spent two months in MAGIQUE-3D in march 2014 and in December 2014.
- Mounir Tlemcani spent one month in MAGIQUE-3D in May 2014.
- Laurent Gizon
- Rabia Djellouli spent two weeks in MAGIQUE-3D in December 2014.

MAGNET Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

MARC TOMMASI and PASCAL DENIS supervise the PhD thesis of DAVID CHATEL on semi-supervised spectral clustering. The PhD is funded by Inria and the "Région Nord – Pas de Calais".

MARC TOMMASI belongs to the scientific committee involved in the process of building the IDEX proposal for Lille.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ANR Lampada (2009-2014)

Participants: Marc Tommasi [correspondent], Rémi Gilleron, Fabien Torre.

The Lampada project on “Learning Algorithms, Models and sPArse representations for structured DAta” is coordinated by Tommasi from Mostrare. Our partners are the SEQUEL project of Inria Lille Nord Europe, the LIF (Marseille), the HUBERT CURIEN laboratory (Saint-Etienne), and LIP6 (Paris). More information on the project can be found on http://lampada.gforge.inria.fr/.

8.2.2. Competitivity Clusters

We are part of FUI HERMES (2012-2015), a joint project in collaboration with many companies (Auchan, KeyneSoft, Cylande, ...). The main objective is to develop a platform for contextual customer relation management. The project started in November 2012.

8.2.3. EFL

PASCAL DENIS is an associate member of the Laboratoire d’Excellence *Empirical Foundations of Linguistics* (EFL), http://www.labex-efl.org/.

8.2.4. Conseil national des universités

FABIEN TORRE is elected for "CNU section 27 (informatique)" since Oct. 2011

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7 & H2020

Program: ERC Advanced Grant
Project acronym: STAC
Project title: Strategic conversation
Duration: Sept. 2011 - Aug. 2016
Coordinator: Nicholas Asher, CNRS, Université Paul Sabatier, IRIT (France)
Other partners: School of Informatics, Edinburgh University; Heriot Watt University, Edinburgh
Abstract: STAC is a five year interdisciplinary project that aims to develop a new, formal and robust model of conversation, drawing from ideas in linguistics, philosophy, computer science and economics. The project brings a state of the art, linguistic theory of discourse interpretation together with a sophisticated view of agent interaction and strategic decision making, taking advantage of work on game theory.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

We invited Prof. Claudio Gentile (University of Insubria, Italy) in January (he gave a talk on "Online Clustering of Bandits in a Social Network") and in June.

Prof. Nicolò Cesa-Bianchi (University of Milan, Italy) visited us in July (he gave a talk on "The Online Approach to Machine Learning").

Finally, we invited Prof. Mark Herbster (University College London) in July (he gave a talk on "Online Approximate Prediction at the Limit of Zero Temperature in an Ising Model") and November.

8.4.2. Visits to International Teams

In May FABIO VITALE visited the Department of Computer Science of the University of Milan, collaborating with Prof. Nicolò Cesa-Bianchi.

MAGNOME Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

MAGNOME works with the ISVV and local industry to develop analyses and tools for rationalizing wine starter strain selection using genomics.

8.2. National Initiatives

8.2.1. ANR MYKIMUN.

Signal Transduction Associated with Numerous Domains (STAND) proteins play a central role in vegetative incompatibility (VI) in fungi. STAND proteins act as molecular switches, changing from closed inactive conformation to open active conformation upon binding of the proper ligand. Mykimun, coordinated by Mathieu Paoletti of the IBGC (Bordeaux), studies the postulated involvement of STAND proteins in heterospecific non self recognition (innate immune response).

In MYKIMUN we extend the notion of fungal immune receptors and immune reaction beyond the *P. anserina* NWD gene family. We develop *in silico* machine learning tools to identify new potential PRRs based on the expected characteristics of such genes, in *P. anserina* and beyond in additional sequenced fungal genomes. This should contribute to extend concept of a fungal immune system to the whole fungal branch of the eukaryote phylogenetic tree.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

A major objective of the "post-genome" era is to detect, quantify and characterise all relevant human proteins in tissues and fluids in health and disease. This effort requires a comprehensive, characterised and standardised collection of specific ligand binding reagents, including antibodies, the most widely used such reagents, as well as novel protein scaffolds and nucleic acid aptamers. Currently there is no pan-European platform to coordinate systematic development, resource management and quality control for these important reagents.

MAGNOME is an associate partner of the FP7 "Affinity Proteome" project coordinated by Prof. Mike Taussig of the Babraham Institute and Cambridge University. Within the consortium, we participate in defining community for data representation and exchange, and evaluate knowledge engineering tools for affinity proteomics data.

8.3.2. Collaborations with Major European Organizations

Prof. Mike Taussig: Babraham Institute & Cambridge University
Knowledge engineering for Affinity Proteomics
Henning Hermjakob: European Bioinformatics Institute
Standards and databases for molecular interactions

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

MAGNOME collaborates with Rodrigo Assar Cuevas at the University of Chile, Santiago, Chile and Joaquín Fernandez at the University of Rosario, Rosario, Argentina on hierarchical hybrid modeling using quantized state systems.

MAGNOME collaborates with Nicolás Loira at the University of Chile on methods for inferring genome-scale metabolic models.

MAGRIT Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Collaboration with Nancy School of Surgery
We are working with Nancy School of Surgery on soft tissue dissection simulation. In an effort to generate a more realistic model of tissue dissection in laparoscopic surgery we started to investigate on a novel method based on a task analysis. Nancy School of Surgery experts have defined the key features of the simulator. Initially we have chosen to model the basic geometry of this task rather than a whole laparoscopic procedure. Preliminary work has led to the development of a real time simulator performing cutting with a haptic thread at 1000Hz on a simple 2D geometry using SOFA Framework [23].

8.2. National Initiatives

8.2.1. ANR

- ANR IDeaS (2012-2016)
  Participants: R. Anxionnat, M.-O. Berger, E. Kerrien.
  The IDeaS Young Researcher ANR grant explores the potential of Image Driven Simulation (IDS) applied to interventional neuroradiology. IDS recognizes the current, and maybe essential, incapacity of interactive simulations to exactly superimpose onto actual data. Reasons are various: physical models are often inherently approximations of reality, simplifications must be made to reach interactive rates of computation, (bio-)mechanical parameters of the organs and surgical devices cannot but be known with uncertainty, data are noisy. This project investigates filtering techniques to fuse simulated and real data. MAGRIT team is in particular responsible for image processing and filtering techniques development, as well as validation.

8.2.2. Project funded by GDR ISIS in collaboration with Institut Pascal, Université de Clermont-Ferrand

- Participant: F. Sur.
  Since June 2012, we have been engaged in a collaboration with Pr. Michel Grédiac. The aim is to give a mathematical analysis and to help improving the image processing tools used in experimental mechanics at Institut Pascal.

  The TIMEX project (2014-2016) is funded by GDR ISIS ("Appel à projet exploratoire, projet interdisciplinaire"). It aims at investigating image processing tools for enhancing the metrological performances of contactless measurement systems in experimental mechanics.

8.2.3. Collaboration with the SHACRA team and AEN SOFA

Participants: R. Anxionnat, M.-O. Berger, E. Kerrien, A. Yureidini.
The SOFA-InterMedS large-scale Inria initiative is a research-oriented collaboration across several Inria project-teams, international research groups and clinical partners. Its main objective is to leverage specific competences available in each team to further develop the multidisciplinary field of Medical Simulation research. Our action within the initiative takes place in close collaboration with both SHACRA Inria project-team in Lille and the Department of diagnostic and therapeutic interventional neuroradiology of Nancy University Hospital. We aim at providing in-vivo models of the patient's organs, and in particular a precise geometric model of the arterial wall. Such a model is used by SHACRA team to simulate the coil deployment within an intracranial aneurysm. The associated medical team in Nancy, and in particular our external collaborator René Anxionnat, is in charge of validating our results. For three years, we have also been collaborating with the SHACRA team about real time augmentation of deformable organs

8.2.4. Collaboration with the Parole team

Participants: M.-O. Berger, P. -F. Villard, B. Wrobel-Dautcourt
Our collaboration with the local Inria team Parole is about the augmented head. This project aims at building a realistic head augmented by external and internal articulators with foreseen applications to language learning technologies [18].

8.3. International Research Visitors

8.3.1. Visits to International Teams

8.3.1.1. Research stays abroad

Pierre-Frédéric Villard started a one year full time CNRS delegation in September 2014 in the Harvard Biorobotics Laboratory.

MAIA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. AME Satelor SATELOR

Participants: François Charpillet, Maxime Rio, Nicolas Beaufort, Xuan Nguyen, Thomas Moinel, Mélanie Lelaure, Theo Biasutto-Lervat.

Economic mobilisation agency in Lorraine has launched a new project SATELOR providing it with 2.5 million Euros of funding over 3 years, out of an estimated total of 4.7 million. The leader of the project is Pharmagest-Diatelic. PHARMAGEST is the French leader in computer systems for pharmacies, with a 43.5 % share of the market, 9,800 clients and more than 700 employees. Pharmagest is in Nancy. Recently, PHARMAGEST Group expanded its activities into e-health and the development of telemedicine applications. The SATELOR project will accompany the partners of the project in developing new services for maintaining safely elderly people with loss of autonomy at home or people with a chronic illness. Maia team will play an important role for bringing some research results such as :

- developing a low cost environmental sensor for monitoring the daily activities of elderly people at home
- developing a low cost sensor for fall detection
- developing a low cost companion robot able to interact with people and monitoring their activities while detecting emergency situations.
- developing a general toolbox for data-fusion : bayesian approach.

8.1.2. CNRS / Université de Lorraine PEPS project "MAJESTIC" (2014)

Participants: Vincent Thomas, Amine Boumaza, Olivier Buffet, Alain Dutech.

Sylvain Castagnos (KIWI team, LORIA/UL), and several members of the Centre de recherche sur les médiations (CREM) of Université de Lorraine —in particular Sébastien Genvo— are external members.

This multidisciplinary project —which involves humanities, social sciences, computer science, and cognitive sciences— proposes to evaluate the playful elements of "expressive" games, which involve and express complex social or individual issues. It aims at elaborating and testing —through qualitative usage analyses— a set of hypotheses allowing to study the factors contributing to reinforce, on the one side, the commitment of the user in these often atypical products and, on the other side, the player's knowledge-building.

This project led to the organisation of an international seminar "expressive game" and to the creation of two platforms for qualitative usage analysis: one in tcrm-Blida (Metz), and one in Artem (Nancy).

8.1.3. Université de Lorraine MSH project "PSYPHINE"

Participants: Amine Boumaza, Alain Dutech.

This multidisciplinary project – which involves philosophy, sociology, psychology and computer sciences – aims at exploring the concept of consciousness in an artificial being. Our main objective is to devise a new non-verbal "Turing test" in order to think about various cognitive levels that are less linked to the capacity of using a language.

8.2. National Initiatives

8.2.1. Inria IPL PAL Personally Assisted Living

Participants: François Charpillet, Olivier Simonin, Mihai Andries.

The PAL project is a national Inria Large Scale Initiative involving several teams of the institute (Arobas, Coprin, E-motion, Lagadic, Demar, Maia, Prima, Pulsar and Trio). It is coordinated by David Daney (Inria Sophia-Antipolis, EPI Coprin). The project focuses on the study and experiment of models for health and well-being. Maia is particularly involved in the People Surveillance work package, by studying and developping intelligent environments and distributed tracking devices for people walking analysis and robotic assistance (smart tiles, 3D camera network, assistant robots).

The PhD of Mihai Andries in funded by the PAL project.

8.2.2. PIA LAR Living Assistant Robot

Participants: François Charpillet, Abdallah Dib.

Partners : Crédit Agricole, Diatelic, Robosoft
LAR project has the objective to designing an assistant robot to improve the autonomy and quality of life for elderly and fragile persons. The project started at the beginning of the year. The role of the Maia Team is to develop a simultaneous localisation and mapping algorithm using a RGB-D camera. The main issue is to develop an algorithm able to deal with dynamic environment. An other issue is for the robot to be able to behave with acceptable social skills.

8.2.3. ANR

8.2.3.1. ANR PHEROTAXIS

Participants: François Charpillet, Olivier Simonin.

Dominique Martinez (Cortex team, Inria NGE) is an external collaborator and the coordinator of the project for Nancy members.

PHEROTAXIS is an “Investissements d’Avenir” ANR 2011-2014 (Coordination: J.-P. Rospars, UMR PISC, INRA Versailles).

The theme of the research is localisation of odour sources by insects and robots. By associating experimental data with models, the project aims at defining a behavioral model of olfactive processes. This work provides several applications, in particular the development of bio-inspired components highly sensitive and selective.

The project is organized in five work packages and involves the PISC research unit (Versailles), Pasteur Institute (Paris) and LORIA/Inria institute (Nancy).

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. CoDyCo

Serena Ivaldi, arrived in November 2014, participates to the European Project CODYCO since its beginning. Her participation to the project has been formalized by including Inria as a new partner of the consortium.

Type: FP7

Defi: NC

Instrument: STREP

Objectif: Cognitive Systems and Robotics (b)

Duration: Marc 2013 - February 2017 (4 years)

Coordinator: Francesco Nori (Italian Institute of Technology)

Partners: TU Darmstadt (Germany), Université Pierre et Marie Curie (France), Josef Stefan Institue (Slovenia), University of Birmingham (UK)

Inria contact: Serena Ivaldi

Abstract: The aim of CoDyCo is to advance the current control and cognitive understanding about robust, goal-directed whole-body motion interaction with multiple contacts. CoDyCo will go beyond traditional approaches: (1) proposing methodologies for performing coordinated interaction tasks with complex systems; (2) combining planning and compliance to deal with predictable and unpredictable events and contacts; (3) validating theoretical advances in real-world interaction scenarios. First, CoDyCo will advance the state-of-the-art in the way robots coordinate physical interaction and physical mobility. Traditional industrial applications involve robots with limited mobility. Consequently, interaction (e.g. manipulation) was treated separately from whole-body posture (e.g. balancing), assuming the robot firmly connected to the ground. Foreseen applications involve robots with augmented autonomy and physical mobility. Within this novel context, physical interaction influences stability and balance. To allow robots to surpass barriers between interaction and posture control, CoDyCo will be grounded in principles governing whole-body coordination with contact dynamics. Second, CoDyCo will go beyond traditional approaches in dealing with all perceptual and motor aspects of physical interaction, unpredictability included. Recent developments in compliant actuation and touch sensing allow safe and robust physical interaction from unexpected contact including humans. The next advancement for cognitive robots, however, is the ability not only to cope with unpredictable contact, but also to exploit predictable contact in ways that will assist in goal achievement. Third, the achievement of the project objectives will be validated in real-world scenarios with the iCub humanoid robot engaged in whole-body goal-directed tasks. The evaluations will show the iCub exploiting rigid supportive contacts, learning to compensate for compliant contacts, and utilizing assistive physical interaction.

8.3.2. Collaborations in European Programs, except FP7 & H2020

8.3.2.1. PHC MUROTEX

This project is with Olivier Simonin from Insa Lyon, Citi lab and Jan Faigl from Czech Technical University in Prague.

Program: Hubert Curien Partnerships

Project acronym: MUROTEX

Project title: Multi-agent coordination in robotics exploration and reconnaissance missions

Duration: 2 years from 1st january 2014

Coordinator: O. Simonin (INSA LYON)

Other partners: Czech Technical University in Prague

Abstract: The main objective of the project is to develop a distributed planning framework for efficient task-allocation planning in exploration and reconnaissance missions by a group of mobile robots operating in an unknown environment with considering communication constraints and uncertainty in localization of the individual team members. One main challenge is to decentralize the decision, in order to scaling up with large fleet of robots (existing solutions are centralized or depend on full communication).

8.4. International Initiatives

Serena Ivaldi and Francois Charpillet are part of the joint Inria-TUD team that was selected to participate to the KUKA Innovation Award. On December 2014, the team received a new industrial manipulator, KUKA iiwa, to prepare the challenge for the first quarter of 2015. The manipulator is lent by KUKA and will be returned at the end of the competition.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Dr. Samuel Nicol, postdoctoral researcher at CSIRO, Ecosystem Sciences division (Brisbane, Australia), visited MAIA for 2 weeks in June 2014.

MAMBA Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

DIGITEO Project (DIM LSC) ALMA

Project title: Mathematical Analysis of Acute Myeloid Leukemia (AML) and its treatments

September 2014 - August 2017

Coordinator: Catherine Bonnet, Disco team, Saclay-IdF

Other partners: Inria Paris-Rocquencourt (Mamba team), France, L2S, France, UPMC (LJLL), St Antoine Hospital, Paris

Abstract: this project follows the regional projects ALMA (2010-2014) and ALMA2 (2011-2013). Starting from the work of J. L. Avila Alonso's PhD thesis in ALMA the aim of this project is to provide a refined coupled model of healthy and cancer cell dynamics in AML whose (stability) analysis will enable evaluation of polychemiotherapies delivered in the case of AML which have a high level of Flt-3 duplication (Flt-3-ITD).

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ANR 2011-2014 Bimod.

It has been prolonged until 2015, time at which an international workshop in Paris on "Multi-scale and hybrid modelling in cell and cell population biology" is organised, with 25-30 speakers on invitations.

8.2.1.2. Submitted ANR 2015 call "Défi de tous les savoirs".

"Mathematical modelling of dynamics in interacting cell populations" (MMDICP) project submitted for 2015.

8.2.1.3. ANR Blanc 2014-2018 "Kibord".

This recently accepted project gather several members of the Mamba team together with the ENS Cachan and Université Paris-Dauphine on the mathematical study of PDE models with application to biology.

8.2.1.4. ANR 2014-2017 IFLOW.

Eric Vibert, Hopital Paul Brousse (coordinator). Partners: Inria REO, Hopital Toulouse, Dirk Drasdo. Objectives are simulation of liver perfusion after partial hepatectomy (PHx) with and without therapeutic manipulations to improve patients survival after PHx.

8.2.1.5. INSERM 2014 - 2016, INVADE.

Emmanuel Barillot, Institut Curie (coordinateur). Partners: Groups from Institut Curie, Dirk Drasdo. Objective is a model for a better understanding of breast cancer invasion.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. NOTOX

Type: COOPERATION

Instrument: Integrated Project

Duration: January 2011 - December 2015

Inria contact: Dirk Drasdo

NOTOX will develop and establish a spectrum of systems biological tools including experimental and computational methods for (i) organotypic human cell cultures suitable for long term toxicity testing and (ii) the identification and analysis of pathways of toxicological relevance. NOTOX will initially use available human HepaRG and primary liver cells as well as mouse small intestine cultures in 3D systems to generate own experimental data to develop and validate predictive mathematical and bioinformatic models characterizing long term toxicity responses. Cellular activities will be monitored continuously by comprehensive analysis of released metabolites, peptides and proteins and by estimation of metabolic fluxes using 13C labelling techniques (fluxomics). At selected time points a part of the cells will be removed for in-depth structural (3D-optical and electron microscopy tomography), transcriptomic, epigenomic, metabolomic, proteomic and fluxomic characterisations ("-omics data"). When applicable, cells derived from human stem cells (hESC or iPS) and available human organ simulating systems or even a multi-organ platform developed in SCREENTOX and HEMIBIO will be investigated using developed methods. Together with curated literature and genomic data these toxicological data will be organised in a toxicological database (cooperation with DETECTIVE, COSMOS and TOXBANK). Physiological data including metabolism of test compounds will be incorporated into large-scale computer models that are based on material balancing and kinetics. Various "-omics data" and 3D structural information from organotypic cultures will be integrated using correlative bioinformatic tools. These data also serve as a basis for large scale mathematical models. The overall objectives are to identify cellular and molecular signatures allowing prediction of long term toxicity, to design experimental systems for the identification of predictive endpoints and to integrate these into causal computer models.

Webpage: http://notox-sb.eu/fp7-cosmetics-europe/

8.3.2. Collaborations with Major European Organizations

U. Klingmüller: DKFZ (German Cancer Center), Department for Systemsbiology (Germany)

Role of HGF in liver regeneration. Lung cancer.

K. Breuhahn: University Hospital of Heidelberg, Pathology (Germany)

Lung cancer invasion. Role of HGF in liver regeneration.

JG Hengstler: Leibniz Center, IfADo (Germany)

Liver research, toxicology, regeneration.

University of Leipzig, Interdisciplinary center for bioinformatics (Germany)

Projects on tissue regeneration, software

Nick Jagiella, Helmholz Center, Institute of Computational Biology

Image guided model parameterisation

8.4. International Initiatives

8.4.1. German Bundesministerium für Bildung und Forschung (BMBF) initiatives

1. German Research Ministry (BMBF) funded project on the systems biology of lung cancer. The major aim is to better understand the early metastasis formation and invasion of lung cancer, including therapeutical options. Data on all levels ranging from intracellular up to organ level will be used to establish successively an integrated multiscale model of cellular and migration decisions in lung cancer. A particular focus will be on

dissecting how cellular organisation and communication in spheroid cultures and co-cultures of lung cancer cell lines with selected endothelial cells affects information processing and the proliferation and migration decisions downstream. To reveal the inhomogeneous spatio-temporal organisation in these tumour growth models, specific probes for medical imaging, quantify extracellular cytokine concentrations will be used, and the effects of pharmacological inhibitors be monitored. By data and model integration, parameters should be identified that critically determine early spread and facilitate to predict possibilities for improved therapeutic options. The project coordinator is Ursula Klingmueller, German Cancer Research Centre (DKFZ), Heidelberg (http://www.lungsys.de/)

2. German Research Ministry (BMBF) funded project on the systems biology of liver (Virtual Liver Network). The aim of the VLN project is to set up multiscale models of liver. The Virtual Liver will be a dynamic model that represents, rather than fully replicates, human liver physiology morphology and function, integrating quantitive data from all levels of organisation. Our part ranges from the intracellular up to the level of groups of liver lobules. A liver lobule is the basic repetitive functional unit of liver. Applications are explained in the text available on the web site. The networks has 69 Principle Investigators organised in about 10 work packages, each of which have a number of sub-projects (http://www.virtual-liver.de/).

8.4.2. Participation In other International Programs

Participation in the EuroMed3+3 governed by Inria. The M3CD network (https://www.rocq.inria.fr/bang/M3CD_website/), coordinated by J. Clairambault, has continued and extended its activities, giving rise to new participations: Politecnico di Torino (M. Delitala), Universidad de Valladolid (Ó. Angulo), to stays of students (Y. Bourfia) and researchers (M. Adimy) and to the organisation of a new workshop in Marrakesh in January 2014. The mid-term report is available on the website. The University of Tlemcen (T. Touaoula) has joined in from January 2015.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Invitation of Min Tang (Shanghai Jao Tong University, China) during one month at UPMC.

8.5.1.1. Internships

Eugenio Lella, Mathematics: Towards a spatio-temporal hybrid mathematical model to simulate drug toxicity in vitro. (2014, master thesis)

8.5.1.2. Research stays abroad

Nicolas Vauchelet stayed two months at IMPA, Rio de Janeiro, Brazil, in the framework of a teaching agreement between UPMC and IMPA.

MANAO Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Carer xD: "Caractérisation et restitution du réel xD"

Currently, the characterization and display of the real world are limited to techniques focusing on a subset of the necessary physical phenomena. A lot of work has been done to acquire geometric properties. However, the acquisition of a geometry on an object with complex reflection property or dynamic behavior is still a challenge. Similarly, the characterization of a material is limited to a uniform object for complex material or a diffuse material when one is interested in its spatial variations.

To reach full interaction between real and virtual worlds (augmented reality, mixed reality), it is necessary to acquire the real world in all its aspects (spatial, spectral, temporal) and to return it as in all these dimensions. To achieve this goal, a number of theoretical and practical tools will be developed around the development of mixed reality solutions and the development of some theoretical framework that supports the entire project.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. "Young Researcher" RichShape (2014-2018):

MANAO
Leader: G. Guennebaud
This project aims at the development of novel representations for the efficient rendering and manipulation of highly detailed shapes in a multi-resolution context.

7.2.1.2. ALTA (2011-2015):

MAVERICK, REVES
Leader: N. Holzschuch (MAVERICK)
The project ALTA aims at analyzing the light transport equations and at using the resulting representations and algorithms for more efficient computation. We target lighting simulations, either off-line, high-quality simulations or interactive simulations.

7.2.1.3. "Young Researcher" IM&M (2011-2015):

IRIT
Leader: L. Barthe (IRIT)
This project aims at the definition of simple and robust tools for the modeling of 3D objects. To this end, the proposed approach consists in combining the nice mathematical properties of implicit surfaces with classical meshes.

7.2.2. Competitivity Clusters

7.2.2.1. LabEx CPU:

IMB (UPR 5251), LABRI (UMR 5800), Inria (CENTRE BORDEAUX SUD-OUEST), I2M (NEW UMR FROM 2011), IMS (UMR 5218), CEA/DAM
Some members of *MANAO* participate in the local initiative CPU. As it includes many thematics, from fluid mechanics computation to structure safety but also management of timetable, safety of networks and protocols, management of energy consumption, etc., numerical technology can impact a whole industrial sector. In order to address problems in the domain of certification or qualification, we want to develop numerical sciences at such a level that it can be used as a certification tool.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

7.3.1.1. FP7 NoE - V-MusT.net (2011-2015):

Participants: cf. http://www.v-must.net/participants
Leader: S. Pescarin (CNR - Italy)
V-MusT.net is a European Network of Excellence dedicated to Virtual Museums. A Virtual Museum is a personalized, immersive, interactive experience that aims to enhance our understanding of the past in museums or on the Internet. The V-Must.net network enables heritage professionals around the world to connect, collaborate and advance the development and use of virtual museums.

7.3.1.2. FP7 ITN - PRISM "Perceptual Representations for Illumination, Shape and Materials" (2013-2016):

Participants: Giessen University, Université Paris-Descartes, Bilkent University, Université de Leuven, Delft University, Birmingham University, Philips and NextLimit
Leader: R. Fleming (Giessen University)
The goal of this project is to better understand how the human visual system understands images in terms of meaningful components: How is shape perceived consistently in varying illumination conditions and for different materials? To which extent are humans able to guess the main illumination directions in a scene? What visual properties do we make use of to estimate the material an object is made of without touching it? Answering these questions will require inter-disciplinary research and collaborations.

7.3.2. Foreign grants

7.3.2.1. DFG Emmy-Noether grant "Plenoptic Acquisition and Projection - Theoretical Developments and Applications" (2012-2017)

Leader: I. Ihrke
This project aims to develop a comprehensive theory of the imaging process in optical-computational devices as developed in the newly emerging field of Computational Optics. The theory will be validated by a number of practical applications.

It will allow for the modeling of image formation processes in measurement systems employing novel computational imaging and projection devices. This makes it possible to optimize these systems with respect to particular imaging tasks, which is currently impossible due to limited models. A further interesting aspect of the project is that computational imaging devices will become comparable with respect to parameters such as their resolution and noise characteristics which is hardly possible at the moment.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. From University of Montréal

Since the summer 2014, we are welcoming in our team Dr. Laurent BELCOUR, a post-doc from the University of Montréal. We are working together on the development of theoretical and practical tools for the analysis and the modeling of light transport operators such as BRDFs [15], [23].

7.4.1.2. From Beijing Normal University

We have long-standing exchanges with the Beijing Normal University. This university is in charge of some virtual reconstruction of the Chinese Cultural Heritage (such as the terracota warrios and the old Beijing). In this context, we received Dr. SHUI Wuyang for a one month visit in February to work on the use of our results to help the reconstruction and the visualization of ancient artefacts.

MARELLE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

In 2014, we participated to two successful applications for funding from the French national agency for research (ANR).

- BRUTUS "Chiffrements authentifiés et résistants aux attaques par canaux auxiliaires", started on October 1st, 2014, for 60 months, with a grant of 41 kEuros for Marelle. Other partners are Université de Rennes 1, CNRS, secrétariat Général de la défense et de la sécurité nationale, and Université des Sciences et Technologies de Lille 1. The corresponding researcher for this contract is Benjamin Grégoire.
- FastRelax, "Fast and Reliable Approximations", started on October 1st, 2014, for 60 months, with a grant of 75 kEuros for Marelle. Other partners are Inria Grenoble (ARIC project-team), LAAS-CNRS (Toulouse), Inria Saclay (Toccata and Specfun project-teams), and LIP6-CNRS (Paris). The corresponding researcher for this contract is Laurence Rideau.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

Our main partner for work on Ssreflect is Georges Gonthier, senior researcher at Microsoft Research, Cambridge.

Our team has important discussions with the team of Thierry Coquand at *Chalmers University and University of Göteborg*. This was illustrated in the past by the European project FORMATH, in the context of which we collaborated around the formalization of various aspects of Algebra (linear algebra and algebraic topology). This effort was continued in the context of the international effort around *homotopy type theory*, where Cyril Cohen is deeply involved (in particular in the implementation of a model for cubical sets). In the future, we may hope to play a continuing role in *homotopy theory* and establish more contacts with other sites involved in this topic.

We participate in the international development of the Coq community and maintain frequent contacts with the most active users around the world. In practice, this implies many contacts with several universities in the United States of America: Princeton University, University of Pennsylvania, the Massachusetts Institute of Technology, Harvard University, and Yale University.

We have intensive collaborations with IMDEA, Madrid. In particular, the software systems EasyCrypt and ZooCrypt are developed in collaboration with this institution, and several of our publications are co-authored between Inria and IMDEA.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

8.3.1.1. Sabbatical programme

Amy Felty, professor at University of Ottawa, was a member of our team until September 30th, on sabbatical leave from her university, and with no extra financial support from Inria.

Dough Howe, professor at Carleton University, was a member of our team until August 31st, on sabbatical leave from his university, and with no extra financial support from Inria.

MASAIE Project-Team

6. Partnerships and Cooperations

6.1. International Initiatives

6.1.1. Inria International Labs

MASAIE is the Inria EPI partner of GRIMCAPE (LIRIMA). It also has strong collaboration with M2IPE2S (LIRIMA). Two PhD students (Diaby and Diouf) are members of M2IPE2S.

G. Sallet participated to The "LIRIMA evaluation seminar", Paris, September 24-26, 2014.

6.1.2. Participation in other International Programs

6.1.2.1. Capes-Cofecub

MASAIE is the french correspondent in a cooperation program with Brazil.

We work with a Brazilian network that has been built in 2011, and which is composed of

- FGV (Fundação Getulio Vargas) Rio de Janeiro. Principal investigator: Jair Koiller.
- UFF (Universidade Federal Fluminense) Rio de Janeiro. Principal investigator: Max Oliveira de Souza.
- UNICAMP (Universidade Estadual de Campinas) Campinas. Principal investigator: Hyun Mo Yang.
- Fondation Oswaldo Cruz (Fiocruz, Rio). Principal investigator: Claudia Codeço.
- IMPA Rio de Janeiro. Principal investigator: Jorge Zubelli.

This project, funded by CAPES-COFECUB, "new methods in epidemiology and early detection of events" began in January 2011 and finished in December 2013. However the collaboration with the Brazilian collaborators has continued and increased during 2014.

6.1.2.2. Paes-Uemoa

A research project on Bilharzia was submitted by the universities of Ouagadougou and Gaston Berger of Saint-Louis, in the framework of PAES(projet d'appui à l'enseignement supérieur) of UEMOA (Union Économique et Monétaire de l'Afrique de l'Ouest). MASAIE is an important component of this network. This project has been accepted in 2012 and funded with 30 000 000 CFA (XOF) ($\approx$ 45 000 euro). This project will finish on January 2015.
The PhD thesis of M. Diaby (MASAIE and UGB St Louis) is part of this project.

6.2. International Research Visitors

6.2.1. Visits of International Scientists

Max Oliveira de Souza, professor at Universidade Federal Fluminense, Rio de Janeiro, Brazil, January 2014.

6.2.2. Visits to International Teams

G. Sallet visited FGV and UFF (Rio de Janeiro) and UNESP (São José dos Campos, Sao Paulo) from November 10, 2014 to November 29, 2014. A. Iggidr visited FGV and UFF (Rio de Janeiro) from April 20, 2014 to May 11, 2014. A. Iggidr visited FGV and UFF (Rio de Janeiro) and UNESP (São José dos Campos, Sao Paulo) from November 7, 2014 to December 5, 2014.

MATHERIALS Team

7. Partnerships and Cooperations

7.1. National Initiatives

The team is involved in several ANR projects:

- the ANR MANIF focuses on the mathematical and numerical analysis of electronic structure models, such as, in particular, the Kohn-Sham model. It includes two research teams: researchers from the JL Lions Laboratory (Paris 6) and the MATHERIALS team. It is coordinated by E. Cancès.
- E. Cancès is involved in the ANR BECASIM, which is concerned with the numerical simulation of Bose-Einstein condensates. This ANR has been accepted in June 2012, and is coordinated by I. Danaila (Université de Rouen).
- C. Le Bris participates to the ANR EMAQS. The scientist in charge is Karine Beauchard.
- T. Lelièvre is member of the ANR-project "STAB" (PI: I. Gentil, Université de Lyon).
- The team also benefited from a NEEDS interdisciplinary funding from CNRS on numerical methods for the simulation of defects in materials

In addition, the team is participating in

- the GdR Quantum dynamics. This interdisciplinary research network is focused on physical and mathematical problems related to the time evolution of quantum systems (transport problems, nonequilibrium systems, etc),
- the GdR Shocks,
- the GdR Maths et entreprise,
- the GdR correl (correlated methods in electronic structure computations),
- the GdR CoDFT (electronic structure computations using density functional theory).

The MATHERIALS team project is involved in two Labex, namely the Labex Bezout (started in 2011) and the Labex MMCD (started in 2012).

7.2. European Initiatives

The ERC consolidator Grant MSMATH (ERC Grant Agreement number 614492, PI T. Lelièvre) has started in June 2014.

7.3. International Initiatives

T. Lelièvre, G. Stoltz and F. Legoll participate to the Laboratoire International Associé (LIA) CNRS / University of Illinois at Urbana-Champaign on complex biological systems and their simulation by high performance computers. This LIA involves on the French side research teams from Université de Nancy, Université de Lyon and Inria Rennes.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

J. Weare (University of Chicago) has been invited for a one month stay (February-March 2014) with the support of the Labex Bezout.

7.4.2. Visits to International Teams

F. Legoll, T. Lelièvre and G. Stoltz have visited the group of K. Schulten (Urbana-Champaign) on January 27-30, 2014

MATHRISK Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

B. Jourdain is involved in the ANR Stab (2013/2016). Partners: Lyon1 and Paris-Dauphine.

8.1.2. Competitivity Clusters

Pôle Finance Innovation.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

- Center of Excellence program in Mathematics and Life Sciences at the Department of Mathematics, University of Oslo, Norway, (B. Øksendal).
- Department of Mathematics, University of Manchester (Tusheng Zhang, currently in charge of an EU-ITN program on BSDEs and Applications).
- Mannheim University (Alexander Schied, Chair of Mathematics in Business and Economics, Department of Mathematics)
- Roma Tor Vergata University (Lucia Caramellino)
- Ritsumeikan University (A. Kohatsu-Higa).

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Arturo Kohatsu-Higa, Ritsumeikan University, 3 months

- Lucia Caramellino, Tor Vergata University, Roma, 2 weeks

- Oleg Kudryavtsev, Rostov University , 2 months

- Xiao Wei, Beijing university, 2 months

8.3.2. Visits to International Teams

8.3.2.1. Research stays abroad

- V. Bally, Ritsumeikan University, Japan, one month
- A. Sulem:

  - "Adjunct Professorship", Center of Mathematics for Applications (CMA), University of Oslo, Norway, 1st Semester 2014.

  - Participation to the "Stochastics in Environmental and Financial Economics" program, Centre of Advanced Studies of the Norwegian Academy of Sciences and Letters, Oslo, Last term 2014.

MAVERICK Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR BLANC: ALTA

Participants: Nicolas Holzschuch [contact], Cyril Soler.

We are funded by the ANR research program "Blanc" for a joint research project with two other Inria research teams, REVES in Sophia-Antipolis and iPARLA in Bordeaux. The goal of this project is studying light transport operators for global illumination, both in terms of frequency analysis and dimensional analysis. The grant started in October 2011, for 48 months.

6.1.2. ANR CONTINT: Galaxy/veRTIGE

Participants: Jean-Dominique Gascuel, Nicolas Holzschuch, Fabrice Neyret [contact].

RTIGE stands for Real-Time and Interactive Galaxy for Edutainment. This is an ANR CONTINT (Contents and Interactions) research program, for a joint research project with the EVASION Inria project-team, the GEPI and LERMA research teams at Paris Observatory, and the RSA Cosmos company. The goal of this project is to simulate the quality multi-spectral real-time exploration of the Galaxy with Hubble-like images, based on simulation data, statistical data coming from observation, star catalogs, and procedural amplification for stars and dust clouds distributions. RSA-Cosmos aims at integrating the results in digital planetariums. The grant started in December 2010, for 48 months.

6.1.3. ANR COSINUS: ROMMA

Participants: Georges-Pierre Bonneau [contact], François Jourdes.

The ANR project ROMMA has been accepted in 2009. It started in january 2010 for a duration of 4 years. The partners of this project are academic and industry experts in mechanical engineering, numerical simulation, geometric modeling and computer graphics. The aim of the project is to efficiently and robustly model very complex mechanical assemblies. We work on the interactive computation of contacts between mechanical parts using GPU techniques. We also investigate the Visualization of data with uncertainty, applied in the context of the project.

6.1.4. ANR CONTINT: MAPSTYLE

Participants: Joëlle Thollot [contact], Hugo Loi.

The MAPSTYLE project aims at exploring the possibilities offered by cartography and expressive rendering to propose original and new cartographic representations. Through this project, we target two types of needs. On the one hand, mapping agencies produce series paper maps with some renderings that are still derived from drawings made by hand 50 years ago: for example, rocky areas in the series TOP25 (to 1/25000) of the French Institut Géographique National (IGN). The rendering of these rocky areas must be automated and its effectiveness retained to meet the requirements of hikers safety. On the other hand, Internet mapping tools allow any user to become a cartographer. However, they provide default styles that cannot be changed (GeoPortal, Google Maps) or they are editable but without any assistance or expertise (CloudMade). In such cases, as in the case of mobile applications, we identify the need to offer users means to design map styles more personalised and more attractive to meet their expectations (decision-making, recreation, etc.) and their tastes. The grant started on October 2012, for 48 months.

6.2. International Initiatives

6.2.1. Inria International Partners

6.2.1.1. Informal International Partners

We have a continuing collaboration with Professor Kavita Bala, from Cornell University, USA, on the subject of global illumination and simulation of light scattering in participating media. Our work has been accepted at ACM transaction on graphics in 2014.

We currently have a very fruitful collaboration with Derek Nowrouzhezarai, from University of Montreal, Canada, dealing with isotropic filter decomposition in the spherical domain, based on zonal harmonic basis.

We also have frequent exchanges and on-going collaborations with Cyril Crassin from nVIDIA-Research.

6.3. International Research Visitors

6.3.1. Visits to International Teams

6.3.1.1. Research stays abroad

Fabrice Neyret has been visiting WETA Digital (New-Zeland) from July to August 2014.

Maxplus Project-Team

8. Partnerships and Cooperations

8.1. Actions nationales/National Initiatives

8.1.1. ANR

- Participation de Cormac Walsh au projet ANR FINSLER (Géométrie de Finsler et applications).
- Projet ANR CAFEIN (Combinaison d'approches formelles pour l'étude d'invariants numériques), responsable P.L. Garoche. Partenaires : ONERA, CEA LIST, ENSTA Paristech, Inria Saclay (Maxplus, Toccata, Parkas), Université de Perpignan, Prover, Rockwell Collins France.
- Projet ANR MALTHY (Méthodes ALgébriques pour la vérification de modèles Temporisés et HYbrides), responsable T. Dang. Partenaires : Verimag, CEA LIST, Inria Rennes, Inria Saclay, VISEO/Object Direct.
- Projet ANR DEMOCRITE ("DEmonstrateur d'un MOteur de Couverture des Risques sur un TErritoire), responsable Emmanuel Lapébie (CEA). Partenaires : CEA-GRAMAT, BSPP, Inria Saclay (Maxplus), Institut PPRIME - UPR3346 (CNRS, Univ. Poitiers, ISAE-ENSMA), IPSIS, SYSTEL, ARMINES-E.M. Alès-ISR, CERDACC (Univ. de Haute-Alsace).

8.1.2. Programme Gaspard Monge pour l'Optimisation

- Projet intitulé "Méthodes tropicales pour l'optimisation", responsable X. Allamigeon, faisant intervenir M. Akian, P. Benchimol, S. Gaubert, R. Katz, et Z. Qu.
- Participation de Marianne Akian et Stéphane Gaubert au projet "STORY: Stochastic and Robust Optimization Network and Teaching", responsables: Laurent El Ghaoui (UC Berkeley) et Michel De Lara(CERMICS).

8.1.3. iCODE (Institut pour le Contrôle et la Décision de l'Idex Paris-Saclay)

Projet "blanc" intitulé "Stabilité et stabilisation des systèmes commutés" (Oct. 2014-fin 2015), faisant intervenir M. Akian, X. Allamigeon, S. Gaubert, et des membres de EPI Geco, L2S, LIX, LSV (ENS Cachan), UVSQ.

8.2. Actions internationales/International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

Collaborations régulières dans le cadre des programmes internationaux ci-dessous, ainsi qu'avec:

- Ricardo Katz (Conicet et Cifasis, Argentine);
- Alexander Guterman (Moscow State University);
- Françoise Tisseur (Université de Manchester) qui participe à l'encadrement de la thèse d'Andrea Marchesini.

8.2.2. Participation In other International Programs

- La thèse de Pascal Benchimol est financée par une bourse Monge/DGA prévoyant des visites régulières du doctorant dans l'équipe de Michael Joswig (TU Berlin).

8.3. Accueils de chercheurs étrangers/International Research Visitors

8.3.1. Chercheurs étrangers/Visits of International Scientists

- Ricardo Katz (Conicet, Rosario, Argentine), 2 mois entre Septembre et Novembre, financé par Digitéo et PGMO.
- Alexander Guterman (Université d'état de Moscou), 3 jours en Mars, 5 jours en Septembre.
- Visites d'un jour de Francisco Santos, Thorsten Theobald et Michael Joswig (autour de la thèse de Pascal Benchimol).
- Visite de Thomas Hansen, une semaine, Octobre 2014.

8.3.2. Séjours à l'étranger/Visits to International Teams

8.3.2.1. Research stays abroad

- A. Marchesini, visite à l'Université de Manchester, 22-25 avril 2014 et participation a NEP14.
- X. Allamigeon, visite à TU Berlin, 28–30 Avril 2014.
- S. Gaubert, visite à TU Berlin, 28–30 Avril 2014.
- S. Gaubert, visite au CIFASIS, Rosario, Argentina, 8-15 Juin 2014.

MC2 Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Angelo Iollo is belongs to the Aerospace Valley committee IGPC. He is monitoring the project ECOSEA for the fnrae http://www.fnrae.org/.

8.2. National Initiatives

8.2.1. ANR MEMOVE

Participants: Thierry Colin, Angelo Iollo, Clair Poignard, Olivier Saut, Lisl Weynans.

Part of the team (M.Colin, T.Colin, A.Iollo, C.Poignard, O.Saut and L. Weynans) is involved in the consortium MEMOVE coordinated by MC2 (coordinator C. Poignard), and which begins at the beginning of 2012. This consortium is composed of four partners (the Vectorology and Anticancer therapies team at the IGR, the bioengineering laboratory AMPERE of Lyon and the Department of mathematics of Versailles). It aims at developing electropermeabilization models from the cell scale to the tissue scale. This project focuses on quite long pulses (from micro- to milli-pulses) compared with the ANR consortium INTCELL that has begun in December 2010. The main goal is to provide multi-scale modelling of "classical" eletroporation, in order to obtain numerical tools that can help from one side the biologists to understand the electropermeabilization process when "non standard" pulses are applied, and from the other side it eventually aims at providing tools for the physicians to optimize the pulse delivering when the electrochemotherapy is used.

8.2.2. French-German cooperative consortium SmartOnline

Participants: Angelo Iollo, Iraj Mortazavi.

- Program: ANR & BMBF
- Project acronym: SmartOnline
- Project title: Online security management toolkit for water distribution networks.
- Duration: 04/2012-04/2015
- Coordinator: Olivier Piller (IRSTEA)
- Other partners: Irstea, Veolia, ENGES, CU Strasbourg, BW Berlin, TZW Dresden, 3S Consult, Franhoefer.
- Abstract: The main objective of the project SMaRT-OnlineWDN is the development of an online security management toolkit for water distribution networks that is based on sensor measurements of water quality as well as water quantity. Its field of application ranges from detection of deliberate contamination, including source identification and decision support for effective countermeasures, to improved operation and control of a WDN under normal and abnormal conditions (dual benefit).

8.2.3. Plan Cancer METASTASIS

Participants: Sébastien Benzekry, Thierry Colin, Clair Poignard, Olivier Saut.

- Program: Plan Cancer: Systems Biology
- Project acronym: METASTASIS
- Project title: Modeling the Interaction of the (Metastasis) Vascular/Tumor Niche Using a Systems Biology Approach
- Duration: 2013-2015
- Coordinator: A. Bikfalvi (Biologie, Bordeaux University)

8.2.4. Plan Cancer MIMOSA

Participants: Sébastien Benzekry, Thierry Colin, Clair Poignard, Olivier Saut.

- Program: Plan Cancer: Physique, Mathématiques et Sciences de l'ingénieur appliqués au Cancer
- Project acronym: MIMOSA
- Project title: Mathematical modeling for exploration of the impact of mechanical constraints on tumor growth
- Duration: 2014-2017
- Coordinator: T. Colin

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. FFAST

Title: FUTURE FAST AEROELASTIC SIMULATION TECHNOLOGIES

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: January 2010 - December 2012

Coordinator: University of Bristol (Saint Pierre And Miquelon)

Others partners: University of Bristol, irias, TU Delft, Politecnico di Milano, Numeca, EADS, DLR, Airbus, University of Cap Town, csir, Optimad

See also: http://www.bris.ac.uk/aerodynamics-research/ffast/

Abstract: The FFAST project aims to develop, implement and assess simulation technologies to accelerate future aircraft design. These technologies will demonstrate a step change in the efficiency and accuracy of the dynamic aeroelastic "loads process" using unique critical load identification methods and reduced order modelling. The outcome from the project will contribute to the industrial need to reduce the number of dynamic loads cases analysed, whilst increasing the accuracy and reducing the cost/time for each unsteady aeroelastic analysis performed compared to the current approach. Unsteady loads calculations play an important part across much of the design and development of an aircraft, and have an impact upon the concept and detailed structural design, aerodynamic characteristics, weight

8.3.2. Collaborations in European Programs, except FP7 & H2020

Program: European associated laboratory

Project acronym: EBAM

Project title: Pulsed electric fields applications in biology and medicine

Duration: January 2011 - December 2014

Coordinator: C. Poignard

Other partners: Institut Gustave Roussy (CNRS, Paris), Laboratory of Pharmacology and Structural Biology (CNRS and University of Toulouse, Toulouse), Laboratory XLIM (Limoges), Faculty of Health Sciences (Primorska), Laboratory of Structure and Reactivity of the Complex Molecular Systems (CNRS and University of Lorraine), University of Ljubljana (Ljubljana), Institute of Oncology (Ljubljana)

Abstract: The main aim of the LEA EBAM is to use an interdisciplinary approach, integrating biology, chemistry, physics, biophysics, mathematics, computational modelling and engineering, through the expertise of its members in order to

- Enhance our understanding on the mechanisms of classical electropermeabilization and of the new nanopermeabilization (electropermeabilization using nanosecond electric pulses), as well as on the mechanisms of transmembrane transport of molecules into electroporated cells and tissues on a microscopic and macroscopic scale.
- Contribute to a better and safer implementation of the electropermeabilization-based applications, and to the development of new applications.
- Develop new devices and new equipment for the nanopermeabilisation at cell and tissue levels.
- Develop new approaches like treatment planning in existing applications, such as antitumor electrochemotherapy and in vivo gene transfer for therapeutic purposes.
- Disseminate the knowledge and the applications in the scientific community and in the society, through publications, a one-week course (already implemented) co-directed by the LEA directors, internal and external training, and through other means that the LEA will develop and/or will apply for (to the EC programs for example).

8.4. International Initiatives

- Collaboration with Hassan Fathallah, Neuro-oncoly and mathematics, University of Alabama at Birmingham. We work on numerical modeling of brain tumor.
- PHC Sakura on cancer modeling with University of Osaka. (12Keur for 2 years) Collaboration with the University of Osaka on the modeling of the cell migration in cancer.
- Collaboration with IAC, CNR (R. Natalini) and E. Signori on tissue electroporation and DNA transfection.
- Collaboration with John Ebos, Roswell Park Cancer Institute, Buffalo, NY, USA. Quantification of metastatic potential and differential effect of anti-angiogenenic therapies on primary tumor and metastasis, in a preclinical setting.
- Collaboration with the Center of Cancer and Systems Biology at Tufts University, Boston, MA, USA. We work together on quantitative modeling of tumor-tumor interactions and their implications on global metastatic dynamics.
- Collaborations with Luca Zannetti, Politecnico di Torino; Simone Camarri, Universita di Pisa; Eyal Arian, Boeing Commercial Airplanes.
- Collaboration with Sinisa Krajnovic, Chalmers University, on the high fidelity simulation and control of ground vehicle flows.
- Collaboration with Spencer Sherwin and Denis Doorly (Imperial College London) on the novel flow diagnostics approaches.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- J. Zubelli (IMPA, Rio de Janeiro, Brazil) from June 30th to July 4th
- V. Pérez-Garcia and A. Martinez (Universidad de Castilla-La Mancha, Ciudad Real, Spain) from November 12th to November 14th
- M. Ohta (Tokyo University of Sciences, Japan) from December 4th to 12th
- L. Wegner (Karlsruhe institute of Technology, Germany) from December 15th to 19th

MCTAO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- The "région" *Provence Alpes Côte d'Azur* (PACA) partially supports Helen Heninger's PhD . The other part comes from Thales Alenia space, see section 7.1 .
- The "région" *Provence Alpes Côte d'Azur* (PACA) partially supports Jérémy Rouot's PhD.

8.2. National Initiatives

8.2.1. IMB - Université de Bourgogne, Dijon

The team is officially a common team with University of Nice, but also has very strong links with Université de Bourgogne and IMB (Institute of Mathematics in Burgundy). Bernard Bonnard is currently on leave from Université de Bourgogne; Jean-Baptiste Caillau collaborates actively with us; there is also an active common seminar http://math.unice.fr/~rifford/publis/Journee_McTAO/J_McTAO.html . A formal convention between Inria and Université de Bourgogne has been signed in 2014. It makes the IMB control team a part of McTAO as of January, 2015.

8.2.2. Explosys (franco-german ANR project)

Bernard Bonnard is a memebr of this project, accepted in October, 2014. The coordinators are Dominique Sugny (Dijon) and Stefen Glaser (Munich). The budget is approximately 500 K€.

8.2.3. Others

Bernard Bonnard and Ludovic Rifford participate in the GDR MOA, a CNRS network on Mathematics of Optimization and Applications. http://gdrmoa.univ-perp.fr/.

Jean-Baptiste Caillau is in the board of governors of the group SMAI-MODE (http://smai.emath.fr/spip.php?article338).

Jean-Baptiste Caillau is a member of the Centre de Compétences Techniques (CCT) Mécanique orbitale du CNES

Jean-Baptiste Caillau is the corresponding member in Dijon for the Labex AMIES (http://www.agence-maths-entreprises.fr/).

8.3. International Initiatives

There is a strong collaboration with the control group in the University of Hawaii around M. Chyba. The purpose of the collaboration is to study the aspects of the contrast problem in Nuclear Magnetic Resonance.

MEPHYSTO Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR BECASIM

G. Dujardin and I. Lacroix are members of the ANR BECASIM project (http://becasim.math.cnrs.fr/). This ANR project gathers mathematicians with theoretical and numerical backgrounds together with engineers. The objective is to develop numerical methods to accurately simulate the behavior of Bose-Einstein condensates.

Title: Simulation numérique avancée pour les condensats de Bose-Einstein.

Type: Modèles Numériques - 2012

ANR reference: ANR-12-MONU-0007

Coordinator: Ionut DANAILA, Université de Rouen.

Duration: January 2013 - December 2016.

Partners: Université Lille 1, UPMC, Ecole des Ponts ParisTech, Inria-Nancy Grand-Est, Université Montpellier 2.

8.1.2. Labex CEMPI

Title: Centre Européen pour les Mathématiques, la Physique et leurs interactions

Coordinator: Stephan De Bièvre.

Duration: January 2012 - December 2019.

Partners: Laboratoire Paul Painlevé and Laser physics department (PhLAM), Université Lille 1.

The “Laboratoire d’Excellence” Centre Européen pour les Mathématiques, la Physique et leurs interactions (CEMPI), a project of the Laboratoire de Mathématiques Paul Painlevé and the Laboratoire de Physique des Lasers, Atomes et Molécules (PhLAM), was created in the context of the "Programme d’Investissements d’Avenir" in February 2012.

The association Painlevé-PhLAM creates in Lille a research unit for fundamental and applied research and for training and technological development that covers a wide spectrum of knowledge stretching from pure and applied mathematics to experimental and applied physics.

One of the three focus areas of CEMPI research is the interface between mathematics and physics. This focus area encompasses three themes. The first is concerned with key problems of a mathematical, physical and technological nature coming from the study of complex behaviour in cold atoms physics and non-linear optics, in particular fibre optics. The two other themes deal with fields of mathematics such as algebraic geometry, modular forms, operator algebras, harmonic analysis and quantum groups that have promising interactions with several branches of theoretical physics.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. QUANTHOM

Type: FP7

Instrument: ERC Starting Grant

Duration: February 2014 - January 2019

Coordinator: Antoine Gloria

Partner: Département de mathématique, Université Libre de Bruxelles (Belgium)

Inria contact: Antoine Gloria

Abstract: Quantitative methods in stochastic homogenization

8.2.2. Collaborations with Major European Organizations

Max Planck Institute for Mathematics in the Sciences (Germany).

Development of a quantitative theory of stochastic homogenization.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

The activity around quantitative stochastic homogenization was developed in collaboration with F. Otto, director of the Max Planck Institute for Mathematics in the Sciences, Leipzig (Germany).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Daniel Marahrens (MPIMS, Leipzig): one week in March (A. Gloria), annealed estimates on Green's functions.
- Felix Otto (MPIMS, Leipzig): one week in April (A. Gloria), quantitative stochastic homogenization.
- Gilbert Reinisch (physicist at University of Reykjavik): from May 12th 2014 to May 28th 2014 (G. Dujardin and M. Gazeau), numerical simulations of several differential systems modelling the evolution of quantum dots. This visit was cofounded by Inria and the LabEx CEMPI. This work is a follow up of the paper [18].
- Marco Cicalese (Univ. Munich): one week in May (A. Gloria), derivation of nonlinear elasticity from polymer-physics.
- Jean-Christophe Mourrat (ENS Lyon): 10 days in May (A. Gloria), quantitative stochastic homogenization.
- Stefan Neukamm (Weierstrass Institute, Berlin, now at Univ. Dresden): 10 days in May (A. Gloria), quantitative stochastic homogenization.
- Ansgar Jüngel (Univ. Vienna): one week in July (C. Chainais and I. Lacroix-Violet), discrete functional inequalities for asymptotic preserving schemes.

MESCAL Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CIMENT

The CIMENT project (Intensive Computing, Numerical Modeling and Technical Experiments, http://ciment.ujf-grenoble.fr/) gathers a wide scientific community involved in numerical modeling and computing (from numerical physics and chemistry to astrophysics, mechanics, bio-modeling and imaging) and the distributed computer science teams from Grenoble. Several heterogeneous distributed computing platforms were set up (from PC clusters to IBM SP or alpha workstations) each being originally dedicated to a scientific domain. More than 600 processors are available for scientific computation. The MESCAL project-team provides expert skills in high performance computing infrastructures. The members of MESCAL involved in this project are Pierre Neyron and Olivier Richard.

8.1.2. Cluster Région

Partners: the Inria GRAAL project-team, the LSR-IMAG and IN2P3-LAPP laboratories.

The MESCAL project-team is a member of the regional "cluster" project on computer science and applied mathematics, the focus of its participation is on handling large amount of data large scale architecture.

8.2. National Initiatives

8.2.1. Inria Large Scale Initiative

- *HEMERA, 2010-2014* Leading action "Completing challenging experiments on Grid'5000 (Methodology)" (see https://www.grid5000.fr/Hemera).

  Experimental platforms like Grid'5000 or PlanetLab provide an invaluable help to the scientific community, by making it possible to run very large-scale experiments in controlled environment. However, while performing relatively simple experiments is generally easy, it has been shown that the complexity of completing more challenging experiments (involving a large number of nodes, changes to the environment to introduce heterogeneity or faults, or instrumentation of the platform to extract data during the experiment) is often underestimated.

  This working group explores different complementary approaches, that are the basic building blocks for building the next level of experimentation on large scale experimental platforms.

8.2.2. ANR

- *ANR GAGA (2014-2017)*

  GAGA is a "Young Researchers" project funded by the French National Research Agency (ANR) to explore the Geometric Aspects of GAmes. The GAGA teamis spread over three different locations in France (Paris, Toulouse and Grenoble), and is coordinated by Vianney Perchet, assistant professor (Maître de Conférences) in the Probabilities and Random Models laboratory in Université Paris VII.

  As the name suggests, our project's focus is game theory, a rapidly developing subject with growing applications in economics, social sciences, computer science, engineering, evolutionary biology, etc. As it turns out, many game theoretical topics and tools have a strong geometrical or topological flavor: the structure of a game's equilibrium set, the design of equilibrium-computing algorithms, Blackwell approachability, the geometric character of the replicator dynamics, the use of semi-algebraicity concepts in stochastic games, and many others. Accordingly, our objective is to perform a systematic study of these geometric aspects of game theory and, by so doing, to establish new links between areas that so far appeared unrelated (such as Hessian-Riemannian geometry and discrete choice theory).

- *ANR MARMOTE, 2013-2016*. Partners: Inria Sophia (MAESTRO), Inria Rocquencourt (DIOGEN), PRiSM laboratory from University of Versailles-Saint-Quentin, Telecom SudParis (SAMOVAR), University Paris-Est Créteil (*Spécification et vérification de systèmes*), Université Pierre-et-Marie-Curie/LIP6.

  The project aims at realizing a software prototype dedicated to Markov chain modeling. It gathers seven teams that will develop advanced resolution algorithms and apply them to various domains (reliability, distributed systems, biology, physics, economy).

- *ANR NETLEARN, 2013-2015*. Partners: PRiSM laboratory from University of Versailles-Saint-Quentin, Telecom ParisTech, Orange Labs, LAMSADE/University Paris Dauphine, Alcatel-Lucent, Inria (MESCAL).

  The main objective of the project is to propose a novel approach of distributed, scalable, dynamic and energy efficient algorithms for managing resources in a mobile network. This new approach relies on the design of an orchestration mechanism of a portfolio of algorithms. The ultimate goal of the proposed mechanism is to enhance the user experience, while at the same time to better utilize the operator resources. User mobility and new services are key elements to take into account if the operator wants to improve the user quality of experience. Future autonomous network management and control algorithms will thus have to deal with a real-time dynamicity due to user mobility and to traffic variations resulting from various usages. To achieve this goal, we focus on two central aspects of mobile networks (the management of radio resources at the Radio Access Network level and the management of the popular contents users want to get access to) and intend to design distributed learning mechanisms in non-stationary environments, as well as an orchestration mechanism that applies the best algorithms depending on the situation.

- *ANR SONGS, 2012-2015*. Partners: Inria Nancy (Algorille), Inria Sophia (MASCOTTE), Inria Bordeaux (CEPAGE, HiePACS, RunTime), Inria Lyon (AVALON), University of Strasbourg, University of Nantes.

  The last decade has brought tremendous changes to the characteristics of large scale distributed computing platforms. Large grids processing terabytes of information a day and the peer-to-peer technology have become common even though understanding how to efficiently exploit such platforms still raises many challenges. As demonstrated by the USS SimGrid project funded by the ANR in 2008, simulation has proved to be a very effective approach for studying such platforms. Although even more challenging, we think the issues raised by petaflop/exaflop computers and emerging cloud infrastructures can be addressed using similar simulation methodology.

  The goal of the SONGS project (Simulation of Next Generation Systems) is to extend the applicability of the SimGrid simulation framework from grids and peer-to-peer systems to clouds and high performance computation systems. Each type of large-scale computing system will be addressed through a set of use cases and led by researchers recognized as experts in this area.

  Any sound study of such systems through simulations relies on the following pillars of simulation methodology: Efficient simulation kernel; Sound and validated models; Simulation analysis tools; Campaign simulation management.

8.2.3. National Organizations

Jean-Marc Vincent is member of the scientific committees of the CIST (Centre International des Sciences du Territoire).

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. Mont-Blanc

Program: FP7 Programme

Project acronym: Mont-Blanc

Project title: Mont-Blanc: European scalable and power efficient HPC platform based on low-power embedded technology

Duration: October 2011 - October 2014

Coordinator: Alex Ramirez

Other partners: BSC (Barcelone), Bull, ARM (UK), Julich (Germany), Genci, CINECA (Italy), CNRS (LIRMM, LIG)

Abstract: There is a continued need for higher compute performance: scientific grand challenges, engineering, geophysics, bioinformatics, etc. However, energy is increasingly becoming one of the most expensive resources and the dominant cost item for running a large supercomputing facility. In fact, the total energy cost of a few years of operation can almost equal the cost of the hardware infrastructure. Energy efficiency is already a primary concern for the design of any computer system and it is unanimously recognized that Exascale systems will be strongly constrained by power.

The analysis of the performance of HPC systems since 1993 shows exponential improvements at the rate of one order of magnitude every 3 years: One petaflops was achieved in 2008, one exaflops is expected in 2020. Based on a 20 MW power budget, this requires an efficiency of 50 GFLOPS/Watt. However, the current leader in energy efficiency achieves only 1.7n GFLOPS/Watt. Thus, a 30x improvement is required.

In this project, the partners believe that HPC systems developed from today's energy-efficient solutions used in embedded and mobile devices are the most likely to succeed. As of today, the CPUs of these devices are mostly designed by ARM. However, ARM processors have not been designed for HPC, and ARM chips have never used in HPC systems before, leading to a number of significant challenges.

8.3.1.2. Mont-Blanc 2

Program: FP7 Programme

Project acronym: Mont-Blanc 2

Project title: Mont-Blanc: European scalable and power efficient HPC platform based on low-power embedded technology

Duration: October 2013 - September 2016

Coordinator: BSC (Barcelone)

Other partners: BULL - Bull SAS (France), STMicroelectronics - (GNB SAS) (France), ARM - (United Kingdom), JUELICH - (Germany), BADW-LRZ - (Germany), USTUTT - (Germany), CINECA - (Italy), CNRS - (France), Inria - (France), CEA - (France), UNIVERSITY OF BRISTOL - (United Kingdom), ALLINEA SW LIM - (United Kingdom)

Abstract: Energy efficiency is already a primary concern for the design of any computer system and it is unanimously recognized that future Exascale systems will be strongly constrained by their power consumption. This is why the Mont-Blanc project has set itself the following objective: to design a new type of computer architecture capable of setting future global High Performance Computing (HPC) standards that will deliver Exascale performance while using 15 to 30 times less energy. Mont-Blanc 2 contributes to the development of extreme scale energy-efficient platforms, with potential for Exascale computing, addressing the challenges of massive parallelism, heterogeneous computing, and resiliency. Mont-Blanc 2 has great potential to create new market opportunities for successful EU technology, by placing embedded architectures in servers and HPC.

The Mont-Blanc 2 proposal has 4 objectives:
1. To complement the effort on the Mont-Blanc system software stack, with emphasis on programmer tools (debugger, performance analysis), system resiliency (from applications to architecture support), and ARM 64-bit support.

2. To produce a first definition of the Mont-Blanc Exascale architecture, exploring different alternatives for the compute node (from low-power mobile sockets to special-purpose high-end ARM chips), and its implications on the rest of the system.
3. To track the evolution of ARM-based systems, deploying small cluster systems to test new processors that were not available for the original Mont-Blanc prototype (both mobile processors and ARM server chips).
4. To provide continued support for the Mont-Blanc consortium, namely operations of the Mont-Blanc prototype, and hands-on support for our application developers

8.3.1.3. QUANTICOL

Program: The project is a member of Fundamentals of Collective Adaptive Systems (FOCAS), a FET-Proactive Initiative funded by the European Commission under FP7.

Project acronym: QUANTICOL

Project title: A Quantitative Approach to Management and Design of Collective and Adaptive Behaviours

Duration: 04 2013 – 03 2017

Coordinator: Jane Hillston (University of Edinburgh, Scotland)

Other partners: University of Edinburgh (Scotland); Istituto di Scienza e Tecnologie della Informazione (Italy); IMT Lucca (Italy) and University of Southampton (England).

Abstract: The main objective of the QUANTICOL project is the development of an innovative formal design framework that provides a specification language for collective adaptive systems (CAS) and a large variety of tool-supported, scalable analysis and verification techniques. These techniques will be based on the original combination of recent breakthroughs in stochastic process algebras and associated verification techniques, and mean field/continuous approximation and control theory. Such a design framework will provide scalable extensive support for the verification of developed models, and also enable and facilitate experimentation and discovery of new design patterns for emergent behaviour and control over spatially distributed CAS.

8.3.1.4. NEWCOM#

Program: FP7-ICT-318306

Project acronym: NEWCOM#

Project title: Network of Excellence in Wireless Communications

Duration: 11 2012 – 10 2015

Coordinator: Consorzio Nazionale Interuniversitario per le Telecomunicazioni (Italy)

Other partners: Aalborg Universitet (AAU). Denmark; Bilkent Üniversitesi (Bilkent). Turkey; Centre National de la Recherche Scientifique (CNRS). France; Centre Tecnològic de Telecomunicacions de Catalunya (CTTC). Spain; Institute of Accelerating Systems and Applications (IASA). Greece; Inesc Inovacao; Instituto de Novas Tecnologias (INOV). Portugal; Poznan University of Technology (PUT). Poland; Technion - Israel Institute of Technology (TECHNION). Israel; Technische Universitaet Dresden (TUD). Germany; University of Cambridge (UCAM). United Kingdom; Universite Catholique de Louvain (UCL). Belgium; Oulun Yliopisto (UOULU). Finland

Abstract: NEWCOM# is a project funded under the umbrella of the 7th Framework Program of the European Commission (FP7-ICT-318306). NEWCOM# pursues long-term, interdisciplinary research on the most advanced aspects of wireless communications like Finding the Ultimate Limits of Communication Networks, Opportunistic and Cooperative Communications, or Energy- and Bandwidth-Efficient Communications and Networking.

8.3.2. Collaborations in European Programs, except FP7 & H2020

8.3.2.1. CROWN

Program: European Community and Greek General Secretariat for Research and Technology

Project acronym: CROWN

Project title: Optimal Control of Self Organized Wireless Networks

Duration: 2012-2015

Coordinator: Tassiulas Leandros

Other partners: Thales, University of Thessaly, National and Kapodistrian University of Athens, Athens University of Economics and Business

Abstract: Wireless networks are rapidly becoming highly complex systems with large numbers of heterogeneous devices interacting with each other, often in a harsh environment. In the absence of central control, network entities need to self-organize to reach an efficient operating state, while operating in a distributed fashion. Depending on whether the operating criteria are individual or global, nodes interact in an autonomic or coordinated way. Despite recent progress in autonomic networks, the fundamental understanding of the operational behaviour of large-scale networks is still lacking. This project will address these emergent network properties, by introducing new tools and concepts from other disciplines.

We will first analyze how imperfect network state information can be harvested and distributed efficiently through the network using machine learning techniques. We will design flexible methodologies to shape the competition between autonomous nodes for resources, with aim to maintain robust social optimality. Both cooperating and non-cooperating game-theoretic models will be used. We also consider networks with nodes coordinating to achieve a joint task, e.g., global optimization. Using algorithms inspired from statistical physics, we will address two representative paradigms in the context of wireless ad hoc networks, namely connectivity optimization and the localization of a network of primary sources from a sensor network.

Finally, we will explore delay tolerant networks as a case study of an emerging class of networks that, while sharing most of the characteristics of traditional autonomic or coordinated networks, they present unique challenges, due to the intermittency and constant fluctuations of the connectivity. We will study tradeoffs involving delay, the impact of mobility on information transfer, and the optimal usage of resources by using tools from information theory and stochastic evolution theory.

8.3.3. Collaborations with Major European Organizations

University of Athens: Panayotis Mertikopoulos was an invited professor for 3 months.

EPFL: Laboratoire pour les communications informatiques et leurs applications 2, Institut de systèmes de communication ISC, Ecole polytechnique fédérale de Lausanne (Switzerland). We collaborate with Jean-Yves Leboudec (EPFL) and Pierre Pinson (DTU) on electricity markets.

University of Antwerp: we collaborate with Benny Van Houdt on caching problems.

TU Wien: Research Group Parallel Computing, Technische Universität Wien (Austria). We collaborate with Sascha Hunold on experimental methodology and reproducibility of experiments in HPC.

8.4. International Initiatives

8.4.1. Inria International Labs

8.4.1.1. North America

- JLESC (former JLPC) (Joint Laboratory for Extreme-Scale Computing) with University of University of Illinois Urbana Champaign, Argonne Nat. Lab and BSC. Several members of MESCAL are partners of this laboratory, and have done several visits to Urbana-Champaign or NCSA.
- Associated Team with Berkeley. MESCAL is thus involved in the Inria@SiliconValley program.

8.4.2. Inria Associate Teams

8.4.2.1. EXASE

Title: Exascale Computing Scheduling and Energy

International Partner (Institution - Laboratory - Researcher):

Universidade Federal do Rio Grande do Sul (Brazil)

Duration: 2014 -

See also: https://team.inria.fr/exase/

The main scientific goal of this collaboration for the three years is the development of state-of-the-art energy-aware scheduling algorithms for exascale systems. Three complementary research directions have been identified : (1) Fundamentals for the scaling of schedulers: develop new scheduling algorithms for extreme exascale machines and use existing workloads to validate the proposed scheduling algorithms (2) Design of schedulers for large-scale infrastructures : propose energy-aware schedulers in large-scale infrastructures and develop adaptive scheduling algorithms for exascale machines (3) Tools for the analysis of large scale schedulers : develop aggregation methodologies for scheduler analysis to propose synthetized visualizations for large traces analysis and then analyze schedulers and energy traces for correlation analysis

8.4.2.2. CLOUDSHARE

Title: Guaranteed Application Performance on Idle Data Center Resources

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (United States)

Duration: 2009 - 2014

See also: http://mescal.imag.fr/membres/derrick.kondo/ea/ea.html

Data centers are often 85% idle as they must over-provision to ensure service level agreements. At the same time, high data center utilization is essential for efficient resource usage and optimal revenue. One way to improve utilization is for low-priority applications to use the idle resources of data centers, allowing high-priority applications to preempt them at any time. While users benefit from the lower costs of using these idle resources, parallel applications such as Map-Reduce can suffer severe overheads and unpredictable performance due to unexpected preemption and unavailability. The goal of this project is to enable complex applications to utilize idle data center resources with guaranteed performance. Our approach will be as follows. First, we will investigate novel statistical methods to predict the execution time of complex batch applications. Second, we will apply machine learning methods to predict idleness in data centers. Third, we will craft fair scheduling algorithms for multiple applications that compete for idle data center resources. The collaboration bridges experts in statistical modeling and simulation from the Inria MESCAL team with system and scheduling experts in the Berkeley BOINC team and the Google Infrastructure team.

8.4.3. Inria International Partners

8.4.3.1. Declared Inria International Partners

- MESCAL has strong connections with both UFRGS (Porto Alegre, Brazil) and USP (Sao Paulo, Brazil). The creation of the LICIA common laboratory (see next section) has made this collaboration even tighter.
- MESCAL has strong bounds with the University of Illinois Urbana Champaign, within the (Joint Laboratory on Petascale Computing, see previous section).
- MESCAL also has long lasting collaborations with University of California in Berkeley.

8.4.4. Participation In other International Programs

8.4.4.1. South America

- LICIA. The CNRS, Inria, the Universities of Grenoble, Grenoble INP and Universidade Federal do Rio Grande do Sul have created the LICIA (*Laboratoire International de Calcul intensif et d'Informatique Ambiante*). Jean-Marc Vincent is the director of the laboratory, on the French side.

  The main themes are high performance computing, language processing, information representation, interfaces and visualization as well as distributed systems.

  More information can be found at http://www.inf.ufrgs.br/licia/.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Rhonda Righter (UC Berkeley), two weeks in May.
- Mario Bravo (University of Chile), one week in March.
- Josu Donsel (LAAS), two weeks in September.
- William H. Sandholm (University of Wisconsin), 4 days in September.
- Jian Li (Texas-A&M University) visited as a PhD intern for two months.
- Wenjing Wu (Chinese Academy of Science) (one month, Sept.- Oct.)
- Rafael Tesser (UFRGS) visited as a PhD intern for one month.
- Philippe Navaux (UFRGS), Nicolas Maillard (UFRGS) and Alexandre Carissimi (UFRGS) and Lucas Schnorr (UFRGS) visited Mescal for two weeks in Jan. and Oct. 2014.

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

- Panayotis Mertikopoulos visited the University of Athens for one trimester to the Department of Physics and the Department of Economics (invited by Aris L. Moustakas and Andreas Polydoros).
- Panayotis Mertikopoulos visited the Univeristy of Neuchâtel for one week (Department of Mathematics, invited by Michel Benaïm).
- Panayotis Mertikopoulos visited the University of Wisconsin–Madison for one week (Department of Economics, invited by William H. Sandholm).
- Arnaud Legrand, Luka Stanisic and Augustin Degomme visited the Barcelona Supercomputer Center in November 2014.
- Jean-Marc Vincent visited UFRGS for two weeks in Feb. - Mar. 2014.

MEXICO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. DIM/LSC TECSTES - 2011-052D

In this DIGITEO project (No. 6024), Hernán Ponce de Léon, Delphine Longuet (ParisSud) and Stefan Haar cooperate on the subject of conformance testing for concurrent systems, using Event Structures. The project started on September 1, 2011 and has ended on August 31, 2014.

8.2. IRT

8.2.1. SystemX

Participants: Simon Theissing, Stefan Haar.

We participate in the project MIC on multi-modal transport systems with in the IRT *System X*, with academic partners UPMC, IFSTTAR and CEA, and several industrial partners including Alstom (project leader), COSMO and Renault. MIC is scheduled to be completed late in 2016.

8.3. National Initiatives

8.3.1. ANR project IMPRO

Participants: Thomas Chatain, Stefan Haar, Serge Haddad.

The Project ANR **ImpRo** ANR-2010-BLAN-0317 involves *IRCCyN* (Nantes), *IRISA* (Rennes), *LIP6*(Paris), *LSV* (Cachan), *LIAFA* (Paris) and *LIF* (Marseille). It addresses issues related to the practical implementation of formal models for the design of communication-enabled systems: such models abstract away from many complex features or limitations of the execution environment. The modeling of *time*, in particular, is usually idealized, with infinitely precise clocks, instantaneous tests or mode communications, etc. Our objective is thus to study to what extent the practical implementation of these models preserves their good properties. We aim at a generic mathematical framework to reason about and measure implementability, and then study the possibility to integrate implementability constraints in the models. A particular focus is on the combination of several sources of perturbation such as resource allocation, the distributed architecture of applications, etc. We also study implementability through control and diagnosis techniques, and apply the developed methods to a case study based on the AUTOSAR architecture, a standard in the automotive industry.

8.4. European Initiatives

8.4.1. FP7 & H2020 Projects

8.4.1.1. Hycon2

Type: FP7 COOPERATION

Defi: Engineering of Networked Monitoring and Control Systems

Instrument: Network of Excellence

Objectif: Engineering of Networked Monitoring and Control systems

Duration: September 2010 - August 2014

Coordinator: CNRS

Partners: ETH Zürich, TU Berlin, TU Delft and many others.

Inria contact: C. Canudas de Wit

Abstract: Hycon2 aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems. It focuses in particular on the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems.

8.5. International Initiatives

8.5.1. Inria International Partners

8.5.1.1. Informal International Partners

1. The CMI (Chennai Mathematical Institute) is a long-standing partner of our team. The project *Île de France/Inde* in the *ARCUS* program from 2008 to 2011 has allowed several exchange visits between Cachan and Chennai, organizations of ACTS workshops with french and indian researchers in Chennai, internships in Cachan, and two theses in *co-tutelle* (Akshay Sundararaman, defended in 2010) and Aiswarya Cyriac (thesis in progress).

   Currently, Paul Gastin is co-head (with Madhavan Mukund) of the CNRS International Associated Laboratory (LIA) INFORMEL (INdo-French FORmal Methods Lab, http://projects.lsv.ens-cachan.fr/informel/), see below.
2. We have been exchanging visits for several years between *MExICo* and the DISCO team (Lucia Pomello and Luca Bernardinello) at University Milano-Bicocca, Italy.
3. Exchanges are frequent with Rolf Hennicker from LMU and Javier Esparza at TUM, both in Munich, Germany.
4. With the computer science and electrical engineering departments at Newcastle University, UK (Maciej Koutny, Alex Yakovlev, Victor Khomenko and Andrey Mokhov), with visits in both directions.

8.5.2. Participation In Other International Programs (non-Inria)

8.5.2.1. EGIDE: TAMTV

Since October 2013, Benedikt Bollig has been the French coordinator of the EGIDE-Procope project TAMTV (2013/2014), which is a collaboration with LIAFA (Paris) and the University of Ilmenau (Germany).

8.5.2.2. LIA INFORMEL

The Indo-French Formal Methods Lab is an International Associated Laboratory (LIA) fostering the scientific collaboration between India and France in the domain of formal methods and applications to the verification of complex systems. Our research focuses on theoretical foundations of games, automata, and logics, three important tools in formal methods. We study applications to the verification of safety-critical systems, with an emphasis on quantitative aspects (time, cost, energy, etc.), concurrency, control, and security protocols. The Laboratory was founded in 2012 by a consortium of researchers from the French Centre for Scientific Research (CNRS), Ecole Normale Supérieure de Cachan (ENS Cachan), Université Bordeaux 1, the Institute of Mathematical Sciences Chennai (IMSc), the Chennai Mathematical Institute (CMI), and the Indian Institute of Science Bangalore (IISc). It is directed by Paul Gastin (ENS Cachan, MExICo team) and Madhavan Mukund (CMI). The LIA has been scientifically extremely active and productive since its creation. The LIA has supported numerous scientific exchanges and joint research papers, see http://projects.lsv.ens-cachan.fr/informel/

8.6. International Research Visitors

8.6.1. Visits of International Scientists

- Maciej Koutny from Newcastle University came as an invited Profeessor (for ENS Cachan) from February 10 to 14 and from March 3 to 7, 2014.
- From May 12 to June 3rd, K. Narayan Kumar from CMI Chennai, India, visited to work with C. Aiswarya and Paul Gastin on controllers for distributed systems.
- From June 1 to 10, 2014, S. Akshay from IIT Bombay visited MExICo to work with Paul Gastin, on split-width techniques for timed systems.
- Stanislav Böhm from the Technical University of Ostrava visited the group from 7 october to 7 december 2014.

8.6.2. Internships hosted by MExICo

Athanasiou Konstantinos - Athanasios

Date: Apr 2014 - Aug 2014

Institution: National University of Athens, Greece

Jana Schubert

Date: 30 Sept 2013 - 28 February 2014

Institution: Universität Dresden, Germany

Akshay Kumar

Date: May 10 to July 22, 2014

Institution: IIT Khanpur

8.6.3. Visits to International Teams

8.6.3.1. Shorter Visits

- Paul Gastin visited S. Akshay at IIT Bombay twice, first January 11-17 to work on probabilistic timed systems , and then from December 7 to 19 to work on timed pushdown systems and to deliver an invited talk at FSTTCS in Delhi.
- Stefan Haar visited the PAIS lab at Higher School of Economics in Moscow from Sept. 15 to 23.

MIMETIC Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. ANR iSpace&Time

Participants: Fabrice Lamarche [contact], Carl Jorgensen, Julien Pettré, Marc Christie.

The iSpace&Time project is founded by the ANR and gathers six partners: IGN, Lamea, University of Rennes 1, LICIT (IFSSTAR), Telecom ParisTech and the SENSE laboratory (Orange). The goal of this project is the establishment of a demonstrator of a 4D Geographic Information System of the city on the web. This portal will integrate technologies such as web2.0, sensor networks, immersive visualization, animation and simulation. It will provide solutions ranging from simple 4D city visualization to tools for urban development. Main aspects of this project are:

- Creation of an immersive visualization based on panoramic acquired by a scanning vehicle using hybrid scanning (laser and image).
- Fusion of heterogeneous data issued by a network of sensor enabling to measure flows of pedestrians, vehicles and other mobile objects.
- Use of video cameras to measure, in real time, flows of pedestrians and vehicles.
- Study of the impact of a urban development on mobility by simulating vehicles and pedestrians.
- Integration of temporal information into the information system for visualization, data mining and simulation purpose.

The mimetic team is involved in the pedestrian simulation part of this project. This project started in 2011 and ended in november 2014.

8.1.1.2. ANR TecSan RePLiCA

Participants: Armel Crétual [contact], Anthony Sorel, Richard Kulpa.

The goal of RePLiCA project is to build and test a new rehabilitation program for facial praxia in children with cerebral palsy using an interactive device.

In a classical rehabilitation program, the child tries to reproduce the motion of his/her therapist. The feedback he/she has lays on the comparison of different modalities: the gesture of the therapist he/she has seen few seconds ago (visual space) and his/her own motion (proprioceptive space). Unfortunately, besides motor troubles these children often have some cognitive troubles and among them a difficulty to convert the information from a mental space to another one.

The principle of our tool is that during a rehabilitation session the child will observe simultaneously on the same screen an avatar, the virtual therapist's one, performing the gesture to be done, and a second avatar animated from the motion he actually performs. To avoid the use of a too complex motion capture system, the child will be filmed by a simple video camera. One first challenge is thus to be able to capture the child's facial motion with enough accuracy. A second one is to be able to provide him/her an additional feedback upon the gesture quality comparing it to a database of healthy children of the same age.

RePLiCA did start in january 2012 and will end in July 2015.

8.1.1.3. ANR JCJC Cinecitta

Participants: Marc Christie [contact], Cunka Sanokho.

Cinecitta is a 3-year young researcher project funded by the French Research Agency (ANR) lead by Marc Christie. The project started in October 2012 and will end in October 2015.

The main objective of Cinecitta is to propose and evaluate a novel workflow which mixes user interaction using motion-tracked cameras and automated computation aspects for interactive virtual cinematography that will better support user creativity. We propose a novel cinematographic workflow that features a dynamic collaboration of a creative human filmmaker with an automated virtual camera planner. We expect the process to enhance the filmmaker's creative potential by enabling very rapid exploration of a wide range of viewpoint suggestions. The process has the potential to enhance the quality and utility of the automated planner's suggestions by adapting and reacting to the creative choices made by the filmmaker. This requires three advances in the field. First, the ability to generate relevant viewpoint suggestions following classical cinematic conventions. The formalization of these conventions in a computationally efficient and expressive model is a challenging task in order to select and propose the user with a relevant subset of viewpoints among millions of possibilities. Second, the ability to analyze data from real movies in order to formalize some elements of cinematographic style and genre. Third, the integration of motion-tracked cameras in the workflow. Motion-tracked cameras represent a great potential for cinematographic content creation. However given that tracking spaces are of limited size, there is a need to provide novel interaction metaphors to ease the process of content creation with tracked cameras. Finally we will gather feedback on our prototype by involving professionals (during dedicated workshops) and will perform user evaluations with students from cinema schools.

8.1.1.4. ANR Contint Entracte

Participants: Charles Pontonnier, Georges Dumont, Steve Tonneau, Franck Multon, Julien Pettré [contact], Ana Lucia Cruz Ruiz, Antoine Muller, Anthony Sorel, Nicolas Bideau, Richard Kulpa.

The ANR project ENTRACTE is a collaboration between the Gepetto team in LAAS, Toulouse (head of the project) and the Inria/MimeTIC team. The project started in November 2013 and will end in August 2017. The purpose of the ENTRACTE project is to address the action planning problem, crucial for robots as well as for virtual human avatars, in analyzing human motion at a biomechanical level and by defining from this analysis bio-inspired motor control laws and bio-inspired paradigms for action planning. The project is launched since november 2013 and Ana-Lucia Cruz-Ruiz has been recruited as a PhD student since this date to begin to work on musculoskeletal-based methods for avatar animation. Moreover, Steve Tonneau, a PhD student currently in third year is also developing bio-inspired posture generators for avatar navigation in encumbered environments.

8.1.2. ADT

8.1.2.1. ADT Man IP

Participants: Franck Multon [contact], Julian Joseph.

The ADT-MAN-IP aims at proposing a common production pipeline for both MimeTIC and Hybrid teams. This pipeline intends to facilitate the production of populated virtual reality environments.

The pipeline starts with the motion capture of an actor, using motion capture devices such as a Vicon (product of Oxford Metrics) system. To do so, we need to design new methods to automatically adapt all motion captures data to an internal skeleton that can be reused to retarget the motion to various types of skeletons and characters. The purpose is then to play this motion capture data on any type of virtual characters used in the demos, regardless their individual skeletons and morphology. The key point here is to make this process be as automatic as possible. During the first year, a software toolbox has been developed in Motion Builder (product of Autodesk) to automate this process. We also developed automatic following methods to make virtual humans locomote along a given path in the environment in Unity 3D.

The second step in the pipeline is to design a high level scenario framework to describe a virtual scene and the possible user's interactions with this scene so that he/she can interact with the story directly. This work will be performed in 2015.

In this ADT we also will have to connect these two opposite parts into a unique framework that can be used by non-experts in computer animation to design new immersive experiments involving autonomous virtual humans. The resulting framework could consequently be used in the Immersia immersive room for various types of application.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. VISIONAIR

Participants: Georges Dumont [contact], Charles Pontonnier, Thierry Duval, Valérie Gouranton, Ronan Gaugne.

Our actual Virtual Reality systems allowed us to be a key partner within the European Project VISIONAIR (http://www.infra-visionair.eu/) that began in February 2011 in the infrastructure call of FP7. Our Immersia (http://www.irisa.fr/immersia) Virtual Reality room is, in Europe, a key place for virtual reality. We are leading the Work Package 9 on Advanced methods for interaction and collaboration of this project and are deeply involved in the directory board and in the scientific piloting committee. The VISIONAIR project's goal is to create a European infrastructure that should be a unique, visible and attractive entry towards high level visualization facilities. These facilities will be open to the access of a wide set of research communities. By integrating our existing facilities, we will create a world-class research infrastructure enabling to conduct frontier research. This integration will provide a significant attractiveness and visibility of the European Research Area. The partners of this project have proposed to build a common infrastructure that would grant access to high level visualization and interaction facilities and resources to researchers. Indeed, researchers from Europe and from around the world will be welcome to carry out research projects using the visualization facilities provided by the infrastructure. Visibility and attractiveness will be increased by the invitation of external projects.

This project is built with the participation of 26 partners, INPG ENTREPRISE SA IESA France , Institut Polytechnique de Grenoble France, University of Patras LMS Greece, Cranfield University United Kingdom, Universiteit Twente Utwente Netherlands, Universitaet Stuttgart Germany, Instytut Chemii Bioorganicznej Pan Psnc Poland, Université De La Méditerranée D'aix-Marseille II France, Consiglio Nazionale Delle Ricerche CNR Italy, Institut National de Recherche en Informatique et en Automatique Inria France, Kungliga Tekniska Hoegskolan Sweden, Technion - Israel Institute of Technology Israel, Rheinisch-Westfaelische Technische Hochschule Aachen RWTH Germany, Poznan University of Technology Poland, Arts et Métiers ParisTech AMPT France, Technische Universitaet Kaiserslautern Germany, The University of Salford United Kingdom, Fraunhofer-gesellschaft zur foerderung der Angewandten Forschung Germany, fundacio privada I2CAT Spain, University of Essex United Kingdom, Magyar Tudomanyos Akademia Szamitastechnikai Es Automatizalasi Kutato Intezet Hungary, École Centrale de Nantes France, University College of London United Kingdom, Politecnico di Milano Polimi Italy, European Manufacturing and Innovation Research Association (cluster leading excellence).

We organized the General Assembly of VISIONAIR, in Rennes Bretagne Atlantique Inria Research centre from 2014, dec. second to dec. fourth. We hosted 60 participants and had very interesting scientific presentations.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. FORMOSA

Title: Fostering Research on Models for Storytelling Applications

International Partner (Institution - Laboratory - Researcher):

National Cheng Chi University (TAIWAN)

Duration: 2013 - 2015

See also: http://www.irisa.fr/mimetic/GENS/mchristi/EA-FORMOSA/

The application context targeted by this proposal is Interactive Virtual Storytelling. The growing importance of this form of media reveals the necessity to re-think and re-assess the way narratives are traditionally structured and authored. In turn, this requires from the research community to address complex scientific and technical challenges at the intersection of literature, robotics, artificial intelligence, and computer graphics. This joint collaboration addresses three key issues in virtual storytelling: (i) delivering better authoring tools for designing interactive narratives based on literary-founded narrative structures, (ii) establishing a bridge between the semantic level of the narrative and the geometric level of the final environment to enable the simulation of complex and realistic interactive scenarios in 3D, and (iii) providing a full integration of the cinematographic dimension through the control of high-level elements of filmic style (pacing, preferred viewpoints, camera motion). The project is founded on a past solid collaboration and will rely on the team's complementarity to achieve the tasks through the development of a joint research prototype.

8.3.1.2. SIMS

Title: Toward realistic and efficient simulation of highly complex systems

International Partner (Institution - Laboratory - Researcher):

University of North Carolina at Chapel Hill (ÉTATS-UNIS)

Duration: 2012 - 2014

See also: http://www.irisa.fr/mimetic/GENS/jpettre/EASIMS/easims.html

The general goal of SIMS is to make significant progress toward realistic and efficient simulation of highly complex systems which raise combinatory explosive problems. This proposal is focused on human motion and interaction, and covers 3 active topics with wide application range: 1. Crowd simulation: virtual human interacting with other virtual humans, 2. Autonomous virtual humans: who interact with their environment, 3. Physical Simulation: real humans interacting with virtual environments. SIMS is orthogonally structured by transversal questions: the evaluation of the level of realism reached by a simulation (which is a problem by itself in the considered topics), considering complex systems at various scales (micro, meso and macroscopic ones), and facing combinatory explosion of simulation algorithms.

MIMOVE Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. ANR MURPHY

Participant: Animesh Pathak [correspondent].

- **Name:** MURPHY – *Dependability-focused Evaluation of Sensor Networks*
- **URL:** http://cedric.cnam.fr/~sailhanf/murphy/
- **Related activities:** § 6.6
- **Period:** [January 2011 – September 2014]
- **Partners:** CNAM (**Coordinator**), Inria MiMove, LAAS - CNRS, SmartGrains, Univ. Valenciennes.

Murphy aims at easing the development of dependable and pervasive applications built on top of robust wireless sensor networks, thus providing a mean for early detection of possible failures, by estimating dependability metrics. This endeavor is undertaken by providing:

- Fault detection based on in-network event processing;
- Fault injection that attempts to accelerate the occurrence of faults so as to judge the quality of the error handling and hence, facilitate the evaluation of dependability;
- Advanced code dissemination across sensor networks, which is intended to enable the dynamic and distributed insertion of faults and hide from the end user the complexity related to this task; and
- Suitable abstractions to reason on faults, wireless sensor networks, data-centric and event-driven applications.

The aforementioned components enable to detect faults, diagnose possible causes and select appropriate corrective actions, and therefore to consolidate the dependability of sensor applications.

7.1.2. Inria Support

7.1.2.1. Inria ADT iConnect

Participant: Valérie Issarny [correspondent].

- **Name:** iConnect – *Emergent Middleware Enablers*
- **Related activities:** § 6.3 and 6.4
- **Period:** [October 2013 – December 2015]
- **Partners:** Inria MiMove.

The pervasive computing vision is hampered by the extreme level of heterogeneity in the underlying infrastructure, which impacts on the ability to seamlessly interoperate. Further, the fast pace at which technology evolves at all abstraction layers increasingly challenges the lifetime of networked systems in the digital environment.

Overcoming the interoperability challenge in pervasive computing systems has been at the heart of the FP7 FET IP CONNECT project (http://www.connect-forever.eu/), which ran from 2009 to 2012, and was coordinated by Inria ARLES (MiMove's predecessor team). Specifically, CONNECT has been investigating the paradigm of *Emergent middleware*, where protocol mediators are dynamically synthesized so as to allow networked systems that provide complementary functionalities to successfully coordinate. The CONNECT project has in particular delivered prototype implementation of key enablers for emergent middleware, spanning discovery, protocol learning, and mediator synthesis and deployment. Further, while CONNECT focused on learning and reconciling interaction protocols at the application layer, the FP7 project CHOReOS (http://www.choreos.eu) to which ARLES contributed as well, investigated a complementary enabler that supports interoperability across systems implementing heterogeneous interaction paradigms (i.e., client-service, event-based and shared memory). The proposed enabler introduces the concept of XSB - eXtensible Service Bus, which revisits the notion of Enterprise Service Bus and features an end-to-end interaction protocol that preserves the interaction paradigms of the individual components, while still allowing interoperability.

The objective of the Inria iConnect ADT is to leverage and integrate the above complementary results, packaging and further enhancing enabler prototypes, for take-up of the results by the relevant open source community. The work will involve development effort focused on the following core enablers:

- Universal discovery of resources composing legacy discovery protocols,
- Dynamic synthesis and deployment of mediators specified as enhanced labelled transition systems,
- XSB as underlying run-time support for mediators so as to support interoperability across systems based on heterogeneous interaction paradigms,
- Experiment in the area of federated social networking.

We are releasing the software prototypes through the OW2 open source initiative FISSi (Future Internet Software and Services initiative – http://www.ow2.org/view/Future_Internet/), as our solutions are of direct relevance to sustaining interoperability in the Future Internet.

7.1.2.2. Inria ADT Yarta

Participant: Animesh Pathak [correspondent].

- **Name:** Yarta – *Middleware for mobile social ecosystems*
- **Related activities:** § 6.8
- **Period:** [October 2012 – September 2014]
- **Partners:** Inria MiMove.

Yarta is a middleware for managing mobile social ecosystems, which builds upon existing research in context-awareness in the pervasive computing domain. The work involves development effort in the multi-layer middleware architecture of Yarta, providing the needed functionalities, including: (*i*) Storage of social data in an interoperable format, using semantic technologies such as RDF; (*ii*) Extraction of social ties from context (both physical and virtual); (*iii*) Enforcement of access control to protect social data from arbitrary access; and (*iv*) A rich set of mobile social ecosystem (MSE) management functionalities, using which mobile social applications can be developed. Specifically, the ADT supports the public open source release and evolution of the Yarta middleware, which is currently a research prototype.

7.1.2.3. Inria ADT CityLab Platform

Participant: Animesh Pathak [correspondent].

- **Name:** CityLab Platform – *A Platform for Smarter Cities Promoting Social and Environmental Sustainability*
- **Related activities:** § 6.5
- **Period:** [November 2014 – October 2016]
- **Partners:** Inria MiMove, Inria CLIME.

The CityLab Platform ADT is part of the CityLab Inria Project Lab focused on the study of ICT-based smart city systems from supporting "sensing" systems up to advanced data analytics and new services for the citizens. While the topic is broad, the lab leverages relevant effort within Inria project-teams that is further revisited as well as integrated to meet the challenges of smart cities

There is the promise of enabling radically new ways of living in, regulating, operating and managing cities through the increasing active involvement of citizens. The latest technology trends of crowd- sourcing/sensing (crowd-Xing) and location-based social networking have reignited citizen engagement, opening new perspectives for cost-effective ways of making local communities and cities more sustainable. However, this requires investigating supporting systems of systems from advanced sensing systems up to integrated data management and associated data analytics. This is specifically the objective of the CityLab Inria ProjectLab, where the related ADT is focused on the development and maintenance of the CityLab Platform. The platform integrates the software prototypes developed as part of the undertaken research and will be made available under open source license. It is further the objective of the ADT to deploy and experiment with the platform within cities.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

We provide below information about the latest FP7 project in which we participated, ICT NoE NESSoS, which ended in 2014. We are currently taking part in two H2020 projects, RIA ICT CHOReVOLUTION and RIA ICT FIESTA, which are starting in 2015 and will appear in next year's report.

7.2.1.1. FP7 ICT NoE NESSoS

Participants: Valérie Issarny [correspondent], Animesh Pathak [correspondent].

Name: NESSoS – *Network of Excellence on Engineering Secure Future Internet Software Services and Systems*

URL: http://www.nessos-project.eu

Type: COOPERATION (ICT)

Defi: Trustworthy ICT

Instrument: Network of Excellence (NoE)

Related activities: § 6.8

Period: [October 2010 - March 2014]

Partners: Atos Origin (Spain), CNR (Italy) [**coordinator**], ETH Zürich (Switzerland), IMDEA Software (Spain), Inria (teams MiMove, CASSIS, and TRISKELL), KU Leuven (Belgium), LMU München (Germany), Siemens AG (Germany), SINTEF (Norway), University Duisburg-Essen (Germany), Universidad de Malaga (Spain), Università degli studi di Trento (Italy).

The Network of Excellence NESSoS on "Engineering Secure Future Internet Software Services and Systems" aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. The NESSoS engineering of secure software services is based on the principle of addressing security concerns from the very beginning in system analysis and design, thus contributing to reduce the amount of system and service vulnerabilities and enabling the systematic treatment of security needs through the engineering process. In light of the unique security requirements exposed by the Future Internet, new results are achieved by means of an integrated research, as to improve the necessary assurance level and to address risk and cost during the software development cycle in order to prioritize and manage investments.

7.2.2. Collaborations in European Programs, except FP7

7.2.2.1. EIT ICT Labs 3cixty

Participant: Animesh Pathak [correspondent].

Name: 3cixty – *A Platform for Apps and Services that Offer Comprehensive Views of a City*

URL: http://www.3cixty.com/

Period: [January 2014 - December 2015]

Partners: Ambientic (F), CEFRIEL (IT), DFKI (DE) [**coordinator**], Eurecom (F) [**associate leader**], Fondazione Politechnico di Milano (IT), Innovalor (NL), Inria MiMove [**associate leader**], LocaliData (ES), Mobidot (NL), Politechnico di Milano (IT), Telecom Italia (IT) [**associate leader**], Thales (F), TU Delft (NL), UC London (UK).

3cixty is a platform, well motivated in business terms, for developing apps for city visitors that makes it easy for application developers to access and process comprehensive heterogeneous information about a city; and a Showcase App using the platform that demonstrates its added value. The project will result new opportunities to enable city visitors to exploit the transportation, business, cultural, and touristic opportunities offered by a city more fully and in a more personally and environmentally appropriate way, thereby benefiting cities, their visitors, and application and service developers.

7.3. International Initiatives

7.3.1. Inria International Labs

Valérie Issarny acts as scientific manager of the Inria@Silicon Valley program (https://project.inria.fr/inria-siliconvalley/) since summer 2013; she is visiting scholar at CITRIS, EECS, University of California, Berkeley.

Sara Hachem conducts her postdoc research in the context of the Inria@Silicon Valley program at UC Berkeley.

7.3.2. Inria Associate Teams

7.3.2.1. Inria DRI/DST-CEFIPRA Associate Team: SARATHI

Participant: Animesh Pathak [correspondent].

Name: SARATHI – *Personalized Mobility Services for Urban Travelers*

Instrument: Inria DRI/DST-CEFIPRA Associate Team

Period: [January 2014 - December 2016]

Partners: Indraprastha Institute of Information Technology (IIIT), Delhi (India), Inria MiMove.

Website: https://mimove.inria.fr/inria-associate-team-sarathi/

The focus of the *Sarathi* project is on creating a personalized mobility service platform for urban travelers. The proposed work would require work on large scale mobile participatory sensing, urban transportation, location-aware services, machine learning, and software engineering. The individual strength of MiMove and IIIT provide complementary technical benefits for the project. MiMove leverages its work on large scale mobile participatory sensing (so far focused on EU-based transit contexts) addressing challenges brought to the fore by dynamic large scale systems in India; IIIT will build up on their previous work on mobile based system to provide route information and work on learning and mining techniques for inferring events of interest in transport systems.

Besides the complementary technical benefits, the collaboration will also help the project in evaluating the proposed solution in context of both developing and developed countries with different societal structure and preferences. Since personalized services are an integral part of the solution, the variety in social structures of India and France will help in developing solutions that are valid across continents. A deployment of the proposed solution in India will also test scalability and robustness of the solution in resource-constrained environments (e.g. intermittent network connectivity, low bandwidth) and will help in developing solutions that can be deployed in different working environments. Similarly, France (with already an advanced transit system) offers opportunities in verifying the requirements of a successful sustainable transport system.

7.3.3. Participation in other International Programs

7.3.3.1. International scientific cooperation program Inria/Brazil – Project M@TURE

Participant: Nikolaos Georgantas [correspondent].

Name: M@TURE – *Models @ runtime for self-adaptive pervasive systems*

Instrument: Inria-Brazil cooperation programme

Period: [October 2012 - September 2014]

Partners: Institute of Informatics of Federal University of Goias (Brazil), Inria MiMove.

The overall goal of the M@TURE project is to design, implement and evaluate a novel approach and architecture - comprising conceptual foundations, engineering techniques, and supporting middleware infrastructure - for self-adaptive pervasive systems by building on the notion of Models@run.time. Models@run.time extends the applicability of models and abstractions to the runtime environment. In contrast to design-time models, runtime models are used to reason about the running system taking into account its operating environment, and thus these models enable automating runtime decisions and actions regarding the creation, configuration, and evolution of the system. We in particular focus on the following dimensions and related models: (i) Requirements models making a system requirements-aware at runtime; (ii) Application- and middleware-level interoperability models exposing to an external observer the technological and business features of a system; and (iii) End-user and system engineer models modeling the internal elements of a system at two different abstraction levels. These models are considered both independently and, more importantly, in synergy in order to introduce a comprehensive conceptual and architectural solution for self-adaptive pervasive systems.

7.4. International Research Visitors

7.4.1. Internships

Raphael de Aquino Gomes (from Sep. 2014 until Aug. 2015)

PhD internship funded by a visitor PhD student scholarship of the Brazilian Science without Borders program provided by CAPES and CNPq.

Subject: *Self-Adaptive Use of Cloud Resources for Heterogeneous Dynamic Service Choreographies*

Institution: Federal University of Goias - UFG (Brazil)

MINT Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. TurboTouch (ANR, Oct 2014-2018)

Participants: Géry Casiez [correspondant], Nicolas Roussel, Thomas Pietrzak.

Touch-based interactions with computing systems are greatly affected by two interrelated factors: the transfer functions applied on finger movements, and latency. Little is actually known on these functions, and latency only recently received attention in this context. This project aims at transforming the design of touch transfer functions from black art to science to support high-performance interactions. We will precisely characterize the functions used and the latency observed in current touch systems. We will develop a testbed environment to support multidisciplinary research on touch transfer functions. We will use this testbed to design latency reduction and compensation techniques, and new transfer functions.

Partners: Inria Lille's NON-A team and the "Perceptual-motor behavior group" from the Institute of Movement Sciences.

8.1.2. Touchit (13th FUI, May 2012-2015)

Participants: Michel Amberg, Géry Casiez, Frédéric Giraud, Thomas Pietrzak, Nicolas Roussel [correspondant], Betty Lemaire-Semail [correspondant].

The purpose of this project is twofold. It aims at designing and implementing hardware solutions for tactile feedback based on programmable friction. It also aims at developing the knowledge and software tools required to use these new technologies for human-computer interaction. Grant for MINT is balanced on 272 keuro handled at University for L2EP, and 220 Keuros for Inria.

Partners: STMicroelectronics, CEA/LETI, Orange Labs, CNRS, EASii IC, MENAPIC and ALPHAUI.

Competitive clusters involved: Minalogic, Cap Digital and MAUD.

8.1.3. Smart-Store (12th FUI, 2011-2014, extended to 2015)

Participants: Samuel Degrande [correspondant], Laurent Grisoni, Fabrice Aubert.

The aim of this project is to set up, in the context of retail, some middleware and hardware setup for retail interactive terminal, that allows customer to connect with their own smart-phone on a system that includes a large screen, and allows to browse some store offer, as well as pre-order and/or link to further reconsulting. SME Idées-3com leads this FUI, which also includes Immochan, Oxylane, and VisioNord. Grant for MINT is 301 Keuros. This project started on September 2012 (start of this project has been delayed due to administrative problems), for a duration of 36 months.

Associated competitivity cluster: PICOM (retail)

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. Happiness (H2020-ICT-2014-1/ICT-03-2014/RIA, Jan 2015 - Jan 2018)

Participants: Thomas Pietrzak, Nicolas Roussel [correspondant].

The main objective of this project is to develop and evaluate new types of haptic actuators based on Advanced Thin, Organic and Large Area Electronics (TOLAE) technologies for use in car dashboards.

Partners: CEA (coordinator), Inria Rennes' HYBRID team, Arkema, Bosch, Glasgow University, ISD, Walter Pack, Fundacion Gaiker.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

Inria Northern lab with LUCID group (Liege, P. Leclercq). We initiated this year a joint work on collaborative tools for architects. One of the goal of this collaboration is to initiate discussions and early results for a H2020 proposal.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Marcelo Wanderley (McGill, dec. 2014)
- Masaya Takasaki (Profesor at Saitama Univerity), one month (july 2014)

MISTIS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **PERSYVACT project.** MISTIS is involved in a 2-year exploratory project, funded (20 keuros for the whole project) by the PERSYVAL labex (https://persyval-lab.org/en), with other teams from local laboratories, LJK, GIPSA-Lab and TIMC. The goal of this research project is to build tools for analyzing hierarchically structured models for high dimensional complex data. In parallel, MISTIS received **15 keuros** from the labex for the PhD of A. Chiancone co-advised with J. Chanussot from GIPSA-Lab.
- **Grenoble Pole Cognition (2013-14).** We received in 2012, 2013 and 2014 **2.5 keuros** from the Grenoble Pole Cogntion, http://www.grenoblecognition.fr/, for collaborative projects involving the GIN and NeuroSpin. This funding was used this year for the internship of Alexis Arnaud on MRI analysis for small animals.
- MISTIS is involved in three regional initiatives: PEPS (funded by CNRS and the PRES of Grenoble), AGIR (funded by Université Grenoble 1 and Grenoble-INP) and the MOTU project (funded by UPMF). The first two projects focus on the modelling of the extreme risk and its application in social science. The partners include the LTHE (Laboratoire d'étude des Transferts en Hydrologie et Environnement) and the 3S-R lab (Sols, Solides, Structures - Risques). The third project focuses on the use of statistical techniques for transportation data analysis and involves the GAEL laboratory (Grenoble Applied Economics Laboratory).
- MISTIS participates in the weekly statistical seminar of Grenoble. Jean-Baptiste Durand is in charge of the organization and several lecturers have been invited in this context.
- S. Girard is at the head of the probability and statistics department of the LJK since september 2012.

8.2. International Initiatives

8.2.1. Informal International Partners

The context of our research is also the collaboration between MISTIS and a number of international partners such as the Statistics Department of University of Washington in Seattle, the Russian Academy of Science in Moscow, the National University of Ireland in Galway, and more recent partners like IDIAP involved in the HUMAVIPS project, Université Gaston Berger in Senegal and University of Melbourne in Australia. We will also work at turning other current European contacts, *e.g.* at EPFL (A. Roche at University Hospital Lausanne and Siemens Healthcare), into more formal partnerships and eventually explore the possibility for a H2020 project in the *Personalizing Health and Care* axis.

The main international collaborations that we are currently trying to develop are with:

- Fabrizio Durante, Free University of Bozen-Bolzano, Italy.
- Emma Holian and John Hinde from National University of Ireland, Galway, Ireland.
- K. Qin and D. Wraith from RMIT in Melbourne, Australia and Queensland University of Technology in Brisbane, Australia.
- E. Deme and S. Sylla from Saint Louis university and IRD in Saint Louis, Senegal.
- Alexandre Nazin and Russian Academy of Science in Moscow, Russia.
- Alexis Roche and University Hospital Lausanne/Siemens Healthcare, Advanced Clinical Imaging Technology group, Lausanne, Switzerland.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Seydou Nourou Sylla (Université Gaston Berger, Sénégal) has been hosted by the MISTIS team for four months.
- Darren Wraith (Queensland University of Technology in Brisbane, Australia) has been hosted by the MISTIS team for 2 weeks.

8.3.1.1. Internships

Alexis Arnaud (Master, from Feb 2014 until June 2013)

Subject: Mixtures of generalized Student multivariate distributions: application to tumor characterisation from multiparametric MRI.

Institution: University Montpellier 2

Anne Charlier (2nd year)

Subject: Estimation of gaz concentrations in a gaz mixture from spectrophotometric measures.

Institution: PHELMA, Grenoble-INP

Lisa Qian-ru (Master)

Subject: Inverse regression to identify and quantify polluants from UV spectroscopy measures.

Institution: Univ. PMF, Hemera, Meylan

Seydou-Nourou Sylla (PhD, from September 2014 to December 2014)

Subject: Classification for medical data

Institution: Université Gaston Berger (Sénégal)

MNEMOSYNE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

As our team just settled in Bordeaux, it was an important priority for our early years of activity to initiate local collaborations, at the regional level.

7.1.1. Project of the Aquitaine Regional Council: Decision making, from motor primitives to action

The aim of this project (partly funding the PhD of Meropi Topalidou) is to investigate decision making at intermediate level in order to establish the link between motor primitives and higher level actions. The question is to understand how continuous complex motor sequences can be dynamically represented as actions such that they can be manipulated to resolve conflict when several actions are possible. This PhD work will require an extensive review of the literature and more specifically literature that promote a global view on decision making. The DANA modeling framework will be used for the design of distributed, numerical and adaptive models using rate based neuron models. The model will ideally be embodied into a simulator or a robotic platform in order to solve a simple taks such as for example, foraging or grasping, with a continuous component at the motor level.

7.1.2. Project of the Department Sciences and Technologies of the University of Bordeaux: Pinokio

In collaboration with school of engineers ENSEIRB and the support of the Department Sciences and Technologies of the University of Bordeaux, we've built a prototype of a motorized lamp equipped with a camera and leds. It can move autonomously and track faces with dedicated algorithms. The goal of this project is to have a dedicated robotic platform to study motor interaction and to investigate decision making in order to establish the link between motor primitives and higher level actions.

7.1.3. Project PEPS of the Idex: Dopamine control of a novel basal ganglia cell-type

The neurotransmitter dopamine (DA) plays a key role in basal ganglia (BG) circuits. However, despite the fundamental importance of DA in those circuits, the electrophysiological effects of dopamine on target neurons are largely unknown. Furthermore, contrary to classical models that only view the globus pallidus (GP) as a relay station of the indirect pathway, our neuroscientist colleagues at IMN have discovered a novel GP cell-type called the Arkypallidal (Arky-GP) neurons that only project to striatum in a very dense way. Arky-GP cells represent a novel BG pathway that might contribute massively to the GABAergic inhibition in striatum. In this project, we would like to explore for the first time whether DA has a direct action on Arky-GP neurons through D2 DA receptors. To do so, this project is based on multidisciplinary approaches that bring together 3 teams of IMN with different but complementary expertise (anatomical, in vivo electrophysiology, optogenetic manipulation, and computational modeling).

7.1.4. Collaboration with the Neurocentre Magendie on parameter optimization: Neurobees

The development of computational models of neurons and networks typically involves tuning of the numerical parameters to fit experimental results. This fitting is necessary to obtain consistent neural activity and therefore consistent action potential genesis and timing which play a key role in neural information encoding. However his task requires the exploration of multidimensional parameter spaces which are rarely accessible to analytical approaches. Moreover, if the parameter tuning can sometimes be manually completed it is more convenient to use automated optimization algorithms at least for two reasons: (i) to apply an homogeneous processing to all the calculation and parameter space exploration which alleviates operator influence and (ii) to avoid a tedious and uncertain result from human operators when the dimensionality increases. In computational

neuroscience, the optimization algorithms are often applied to cell scale models to mimic the electrical activity of their biological counterpart. Most of the time, it is necessary for the neuroscientist to quantify biophysical parameters such as dynamic conductances, ionic concentrations or even neuronal structure to understand the neuron dynamic properties. In this field, there is an important need for innovative optimization tools. We have recently developed with neuroscientists of the Bordeaux Magendie Neurocentre, a new multi-agent algorithm in line with ABC (Artificial Bee Colony) paradigm. This algorithm whose principle is based on honeybees food foraging has been successfully applied to several neural modeling optimization problems. We have applied it to several benchmarks and it has shown significantly higher performances in computing optimal parameter values in comparison with the previous optimization tools. A method paper summarizing all these results will be submitted at the begining of 2015.

7.1.5. Collaboration with IMS on GSM signal effects: JNNS (Julia Neural networks Simulator)

In collaboration with IMS (Laboratory of Material and System Integration, in Bordeaux) we have developed a electrophysiological setup aiming at the investigation of the effects of GSM (Global System for Mobile communications) signal on neural living tissue [15]. Our biological model consists in a cortical cell culture growing on a multi-electrode array. A first series of observations have been published showing a significant effect of these wavelengths on primary neural cell cultures spontaneous electrical activity. We are now looking for the action mechanism and site which could explain the observed effects. Along with these experimental investigations, modeling studies are considered. A spiking neuron network model is developed, taking into account biological features of the cell culture and exhibiting similar excitatory/inhibitory connectivity ratios as well as spontaneous bursting activity and a model of the recording setup (extracellular electrodes). To optimize the model development and notably the simulation speed, we have implemented the model using the Julia language. This tool is also be developed following the NeuroML initiative standards.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. ANR project KEOPS

Participants: Frédéric Alexandre, Thierry Viéville.

We were responsible for this “ANR Internal White Project” involving Mnemosyne and Neuromathcomp Inria Project-Teams in France with the U. of Valparaiso, U. Tecnica Frederico Santa-Maria, and U. Chile, that ended in december 2014. The project was addressing the integration of non-standard behaviors of retinal neural sensors, observed in natural conditions, into neural coding models and their translation into real, highly non-linear, bio-engineering artificial solutions. Results concerning the thalamus and the retina evoked in § 6.3 have been obtained in this project. Furthermore, new collaboration tracks have been conducted, taking benefit of interdisciplinarity of this international collaboration, e.g. at the methodological level (*cf.* the ECOS project in § 7.3).

7.3. International Initiatives

7.3.1. Project BGaL with India

In the 3-years project “Basal Ganglia at Large (BGaL)”, funded by the CNRS and the CEFIPRA, we collaborate with the computer science department of IIIT Hyderabad and the biomedical department of IIT Madras, for the design of models of basal ganglia, of their relation with other brain structures and or their implementation at large scale.

7.3.2. Project ECOS-Sud with Chile

In the 3-years project "A network for computational neuroscience, from vision to robotics", funded by ECOS-Sud and Conicyt, we collaborate with University Santa Maria and University of Valparaiso in Chile, and also with another Inria EPI, NeuroMathComp. The goal of the project is to rely on our experience of previous collaborations with these teams, to develop original tools and experimental frameworks to open our scientific domains of investigation to new fields of valorization, including medical (neurodegeneration) and technological aspects (robotics).

7.4. International Research Visitors

7.4.1. Internships

P Mehta Hima

Date: June - Dec 2014

Institution: Univ. Hyderabad (India)

7.4.2. Visits to International Teams

M. Topalidou, N. Rougier and F. Alexandre visited IIIT of Hyderabad (India) from 7 to 12 Dec. 2014 (*cf.* the BGaL project in § 7.3).

MOAIS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- **ANR grant MOEBIUS (2013-2015).** Multi-objective scheduling for large computing platforms. Coordinator: Grenoble INP (Moais team). Partners: Grenoble INP, Inria, BULL.
- **ANR grant EXAVIZ (2011-2015).** Large Scale Interactive Visual Analysis for Life Science. Partners: Inria Rhône-Alpes, Université d'Orléans, the LBT lab from IBPC, the LIMSI from Université d'Orsay, and the CEMHTI labs from CNRS.
- **ANR HPAC (2012-2015)**. High Performance Algebraic Computing. Coordinator: UJF (LJK/CASYS team). Partners: project-team MOAIS (Grenoble), project-team ARENAIRE (LIP, Lyon), project-team SALSA (LIP6, Paris), the ARITH group (LIRMM lab, Montpellier).
- **Equipex Kinovis (2012-2017)**. 2.6 Meuros. Large scale multi-camera platform (extension of the Grimage platform to 60 cameras, depth and X-ray cameras). Coordinator E Boyer, LJK Inria MORPHEO team. Partners: Inria Rhône-Alpes and the LJK, LIG, LADAF and GIPSA labs.
- **ANR-11-LABX-0025 PERSYVAL-Lab** funds the following PhD in collaboration with other labs:
  - in collaboration with Verimag: Multi-objective optimization for resource management on multicore systems, (PhD Abhinav Srivastav, since 9/2012)
  - In collaboration with Gipsa-lab and Inria BiBop: Simulations of Fibrous Materials. (PhD Gilles Daviet, since 9/2013)
  - in collaboration with Inria Privatics and Verimag: Secure Outsourcing (PhD Amrit Kumar, since 11/2013)

7.1.2. Competitivity Clusters

- **SoC-Trace**, Minalogic 2011-2014 contract. This project aims the development of tools for the monitoring and debug of mumticore systems on chip. Leader: ST-Microelectonic. Partners: Inria (Mescal, Moais); UJF (TIMA, LIG/Hadas); Magilem, ProBayes. Moais contributes with technics and tools for visual aggregation of application traces. The contract funds 1 phD thesis (Damien Dosimont) and 1 year engineer.
- **ARAMIS, PIA contract n°P3342-146798 (2014-2017)**: Architecture Robuste pour les Automates et Mate´riels des Infrastructures Sensibles. Coordinator: ATOS-WorldGrid; Partners: CEA, SecLab, UJF. The UJF gathers the folowing teams: LIG (Moais, Drakkar, Vasco); LJK (Casys); IF; Verimag (DCS). BPI funds UJF with 775 ke (funds 4 PhDs and 5 years egineers), among which 410ke for LIG. Moais co-advises two PhD Thesis: Nicolas Kox with LIG-VASCO team (Rupture de protocole avec garanties de se´curite´ pour les syste`mes de contro^le-commande); Maxime Puys with VERIMAG-DCS (Processus de ge´ne´ration de filtres certifie´s pour les syste`mes de contro^le-commande).
- **PIA ELCI (2014-2017)**. Environnement Logiciel pour le Calcul Intensif. Coordinator BULL. Partners: BULL, CEA, Inria, SAFRAB, UVSQ.

7.1.3. National ADT

- ADT K'STAR with cooperation between EPIs MOAIS and RUNTIME (Bordeaux). Coordinator: T. Gautier. https://gforge.inria.fr/projects/kstar. The main objective is to provide OpenMP-3.1 with some extension from OpenMP-4.0 standard to perform OpenMP programs on multi-CPUs multi-GPUs by using XKaapi and StarPU runtimes.

7.1.4. Inria Project Lab

7.1.4.1. C2S@Exa - Computer and Computational Scienecs at Exascale

Participants: Olivier Aumage [RUNTIME project-team, Inria Bordeaux - Sud-Ouest], Jocelyne Erhel [SAGE project-team, Inria Rennes - Bretagne Atlantique], Philippe Helluy [TONUS project-team, Inria Nancy - Grand-Est], Laura Grigori [ALPINE project-team, Inria Saclay - Île-de-France], Jean-Yves L'excellent [ROMA project-team, Inria Grenoble - Rhône-Alpes], Thierry Gautier [MOAIS project-team, Inria Grenoble - Rhône-Alpes], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Michel Kern [POMDAPI project-team, Inria Paris - Rocquencourt], Stéphane Lanteri [Coordinator of the project], François Pellegrini [BACCHUS project-team, Inria Bordeaux - Sud-Ouest], Christian Perez [AVALON project-team, Inria Grenoble - Rhône-Alpes], Frédéric Vivien [ROMA project-team, Inria Grenoble - Rhône-Alpes].

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

T. Gautier is coordinator of the Pole 4: Programming Models.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. VISIONAIR

Type: FP7

Defi: NC

Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUPPORT ACTIONS

Objectif: NC

Duration: February 2011 - January 2015

Coordinator: Frederic Noël, Grenoble INP.

Partner: Gather 27 European Partners.

Inria contact: G. Dumont

Abstract: Federation of European Virtual Reality and Scientific Visualization Platforms opened to European researchers. Moais involved through the Grimage Platform.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. ANOMALIES@EXASCALE

Title: Anomalies Detection and Handling towards Exascale Platforms

International Partner (Institution - Laboratory - Researcher):

University of Chicago (ÉTATS-UNIS)

Duration: 2014 - 2016

See also: http://intra-id.imag.fr/

The Anomalies@exascale project intends to prospect new scheduling solutions for very large parallel computing platforms. In particular, we consider the new problems related to fault tolerance raising with the developments of exascale platforms. We expect to define new ways to detect both execution failures and more transient performance anomalies. Information gathered from the detectors will then be taken into account by schedulers to implement corrective measures.

7.3.1.2. ExaSE

Title: Exascale Computing Scheduling and Energy

International Partner (Institution - Laboratory - Researcher):

UFRGS, PUC Minas and UPS (Brazil)

Duration: 2014 - 2016

See also: https://team.inria.fr/exase/

The main scientific context of this project is high performance computing on Exascale systems: large-scale machines with billions of processing cores and complex hierarchical structures. This project intends to explore the relationship between scheduling algorithms and techniques and the energy constraints present on such exascale systems.

7.3.2. Participation to other International Programs

7.3.2.1. LICIA

Title: International Laboratory in High Performance and Ubiquitous Computing

International Partner (Institution - Laboratory - Researcher):

UFRGS (Brazil)

Duration: 2011 - 2018

See also: http://licia-lab.org/

The LICIA is an Internacional Laboratory and High Performance and Ubiquitous Computing born in 2011 from the common desire of members of Informatics Institute of the Federal University of Rio Grande do Sul and of Laboratoire d'Informatique de Grenoble to enhance and develop their scientific parternship that started by the end of the 1970. LICIA is an Internacional Associated Lab of the CNRS, a public french research institution. It has support from several brazilian and french research funding agencies, such as CNRS, Inria, ANR, European Union (from the french side) and CAPES, CNPq, FAPERGS (from the Brazilian side). Moais is deeply invovled in the creation and animation of LICIA. Bruno Raffin is LICIA associate director.

7.3.2.2. CAPES/COFECUB StarShip

Title: Scalable Tools and Algorithms para Resilient, Scalable, Hybrid Interactive Processing

International Partner (Institution - Laboratory - Researcher):

UFRGS (Brazil)

Duration: 2013 - 2016

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Guochuan Zhang. Professor at Zhejiang University, China, one month stay at Moais in 2014.
- Adel Safi, Associate Professor ar ESSTT, Tunisia, 2 weeks stay at Moais in 2014.
- Andreï Tchernykh, Researcher at CICESE, Mexico, one month stay at Moais in 2014.
- Monica Liliana Hernandez Ariza, Master Student at University of Santander, Colombia, 4 months stay at Moais in 2014.

MODAL Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Collaborations within SIRIC

Participants: Guillemette Marot, Alain Celisse.

SIRIC (Site of integrated research in Cancerology) ONCOLille has been created during "Plan Cancer 2". More information about it can be found at http://www.canceropole-nordouest.org/qui-sommes-nous/le-cancer-en-region/le-siric-oncolille.html. Collaborations established through common articles or funding proposals writings with members of MODAL concern the following teams:

Univ. Lille 2, Functional and structural genomics, M. Figeac

CHRU Lille, Hematology laboratory, C. Preudhomme

CNRS, UMR8161, IBL (Institute of Biology of Lille), O. Pluquet

Inserm UMR837 - Team 5, I. Van Seuningen

8.1.2. Other collaborations

Institut Pasteur Lille, Transcriptomics and Applied Genomics, D. Hot (**Participant:** G. Marot)

Inserm U1011, J. Eeckhoute (**Participants:** G. Marot, A. Celisse)

Registre Regional des Cancers de Lille et sa Region, Dr. Karine Ligier (**Participant:** C. Preda)

8.2. National Initiatives

8.2.1. ANR ClinMine

Participants: Julien Jacques, Cristian Preda, Vincent Vandewalle.

Modal team is member of ClinMine ANR project (http://www.lifl.fr/ClinMine/pmwiki/index.php) in charge with statistical methdology. Collaborators : LIFL, CHRU Lille, CHU Montpellier, ALICANTE, GHICL.

8.2.2. Working groups

Alain Celisse belongs to the Statistics for Systems Biology group (SSB) in Paris.

Guillemette Marot belongs to the StatOmique working group http://vim-iip.jouy.inra.fr:8080/statomique/

8.3. International Initiatives

8.3.1. Inria Associate Teams

Associate Team acronym: SIMERGE (Statistics Inference for the Management of Extreme Risks and Global Epidemiology)

Principal investigator (Inria): Stéphane Girard Mistis, Inria Grenoble Rhône-Alpes, France.

Principal investigator (Main team): Abdou Kâ Diongue LERSTAD, Université Gaston Berger, Sénégal.

Other participants: Laboratory EQUIPPE (Economie QUantitative Intégration Politiques Publiques Econométrie), Univ. Lille 1, 2 and 3, MODAL, IRD (Institut de Recherche pour le Développement), Unité de Recherche sur les Maladies Infectieuses et Tropicales Emergentes (URMITE), Dakar, Sénégal.

MODEMIC Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Labex Numev

Within the Labex Numev (Solutions Numériques, Matérielles et Modélisation pour L'Environnement et le Vivant [0]), the team is the coordinator since 2012 of a working group on Modelling and numerical probabilities for ecology and biology with Univ. Montpellier II, Univ. Montpellier I and CNRS ISEM.

A one day workshop on "Stochastic Models for Biology" has been organized in January with Pierre Pudlo (Univ. Montpellier II). The invited speakers were Nicolas Champagnat (Inria/Institut Élie Cartan), Jean-François Delmas (Ecole des Ponts ParisTech – CERMICS), and Michel Benaïm (Université de Neuchâtel).

7.1.2. Inter-teams seminar

J. Harmand is the coordinator of the inter-teams seminar about the modelling of bioprocesses [0], involving the labs INRA-LBE (Narbonne), UMR LISPB (Toulouse) and the two Inria project teams BIOCORE and MODEMIC.

A. Rapaport has been invited to participate to the "Séminaire au vert" of BIOCORE team in November 2014.

7.2. National Initiatives

7.2.1. RNSC project "MnMs"

The MnMs [0] (Numerical Models for Microbial ecosystems) project has been funded by the RNSC (National Network on Complex Systems) in 2013 for two years.

It aims at studying how to articulate existing models (discrete, continuous, deterministic, stochastic...) in a multi-scale framework with interactions between various scales. The team has been the coordinator and the other partners were Irstea LISC (Clermont-Ferrand) and CNRS/UMPC LPMTC (Paris VI).

7.2.2. Inria Project Lab "Algae in Silico"

MODEMIC is a partner of the proposal of the Inria Project Lab *Algae in Silico* launched last year by BIOCORE Inria project-team.

7.2.3. INRA-CEPIA project "New perspectives for the MSCF"

The project entitled *Multi-Stage Continuous Fermentor (MSCF): Study of fermentation with disturbances, and development of a control law* has been funded in 2013 by the INRA Dept. CEPIA for two years, in which the Montpellier Units SPO and Mistea are involved.

It is the continuation of the work initiated within the former European CAFE project about the control of a wine fermentation process. The goal of this project is to study the fermentation with nitrogen addition. From a control point of view, we study how to regulate both the sugar concentration and the CO_2 production rate in a series of four tanks of a MSCF, that mimics in continuous culture four important physiological states of a batch fermentation.

[0] http://www.lirmm.fr/numev
[0] https://sites.google.com/site/journeesthematiquesdulbe/
[0] http://www-sop.inria.fr/members/Fabien.Campillo/projects/mnms

7.2.4. PGMO "OPTIBIO"

OPTIBIO (New challenges in the optimal control of bioprocesses) is a new project funded by the french Fundation FMJH (Fondation Mathématique Jacques Hadamard) in 2014 for three years, within the program PGMO (Gaspard Monge Program for Optimization and operations research).

The project is coordinated by T. Bayen (ACSIOM, Univ. Montpellier II) and the other partners are: MODEMIC, Univ. Limoges, EPI COMMANDS (Saclay) and EPI BIOCORE (Sophia Antipolis).

The overall objective of this project is to address the optimization of bioprocesses over an *infinite horizon*. Infinite horizon optimal control is well suited for every problem where the time horizon is uncertain and can be expected to be large: e.g. economics models related to optimal growth and sustainable development, biological models such as the optimal control of interacting species and pest control, stabilization of controlled mechanical systems...The recent expectations of sustainable development raise new optimization problems that take into account auxiliary outputs, such as biogas production, that were neglected in the past. It appears that mathematical problems that come from the modelization of these processes are often difficult to solve, and one objective of the proposal is to develop new mathematical methods in order to address these issues. More precisely, the objective of the project is to study the following issues:

- Optimization of bioprocess over an infinite horizon.
- Development of accurate methods in order to deal with uncertainties that affects the chemostat model (uncertainties come from unknown parameters or noise from the measurements).
- Stabilization of the chemostat model including delay in the system.

7.2.5. INRA-MIA methodological networks

The team is involved in two new networks of the MIA (Applied Mathematics and Informatics) Department of INRA:

- MEDIA [0] (Modèles d'Équations DIfférentielles et Autres systèmes dynamiques pour l'écologie),
- REM [0] (RÉduction de Modèles),

that have been launched this year.

7.3. International Initiatives

7.3.1. Inria International Labs

Within the BioNature [0] operation program of CIRIC Center (Inria Chile), the team participates to the axis *Modeling, control and optimization of waste-water treatment processes and biogas production*, and more specifically to the research lines

- automation and control of anaerobic digestion,
- innovative technologies and modeling on wastewater and residues treatment.

In this framework, the team has co-supervised the postdoctoral stay of. M. Sebbah in Chile.

7.3.2. Inria Associate Teams

7.3.2.1. DYMECOS2

Title: Modelling of microbial ecosystems, bioprocesses control and numerical simulations

International Partner (Institution - Laboratory - Researcher):

Departamento de Ingeniería Matemática (DIM), Universidad de Chile

Centro de Modelamiento Matemático (CMM), UMi CNRS/ Universidad de Chile

[0] http://www.netvibes.com/reseaumiamedia
[0] https://sites.google.com/site/reseaurem2/
[0] http://www.bionature.cl

Departamento de Matematica, Universidad Tecnica Federico Santa Maria (UTFSM), Valparaiso (Chile)

Bionature, CIRIC, Inria Chile

Duration: 2014-2016

See also: https://sites.google.com/site/eadymecos/

The objective is to develop, from expert knowledge and experimental observations, models of microbial ecosystems that are simple enough to carry out the determination of explicit "control laws", and realistic enough to represent real bio-processes. One of the difficulties is to identify the limits of the validity of these models, in terms of spatial heterogeneity and microbial population size. We aim also outcomes of the modeling for the optimal design of waste-water treatment plants.

7.3.3. Inria International Partners

7.3.3.1. Declared Inria International Partners

LIRIMA NuWat [0] 2013-... (Tlemcen, Algeria and Tunis, Tunisia). NuWat focuses on the numerical Modeling and simulation of microbial ecosystems and their application in biotechnology with a focus on solutions considered as promising for countries of the Maghreb, for instance in waste-water treatment systems and its reuse in agriculture under semi-arid climates. NuWat handles the two following related topics: (1) the elaboration of numerical hybrid models for simulation of bacterial ecosystems combining discrete models (for small size populations) and continuous models (for large size populations, substrate and environment); (2) the systematic numerical and software development for biotechnology process control. The project was initially developed in collaboration with the Univ. of Tlemcen but is now extended to the ENIT in Tunis, with an extension of the domain of application to system biology and biotechnologies.

7.3.3.2. Informal International Partners

CESAME, Univ. Louvain, Belgium : D. Dochain

3BIO, Univ. Mons, Belgium : A. Vande Wouver

Univ. Neuchâtel, Switzerland : M. Benaim

MOMAT, Univ. Madrid, Spain : B. Ivorra

Univ. Newcastle, U.K. : M. Wade

7.3.4. Participation In other International Programs

7.3.4.1. CIB (Centre Interfacultaire Bernoulli)

Program: Bernoulli workshops

Title: The role of mathematics and computer science in ecological theory

Inria principal investigator: MODEMIC (C. Lobry),

Partners: EPFL, Lausanne (Switzerland).

Duration: July 1 to December 31, 2014

Abstract: A former collaboration of Inria with ecologists (the COREV network presently animated by R. Arditi) initiated (at the beginning of the 90s) by J-L. Gouzé and C. Lobry within the framework of the Inria project team COMORE, pursued then by MERE and COMORE raised an important event: the half-year *Mathematics and computer sciences in theoretical ecology* which we co-organize with R. Arditi (associated with D. de Angelis and L. Ginzburg) at the Federal Polytechnical School of Lausanne (Centre Interfacultaire Bernoulli).

The program lasted from July 1 to December 31, 2014. It gathered about 90 participants among them very well known scientists from Theoretical Ecology (S. Allesina, D. de Angelis, P. Chesson, J. Damuth, L. Ginzburg, R. Holt...) and from Mathematics (M. Benaïm, N. Berglund, M. and F. Diener, M. Krupa, A. Lam, W.M. Ni...).

Six one-week workshops where organized (one each month) on the following topics:

[0] https://project.inria.fr/nuwat/

- Non-adaptive selection: explaining macroscopic laws in ecology and evolution (Organizers: L. Ginzburg, R. Arditi, L.-F. Bersier).
- Dispersal and competition of populations and communities in spatially inhomogeneous environments (Organizer: D. DeAngelis).
- Validation of uncertain ecological models with imprecise data (Organizer : S. Ferson)
- Discrete, explicit simulations versus continuous, aggregated models (Organizers: R. Arditi, C. Lobry, Y. Tyutyunov).
- Multi-scale models, slow-fast differential equations, averaging in ecology (Organizers: M. Desroches, O. Faugeras, C. Lobry, T. Sari).
- Microbial ecology and mathematical modelling (Organizers : R. Arditi, J.J. Godon, J. Harmand, C. Lobry)

The third workshop was organized in collaboration with O. Faugeras (EPI Neuromathcomp, Sophia-Antipolis) and M. Desroches (EPI MYCENAE, Rocquencourt) and tried to find connections between neurosciences and theoretical ecology through mathematical models.

Web-site: http://mathcompecol.epfl.ch/

7.3.4.2. TREASURE

Program: Euromediterranean 3+3

Title: Treatment and Sustainable Reuse of Effluents in semiarid climates

Inria principal investigator: MODEMIC (J. Harmand),

Partners: Centre de Biotechnology de Sfax, Department of environmental engineering (Tunisia), Ecole Nationale des Ingénieurs de Tunis, Dept. de Mathématiques (Tunisia), Institut National de la Recherche Agronomique, Dept. EA, MICA et MIA (France), National Research Center, Water Pollution Control (Egypt), University of Patras, Process Control Laboratory (Greece), University of Tlemcen, Automatic control (Algeria), University of santiago de compostella, Environmental engineering (Spain) Université Cadi Ayyad de Marrakech, Faculté des Sciences de Semlalia, Dépt. de Mathématiques (Morocco), Centre National de Recherche sur l'Eau et l'Energie, Université Française d'Egypte (Egypt)

Duration: Jan 2012 - Dec 2015

Abstract: The TREASURE network aims at integrating knowledge on the modelling, the control and the optimization of biological systems for the treatment and reuse of waste-waters in countries submitted to semi-arid climates under both socio-economical and agronomic constraints within the actual context of global changes. A special focus of the actual project concerns the integration of technical skills together with socio-economical and agronomic studies for the integrated solutions developed within the network to be evaluated and tested in practice in the partner's countries and, as possible as it may be within the context of the actual research network, valorizing these proposed technologies with the help of industrial on site in partners from South.

Web-site: https://project.inria.fr/treasure

7.3.4.3. TASSILI

Program: Hubert Curien Program

Title: Procédés membranaires pour le traitement anaérobie des eaux usées - Modélisation, commande et optimisation

Inria principal investigator: MODEMIC (J. Harmand),

Partners: LBE-INRA (Narbonne), Univ. Tlemcen (Algeria)

Duration: 3 years

Abstract: This project aims at promoting collaborations with our historical Algerian partners of the department of automatic control of the University of Tlemcen. The objectives of the project are to develop research on the modeling and the control of anaerobic systems through the co-advisoring of Zeyneb Khedim (PhD 'co-tutelle' between UM2 and Univ. Tlemcen).

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Imme Van Den Berg

Subject: Construction, analysis and simulation of population dynamics models

Date: until Feb. 2014

Institution: Univ. of Evorra (Portugal)

7.4.1.1. Internships

Moshen Chebbi

Subject: Stochastic modeling for membrane bioreactors

Date: from Sep 2014 until Nov 2014

Institution: ENIT, Tunis (Tunisia)

Alejandro Rojas-Palma

Subject: Study of some problems related to modelling and optimization of bioprocesses

Date: from Oct 2014 until dec 2014

Institution: Univ. of Chile

Victor Riquelme

Subject: Optimal control for the preservation of exploited water resources

Date: from Nov 2014 until Jan 2015

Institution: Univ. of Chile

7.4.2. Visits to International Teams

7.4.2.1. Research stays abroad

C. Lobry has spent one semester (July-December 2014) at CIB, EPFL (Lausanne, Switzerland) for the co-organization of the Bernoulli workshop on the role of mathematics and computer science in ecological theory (see 7.3.4.1).

B. Cloez has spent one month (November-December) in Switzerland at Univ. Neuchâtel and at CIB-EPFL, Lausanne.

MOISE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Clémentine Prieur is a member of the project "Soutien à l'Excellence et à l'Innovation Grenoble INP" MEPIERA (MEthodologies innovantes Pour l'Ingénierie de l'Eau et des Risques Associés) leaded by A.- C. Favre (LTHE).
- N. Feyeux PhD is sponsored by the action ARC3 Environment of the Region Rhone-Alpes.

8.1.1. Collaborations with Various Regional Research Teams

- LGGE Grenoble, Edge team (C. Ritz, O. Gagliardini, F. Gillet-Chaulet, G. Durand), see paragraphs 6.3.2 .
- LTHE, A.C. Favre: hydrological risk assessment.
- LTHE, Thierry Lebel, Théo Vischel: tracking of mesoscale convective systems,
- LTHE, MISTIS, LJK: AGIR project. Clémentine Prieur obtained the funding for a thesis on risk assessment.
- Univ. Lyon 1 collaboration with V. Maume-Deschamps.
- LGGE, MEOM team : 6.2.3 ,6.3.1 ,6.2.3.1 ,6.2.5 , 6.2.1 , 6.1.1 .

8.2. National Initiatives

8.2.1. Interactions with other Inria Project-Teams or Actions

Participants	Inria Project-Team	Research topic	Link
M. Nodet C.Prieur, P. Tencaliec	LEMON MISTIS	Life-Fluid coupling hydrological risk assessment	https://team.inria.fr/lemon/ 6.6
L. Gilquin, C. Helbert, C.Prieur, A. Vidard	STEEP	Calibration and sensitivity analysis for LUTI models	6.8
C.Prieur, L. Viry	GRAAL	Grid deployment for the study of West African Monsoon	6.4
A. Vidard M. Nodet F.X. Le Dimet	CLIME, FLUMINANCE	Image assimilation	6.2.3
A. Vidard, M. Nodet, E.Kazantsev	SCIPORT	Ocean Adjoint Modelling	6.3.1 ,6.2.5

8.2.2. Collaborations with other Research Teams in France

Participants	Research Team	Research topic	Link
C. Prieur	IMT Toulouse, EDF	Sensitivity analysis	6.4.1
C. Helbert, S. Nanty, C. Prieur	CEA Cadarache	Sensitivity analysis	6.4.1
C. Prieur	ICJ Lyon 1, CEDRIC CNAM	Multivariate risk indicators	6.6
C. Prieur	IMT Toulouse, Caracas	Non parametric estimation for hypoelliptic diffusions	6.7
A. Vidard	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique (Toulouse), Mercator-Océan (Toulouse), Laboratoire de Physique des Océans (Brest),	Ocean Data Assimilation	6.3.1
A. Vidard	LOCEAN (Paris)	Ocean Adjoint Modelling	6.3.1
A. Vidard	LPO (Brest), CERFACS	Ocean data assimilation	6.3.1
F. Lemarié, L. Debreu	Ifremer (Brest), LEGOS (Toulouse), LOCEAN (Paris), UPS (Toulouse), SHOM (Toulouse)	Numerical schemes for ocean modelling	6.1.1
F. Lemarié	LPO (Brest), Meteo France (Toulouse), Mercator-Ocean (Toulouse)	Atmospheric boundary layer modeling	6.1.2
L. Debreu, F. Lemarié	LMD (Paris), CNRM (Toulouse), LSCE (Saclay)	Numerical schemes for atmospheric modelling	6.1.1
E. Blayo, F. Lemarié	LSCE (Saclay)	Coupling methods for climate models	6.1.2

8.2.3. Other National Initiatives

- C. Prieur chairs GdR MASCOT NUM, in which are also involved M. Nodet, E. Blayo, C. Helbert, L. Viry, S. Nanty, L. Gilquin.

  http://www.gdr-mascotnum.fr/doku.php
- C. Prieur is the leader of the LEFE/MANU project MULTIRISK (2014-2016) on multivariate risk analysis, which gathers experts from Lyon 1 University, CNAM, LSCE and Grenoble University mainly.
- M. Nodet is involved in GDR Calcul and GDR Ondes.
- A. Vidard leads a group of projects gathering multiple partners in France and UK on the topic "Variational Data Assimilation for the NEMO/OPA9 Ocean Model", see 6.3.1 .
- E. Blayo is the chair of the CNRS-INSU research program on mathematical and numerical methods for ocean and atmosphere LEFE-MANU. http://www.insu.cnrs.fr/co/lefe
- L. Debreu is the coordinator of the national group COMODO (Numerical Models in Oceanography)
- E.Kazantsev, E.Blayo, F. Lemarié participate in the project "PACO - Vers une meilleure paramétrisation de la côte et des conditions limites dans les modèles d'océan" supported by LEFE-GMMC and LEFE-MANU .

8.2.4. ANR

- A 4-year ANR contract: ANR TOMMI (Transport Optimal et Modèles Multiphysiques de l'Image), see paragraphs 6.2.3.2 ,6.2.3 .

- A 4 year ANR contract (2011-2015): ANR COMODO (Communauté de Modélisation Océanographique) on the thematic "Numerical Methods in Ocean Modelling". (coordinator L. Debreu) 6.1.1
- A 4-year ANR contract (2014-2018) : ANR HEAT (Highly Efficient Atmospheric modelling) on the development of numerical schemes for atmospheric models (coordinator: T. Dubos, LMD)
- A 3.5 year ANR contract: ANR CITiES (numerical models project selected in 2012). http://steep.inrialpes.fr/?page_id=46

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. ERA-CLIM2

Type: COOPERATION

Instrument: Specific Targeted Research Project

Program: Collaborative project FP7-SPACE-2013-1

Project acronym: ERA-CLIM2

Project title: European Reanalysis of the Global Climate System

Duration: 01/2014 - 12/2016

Coordinator: Dick Dee (ECMWF, Europe)

Other partners: Met Office (UK), EUMETSAT (Europe), Univ Bern (CH), Univ. Vienne (AT), FFCUL (PT), RIHMI-WDC (RU), Mercator-Océan (FR), Météo-France (FR), DWD (DE), CERFACS (FR), CMCC (IT), FMI (FI), Univ. Pacifico (CL), Univ. Reading (UK), Univ. Versailles St Quentin en Yvelines (FR)

Inria contact: Arthur Vidard

8.3.2. Collaborations with Major European Organizations

Partner: GDR-E CONEDP

Subject: Control of Partial Differential Equations.

Partner: University of Reading, Department of Meteorology, Department of Mathematics

Subject: Data assimilation for geophysical systems.

Partner: European Centre for Medium Range Weather Forecast. Reading (UK)

World leading Numerical Weather Center, that include an ocean analysis section in order to provide ocean initial condition for the coupled ocean atmosphere forecast. They play a significant role in the NEMOVAR project in which we are also partner.

Partner: Met Office (U.K) National British Numerical Weather and Oceanographic service. Exceter (UK).

We do have a strong collaboration with their ocean initialization team through both our NEMO, NEMO-ASSIM and NEMOVAR activities. They also are our partner in the NEMOVAR consortium.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

Jose R. León (UCV, Caracas) was funded for a 1,5 months invitation.

8.4.2. Participation In other International Programs

- C. Prieur collaborates with Jose R. León (UCV, Central University of Caracas).
- C. Prieur is leader of a project ECOS Nord with Venezuela (2012-2015).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Jose-Raphael Leon-Ramos, Caracas University, 3 months
- Victor Shutyaev, Russian Academy of Sciences, 2 weeks

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

- M. Nodet visited the University of Reading Data Assimilation group and gave a seminar.
- F.-X. Le Dimet visited the Florida State University, department of meteorology and oceanography during three weeks in June 2014 (Invitation of Prof. Xiaolei Zou). One seminar given on assimilation of images 6.2.3 .
- F.-X. Le Dimet visited the Harbin Institute of Technology, department of mathematics during one month in October 2014 (Invitation of Prof. Jianwei Ma). A serie of four one-hour seminars has been delivered on variational methods in data assimilation.

MOKAPLAN Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

Jean-David Benamou is the coordinator of the ANR ISOTACE (Interacting Systems and Optimal Transportation, Applications to Computational Economics) ANR-12-MONU-0013 (2012-2016). The consortium explores new numerical methods in Optimal Transportation AND Mean Field Game theory with applications in Economics and congested crowd motion. Four extended seminars have been organized/co-organized by Mokaplan. Check https://project.inria.fr/isotace/news.
Christophe Duquesne (Aurigetech) is a software and mobility consultant hired on the ANR budget. He helps the consortium to develop its industrial partnerships.

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. MOKALIEN

Title: Numerical Optimal Transportation in (Mathematical) Economics

International Partner (Institution - Laboratory - Researcher):

McGill University (CANADA)

Duration: 2014 - 2016

See also: https://team.inria.fr/mokaplan/mokalien/

The overall scientific goals is to develop numerical methods for large scale optimal transport and models based on optimal transport tools
see https://team.inria.fr/mokaplan/files/2014/09/MOKALIEN_Proposal_2013.pdf, section 2.

A few additional applications were suggested at our annual workshop in october
https://team.inria.fr/mokaplan/first-meeting-in-montreal-at-u-mcgill-october-20-24-2014/

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Adam Oberman (U. Mc Gill) visited Mokaplan in June.

7.3.2. Visits to International Teams

7.3.2.1. Sabbatical programme

Guillaume Carlier in on sabbatical for the academic year (délégation CNRS at the UMI-CNRS 3069 PIMS at UVIC, Victoria, British Columbia, Canada). He is taking advantage of this full-research year to work on optimal transport methods for kinetic models for granular media (with M. Agueh and Reinhard Illner), Wasserstein barycenters and to continue to develop joint projects on numerical optimal transport with J.D. Benamou's MOKAPLAN team.

MORPHEME Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

- iBV, "Genetics of mouse brain development" (Michèle Studer 's group): morphological analysis of neurons within the layer V of mice cortex
- TIRO group (CEA, UNS, Lacassagne center): histopathology analysis
- TIRO group (CEA, UNS, Lacassagne center): dynamics of iodin in the stomachal wall

6.2. National Initiatives

6.2.1. LABEX SIGNALIFE

The MORPHEME team is member of the SIGNALIFE Laboratory of Excellence.

Florence Besse and Xavier Descombes are members of the Scientific Committee.

Florence Besse and Grégoire Malandain participated in the selection committee for LabeX PhD programme students.

6.2.2. ANR MOTIMO

Participants: Laure Blanc-Féraud, Xavier Descombes, Eric Debreuve, Huei Fang Yang, Ana Rita Lopes Simoes.

In collaboration with Institut de Mathématiques de Toulouse, INRA, Institut de Mécanique des Fluides de Toulouse, Laboratoire J-A Dieudonné, et IMV Technologies (PME). Details on the (website)

6.2.3. ANR POXADRONO

Participants: Florence Besse [PI], Xavier Descombes, Laure Blanc-Féraud.

The young researcher ANR project POXADRONO is in collaboration with Caroline Medioni, Hélène Bruckert, Giovanni Marchetti, Charlène Perrois and Lucile Palin from iBV. It aims at studying ARN regulation in the control of growth and axonal guidance by using a combination of live-imaging, quantitative analysis of images, bio-informatic analysis and genetic screening.

6.2.4. ANR DIG-EM

Participants: Grégoire Malandain, Xavier Descombes.

Morphogenesis controls the proper spatial organization of the various cell types. While the comparatively simple process of patterning and cell differentiation has received considerable attention, the genetic and evolutionary drivers of morphogenesis are much less understood. In particular, we very poorly understand why some morphogenetic processes evolve very rapidly, while others show remarkable evolutionary stability.

This research program aims at developing a high-throughput computational framework to analyze and formalize high-throughput 4D imaging data, in order to quantify and formally represent with cellular resolution the average development of an organism and its variations within and between species. In addition to its biological interest, a major output of the project will thus be the development of robust general computational methods for the analysis, visualization and representation of massive high-throughput light-sheet data sets.

This 4-years project started october the 1st, 2014 and is leaded by P. Lemaire (CRBM, Montpellier). Participants are the CRBM, and two Inria project-team, Morpheme and Virtual Plants.

6.2.5. ANR PhaseQuant

Participants: Grégoire Malandain, Eric Debreuve.

The PhaseQuantHD project aims at developing a high-content imaging system using quadriwave lateral shearing interferometry as a quantitative phase imaging modality. Automated analysis methods will be developed and optimized for this modality. Finally an open biological study question will be treated with the system.

This 3-years project started october the 1st, 2014 and is leaded by B. Wattelier (Phasics, Palaiseau). Participants are Phasics, and three academic teams TIRO (UNS/CEA/CAL), Nice, Mediacoding (I3S, Sophia-Antipolis), and Morpheme.

6.2.6. Inria Large-scale initiative Morphogenetics

Participants: Grégoire Malandain, Xavier Descombes, Gaël Michelin.

This action gathers the expertise of three Inria research teams (Virtual Plants, Morpheme, and Evasion) and other groups (RDP (ENS-CNRS–INRA, Lyon), RFD (CEA-INRA-CNRS, Grenoble)) and aimed at understanding how shape and architecture in plants are controlled by genes during development. To do so, we will study the spatio-temporal relationship between genetic regulation and plant shape utilizing recently developed imaging techniques together with molecular genetics and computational modelling. Rather than concentrating on the molecular networks, the project will study plant development across scales. In this context we will focus on the Arabidopsis flower, currently one of the best-characterised plant systems.

6.3. International Initiatives

6.3.1. Participation In other International Programs

We have obtained a CNRS/RAS project between IITP Moscow (S. Komech, E. Pechersky and E. Zhizhina) and Morpheme team (X. Descombes, A. Razetti).

6.4. International Research Visitors

6.4.1. Visits of International Scientists

Elena Zhizhina, Evgueny Pechersky and Serguei Komech from IITP Moscow (Russian Academy of Science) was invited one week in november.

Sonia Chaibi, PhD student at Badji Mokhtar-Annaba University (Algeria) has visited the Morpheme team during two months (january-february).

6.4.1.1. Internships

Tarun Yellamraju : IIT Bombay, Bachelor. Marked poiont process, graph cut and attractive interactions. Supervisors: X. Descombes.

6.4.2. Visits to International Teams

Xavier Descombes has visited the IITP in Moscow during one week in july within a CNRS/RAS program.

MORPHEO Project-Team

8. Partnerships and Cooperations

8.1. ARC6 project PADME – Perceptual quality Assessment of Dynamic MEshes and its applications

In this project, we propose to use a new and experimental "bottom-up" approach to study an interdisciplinary problem, namely the objective perceptual quality assessment of 3D dynamic meshes (i.e., shapes in motion with temporal coherence). The objectives of the proposed project are threefold:

1. to understand the HVS (human visual system) features when observing 3D animated meshes, through a series of psychophysical experiments;
2. to develop an efficient and open-source objective quality metric for dynamic meshes based on the results of the above experiments;
3. to apply the learned HVS features and the derived metric to the application of compression and/or watermarking of animated meshes.

This work is funded by the Rhône-Alpes région through an ARC6 grant for the period 2013-2016. The three partners are LIRIS (University Lyon 1, Florent Dupont), GIPSA-Lab (CNRS, Kai Wang) and LJK (University of Grenoble, Franck Hétroy-Wheeler). A PhD student, Georges Nader, is working on this project.

8.2. National Initiatives

8.2.1. Motion analysis of laboratory rodents

In order to evaluate the scalabililty of previous work on motion analysis of laboratory rodents, a collaboration has been initiated with the Institut Clinique de la Souris (ICS), in Institut de Génétique et de Biologie Moléculaire et Cellulaire (IGBMC). This institute is dedicated to phenotypying of mice and requires reliable motion analysis tools. A multicamera plateform has been deployed at ICS and will be exploited next year for tests ranging from one to two hundreds mice.

8.2.2. ANR

8.2.2.1. ANR project Morpho – Analysis of Human Shapes and Motions

Morpho is aimed at designing new technologies for the measure and for the analysis of dynamic surface evolutions using visual data. Optical systems and digital cameras provide a simple and non invasive mean to observe shapes that evolve and deform and we propose to study the associated computing tools that allow for the combined analysis of shapes and motions. Typical examples include the estimation of mean shapes given a set of 3D models or the identification of abnormal deformations of a shape given its typical evolutions. Therefore this does not only include static shape models but also the way they deform with respect to typical motions. It brings a new research area on how motions relate to shapes where the relationships can be represented through various models that include traditional underlying structures, such as parametric shape models, but are not limited to them. The interest arises in several application domains where temporal surface deformations need to be captured and analyzed. It includes human body analyses but also extends to other deforming objects, sails for instance. Potential applications with human bodies are anyway numerous and important, from the identification of pathologies to the design of new prostheses. The project focus is therefore on human body shapes and their motions and on how to characterize them through new biometric models for analysis purposes. 3 academic partners will collaborate on this project: the Inria Rhône-Alpes with the Morpheo team, the GIPSA-lab Grenoble and the Inria Lorraine with the Alice team. Website: http://morpho.inrialpes.fr/.

8.2.3. Competitivity Clusters

8.2.3.1. FUI project Creamove

Creamove is a collaboration between the Morpheo team of the Inria Grenoble Rhône-Alpes, the 4D View Solution company specialised in multi-camera acquisition systems, the SIP company specialised in multimedia and interactive applications and a choreographer. The objective is to develop new interactive and artistic applications where humans can interact in 3D with virtual characters built from real videos. Dancer performances will be pre-recorded in 3D and used on-line to design new movement sequences based on inputs coming from human bodies captured in real time. Website: http://www.creamove.fr.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. Re@ct

Type: FP7 COOPERATION

Defi: IMMERSIVE PRODUCTION AND DELIVERY OF INTERACTIVE 3D CONTENT

Instrument: Specific Targeted Research Project

Objectif: Networked Media ans Search Systems

Duration: December 2011 - November 2014

Coordinator: BBC (UK)

Partner: BBC (UK), Fraunhofer HHI (Germany), University of Surrey (UK), Artefacto (France), OMG (UK).

Inria contact: Jean-Se´bastien Franco, Edmond Boyer

Abstract:RE@CT will introduce a new production methodology to create film-quality interactive characters from 3D video capture of actor performance. Recent advances in graphics hardware have produced interactive video games with photo-realistic scenes. However, interactive characters still lack the visual appeal and subtle details of real actor performance as captured on film. In addition, existing production pipelines for authoring animated characters are highly labour intensive. RE@CT aims to revolutionise the production of realistic characters and significantly reduce costs by developing an automated process to extract and represent animated characters from actor performance capture in a multiple camera studio. The key innovation is the development of methods for analysis and representation of 3D video to allow reuse for real-time interactive animation. This will enable efficient authoring of interactive characters with video quality appearance and motion. The project builds on the latest advances in 3D and free-viewpoint video from the contributing project partners. For interactive applications, the technical challenges are to achieve another step change in visual quality and to transform captured 3D video data into a representation that can be used to synthesise new actions and is compatible with current gaming technology.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

8.4.1.1.1. Joint project with Forest Research, UK

A common work with an ecophysiologist from Forest Research, Eric Casella, is currently carried out to detect, analyse and correct acquisition noise from terrestrial laser scans (t-LiDAR) of trees. This project is funded by Grenoble university, through the AGIR framework. First results have been presented during the 5th French-Canadian workshop “Use of t-LiDAR systems in forest ecology”.

8.4.1.2. Informal International Partners

8.4.1.2.1. Collaboration with TU Munich

The long term collaboration with TU Munich and Slobodan Ilic on human motion capture is ongoing with the work of Paul Huang [5] that was published atCVPR this year. The work contributes with an approach that identifies and takes benefit of key poses when tracking shapes.

8.5. International Research Visitors

8.5.1. Visits to International Teams

8.5.1.1. Sabbatical programme

Reveret Lionel

Date: Jul 2014 - June 2015

Institution: Brown University (USA)

MULTISPEECH Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Equipex ORTOLANG

Project acronym: ORTOLANG [0]

Project title: Open Resources and TOols for LANGuage

Duration: September 2012 - May 2016 (phase I, signed in January 2013)

Coordinator: Jean-Marie Pierrel, ATILF (Nancy)

Other partners: LPL (Aix en Provence), LORIA (Nancy), Modyco (Paris), LLL (Orléans), INIST (Nancy)

Abstract: The aim of ORTOLANG (Open Resources and TOols for LANGuage) is to propose a network infrastructure offering a repository of language data (corpora, lexicons, dictionaries, etc.) and tools and their treatment that are readily available and well-documented which will:

- enable a real mutualization of analysis research, of modeling and automatic treatment of the French language;
- facilitate the use and transfer of resources and tools set up within public laboratories towards industrial partners, in particular towards SME which often cannot develop such resources and tools for language treatment due to the costs of their realization;
- promote the French language and local languages of France by sharing knowledge which has been acquired by public laboratories.

Several teams of the LORIA laboratory contribute to this Equipex, mainly with respect to providing tools for speech and language processing. MULTISPEECH contributes text-speech alignment and speech visualization tools.

8.1.2. ANR ORFEO

Project acronym: ORFEO [0]

Project title: Outils et Ressources pour le Français Ecrit et Oral

Duration: February 2013 - February 2016

Coordinator: Jeanne-Marie DEBAISIEUX (Université Paris 3)

Other partners: ATILF, CLLE-ERSS, ICAR, LIF, LORIA, LATTICE, MoDyCo

Abstract: The main objective of the ORFEO project is the constitution of a Corpus for the Study of Contemporary French.

In this project, we have provided so far an automatic alignment at the word and phoneme levels for audio files from the corpus TCOF (Traitement de Corpus Oraux en Français). This corpus contains mainly spontaneous speech, recorded under various conditions with a large SNR range and a lot of overlapping speech. We tested different acoustic models and different adaptation methods for the forced speech-text alignment. Other corpora are currently being processed.

[0] http://www.ortolang.fr

[0] http://www.agence-nationale-recherche.fr/en/anr-funded-project/?tx_lwmsuivibilan_pi2[CODE]=ANR-12-CORP-0005

8.1.3. ANR-DFG IFCASL

Project acronym: IFCASL

Project title: Individualized feedback in computer-assisted spoken language learning

Duration: March 2013 - February 2016

Coordinator: Jürgen Trouvain (Saarland University)

Other partners: Saarland University (COLI department)

Abstract: The main objective of IFCASL is to investigate learning of oral French by German speakers, and oral German by French speakers at the phonetic level.

The work has mainly focused on the design of a corpus of French sentences and text that has been recorded by German speakers learning French, recording a corpus of German sentences read by French speakers, and tools for annotating French and German corpora. Beforehand, two preliminary small corpora have been designed and recorded in order to bring to the fore the most interesting phonetic issues to be investigated in the project. In addition this preliminary work was used to test the recording devices so as to guarantee the same quality of recording in Saarbrücken and in Nancy, and to design and develop recording software.

In this project, we also provided an automatic alignment procedure at the word and phoneme levels for 4 corpora: French sentences uttered by French speakers, French sentences uttered by German speakers, German sentences uttered by French speakers, German sentences uttered by German speakers.

8.1.4. ANR ContNomina

Project acronym: ContNomina

Project title: Exploitation of context for proper names recognition in diachronic audio documents

Duration: February 2013 - July 2016

Coordinator: Irina Illina (Loria)

Other partners: LIA, Synalp

Abstract: the project ContNomina focuses on the problem of proper names in automatic audio processing systems by exploiting in the most efficient way the context of the processed documents. To do this, the project addresses:

- the statistical modeling of contexts and of relationships between contexts and proper names;
- the contextualization of the recognition module through the dynamic adjustment of the lexicon and of the language model in order to make them more accurate and certainly more relevant in terms of lexical coverage, particularly with respect to proper names;
- the detection of proper names, on the one hand, in text documents for building lists of proper names, and on the other hand, in the output of the recognition system to identify spoken proper names in the audio/video data.

8.1.5. FUI RAPSODIE

Project acronym: RAPSODIE [0]

Project title: Automatic Speech Recognition for Hard of Hearing or Handicapped People

Duration: March 2012 - February 2016 (signed in December 2012)

Coordinator: eRocca (Mieussy, Haute-Savoie)

Other partners: CEA (Grenoble), Inria (Nancy), CASTORAMA (France)

Abstract: The goal of the project is to realize a portable device that will help a hard of hearing person to communicate with other people. To achieve this goal the portable device will embed a speech recognition system, adapted to this task. Another application of the device will be environment vocal control for handicapped persons.

[0] http://erocca.com/rapsodie

In this project, MULTISPEECH is involved for optimizing the speech recognition models for the envisaged task, and contributes also to finding the best way of presenting the speech recognition results in order to maximize the communication efficiency between the hard of hearing person and the speaking person.

8.1.6. ADT FASST

The Action de Développement Technologique Inria (ADT) FASST (2012–2014) was conducted by PAROLE in collaboration with the teams PANAMA and TEXMEX of Inria Rennes. It reimplemented into efficient C++ code the Flexible Audio Source Separation Toolbox (FASST) originally developed in Matlab by the METISS team of Inria Rennes. This enabled the application of FASST on larger data sets, and its use by a larger audience. The new C++ version was released in January 2014. Two modules were also developed for HTK and Kaldi in order to perform noise robust speech recognition by uncertainty decoding.

8.1.7. ADT VisArtico

The technological Development Action (ADT) Inria Visartico (2013–2015) aims at developing and improving VisArtico, an articulatory vizualisation software. In addition to improving the basic functionalities, several articulatory analysis and processing tools are being integrated. We will also work on the integration of multimodal data.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

E. Vincent was responsible for his former team (PANAMA) of the following project.

Program: Eureka - Eurostars

Project acronym: i3DMusic

Project title: Real-time Interactive 3D Rendering of Musical Recordings

Duration: October 2010 to March 2014

Coordinator: Audionamix (FR)

Other partners: EPFL (CH), Sonic Emotion (CH)

Abstract: The i3DMusic project aims to enable real-time interactive respatialization of mono or stereo music content. This is achieved through the combination of source separation and 3D audio rendering techniques. PANAMA is responsible for the source separation work package, more precisely for designing scalable online source separation algorithms and estimating advanced spatial parameters from the available mixture.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

E. Vincent is involved as an associate member in the national Japanese JSPS Grant-in-Aid for Scientific Research project on distributed microphone arrays led by Nobutaka Ono from the National Institute of Informatics together with other partners from the University of Tsukuba and Tokyo Institute of Technology.

A. Liutkus is involved in a national project in Ireland, still at the proposal stage, on the topic of Audio Forensics, led by Derry Fitzgerald (Cork Institute of Technology). He is an associate researcher on some workpackages of this project, notably those focusing on the theory of audio source separation.

A. Liutkus is co-advisor for the Ph.D. of Donal O'Donovan (Cork Institute of Technology, Ireland), whose Ph.D. topic lies in the applications of the Kernel Additive Modelling framework to image processing.

8.3.2. Participation in other International Programs

A. Liutkus is an associate researcher in a national project in the USA, funded by the National Science Fundation (NSF) on the program "Cyber-Human Systems" (CHS) under the name "CHS:Small: Robust Interactive Audio Source Separation" and led by Bryan Pardo (Northwestern University, Chicago).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

RIBAS Dayana

Date: Sep 2014 - Dec 2014

Institution: CENATAV Advanced Technologies Application Center, La Habana (Cuba)

BANDINI Andrea

Date: Oct 2014 - Mar 2015

Institution: University of Bologna, Bologna, Italy.

8.4.2. Visits to International Teams

8.4.2.1. Explorer program

VINCENT Emmanuel

Date: Jun 2014 - Aug 2014

Institution: Mitsubishi Electric Research Labs (USA)

LIUTKUS Antoine

Date: Oct 2014 - Dec 2014

Institution: BU (Turkey)

Description: This Explorer program had several objectives. First, it aims at studying several ambitious scientific problems, such as the analysis of multimodal and multirate data and also to extend Nonnegative Matrix Factorization to alpha-stable models, significantly generalizing the classical Gaussian model for audio signals. Second, this program is the occasion to build an international academic network involving researchers of the Bogazici University. It is planned to submit an ambitious proposal for a Marie-Curie International Training Network (ITN) in 2015.

MUSE Team

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. User-Centric Networking (UCN)

Type: FP7
Instrument: Specific Targeted Research Project
Duration: October 2013 - September 2016
Coordinator: Technicolor
Other partners: Eurecom, Fraunhofer FOKUS, Intamac, University of Cambridge, University of Nottingham, Martel, NICTA, Portugal Telecom
Inria contact: Renata Teixeira
Abstract: This project introduces the concept of User Centric Networking (UCN), which is a new paradigm leveraging user information at large to deliver novel content recommendation systems and content delivery frameworks. UCN recommendation and content delivery systems will leverage in-depth knowledge about users to help them find relevant content, identify nearby network resources and plan how to deliver the actual content to the appropriate device at the desired time. These systems will additionally account for influences from users' social networks on their content consumption. The goal of this project is to design a UCN system architecture for user-centric connected media services. We will build UCN upon three complementary research pillars:

1. understanding user context: This data can be broadly categorized into three groups. First, the physical and environmental context A second category of data is that which can be extracted from social network interactions. The third category of data is behavioural
2. profiling and predicting user interests: By gaining a deep understanding of the user, we may be able to cast a much wider net in the content ocean and locate a richer catalogue of interesting content for the user
3. personalizing content delivery: Rather than the user (or the service provider) having to worry about the mode of connectivity, device, service, location, etc., the network intelligently directs and adapts the transport stream, or perhaps pre-fetches and replicates content chunks, to the particular and immediate needs of the user.

See also: http://usercentricnetworking.eu/

8.2. International Initiatives

8.2.1. Informal International Partners

- Georgia Institute of Technology (Prof. Nick Feamster and his doctoral students Srikanth Sundaresan and Sarthak Grover): We have a long-term collaboration on measuring the performance of residential broadband Internet access networks and more recently on home network diagnosis.
- ICSI, UC Berkeley (Prof. Vern Paxson, Dr. Christian Kreibich, Dr. Robin Sommer): With V. Paxson and C. Kreibich, we have been developing Fathom, a browser-based network measurement platform. We are now adding home network diagnosis capabilities to Fathom. In addition, with Robin Sommer we are working on the potential of matching the profiles of a user across multiple online social networks.

8.3. International Research Visitors

8.3.1. Internships

- O. Belkadi, master intern, National School of Applied Sciences (ENSA), Tangier, from Apr 2014 until Aug 2014.
- S. Grover, doctoral intern from Georgia Tech, from May 2014 until Aug 2014.
- M. Santoro, master intern, Universidad Politecnica de Valencia, from May 2014 until Sep 2014.

MUTANT Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. INEDIT

Title: Interactivity in the Authoring of Time and Interactions

Project acronym: INEDIT

Type: ANR Contenu et Interaction 2012 (CONTINT)

Instrument: ANR Grant

Duration: September 2012 - September 2015

Coordinator: IRCAM (France)

Other partners: Grame (Lyon, France), LaBRI (Bordeaux, France).

Abstract: The INEDIT project aims to provide a scientific view of the interoperability between common tools for music and audio productions, in order to open new creative dimensions coupling *authoring of time* and *authoring of interaction*. This coupling allows the development of novel dimensions in interacting with new media. Our approach lies within a formal language paradigm: An interactive piece can be seen as a virtual interpreter articulating locally synchronous temporal flows (audio signals) within globally asynchronous event sequence (discrete timed actions in interactive composition). Process evaluation is then to respond reactively to signals and events from an environment with heterogeneous actions coordinated in time and space by the interpreter. This coordination is specified by the composer who should be able to express and visualize time constraints and complex interactive scenarios between mediums. To achieve this, the project focuses on the development of novel technologies: dedicated multimedia schedulers, runtime compilation, innovative visualization and tangible interfaces based on augmented paper, allowing the specification and realtime control of authored processes. Among posed scientific challenges within the INEDIT project is the formalization of temporal relations within a musical context, and in particular the development of a GALS (Globally Asynchronous, Locally Synchronous) approach to computing that would bridge in the gap between synchronous and asynchronous constraints with multiple scales of time, a common challenge to existing multimedia frameworks.

7.1.2. Other National Initiatives

Jean-Louis Giavitto participates in the SynBioTIC ANR Blanc project (with IBISC, University of Evry, LAC University of Paris-Est, ISC - Ecole Polytechnique).

The team is also an active member of the ANR network CHRONOS (investigator Gérard Berry, Collège de France).

7.2. European Initiatives

7.2.1. Collaborations in European Programs, except FP7 & H2020

Mutant has started a cooperation with the team of Christoph Kirsch at the University of Salzburg, Austria, around the application of the application of the Logical Execution Time realtime programming paradigm to computer music systems supporting advanced temporal structure in music and advanced dynamics in interactivity. We have settled a project LETITBE accepted in the program PHC Amadeus, and to be started in january 2015.

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. Informal International Partners

- Shlomo Dubnov (UCSD)
- Edward Lee (UC Berkeley)
- Miller Puckette (UCSD)
- Masahiko Sakai (U. Nagoya)
- Slawek Staworko (U. Edinburgh)
- David Wessel (UC Berkeley)

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Masahiko Sakai (Professor at the University of Nagoya) visited MuTant for two weeks in April and October 2014, For collaborations on term rewriting techniques applied to the representations of rhythm in music notations.

Slawek Staworko (LINKS, on leave at U. of Edinburgh) visited MuTant for two weeks in June and July 2014, for collaborations on the problem of automatic rhythm transcriptions.

7.4.2. Visits to International Teams

MuTant team members Arshia Cont, Jean-Louis Giavitto and José Echeveste made a formal visit to M.I.T. MediaLab in May 2014 to showcase MuTant work and discuss further collaborations with several New Media teams at MIT.

7.4.2.1. Research stays abroad

José Echeveste stays during six weeks in several Universities of United States which enables collaborations with the following teams and centers:

- Center for Hybrid and Embedded Software Systems (UC Berkeley)
- The Center for New Music and Audio Technologies (UC Berkeley)
- Center for Computer Research in Music and Acoustics (Stanford)
- Roger Dannenberg's team (Carnegie Mellon University)
- Computer Music Center (Columbia University)

This trip allows to share research experience with many people with different areas of expertise and to broadly disseminate the Mutant team work in the main computer music centers and other important computer research centers of United States.

José Echeveste (MuTant PhD students) undertook a Research Stay in UC Berkeley's EECS department, Center for Hybrid and Embedded Software Systems (CHESS) for two months between April and May 2014. His visit was highlighted by several master classes and workshops on MuTant research in diverse institutions such as UC Berkeley, Columbia University and MIT.

MYCENAE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

PSL☆ project NeuroMathematics (of Sensory Switch)- NeuroMath(SensoS)

7.2. National Initiatives

7.2.1. ANR

Jonathan Touboul is member of the ANR Kibord (KInetic models in Biology Or Related Domains) obtained in 2014.

7.2.2. National Networks

- GdR REPRO (member of the direction board, F. Clément)
- DLeRBio network: Dynamiques Lentes-Rapides avec applications Biologiques (animation, M. Desroches)
- MIA REM network: Réduction de modèles (PI Béatrice Laroche, INRA Jouy)

7.2.3. National Collaborations

- Center for Interdisciplinary Research in Biology, Collège de France (Alain Prochiantz)
- Jacques-Louis Lions Laboratory, Pierre & Marie Curie University (Jean-Pierre Françoise, Marie Postel)
- UMR Physiologie de la Reproduction et des Comportements, INRA Tours (Bios and Bingo teams)
- Group for Neural Theory, École Normale Supérieure, Paris (Boris Gutkin)
- Centre de Recherche en Mathématiques de la Décision, Paris Dauphine University (Stéphane Mischler)
- Computational Biology and Biomathematics, Jacques Monod Institute, Paris Diderot University (Khashayar Pakdaman)
- LAGA (Laboratoire Analyse, Géométrie et Applications), Paris-Nord University (Gilles Wainrib)
- Unité de Neurosciences, Information & Complexité (UNIC), CNRS Gif-sur-Yvette (Alain Destexhe)

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. Informal International Partners

- **USA**: Florida State University (Richard Bertram, Patrick Fletcher, Joël Tabak), University of Pittsburgh (Bard Ermentrout, Jonathan Rubin), Princeton University (William Bialek, Thibault Taillefumier)
- **UK**: University of Bristol (Alan R. Champneys), University of Nottingham (Daniele Avitabile), Plymouth University (Serafim Rodrigues)
- **Spain**: University of the Balearic Islands (Antonio .E. Teruel, Rafel Prohens), Polytechnic University of Catalunya (Toni Guillamon), University of Sevilla (Enrique Ponce)
- **Denmark**: Technical University of Denmark (Morten Brøns and Frank Schilder)

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- William Bialek (Princeton University), May 2014
  seminar More than the sum of their parts: Collective behavior in flocks of birds and networks of neurons, Grands séminaires du Collège de France
- Bard Ermentrout (University of Pittsburgh), June 2014
  seminar Keeping the beat : Homeostatic frequency control in coupled oscillators held in EITN (European Institute for Theoretical Neuroscience)
- Jacques Cowan (University of Chicago, USA), October 2014 (two weeks)
  Mathematics of the Brain Colloquium
- Alexey Kuznetsov (Indiana University-Purdue, University Indianapolis, USA, July 2014 (one week
  seminar A highly-reduced model of the dopaminergic neuron: mechanisms of oscillations
- Martin Wechselberger (University of Sydney, Australia), November 2014 (one week)
  seminar Neuronal Excitability and Canards

7.4.2. Visits to International Teams

7.4.2.1. Research stays abroad

- M. Desroches, one-month research stay in the Department of Mathematics of the University of the Balearic Islands (UIB, Palma, Spain), funded by a scholarship from the UIB, in the framework of a collaboration with Antonio E. Teruel and Rafel Prohens (June 2014).
- J. Touboul, twice one-month research stay in Princeton University, partially funded by the NeuroInfo PEPS PTI project, in the framework of a collaboration with the group of William Balek (March 2014 and December 2014).

MYRIADS Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. CominLabs EPOC project (2013-2016)

Participants: Sabbir Hasan Rochi, Yunbo Li, Anne-Cécile Orgerie, Jean-Louis Pazat.

In this project, partners aim at focusing on energy-aware task execution from the hardware to application's components in the context of a mono-site data center (all resources are in the same physical location) which is connected to the regular electric Grid and to renewable energy sources (such as windmills or solar cells). In this context, we tackle three major challenges:

- Optimizing the energy consumption of distributed infrastructures and service compositions in the presence of ever more dynamic service applications and ever more stringent availability requirements for services.
- Designing a clever cloud's resource management which takes advantage of renewable energy availability to perform opportunistic tasks, then exploring the trade-off between energy saving and performance aspects in large-scale distributed systems.
- Investigating energy-aware optical ultra high-speed interconnection networks to exchange large volumes of data (VM memory and storage) over very short periods of time.

6.1.2. EcoPaaS, Brittany region SAD project(2014-2015)

Participants: Maria Del Mar Callau Zori, Anne-Cécile Orgerie, Guillaume Pierre, Lavinia Samoila.

Many research efforts have been dedicated to reducing cloud energy consumption, in particular by optimizing the Infrastructure-as-a-Service layer of the Cloud. Infrastructure-as-a-Service (IaaS) is the layer in charge of the virtualization of physical resources, and therefore has direct control over energy-related elements. However, the IaaS layer has no knowledge about the nature of applications which run over these resources, which limits the scope of decisions it can take.

The EcoPaaS project therefore aim at making the IaaS layer (in charge of resources) and the PaaS layer (in charge of applications) collaborate to further reduce the Cloud energy consumption. The idea is to define standard interfaces that allow both layers to exchange relevant information and to coordinate their actions. Exchanging information will for example allow the PaaS layer to estimate the energy consumption of each application it is running. Coordinating actions will in turn allow the system to avoid situations where both layers simultaneously take mutually-damaging actions. This project is funding Maria del Mar Callau-Zori's postdoc.

6.1.3. Monitoring for Cloud Security, collaboration with DGA-MI (2014-2017)

Participants: Anna Giannakou, Christine Morin, Jean-Louis Pazat, Louis Rilling.

Our study aims at designing a self-adaptable system for security supervision in clouds. The considered system should cope with the dynamic nature of clouds and have a minimal impact on performance. The funding from DGA funds a PhD student, Anna Giannakou, who joined Myriads team in March 2014. Anna Giannakou is co-advised by Christine Morin (Inria), Jean-Louis Pazat (INSA Rennes) and Louis Rilling (DGA-MI). Louis Rilling was formally appointed as external collaborator in Myriads team effective from March 1st 2014.

6.1.4. IRT B-Com

Participants: Yvon Jégou, Edouard Outin, Jean-Louis Pazat.

Yvon Jégou and Jean-Louis Pazat are at IRT B-Com [0] one day per week. With Édouard Outin, B-com PhD student, they contribute to the B-Com *Indeed* project, which aims at developing a distributed cloud software stack with a high degree of adaptability.

6.2. National Initiatives

6.2.1. Inria ADT GinFlow (2014-2016)

Participants: Christine Morin, Javier Rojas Balderrama, Matthieu Simonin, Cédric Tedeschi.

The GinFlow technological development action funded by INRIA targets the development of a fully-operational workflow management system based on the HOCL-TS software prototype developed during the PhD thesis of Héctor Fernandez between 2009 and 2012. Also, it allows the integration of this software with the TIGRES workflow engine developed at the Lawrence Berkeley National Lab so as to make the workflows submitted using the TIGRES programming model run in a decentralized fashion.

6.2.2. Inria ADT Snooze (2012-2014)

Participants: Eugen Feller, Yvon Jégou, David Margery, Christine Morin, Anne-Cécile Orgerie, Matthieu Simonin.

The Snooze technological development action funded by INRIA aims at developing an IaaS cloud environment based on the Snooze virtual machine framework developed by the team (http://snooze.inria.fr) and to make this new environment available to a wide community. In 2014, we refactored some parts of the code to enable the use of plugins. We also developed the Cloud Agnostic Checkpointing Service (CACS) service on top of Snooze to enable application recovery in the event of the failure of servers hosting virtual machines [31].

6.2.3. HEMERA Inria AEN (2010-2014)

Participants: Bogdan Florin Cornea, Yvon Jégou, Anne-Cécile Orgerie.

The Myriads team is involved in the HEMERA large wingspan project funded by INRIA (http://www.grid5000.fr/mediawiki/index.php/Hemera). This project aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid'5000 infrastructure, at animating the scientific community around Grid'5000 and at enlarging the Grid'5000 community by helping newcomers to make use of Grid'5000. Yvon Jégou is co-chair of the "Bring Grids Power to Internet-Users thanks to Virtualization Technologies" working group. Anne-Cécile Orgerie is involved in the "Energy" working group which is currently looking at making energy-aware experiments on Grid'5000 easier for the users. This project funded Bodgan Florin Cornea's postdoc supervised by Anne-Cécile Orgerie and Laurent Lefèvre (Inria, LIP, Lyon).

6.2.4. Inria IPL CityLab (under submission) (2014-2018)

Participants: Roberto-Gioacchino Cascella, Christine Morin.

The Inria Project Lab (IPL) CityLab@Inria (informally started - see https://citylab.inria.fr) studies ICT solutions toward smart cities that promote both social and environmental sustainability. A strong emphasis of the Lab is on the undertaking of a multi-disciplinary research program through the integration of relevant scientific and technology studies, from sensing up to analytics and advanced applications, so as to actually enact the foreseen smart city Systems of Systems. City-scale experiments of the proposed platforms and services are planned in cities in California and France, thereby learning lessons from diverse setups.

Myriads investigates advanced cloud solutions for the Future Internet, which are critical for the processing of urban data. It leverages its experience in cloud computing and Internet of services while expanding its research activities to the design and implementation of cloud services to support crowd-Xing applications and mobile social applications.

[0] http://b-com.org/wp/

6.2.5. MIHMES ANR Investissements d'Avenir (2012 - 2018)

Participants: Yvon Jégou, Christine Morin.

The MIMHES project (http://www.inra.fr/mihmes) led by INRA/BioEpAR aims at producing scientific knowledge and methods for the management of endemic infectious animal diseases and veterinary public health risks. Myriads team will provide software tools to efficiently manage and ease the use of a distributed computing infrastructure for the execution of different simulation applications.

In 2014, we interacted with the INRA/BioEpAR research team in order to improve the initial software prototype and to make it ready for parallelisation. A first parallel version of the code was delivered by Inria during summer 2014. This first version uses the OpenMP standard to exploit multiple processor cores of the same server. A speed-up approaching 20 has been observed on a 24-cores Dell server for a single run. A whole simulation necessitates multiple runs (a few hundreds) to reach precise results. During the next steps, the presence of these runs will be exploited both to increase the volume of the internal computations (increase the efficiency of multi-core computation) and to exploit multiple servers.

6.2.6. CNRS GDS EcoInfo

Participant: Anne-Cécile Orgerie.

The EcoInfo group deals with reducing environmental and societal impacts of Information and Communications Technologies from hardware to software aspects. This group aims at providing critical studies, lifecycle analyses and best practices in order to improve the energy efficiency of printers, servers, data centers, and any ICT equipment in use in public research organizations.

6.3. European Initiatives

6.3.1. FP7 & H2020 Projects

6.3.1.1. CONTRAIL

Participants: Roberto-Gioacchino Cascella, Stefania Costache, Florian Dudouet, Filippo Gaudenzi, Yvon Jégou, Christine Morin.

Type: COOPERATION

Defi: Internet of Services, Software & Virtualisation

Instrument: Integrated Project

Objectif: Internet of Services, Software and Virtualisation

Duration: October 2010 - January 2014

Coordinator: Inria

Partner: XLAB Razvoj Programske Opreme In Svetovanje d.o.o., Slovenia; Italian National Research Council, ISTI-CNR & IIT-CNR, Italy; Vrije Universiteit Amsterdam, The Netherlands; Science and Technology Facilities Council, STFC, UK; Genias Benelux bv, The Netherlands; Tiscali Italia SpA, Italy; Konrad-Zuse-Zentrum für Informationstechnik Berlin, ZIB, Germany; Hewlett Packard Italiana S.r.l - Italy Innovation Center, Italy; Country Constellation Technologies Ltd, UK; Linagora, France.

Inria contact: Christine Morin

Abstract: The goal of the Contrail project is to design, implement, evaluate and promote an open source system for Cloud Federations. Resources that belong to different operators will be integrated into a single homogeneous federated Cloud that users can access seamlessly. The Contrail project has built a complete Cloud platform which integrates Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) offerings [2].

6.3.1.2. $ECO_2Clouds$

Participants: Maxence Dunnewind, Nicolas Lebreton, Julien Lefeuvre, David Margery, Eric Poupart.

Type: FP7

Defi: Future internet experimental facility and experimentally-driven research

Instrument: Specific Targeted Research Project

Objectif: Future Internet Research and Experimentation (FIRE)

Duration: October 2012 - September 2014

Coordinator: Atos Spain SA (ATOS, Spain)

Partner: Atos Spain SA (ATOS, Spain) The University of Manchester (UNIMAN, United Kingdom) The University of Edinburgh (UEDIN, United Kingdom) Universitaet Stuttgart (USTUTT, Germany) Politecnico di Milano (POLIMI, Italy)

Inria contact: David Margery

Abstract: In ECO_2Clouds, we add to BonFIRE energy probes to be able to measure power consumption of the infrastructure, combine it with information about energy sources used to produce the power so as to be able to bill CO_2 usage to experimenters running VMs. To allow for scheduling and adaptation of running applications, CO_2 usage is not only billed after the fact but also quoted in advance for a given period for according to resource usage units.

6.3.1.3. Fed4FIRE

Participants: Maxence Dunnewind, Julien Lefeuvre, David Margery.

Type: FP7

Defi: Future internet experimental facility and experimentally-driven research

Instrument: Integrated Project

Objectif: ICT-2011.1.6 Future Internet Research and Experimentation (FIRE) with a specific focus on b) FIRE Federation

Duration: October 2012 - September 2016

Coordinator:Interdisciplinary institute for broadband technology (iMinds, Belgium)

Partner: Interdisciplinary institute for broadband technology (iMinds, Belgium), University of Southampton (It Innovation, United Kingdom) Universite Pierre et Marie Curie - paris 6 (UPMC, France) Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.v (Fraunhofer, Germany) Technische Universitat Berlin (TUB, Germany) The University of Edinburgh (UEDIN, United Kingdom) National Ict Australia Limited (NICTA, Australia) Atos Spain SA (Atos, Spain) Panepistimio Thessalias (University of Thessaly) (UTH, Greece) National Technical University of Athens (NTUA, Greece) University of Bristol (UNIVBRIS, United Kingdom) Fundacio Privada i2cat, Internet I Innovacio Digital a Catalunya (i2cat, Spain) Eurescom-European Institute for Research and Strategic Studies in Telecommunications (EUR, Gmbh Germany) Delivery of Advanced Network Technology to Europe limited (DANTE limited, United Kingdom) Universidad de Cantabria (UC, Spain) National Information Society agency (NIA, Korea (republic of))

Inria contact: David Margery

Abstract: In Fed4FIRE, we investigate the means by which our experimental platforms (BonFIRE, and in a secondary way Grid'5000) could be made interoperable with a wider eco-system of experimental platforms in Europe and beyond. The baseline architectural choice for this project is to use the key concepts of the Slice Federation Architecture (SFA) to provision resources on experimental platforms, a Control and Management Framework for Networking Testbeds named OMF for experiment control and OML, the OMF Measurement library for data collection. We investigate whether these can be used to run experiments on BonFIRE and how they need to be extended to support the operating model of BonFIRE.

6.3.1.4. HARNESS

Participants: Eliya Buyukkaya, Georgios Ioannidis, Ancuta Iordache, Guillaume Pierre, Genc Tato.

Type: COOPERATION

Defi: Pervasive and Trusted Network and Service Infrastructures

Instrument: Small or medium-scale focused research project

Objectif: ICT-2011.1.2 Cloud Computing, Internet of Services and Advanced Software Engineering

Duration: October 2012 - September 2015

Coordinator: Imperial College London (IMP, United Kingdom)

Partner: Ecole polytechnique fédérale de Lausanne (EPFL, Switzerland), Université de Rennes 1 (UR1, France), Konrad-Zuse-Zentrum für Informationtechniek Berlin (ZIB, Germany), Maxeler Technologies (MAX, United Kingdom), SAP AG (SAP, Germany)

UR1 contact: Guillaume Pierre

Abstract: The HARNESS FP7 project aims to incorporate innovative hardware and network technologies seamlessly into data centres that provide platform-as-a-service cloud infrastructures.

The dominant approach in offering cloud services today is based on homogeneous commodity resources: large numbers of inexpensive machines, interconnected by off-the-shelf networking equipment, supported by stock disk drives. However, cloud service providers are unable to use this platform to satisfy the requirements of many important and high-value classes of applications.

Today's cloud platforms are missing out on the revolution in new hardware and network technologies for realising vastly richer computational, communication, and storage resources. Technologies such as Field Programmable Gate Arrays (FPGA), General-Purpose Graphics Processing Units (GPGPU), programmable network routers, and solid-state disks promise increased performance, reduced energy consumption, and lower cost profiles. However, their heterogeneity and complexity makes integrating them into the standard Platform as a Service (PaaS) framework a fundamental challenge.

The HARNESS project brings innovative and heterogeneous resources into cloud platforms through a rich programme of research, validated by commercial and open source case studies.

6.3.1.5. PaaSage

Participants: Christine Morin, Nikolaoss Parlavantzas, Aboozar Rajabi.

Type: COOPERATION

Objectif: ICT-2011.1.2 Cloud Computing, Internet of Services and Advanced Software Engineering

Instrument: Collaborative Project

Duration: October 2012 - September 2016

Coordinator: GEIE ERCIM (France)

Partner: SINTEF (Norway), Science and Technology Facilities Council (UK), University of Stuttgart (Germany), Inria (France), Centre d'Excellence en Technologies de l'Information et de la Communication (Belgium), Foundation for Research and Technology Hellas (Greece), BE.Wan SPRL (Belgium), EVRY AS (Norway), SysFera SAS (France), Flexiant Limited (UK), Lufthansa Systems AG (Germany), Gesellschaft fur Wissenschaftliche Datenverarbeitung MBH Gottingen (Germany), Automotive Simulation Center Stuttgart (Germany), University of Ulm (Germany), Akademia Górniczo-Hutnicza im. Stanislawa Staszica (Poland), University of Cyprus (Cyprus), IBSAC-Intelligent Business Solutions ltd (Cyprus), University of Oslo (Norway)

Inria contact: Nikolaos Parlavantzas

See also: http://www.paasage.eu/

Abstract: PaaSage aims to deliver an open and integrated platform to support both deployment and design of Cloud applications, together with an accompanying methodology that allows model-based application development, configuration, optimisation, and deployment on multiple Cloud infrastructures.

6.3.2. Collaborations in European Programs, except FP7 & H2020

6.3.2.1. NESUS

Participant: Anne-Cécile Orgerie.

Program: ICT COST

Project acronym: NESUS

Project title: Network for Sustainable Ultrascale Computing (ICT COST Action IC1305)

Duration: 2014 - 2018

Coordinator: Professor Jesus Carretero, University Carlos III of Madrid, Spain, http://www.nesus.eu

Other partners: 33 COST countries and 11 non-COST countries

Abstract: Ultrascale systems are envisioned as large-scale complex systems joining parallel and distributed computing systems that will be two to three orders of magnitude larger that today's systems. The EU is already funding large scale computing systems research, but it is not coordinated across researchers, leading to duplications and inefficiencies. The goal of the NESUS Action is to establish an open European research network targeting sustainable solutions for ultrascale computing aiming at cross fertilization among HPC, large scale distributed systems, and big data management. The network will contribute to glue disparate researchers working across different areas and provide a meeting ground for researchers in these separate areas to exchange ideas, to identify synergies, and to pursue common activities in research topics such as sustainable software solutions (applications and system software stack), data management, energy efficiency, and resilience. Some of the most active research groups of the world in this area are members of this proposal. This Action will increase the value of these groups at the European-level by reducing duplication of efforts and providing a more holistic view to all researchers, it will promote the leadership of Europe, and it will increase their impact on science, economy, and society.

6.3.2.2. MC-DATA

Participants: Stéphane Chevalier, Teodor Crivat, Guillaume Pierre.

Program: EIT ICT Labs

Project acronym: MC-DATA

Project title: Multi-cloud data management

Duration: Jan-Dec 2014

Coordinator: Dr. Peter Pietzuch, Imperial College London

Other partners: SICS, Vodafone

Abstract: In 2014, the continuation of the MC-Data project had two main innovation objectives: (a) to provide and release a novel open-source Platform-as-a-Service (PaaS) cloud computing software stack (MC-ConPaaS) that explicitly targets cloud application deployments across multiple data centre sites; (b) to demonstrate the business value of the MC-ConPaaS platform through a use case of cloud-assisted real-time smartphone applications, thus affecting the future business models of mobile operators. Its expected outcomes are:

- to release the MC-ConPaaS multi-site cloud platform as open source;
- to foster the adoption of the MC-ConPaaS platform by creating tutorials and documentation;
- to transfer the technology of the MC-ConPaaS platform to a mobile operator (VODAFONE), enabling them to offer a cloud infrastructure that supports cloud-assisted real-time applications;
- to develop new business models for mobile operators based on cloud-assisted real-time services running on virtualised mobile base stations.

6.3.2.3. VEP-S

Participants: Roberto-Gioacchino Cascella, Yvon Jégou, Christine Morin, Arnab Sinha.

Program: EIT ICT Labs

Project acronym: VEP-S

Project title: SLA-Aware Heterogeneous Data-Centers Management through Standards

Duration: Jan-Dec 2014

Coordinator: Christine Morin, Inria

Other partners: Intel (Ireland), Reply (Italy)

Abstract: We designed the VEP-S system, which consists of the Virtual Execution Platform (VEP) component with support for OCCI, integration of the OCCI SLA extension, and the monitoring system for deploying and running distributed applications packaged following the Open Virtualization Format (OVF), a DMTF standard, on top of an IaaS cloud. The Virtual Execution Platform (VEP), developed in the framework of Contrail European project, is in charge of provisioning hardware resources from Cloud providers and to deploy and run distributed applications submitted by users under the control of a negotiated Service Level Agreements (SLA). VEP interacts with the underlying IaaS manager to create application networks, register VM images, generate VM templates and manage the lifecycle of virtual machines. The OCCI SLA API extends the OCCI Core Model to implement a SLA management API. This API allows for the creation and management of resources related with the realization of agreements between an OCCI- enabled cloud service provider and potential consumers of the provider's resources. In the context of the VEP-S project, this extension is used to describe SLA terms and map them with the resources and services a cloud provider can offer. The monitoring component will provide three types of services: monitoring the IaaS resource manager to check whether the machine has started or not; monitoring the IaaS to check the usage of the resources; monitoring on the VM (monitoring agent in the VM and activated by the user). The technology used for the monitoring is Zabbix.

6.4. International Initiatives

6.4.1. Inria International Labs

Christine Morin was one of the co-organizers of the BIS 2014 workshop held in Paris in June 2014 in the framework of the Inria@Silicon Valley Inria International Lab. Christine Morin and Deb Agarwal were the co-chairs of the session on computation and communication for the future internet at BIS 2014. Several Myriads team members (Christine Morin, Anne-Cécile Orgerie, Javier Rojas Balderrama, Matthieu Simonin, Cédric Tedeschi) are involved in the DALHIS associate team on data analysis on large-scale heterogeneous infrastructures for science, which is part of the Inria@SiliconValley program.

6.4.2. Inria Associate Teams

6.4.2.1. DALHIS

Participants: Christine Morin, Anne-Cécile Orgerie, Javier Rojas Balderrama, Matthieu Simonin, Cédric Tedeschi.

Title: Data Analysis on Large Heterogeneous Infrastructures for Science

International Partner (Institution - Laboratory - Researcher):

Lawrence Berkeley National Laboratory, Berkeley, USA

Data Science and Technology department

French PI: Christine Morin

American PI: Deb Agarwal, head of the Data Science and Technology department

Duration: 2013 - 2015

See also: https://project.inria.fr/dalhis/

The worldwide scientific community is generating large datasets at increasing rates causing data analysis to emerge as one of the primary modes of science. Existing data analysis methods, tools and infrastructure are often difficult to use and unable to handle the "data deluge". A scientific data analysis environment needs to address three key challenges: a) programmability: easily composable and reusable programming environments for analysis algorithms and pipeline execution, b) agility: software that can adapt quickly to changing demands and resources, and, c) scalability: take advantage of all available resource environments including desktops, clusters, grids, clouds and HPC environments. The goal of the DALHIS associated team is to coordinate research and create together a software ecosystem to facilitate data analysis seamlessly across desktops, HPC and cloud environments. Specifically, our end goal is to build a dynamic environment that is user-friendly, scalable, energy-efficient and fault tolerant through coordination of existing projects. We plan to design a programming environment for scientific data analysis workflows that will allow users to easily compose their workflows in a programming environment such as Python and execute them on diverse high-performance computing (HPC) and cloud resources. We will develop an orchestration layer for coordinating resource and application characteristics. The adaptation model will use real-time data mining to support elasticity, fault-tolerance, energy efficiency and provenance. We investigate how to provide execution environments that allow users to seamlessly execute their dynamic data analysis workflows in various research environments. The work done in 2014 on scientific workflows, energy efficiency and data management is described respectively in Sections 5.5.1 , 5.4.1 and 5.3.3 . Christine Morin, Anne-Cécile Orgerie, Javier Rojas Balderrama, Cédric Tedeschi and Deb Agarwal participated in the BIS 2014 workshop held in Paris in June 2014. Christine Morin and Deb Agarwal were the co-chairs of the session on Computation and communication for the Future Internet at BIS 2014. Cédric Tedeschi presented the DALHIS activities during this session focusing on our results on scientific workflows. Deb Agarwal has been awarded an Inria International Chair for the 2015-2019 period enabling long visits in the Myriads team.

6.4.3. Inria International Partners

6.4.3.1. Informal International Partners

Northeastern University We started a collaboration with Professor Gene Cooperman, Northeastern University, Boston, USA on the design of a cloud agnostic checkpointing service on top of IaaS clouds for reliable application execution, inter-cloud application migration and easing application "cloudification". Gen Cooperman was hosted in Myriads team for a 1.5-month visit in March-April 2014. His PhD student, Jiajun Cao did a 3-month internship in Myriads team from May to August 2014.

ORNL/TTU We collaborate on cloud computing with Stephen Scott, Professor at Tennessee Tech University (TTU) and researcher at Oak Ridge National Laboratory (ORNL) in the USA. He visited Myriads team in July 2014 to investigate synergetic work directions on cloud security.

Argonne/ Chicago University We collaborate on cloud computing with Kate Keahey from Argonne National Laboratory, USA. She hosted Ismael Cuadrado Cordero in her team for a 12-week summer internship (June-September 2014) on using extended on-availability leases to increase utilization in scientific IaaS clouds.

University of Guadalajara Nikolaos Parlavantzas is collaborating with the team of Prof. Héctor Duran-Limon of the University of Guadalajara, Mexico, preparing a joint ANR-CONACYT project submission.

VU University amsterdam We collaborate with Thilo Kielmann's research group at VU University Amsterdam on research and development around the ConPaaS system. This collaboration has lead to two joint publications this year, and another paper has been accepted in 2015.

6.5. International Research Visitors

6.5.1. Visits of International Scientists

Jiajun Cao, PhD student at the Northeastern University (Boston, USA), made a 3-month visit in Myriads team (May-August 2014). He contributed to the design, implementation and evaluation of a cloud agnostic checkpointing service exploiting the DMTCP process-level checkpointing technology developed in Gene Cooperman's team at the Northeastern University. This service was experimented on top of Snooze IaaS cloud management system developed in Myriads team. A paper on this work will be presented at CC-Grid 2015.

Gene Cooperman, Professor at the Northeastern University (Boston, USA), made a 1.5 month sabbatical visit in Myriads team (March-April 2014). His visit was partially funded by the University of Rennes 1.

Georgios Ioannidis (PhD student at EPFL, Switzerland) made a 3-months visit in the Myriads team (Oct-Dec 2014). The goal was to reinforce the collaboration between the two teams in the context of the HARNESS FP7 project.

Palakiyem Wallah, assistant professor at the University of Kara (Togo) visited Myriads team from October to December 2014 in the framework of his PhD thesis, which is co-advised by Jean-Louis Pazat and Cédric Tedeschi.

Qian Zhang (PhD student at the Australian National University) spent 3 weeks in Myriads team in October 2014 to learn more about our research activities on SLA management. Her visit was supported by a grant from the Australian-French Association for Science and Technology (AFAS).

6.5.1.1. Internships

Vishrut Mehta Vishrut

Date: May 2014 - Jul 2014

Institution: IITH (India)

6.5.2. Visits to International Teams

6.5.2.1. Research stays abroad

Ancuta Iordache visited Maxeler Technologies (London, U.K.) from May 1st 2014 to July 31st 2014. This visit reinforced the collaboration between the two teams in the context of the HARNESS E.U. project, and was funded by the EIT ICT Labs Doctoral Training Center. We plan another 3-months visit in 2015.

Ismael Cuadrado Cordero, who is a student of the EIT ICT Labs Doctoral School, visited the Argonne National Laboratory (USA) for a research internship from June to September 2014. He was hosted in Kate Keahey's team working on resource management in scientific clouds.

NACHOS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Inria Project Lab

7.1.1.1. C2S@Exa (Computer and Computational Sciences at Exascale)

Participants: Olivier Aumage [RUNTIME project-team, Inria Bordeaux - Sud-Ouest], Jocelyne Erhel [SAGE project-team, Inria Rennes - Bretagne Atlantique], Philippe Helluy [TONUS project-team, Inria Nancy - Grand-Est], Laura Grigori [ALPINE project-team, Inria Saclay - Île-de-France], Jean-Yves L'excellent [ROMA project-team, Inria Grenoble - Rhône-Alpes], Thierry Gautier [MOAIS project-team, Inria Grenoble - Rhône-Alpes], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Michel Kern [POMDAPI project-team, Inria Paris - Rocquencourt], Stéphane Lanteri [Coordinator of the project], François Pellegrini [BACCHUS project-team, Inria Bordeaux - Sud-Ouest], Christian Perez [AVALON project-team, Inria Grenoble - Rhône-Alpes], Frédéric Vivien [ROMA project-team, Inria Grenoble - Rhône-Alpes].

Since January 2013, the team is coordinating the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

7.1.2. ANR project

7.1.2.1. TECSER

Participants: Emmanuel Agullo [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Xavier Antoine [CORIDA project-team, Inria Nancy - Grand-Est], Patrick Breuil [Nuclétudes, Les Ulis], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Stéphane Lanteri, Ludovic Moya, Guillaume Sylvand [Airbus Group Innovations].

Type: ANR ASTRID

Duration: May 2014 - April 2017

Coordinator: Inria

Partner: Airbus Group Innovations, Inria, Nuclétudes

Inria contact: Stéphane Lanteri

Abstract: the objective of the TECSER projet is to develop an innovative high performance numerical methodology for frequency-domain electromagnetics with applications to RCS (Radar Cross Section) calculation of complicated structures. This numerical methodology combines a high order hybridized DG method for the discretization of the frequency-domain Maxwell in heterogeneous media with a BEM (Boundary Element Method) discretization of an integral representation of Maxwell's equations in order to obtain the most accurate treatment of boundary truncation in the case of theoretically unbounded propagation domain. Beside, scalable hybrid iterative/direct domain decomposition based algorithms are used for the solution of the resulting algebraic system of equations.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. DEEP-ER

Type: FP7

Defi: Special action

Instrument: Integrated Project

Objectif: Exascale computing platforms, software and applications

Duration: October 2013 - September 2016

Coordinator: Forschungszentrum Juelich Gmbh (Germany)

Partner: Intel Gmbh (Germany), Bayerische Akademie der Wissenschaften (Germany), Ruprecht-Karls-Universitaet Heidelberg (Germany), Universitaet Regensburg (Germany), Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung E.V (Germany), Eurotech Spa (Italy), Consorzio Interuniversitario Cineca (Italy), Barcelona Supercomputing Center - Centro Nacional de Supercomputacion (Spain), Xyratex Technology Limited (United Kingdom), Katholieke Universiteit Leuven (Belgium), Stichting Astronomisch Onderzoek in Nederland (The Netherlands) and Inria (France).

Inria contact: Stéphane Lanteri

Abstract: the DEEP-ER project aims at extending the Cluster-Booster Architecture that has been developed within the DEEP project with a highly scalable, efficient, easy-to-use parallel I/O system and resiliency mechanisms. A Prototype will be constructed leveraging advances in hardware components and integrate new storage technologies. They will be the basis to develop a highly scalable, efficient and user-friendly parallel I/O system tailored to HPC applications. Building on this I/O functionality a unified user-level checkpointing system with reduced overhead will be developed, exploiting multiple levels of storage. The DEEP programming model will be extended to introduce easy-to-use annotations to control checkpointing, and to combine automatic re-execution of failed tasks and recovery of long-running tasks from multi-level checkpoint. The requirements of HPC codes with regards to I/O and resiliency will guide the design of the DEEP-ER hardware and software components. Seven applications will be optimised for the DEEP-ER Prototype to demonstrate and validate the benefits of the DEEP-ER extensions to the Cluster-Booster Architecture.

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. Declared Inria International Partners

Dr. Maciej Klemm: University of Bristol, Communication Systems & Networks Laboratory, Centre for Communications Research (United Kingdom)

7.3.2. Participation In other International Programs

7.3.2.1. CNPq-Inria HOSCAR project

Participants: Reza Akbarinia [ZENITH project-team, Inria Sophia Antipolis - Méditerranée], Rossana Andrade [CSD/UFC], Hélène Barucq [MAGIQUE-3D project-team, Inria Bordeaux - Sud-Ouest], Alvaro Coutinho [COPPE/UFR], Julien Diaz [MAGIQUE-3D project-team, Inria Bordeaux - Sud-Ouest], Thierry Gautier [MOAIS project-team, Inria Grenoble - Rhone-Alpes], Antônio Tadeu Gomes [LNCC], Pedroedro Leite Da Silva Dias [LNCC, Coordinator of the project on the Brazilian side], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Stéphane Lanteri [Coordinator of the project on the French side], Alexandre Madureira [LNCC], Nicolas Maillard [INF/UFRG], Florent Masseglia [ZENITH project-team, Inria Sophia Antipolis - Méditerranée], Marta Mattoso [COPPE/UFR], Philippe Navaux [INF/UFRG], Esther Pacitti [ZENITH project-team, Inria Sophia Antipolis - Méditerranée], François Pellegrini [BACCHUS project-team, Inria Bordeaux - Sud-Ouest], Fabio Porto [LNCC], Bruno Raffin [MOAIS project-team, Inria Grenoble - Rhone-Alpes], Pierre Ramet [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Jean-Louis Roch [MOAIS project-team, Inria Grenoble - Rhone-Alpes], Patrick Valduriez [ZENITH project-team, Inria Sophia Antipolis - Méditerranée], Frédéric Valentin [LNCC].

Since July 2012, the team is coordinating the HOSCAR http://www-sop.inria.fr/hoscar Brazil-France collaborative project. he HOSCAR project is a CNPq - Inria collaborative project between Brazilian and French researchers, in the field of computational sciences. The project is also sponsored by the French Embassy in Brazil.

The general objective of the project is to setup a multidisciplinary Brazil-France collaborative effort for taking full benefits of future high-performance massively parallel architectures. The targets are the very large-scale datasets and numerical simulations relevant to a selected set of applications in natural sciences: (i) resource prospection, (ii) reservoir simulation, (iii) ecological modeling, (iv) astronomy data management, and (v) simulation data management. The project involves computer scientists and numerical mathematicians divided in 3 fundamental research groups: (i) numerical schemes for PDE models (Group 1), (ii) scientific data management (Group 2), and (iii) high-performance software systems (Group 3). Several Brazilian institutions are participating to the project among which: LNCC (Laboratório Nacional de Computaçäo Científica), COPPE/UFRJ (Instituto Alberto Luiz Coimbra de Pós-Graduaçäo e Pesquisa de Engenharia/Alberto Luiz Coimbra Institute for Grad<uate Studies and Research in Engineering, Universidade Federal do Rio de Janeiro), INF/UFRGS (Instituto de Informática, Universidade Federal do Rio Grande do Sul) and LIA/UFC (Laboratórios de Pesquisa em Ciência da Computaçäo Departamento de Computaçäo, Universidade Federal do Ceará). The French partners are research teams from several Inria research centers.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Liang Li, UESTC, China, July 15-August 8

Jay Gopalakrishnan, Portland University, USA, December 8-11

Maciej Klemm, University of Bristol, UK, July 29-August 2

NANO-D Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

We have funding from the Rhone-Alpes region through an ARC6 grant for the development of parallel algorithms for adaptively restrained particle simulations. This grant is funding Krishna Kant Singh's PhD project.

6.2. National Initiatives

6.2.1. ANR

In 2014, NANO-D had funding from two ANR programs:

- **ANR Jeunes Chercheurs Jeunes Chercheuses (JCJC)**: 340,000 Euros over three years (2011-2014). This grant has been provided to S. Redon by the French Research Agency for being a finalist in the ERC Starting Grant 2009 call, and is for two PhD students and an engineer.
- **ANR Modeles Numeriques (MN)**: 180,000 Euros over four years (2011-2015). This project, coordinated by NANO-D (S. Grudinin), gathers biologists and computer scientists from three research groups: Dave Ritchie at LORIA, Valentin Gordeliy at IBS (total grant: 360,000 Euros).

6.2.2. PEPS

Sergei Grudinin participates in the Cryo-CA PEPS project. Cryo-CA (Computational algorithms for biomolecular structure determination by cryo-electron microscopy) is a 2-years project, supported by the Projets Exploratoires Pluridisciplinaires (PEPS) program in the panel Bio-Maths-Info provided by CNRS (French National Centre for Scientific Research). The project started on the 01/09/2012. Its main goal is to develop computational algorithms for cryo-electron microscopy (cryo-EM).

The partners of the Cryo-CA project are: Inria Nancy / Team Orpailleur (David Ritchie); Inria Grenoble / Team NANO-D (Sergei Grudinin); and INSERM IGBMC/ Team Integrated structural Biology (Annick Dejaegere, Patrick Schultz, and Benjamin Schwarz).

The main scientific aim of this cross-disciplinary project is to develop computational algorithms to help experimentalists and molecular modelers to solve more rapidly and accurately the structures of macromolecular complexes using cryo-electron microscopy (cryo- EM) and integrative structural biomolecular modeling techniques. More specifically, this PEPS initiative aims to address two important challenges in single particle cryo-EM, namely particle picking and multi-dimensional structure fitting. In the longer term, a further driving aim of this project is to develop strong collaborations amongst the participating teams to position ourselves for a larger project proposal to ANR or ERC.

6.3. European Initiatives

6.3.1. FP7 & H2020 Projects

6.3.1.1. ADAPT

Type: IDEAS

Defi: NC

Instrument: ERC Starting Grant

Objectif: Theory and algorithms for adaptive particle simulation

Duration: September 2012 - August 2017

Coordinator: Stephane Redon

Inria contact: Stephane Redon

6.4. International Initiatives

6.4.1. Inria International Partners

6.4.1.1. Informal International Partners

- We have a collaboration with Boston University on the development of docking algorithms (Dima Kozakov).
- We have a collaboration with ETH Zurich on the development of interactive algorithms for quantum chemistry (Markus Reiher).

6.5. International Research Visitors

6.5.1. Visits of International Scientists

Prof. Dima Kozakov visited the group in 2014. Dima Kozakoz is a Research Assistant Professor at Boston University (http://www.bu.edu/bmerc/people/affiliated-faculty/). Proteomics revolution provided blue-print of molecular interactions in the cell, however, full mechanistic understanding of how molecules interact comes only from three-dimensional structures. As was shown by Protein Structure Initiative (PSI), it is much more difficult to obtain structures of the protein complexes using high resolution experimental approaches, such as an X-ray or NMR, rather than structures of its individual components. Our groups (at Boston University and Inria / LJK Grenoble) have developed highly efficient protein docking approaches, which were successful in the CAPRI protein docking competition, and thus our next goal is to apply these to genome scale studies. We hope that structural modeling can not only provide potential complex structures, but also clean up uncertainty of the data obtained from high-trhoughtput approaches.

NECS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. PEPS META-TRAM

META-TRAM is a PEPS-CNRS project funded for two years (2013-2015). It aims at studying tensor methods for analyzing traffic data. Indeed, for a better management of mobility in modern cities (avoid or better control episodes of congestion, accurately predict traffic trends, finely analyze urban and suburban trips via multimodal networks), it is necessary to develop appropriate analytic tools that integrate multimodality and heterogeneity of networks from inherently multidimensional measures. Three areas are studied: tensor modeling for estimating origin-destination matrices, dynamic clustering flow and synthesis of distributed algorithms adapted to large volume of data, diversity of sensors, and their spatial dispersion. This project involves also I3S Lab (Sophia Antipolis) and CRAN (Nancy).

8.1.2. Projet exploratoire Persyval LOCATE-ME

LOCATE-ME (LOcalization teChniques for pedestriAn navigaTion based on inErtial MEasurements in indoor environments) is a Persyval project funded from April 2014 to August 2015. It aims at proposing a new and fresh look on innovative technologies for localization. It will construct the scientific foundations for development of a prototype of a pedestrian indoor localization system, which has the ability to monitor and track the positions of pedestrians in an indoor environment, where GPS is not available. LOCATE-ME will bring some responses on how to advance the current pedestrian navigation solutions for the critical domains, using robust software. The specific contribution of LOCATE-ME will be the development of a novel fusion algorithm merging two different methods of localization (INS and SHS) to obtain a concrete improvement on tracking position. This project involves also Tyrex team (LIG, Inria Grenoble).

8.1.3. Other collaborations

Inertial and magnetic data integration for human movements analysis

The goal of this consortium, which is in its second year, is to work on how to deal with inertial data in different or complementary fields. Orange Grenoble lab works on the analysis of inertial data and sells some smart-phones equipped with inertial unit. The goal of Orange is to develop from these data some analysis bricks. The bricks are identified by: a) Monitoring of activity by identifying postures and deduce the activity by a correlation table, b) Prevention of falls by an analysis of walking monitoring, c) Monitoring of indoor and outdoor trajectory, d) Position of the sensor, and e) Identification of the dynamic parts of the signal. Orange offers to provide laboratories participating in the consortium: a) The database created through a 2012 IGS experiment where 7 peoples wore smart-phones for 3 months and the report of the experiment, b) The ability to store the data recorded by the consortium on a server in the capacity limit of the predefined server, c) The loan of smart-phones, and d) A schedule of specifications of a service activity monitoring of remote person. A consortium agreement has been signed by eight laboratories: INSA-INL, UJF-AGIM, UJF-GIPSA, CNRS-LAAS, CNRS-IRIT, Ecole des mines de Douai, ISFTTAR, UTT et Orange Labs.

8.2. European Initiatives

8.2.1. Hycon2

Type: COOPERATION

Objective: Engineering of Networked Monitoring and Control Systems

Instrument: Network of Excellence

Objective: Engineering of Networked Monitoring and Control systems

Duration: September 2010 - August 2014

Coordinator: CNRS (France)

Partners: Inria (France), ETH Zurich (Switzerland), TU Berlin (Germany), TU Delft (Netherlands) and many others

Inria contact: C. Canudas de Wit

Abstract: Hycon 2 aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems. It focuses in particular on the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems.

See also: http://www.hycon2.eu

8.2.2. SPEEDD (Scalable ProactivE Event-Driven Decision making)

Type: STREP

Objective: ICT-2013.4.2a – Scalable data analytics – Scalable Algorithms, software frameworks and viualisation

Duration: Feb. 2014 to Jan. 2017.

Coordinator: National Centre of Scientific Research 'Demokritos' (Greece)

Partners: IBM Israel, ETH Zurich (CH), Technion (Israel), Univ. of Birmingham (UK), NECS CNRS (France), FeedZai (Portugal)

Inria contact: C. Canudas de Wit

Abstract: SPEEDD will develop a prototype for robust forecasting and proactive event-driven decision-making, with on-the-fly processing of Big Data, and resilient to the inherent data uncertainties. NECS will lead the intelligent traffic-management use and show case.

See also: http://speedd-project.eu

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. COMFORT

Title: COntrol and FOrecasting in Transportation networks

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (ÉTATS-UNIS)

Duration: 2014 - 2016

See also: http://necs.inrialpes.fr/v2/pages/comfort/EA_homepage_COMFORT.html

COMFORT is an Associate Team between Inria project-team NeCS and the Berkeley University project PATH. The joint team is in its 1st year of activity. COMFORT addresses open issues for Intelligent Transportation Systems (ITS). The goal of these systems is to use information technologies (sensing, signal processing, machine learning, communications, and control) to improve traffic flow, as well as enhance the safety and comfort of drivers. It has been established over the past several decades, through field studies and many scholarly publications, that the tools of ITS can significantly improve the flow of traffic on congested freeways and streets. Traffic operators can manage the system in a top-down fashion, for example, by changing the speed limit on a freeway, or by controlling the flow on the onramps (ramp metering). Individual drivers can also affect traffic conditions from the bottom up, by making decisions based on reliable predictions. These predictions must be provided by a centralized system that can evaluate the decisions based on global information and sophisticate modeling techniques. It is now crucial to develop efficient algorithms for control and prediction

that are well adapted to current and emerging sensing and communication technologies. The areas of traffic modeling and calibration, state estimation, and traffic control remain central to this effort. Specifically, COMFORT will address issues related to model validation before developing new traffic forecasting and distributed control algorithms. In particular the crucial issue of robustness will be considered through a complementary approach based on both stochastic and deterministic methods. The efficiency of the derived methods will be assessed using large networks simulators and real data obtained from the Californian and the Grenoble's testbed. Three main objectives will be addressed in this collaboration: a) Model validation and robust modeling for traffic estimation, control and forecasting; b) New methods for traffic forecasting; c) New methods for distributed traffic control and estimation.

8.3.2. Inria International Partners

H. Fourati has a collaboration with the Kazakhstan National Technical University (KazNTU). He co-advised (with Pr. Olga Shiryayeva in KazNTU) Zarina Samigulina, a PhD student in KazNTU, which defended her PhD Thesis in May 2014.

8.3.3. Participation In other International Programs

F. Garin, A. Kibangou, P. Grandinetti, and C. Canudas de Wit participated in the workshop Berkeley-Inria-Stanford (BIS'2014, Paris) wich is the joint research program inria@Silicon Valley.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

- Massinissa Boudraham, Master student, University of Bordeaux, from March to September 2014, co-advised by H. Fourati and P. Geneves, master thesis: *Systèmes de navigation pédestre : Analyse et étude comparative*.

8.4.2. Visits to International Teams

8.4.2.1. Sabbatical programme

- C. Canudas de Wit spent one week at the UC Berkeley. He has several meetings with Prof. Horowitz and Dr. Gomes to set up the ground for the collaboration with the student Giovanni De Nunzio on the problem of bandwidth optimization of green waves under eco-driving constraints. He has also two working meetings with Prof. Varaiya on issues of back-pressure control for light intersections, and discussion on modeling limitations of the CTM. He participated also in two seminars organized by the Transportation Institute at UC Berkeley. He also met with Prof. Murat Arcak and his student Sam Coogan and have some discussions on issues of monotonicity in traffic models.
- A. Kibangou spent one week in the Advanced Sensor Networks Group of the department of Electrical and Electronical Engineering of the University of Pretoria (South Africa), one of the top university in Africa.

8.4.2.2. Explorer programme

Giovanni De Nunzio

Date: 24/09/2014 – 14/12/2014

Institution: University of California Berkeley (USA) Visit of Giovanni De Nunzio (Ph.D. student at NeCS team) at PATH, UC Berkeley. Collaboration with Dr. Gabriel Gomes and Prof. Roberto Horowitz. Participation to weekly meeting both for Freeway Traffic research group (held by Prof. Howitz) and Arterial Traffic research group (held by Prof. Varaiya). Two presentations were given at the Arterial meeting: one about the preliminary results with Dr. Gomes, one about the research activities carried out at NeCS team. Participation to the bi-weekly Intelligent Transportation Systems seminars at UC Berkeley.

NEUROMATHCOMP Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

6.1.1.1. KEOPS

See section "International Initiatives" below.

6.2. European Initiatives

6.2.1. FP7 & H2020 Projects

6.2.1.1. BRAINSCALES

Title: BrainScaleS: Brain-inspired multiscale computation in neuromorphic hybrid systems

Type: COOPERATION (ICT)

Defi: Brain-inspired multiscale computation in neuromorphic hybrid systems

Instrument: Integrated Project (IP)

Objectif: FET proactive 8: Brain Inspired ICT

Duration: January 2011 - December 2014

Coordinator: Universitaet Ruprecht- Karls Heidelberg (Germany)

Other Partners: Nederlandse Akademie van Wetenschappen, Amsterdam; Universitetet For Miljo Og Biovitenskap, Aas; Universitat Pompeu Fabra, Barcelona; University of Cambridge, Cambridge; Debreceni Egyetem, Debrecen; Technische Universität Dresden, Dresden; CNRS-UNIC, Gif-sur-Yvette; CNRS-INCM, Marseille; CNRS-ISM, Marseille; TUG, Graz; Ruprecht-Karls-Universität Heidelberg, Heidelberg; Forschungszentrum Ju¨lich GmbH, Jülich; EPFL LCN, Lausanne; EPFL-BBP, Lausanne; The University Of Manchester, Manchester; KTH, Stockholm; Universität Zuürich, Zuürich

See also http://brainscales.kip.uni-heidelberg.de/

Inria contact: Olivier Faugeras

Abstract: The BrainScaleS project aims at understanding function and interaction of multiple spatial and temporal scales in brain information processing. The fundamentally new approach of BrainScaleS lies in the in-vivo biological experimentation and computational analysis. Spatial scales range from individual neurons over larger neuron populations to entire functional brain areas. Temporal scales range from milliseconds relevant for event based plasticity mechanisms to hours or days relevant for learning and development. In the project generic theoretical principles will be extracted to enable an artificial synthesis of cortical-like cognitive skills. Both, numerical simulations on petaflop supercomputers and a fundamentally different non-von Neumann hardware architecture will be employed for this purpose. Neurobiological data from the early perceptual visual and somatosensory systems will be combined with data from specifically targeted higher cortical areas. Functional databases as well as novel project-specific experimental tools and protocols will be developed and used. New theoretical concepts and methods will be developed for understanding the computational role of the complex multi-scale dynamics of neural systems in-vivo. Innovative in-vivo experiments will be carried out to guide this analytical understanding. Multiscale architectures will be synthesized into a non-von Neumann computing device realised in custom designed electronic hardware. The proposed Hybrid Multiscale Computing Facility (HMF) combines microscopic neuromorphic

physical model circuits with numerically calculated mesoscopic and macroscopic functional units and a virtual environment providing sensory, decision-making and motor interfaces. The project also plans to employ petaflop supercomputing to obtain new insights into the specific properties of the different hardware architectures. A set of demonstration experiments will link multiscale analysis of biological systems with functionally and architecturally equivalent synthetic systems and offer the possibility for quantitative statements on the validity of theories bridging multiple scales. The demonstration experiments will also explore non-von Neumann computing outside the realm of brain-science. BrainScaleS will establish close links with the EU Brain-i-Nets and the Blue Brain project at the EPFL Lausanne. The consortium consists of a core group of 10 partners with 13 individual groups. Together with other projects and groups the BrainScaleS consortium plans to make important contributions to the preparation of a future FET flagship project. This project will address the understanding and exploitation of information processing in the human brain as one of the major intellectual challenges of humanity with vast potential applications.

This project started on January 1st, 2011 and is funded for four years.

6.2.1.2. MATHEMACS

Title: Mathematics of Multilevel Anticipatory Complex Systems

Type: Collaborative project (generic) (FP7-ICT)

Defi: develop a mathematical theory of complex multilevel systems and their dynamics.

Instrument: Integrated Project (IP)

Objectif: NC

Duration: October 2012 - September 2015

Coordinator: Fatihcan Atay, Max Planck Institute for Mathematics in the Sciences, Leipzig (Germany)

Other Partners: Max Planck Institute for Mathematics in the Sciences (Leipzig, Germany), Universität Bielefeld (Germany), Chalmers University of Technology (Gothenburg, Sweden), Ca'Foscari University of Venice (Italy), Università Politecnica delle Marche (Ancona, Italy).

See also: http://www.mathemacs.eu/description.html

Inria contact: Olivier Faugeras

Abstract: The MATHEMACS project aims to develop a mathematical theory of complex multi-level systems and their dynamics. This is done through a general formulation based on the mathematical tools of information and dynamical systems theories. To ensure that the theoretical framework is at the same time practically applicable, three key application areas are represented within the project, namely neurobiology, human communication, and economics. These areas not only provide some of the best-known epitomes of complex multi-level systems, but also constitute a challenging test bed for validating the generality of the theory since they span a vast range of spatial and temporal scales. Furthermore, they have an important common aspect; namely, their complexity and self-organizational character is partly due to the anticipatory and predictive actions of their constituent units. The MATHEMACS project contends that the concepts of anticipation and prediction are particularly relevant for multi-level systems since they often involve different levels. Thus, as a further unique feature, the project includes the mathematical representation and modeling of anticipation in its agenda for understanding complex multi-level systems.

This project started on October 1st, 2012 and is funded for four years.

6.2.1.3. RENVISION

Type: COOPERATION, FP7 FET (Future Emerging technology) proactive program: Neuro-Bio-Inspired Systems Call 9 Objective 9.11

Defi: Retina-inspired ENcoding for advanced VISION tasks (RENVISION)

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: March 2013 - February 2016

Coordinator: Vittorio Murino, PAVIS, IIT (Italy)

Partner: PAVIS, IIT (Italy), NBT, IIT (Italy), NAPH, IIT (Italy), The Institute of Neuroscience, Newcastle University (UK), Institute for Adaptive and Neural Computation, The University of Edimburgh (UK), Neuromathcomp project-team, Inria (France)

Inria contact: Pierre Kornprobst

Abstract: The retina is a sophisticated distributed processing unit of the central nervous system encoding visual stimuli in a highly parallel, adaptive and computationally efficient way. Recent studies show that rather than being a simple spatiotemporal filter that encodes visual information, the retina performs sophisticated non-linear computations extracting specific spatio-temporal stimulus features in a highly selective manner (e.g. motion selectivity). Understanding the neurobiological principles beyond retinal functionality is essential to develop successful artificial computer vision architectures.

RENVISION's goal is, therefore, twofold:

- To achieve a comprehensive understanding of how the retina encodes visual information through the different cellular layers;
- To use such insights to develop a retina-inspired computational approach to high-level computer vision tasks.

To this aim, exploiting the recent advances in high-resolution light microscopy 3D imaging and high-density multielectrode array technologies, RENVISION will be in an unprecedented position to investigate pan-retinal signal processing at high spatio-temporal resolution, integrating these two technologies in a novel experimental setup. This will allow for simultaneous recording from the entire population of ganglion cells and functional imaging of inner retinal layers at near-cellular resolution, combined with 3D structural imaging of the whole inner retina. The combined analysis of these complex datasets will require the development of novel multimodal analysis methods.

Resting on these neuroscientific and computational grounds, RENVISION will generate new knowledge on retinal processing. It will provide advanced pattern recognition and machine learning technologies to ICTs by shedding a new light on how the output of retinal processing (natural or modelled) allows solving complex vision tasks such as automated scene categorization and human action recognition.

6.2.1.4. HBP

Type: COOPERATION, FET Flagship' project

Defi: Understanding the brain

Instrument: FET Flagship' project

Objectif: NC

Duration: October 2013 - March 2016

Coordinator: EPFL (Switzerland)

Partner: see http://www.humanbrainproject.eu.

Inria contact: Olivier Faugeras

Abstract: The Human Brain Project (HBP) is supported by the European Union as a 'FET Flagship' project and the 86 institutions involved will receive one billion euro in funding over ten years. HBP should lay the technical foundations for a new model of ICT-based brain research, driving integration between data and knowledge from different disciplines, and catalysing a community effort to achieve a new understanding of the brain, new treatments for brain disease and new brain-like computing technologies. http://www.humanbrainproject.eu

6.3. International Initiatives

6.3.1. Participation In other International Programs

6.3.1.1. ANR KEOPS

Title: Algorithms for modeling the visual system: From natural vision to numerical applications.

principal investigator: Thierry Viéville (Mnemosyne)

International Partner:

Institution: University of Valparaiso (Chile)

Laboratory: Centro Interdiciplinario de Neurociencia de Valparaiso

Researcher: Adrian PALACIOS

International Partner:

Institution: UTFSM Valparaiso (Chile)

Laboratory: Direccion General de Investigacion y Postgrado

Researcher: Maria-Jose ESCOBAR

Duration: 2011 - 2014

See also: http://cortex.loria.fr/Research/Keops

KEOpS attempts to study and model the non-standard behavior of retinal (ganglion cells) sensors observed in natural scenarios. KEOpS also attempts to incorporate the resulting models into real engineering applications as new dynamical early-visual modules. The retina, an accessible part of the brain, is a unique model for studying the neural coding principles for natural scenarios. A recent study proposes that some visual functions (e.g. movement, orientation, anticipatory temporal prediction, contrast), thought to be the exclusive duty of higher brain centers, are actually carried at the retina level. The anatomical and physiological segregation of visual scenes into spatial, temporal and chromatic channels begins at the retina through the action of local neural networks. However, how the precise articulation of this neural network contributes to local solutions and global perception necessary to resolve natural task remains in general a mystery. KEOpS thus attempts to study the complexity of retinal ganglion cells (the output to the brain) behaviors observed in natural scenarios2 and to apply this result to artificial visual systems. We revisit both the retinal neural coding information sent to the brain, and at the same time, the development of new engineering applications inspired by the understanding of such neural encoding mechanisms. We develop an innovative formalism that takes the real (natural) complexity of retinal responses into account. We also develop new dynamical early-visual modules necessary to solve visual problems task.

6.4. International Research Visitors

6.4.1. Visits of International Scientists

- Paul Bressloff, Professor of mathematics at the University of Utah won an international chair at Inria (2013-2017).
- Michele Migliore, Research Scientist at the Institute of Biophysics, National Research Council, Palermo, Italy. Funded by the "Axe Interdisciplinaire de Recherche de l'Université de Nice – Sophia Antipolis".
- Cyan O'Donnell, Postdoc at the Computational Neurobiology Laboratory in the Salk Institute, Califorina, from 9th July until 19th July 2014. Funded by the "Axe Interdisciplinaire de Recherche de l'Université de Nice – Sophia Antipolis".

6.4.1.1. Internships

- Cesar Ravello, pHd student with A. Palacios, Centro Interdisciplinario de Neurociencia de Valparaíso, Univ de Valparaíso, Valparaíso, Chile. From May 2014 until Jun 2014
- Ruben Herzog, Master student in Valparaiso, with A. Palacios, Centro Interdisciplinario de Neurociencia de Valparaíso, Univ de Valparaíso, Valparaíso. From November, 12th 2014 until November 14th 2014.

NEUROSYS Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

In the *Contrat de Projet État Région (CPER) Action Modeling, Simulation and Interaction* (2009-2014), we are contributing to the axis *Situed Informatic* through the project CoBras for controlling a jaco robotic arm using EEG. Contact in Neurosys is Laurent Bougrain.

7.2. National Initiatives

7.2.1. ANR

We participate in the project *Keops:* Algorithms for modeling the visual system: From natural vision to numerical applications (2011-2014).
A recent description in the retina of non-standard ganglion cells types, beside a complex repertoire of standard ganglion cells, responses in front of natural stimulus and conveys important questions about the real, early processing capacity of the retina. This leads to revisit both the neural coding of the information the eye is sending to the brain, and also sheds light to engineering applications from the understanding of such encoding, as detailed in the sequel. At the modeling level, retinal cells are mainly formalized using a LN (Linear spatio-temporal filtering followed by a static Non-linear transduction), while an important fraction of non-standard cells response cannot be represented in such a model class. This is a challenge to develop an innovative formalism that takes such complex behaviors into account, with such immediate applications as new dynamical early-visual modules. Proposing new innovative bioinspired formalisms in order to perform dynamical visuo-perceptual tasks adapted to natural environment is a main goal of this project, with a special focus to scenes including complex visual motion interacting with light.
The project is a cooperation between the University of Nice (France), the University of Valparaiso (Chile), the Pontifical Catholic University of Chile in Santiago de Chile, the Inria teams NeuroMathComp, Mnemosyne, Cortex and Neurosys.

7.2.2. Others

- Inria Technological development action (ADT): OpenViBE-NT
  This is a three-year multi-site project (2012–2015) to develop OpenViBE further on several fronts such as usability, new algorithms and scope of applicability. Teams of the ADT are Hybrid(Rennes), Athena (Sophia), Potioc (Bordeaux) and Neurosys. Coordinator is Laurent Bougrain.
- Multidisciplinary Exploratory Project (PEPS 2014) Bio-Maths-Info (BMI): *Characterising the laminar profile of motor cortical oscillatory synchronization during visuomotor behavior with new analysis tools.*
  Oscillations are omnipresent in the brain, but their function is still disputed. In motor cortex, beta and gamma oscillations are often observed, but their proposed roles in sensorimotor behavior are largely overlapping. While much is known on the laminar distribution of oscillations in sensory areas, the very sparse data on the laminar profile of motor cortical oscillations largely limits their functional interpretations. The 2-years project studies the layer specificity of monkey motor cortical oscillations and oscillatory interactions between the motor areas M1 and PMd during visuomotor behavior. Extending conventional tools, such as coherency analysis, Neurosys develops a new method to quantify short-lasting partial amplitude and phase synchronization in single-trial data, based on wavelets, exploiting the predefined vicinity of contacts on the laminar probes. The application of this new method to the data recorded in Marseille will reveal instantaneous amplitude and phase synchronization between cortical layers and between the brain areas *M*1 and *P*Md, providing novel insights into the functional roles of beta and gamma oscillations in visuomotor behavior. The experimental partner at the *Institut de Neurosciences de la Timone* in Marseille is Bjork Kilavik. The contact in Neurosys is Axel Hutt.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

The *ITN*-project *Neural Engineering Transformative Technologies (NETT)* (2012-2016) is a Europe-wide consortium of 18 universities, research institutes and private companies which together hosts 17 PhD students and 3 postdoctoral researchers over the next 4 years. Neural Engineering brings together engineering, physics, neuroscience and mathematics to design and develop brain-computer interface systems, cognitive computers and neural prosthetics. Neurosys will host a PhD-student from University of Barcelona for three months in fall 2015. Contact is Axel Hutt.

7.3.2. Collaborations in European Programs, except FP7 & H2020

Program: ERC Starting Grant

Project acronym: MATHANA

Project title: Mathematical Modeling of Anaesthesia

Duration: January 2011 – December 2015

Coordinator: Axel Hutt

Abstract: MATHANA aims to study mathematically spatially extended neural systems and reveal their spatio-temporal dynamics during general anaesthesia.

7.3.3. Collaborations with Major European Organizations

Lifestyle Research Association (LIRA): Philips (Netherlands), Fraunhofer (Germany), Inria

Sleep is an essential part of a healthy life, but many people have trouble getting enough uninterrupted sleep. Special sensors installed in a mobile phone or bed can analyze activities, stress patterns and sleep sequences and provide ideas for new strategies and, eventually, products that support a healthier night's sleep. NEUROSYS has a Postdoc project running merging all sensor signals in a single data analysis technique to improve existing sleep monitors.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Informal International Partners

- We collaborate with Jamie Sleigh (University of Auckland, New Zealand), who provides us with experimental EEG-data obtained in humans during anaesthesia (A. Hutt).
- In the collaboration with Flavio Frohlich (University of North Carolina - Chapel Hill), we receive experimental data measured intracranially in ferrets and analyse them on spectral properties (A. Hutt).
- In the collaboration with Jérémy Lefebvre (University of Lausanne), we have been working out together a stochastic delayed neural field analysis leading to new insights into the effects of additive noise (A. Hutt).
- The collaboration with Peter beim Graben (Humboldt University Berlin) on recurrence data analysis has led to analysis techniques to detect meta-stable states in EEG-signals (A. Hutt).
- We have an ongoing collaboration with Pr. Motoharu Yoshida at the Ruhr University Bochum, Germany, aiming to study the role of persistent firing neurons in memory and more specifically in neural network synchronization. M. Yoshida provides us with biological data that we combine with simulations to test hypotheses on memory formation (L. Buhry).
- We also collaborate with Pr. John Rinzel (New York University, USA) and Pr. LieJune Shiau (University of Houston, Texas, USA) on more theoretical approaches concerning the role of intrinsic neuronal dynamics in network synchronization and brain oscillations (L. Buhry).

7.5. International Research Visitors

7.5.1. Visits of International Scientists

We have hosted the visiting professor LieJune Shiau (University of Houston, June) to discuss future collaborations on the modeling of neural populations based on single neuron properties in the presence of anaesthetic drugs. In addition, Motoharu Yoshida (Ruhr-Universität Bochum, Germany) visited our lab, gave a seminar and we discussed our current collaboration about memory and persistent firing cells of the hippocampus.

7.5.2. Visits to International Teams

7.5.2.1. Research stays abroad

Axel Hutt has stayed for 1 month at the Humboldt University Berlin to enforce the collaboration with Peter beim Graben (October - November).

NON-A Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Project ARCIR «Estimation distribuée de systèmes dynamiques en réseaux», coordinator Prof. Mihaly Petreczky, URIA – Mines de Douai, 2013–2015
- CPER CIA, "Internet of Things", 2011–2015
- CPER CISIT (becoming ELSAT in 2015), "Campus international sur la securite et intermodalite de transport", project "CONTRAERO" with LML and IEMN, 2011–2015
- ADT Inria SLIM "Development of ROS software library for multi-robots cooperation", 2013–2014 Project Agrégation, Conseil Général du Val d'Oise, (http://www.scilab.org/fr/community/scilabtec/2013/Projet-Agregation-la-simulation-numerique-dans-les-essais)

8.2. National Initiatives

- ANR project TourboTouch (High-performance touch interactions), coordinator Prof. Géry Casiez (MJOLNIR team, Inria): 2014-2019
- ANR project ChaSliM (Chattering-free Sliding Modes), coordinator Prof. B. Brogliato (BIBOP team, Inria): 2012-2015
- ANR ROCC-SYS (Robust Control of Cyber-Physical Systems), coordinator Dr. L. Hetel: 2014-2017
- We are also involved in several technical groups of the GDR MACS (CNRS, "Modélisation, Analyse de Conduite des Systèmes dynamiques", see http://www.univ-valenciennes.fr/GDR-MACS), in particular: Technical Groups "Identification", "Time Delay Systems", "Hybrid Systems", "Complex Systems, Biological Systems and Automatic Control," and "Control in Electrical Engineering".
- Model-free control: collaborations with the startup ALIEN SAS (created by C. Join and M. Fliess).

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

- HYCON2 (http://www.hycon2.eu/) The FP7 NoE HYCON2, started in September 2010, is a four-year project coordinated by the CNRS (Françoise Lamnabhi-Lagarrigue). It aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems. It focuses in particular on the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems. Our PhD students are regularly supported for their participation to the EECI training.

8.3.2. Collaborations in European Programs, except FP7 & H2020

- SYSIASS (http://www.sysiass.eu/) Here is the major issue on which the project SYSIASS seeks to answer by developing new technologies and putting them in the service of patients and health professionals from our regions. Indeed preserve the autonomy of the elderly and disabled people is a major issue in today's society. In Europe, with the progressive ageing of the population policy to support the elderly is increasingly based on the assumption that care must be provided efficiently to the patient where he is based. In addition, special attention is devoted to people with disabilities for their better integration into society. Advances in technology proposed by SYSIASS (SYStème Intelligent et Autonome d'aide aux Soins de Santé / Autonomous and Intelligent Healthcare System) will be realized in practice through an intelligent wheelchair that can provide better mobility to

the patient and to allow health care professionals to easily transport patients to desired locations within a clinic or home environment. Moreover such a system must be able to communicate with the outside world, to adapt to specific patient needs and any special disability that he may have, and to facilitate access to medical data for health professionals. Our PhD students are regularly supported for participation in the accociated EECI traning.

- ICityForAll: EU Ambiant Assisted Living Program (http://www.icityforall.eu/) The project is leaded by CEA and it includes University of Paris Descartes-UPD, CENTICH, Active Audio (SME, France), Tech. Univ of Munich - TUM (Germany), EPFL (Suisse), ENEA (Italy), Centro Ricerche FIAT-CRF (Italy). The goal of I'City for All (Age sensitive ICT systems for Intelligible City for All) is to enhance speech and audio alarms intelligibility in order to improve the sense of well-being of seniors through better social interactions, better security and then improved mobility. Mamadou Mboup is involved as a subcontractor of UPD.

8.4. International Initiatives

8.4.1. Inria Associate Teams

- Associate team with Norwegian University of Science and Technology (Tronheim, Norway) and UMEA university (Sweden), 2013-2016
  Subject: "Dynamical precision improvement for industrial robots"

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

- Professor Emilia Fridman, Tel Aviv University, Israel
- Sliding Mode Control Lab., UNAM, Mexico
- Department Control Automatico, CINVESTAV-IPN, Mexico
- UPIBI, National Polytechnic Institute, Mexico
- Department of Control Systems and Informatics, Saint Petersburg State University of Information Technologies Mechanics and Optics (ITMO), Russia

8.4.3. Participation In other International Programs

- CNRS GDRI DelSys (http://www.cnrs.fr/ins2i/spip.php?article217)
- CNRS-CONACYT project, UNAM, Mexico, "Estimation of state for hybrid systems using sliding mode techniques", 2014

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Prof. Emilia Fridman, Tel Aviv State University, Israel, from Jun 2014 until Jul 2014
  Subject:*Homogeneity application for time-delay systems : finite-time stability*
- Dr. Francisco Bejarano Rodriguez, National Polytechnic Institute, Mexico, until Jul 2014
  Subject:*Observability and observer for linear time-delay systems with unknown inputs*
- Prof. Leonid Fridman, UNAM, Mexico, until Jul 2014
  Subject:*State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes*

8.5.1.1. Internships

- Mimia Benhadri, Skikda University Algeria, Jun 2014
  Subject:*Time Delay Systems*

- Andrea Aparicio Martinez, UNAM, Mexico, from Jun 2014 until Jul 2014
  Subject:*State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes*
- Ivan De Jesus Salgado Ramos, National Polytechnic Institute, Mexico, from Jul 2014
  Subject:*PID control design based on the different differentiation techniques*
- Tonametl Sanchez Ramirez,UNAM, Mexico, until Jul 2014
  Subject:*State Observation and Parameter Identification in Hybrid Systems via High-Order Sliding-Modes*
- Carlos Vazquez Aguilera, UMEA, Sweden, from Nov 2014
  Subject:*Application of discontinuous Lyapunov functions for dead-zone compensation*
- Konstantin Zimenko, ITMO, Russia, from Nov 2014
  Subject:*Transfer functions for homogeneous finite-time stable systems*
- Zohra Kader from March 2014 to September 2014
  Subject: *Left inversion of nonlinear time delay system*.

8.5.2. Visits to International Teams

8.5.2.1. Explorer programme

- Gang Zheng, Nanjing University of Science and Technology (China), in December 2014, supported Sino-French International Joint Laboratory of Automation and Signals (University Lille 1)
- Andrey Polyakov, UPIBI, National Polytechnic Institute, Mexico, in October 2014, supported by UPIBI-IPN

NUMED Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Two regional grants for mobility to develop collaborations with A. Samson (Grenoble) and Didier Bresch (Chambéry) respectively.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. DDMoRE

Type: FP7

Duration: February 2011 - January 2016

Inria contact: Marc Lavielle

URL : http://www.ddmore.eu/

7.2.2. Collaborations with Major European Organizations

ERC Grant for Vincent Calvez.

7.3. International Research Visitors

7.3.1. Explorer programme

Emeric Bouin will spent three months as a post doc at Stanford university.

7.3.2. Research stays abroad

E. Bouin and V. Calvez worked two weeks in Austarlia. E. Grenier spent one week in Princeton. P. Vigneaux goes for two months in Sevilla.

OAK Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

DW4RDF is a Digiteo project joint between Inria and U. Paris Sud, focused on analytic platforms for RDF data. The project has ended in October 2014, it has lasted three years, and it was coordinated by François Goasdoué. The project has provided the framework for the PhD of Alexandra Roatis [10], [28], [4], [28], [2].
S4 (Social, Structured and Semantic Search) is a Digicosme project joint between Inria and U. Paris Sud, focused on developing novel models and algorithms for user-centric search in a social context where complex documents are authored and endowed with rich semantics. The project provides the framework for the PhD of Raphael Bonaque [19].

7.2. National Initiatives

7.2.1. ANR

Apprentissage Adaptatif pour le Crowdsourcing Intelligent et l'Accès à l'Information (ALICIA) is a 4-year project, started in February 2014, supported by the ANR CONTINT call. The project is coordinated by Bogdan Cautis, with Nicole Bidoit, and Ioana Manolescu. Its goal is to study models, techniques, and the practical deployment of adaptive learning techniques in user-centric applications, such as social networks and crowdsourcing.
Cloud-Based Organizational Design (CBOD) is a 4-year ANR started in 2014, coordinated by prof. Ahmed Bounfour from UNIV. PARIS-SUD. Its goal is to study and model the ways in which cloud computing impacts the behavior and operation of companies and organizations, with a particular focus on the cloud-based management of data, a crucial asset in many companies.
Datalyse is funded for 3.5 years as part of the *Investissement d'Avenir - Cloud & Big Data* national program. The project is led by the Grenoble company Eolas, a subsidiary of Business & Decision. It is a collaboration with LIG Grenoble, U. Lille 1, U. Montpellier, and Inria Rhône-Alpes aiming at building scalable and expressive tools for Big Data analytics.

7.2.2. LabEx, IdEx

Structured, Social and Semantic Search is a 3-year project started in October 2013, financed by the *LabEx (Laboratoire d'Excellence)*DIGICOSME. The project aims at developing a data model for rich structured content enriched with semantic annotations and authored in a distributed setting, as well as efficient algorithms for top-k search on such content.
BizModel4Cloud is a one-year (2014) interdisciplinary research project funded under a *Projet Exploratoire Premier Soutien (PEPS)* call joint between the CNRS and the IdEx Paris Saclay. It reunites the same partners as the ANR CBOD project of which it is an initial, short version.

7.2.3. Others

ODIN is a four-year project started in 2014, funded by the Direction Générale de l'Armement, between the SemSoft company, IRISA Rennes and Inria Saclay (OAK). The project aims to develop a complete framework for analytics on Web data, in particular taking into account uncertainty, based on Semantic Web technologies such as RDF.

7.3. European Initiatives

7.3.1. Collaborations in European Programs, except FP7 & H2020

Program: COST

Project acronym: Keystone

Project title: Semantic keyword-based search on structured data sources

Duration: Oct 2013 – Oct 2018

Coordinator: Francesco Guerra (U. Modena, Italy)

Other partners: The project involves 24 countries, see http://www.cost.eu/domains_actions/ict/Actions/IC1302?parties

Abstract: To build efficient and expressive keyword search tools, the action "semantic KEYword-based Search on sTructured data sOurcEs" (KEYSTONE) proposes to draw upon competencies from several disciplines, such as semantic data management, the semantic web, information retrieval, artificial intelligence, machine learning, user interaction, service science, service design, and natural language processing.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. OAKSAD

Title: Languages and techniques for efficient large-scale Web data management

International Partner (Institution - Laboratory - Researcher):

University of California, San Diego (ÉTATS-UNIS)

Duration: 2013 - 2015

See also: https://team.inria.fr/oak/oaksad/

Data on the Web is increasingly large and complex. The ways to process and share it have also evolved, from the classical scenario where users connect to a database, to today's complex processes whereas data is jointly produced on the Web, disseminated through streams, corroborated and enriched through annotations, and exploited through complex business processes, or workflows. The OAK and San Diego teams work together to devise expressive languages, efficient techniques and scalable platforms for such applications. The main areas on which our interest is shared are: semantic Web annotations; large-scale distributed data sharing; monitoring and verification of automated data processing workflows in the cloud.

7.4.2. Inria International Partners

7.4.2.1. Informal International Partners

We have started discussions with the University of Tsukuba (Japan) and prepare a future submission of an associate team with them, on topics related to efficient techniques for querying distributed heterogeneous data sources.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Yannis Velegrakis (U. Trento) visited the team in December 2014 and gave a seminar on recommender systems.
- Konstantinos Karanasos (Microsoft Research) visited the team in November 2014 and gave a seminar on dynamic query optimization in large-scale data processing platforms.
- Tamer Ozsu (U. Waterloo) visited the team in October 2014 and gave a seminar on distributed RDF data management.
- Alin Deutsch (UCSD) visited the team in October 2014 as part of our OAKSADjoint work.
- Dan Olteanu (Oxford U.) visited the team in October 2014 and gave a seminar on modern Datalog evaluation engines.
- Julien Leblay (Oxford U.) visited the team in May 2014 and gave a seminar on querying the deep web.
- Laurent Daynès (Oracle) visited the team in February 2014 and gave a seminar on optimization techniques for evaluating arithmetic expressions in Oracle.

7.5.1.1. Internships

- Sejla Cebiric (M2 intern), from University of Sarajevo, Bosnia (March - August 2014)
- Elham Akbari Azirani (M2 intern), from University of Teheran, Iran (April - September 2014)

7.5.2. Visits to International Teams

7.5.2.1. Research stays abroad

Bogdan Cautis visited Yahoo Labs Barcelona, in July, on the account of ongoing collaborations in as-you-type search and query recommendation in social media. He also visited the University of Singapore for one week in April (Stephane Bressan's team).

OPALE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Project "SOKA"

OPALE team is coordinator of the project SOKA, funded by INSEP. The objective is the optimization of the shape of racing canoes in the perspective of 2016 Olympic Games in Rio. Other partners are the Ecole Centrale de Nantes and FFCK (French Federation of Canoe-Kayak).

7.1.2. Project "OASIS"

The OASIS project, Optimization of Addendum Surfaces In Stamping, is an R&D consortium (CS, Arcelor-Mittal, ErDF, Inria, UTC, EURODECISION, ESILV, NECS, DeltaCAD, SCILAB-DIGITEO) of the Pole Systemtic Paris-Region dedicated to develop an optimal design framework (methods-software platforms-applications) for stamping processes. The EPI OPALE/Inria is the leader within the consortium for the Optimization work-package (one of six WP), the role of which is to develop efficient tools well adapted to Pareto front identification of the multicriteria-dependent stamping processes.

The OASIS project yields 2.4 Meuro total financial support (one Ph.D thesis, two post-doctoral positions and 12 months internship for OPALE).

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. GRAIN 2

Type: Cooperation

Defi: Transport (incl. Aeronautics)

Instrument: Coordination and Support Action (CSA)

Objectif: NC

Duration: October 2013 - June 2016

Coordinator: Centre Internacional de Metodes Numerics en Enginyeria, Barcelone (Spain)

Partner: Airbus (Sp), Alenia (I), EADS-IW (F), Rolls-Royce (UK), Ingenia (Sp.), Numeca (B), U. Sheffield (UK), U. Birmingham (UK), CIRA (I), VKI (B), Airbone (NL), Leitat (Sp), Cerfacs (F), U. Cranfield (UK), CAE (CN), GTE (CN), ARI (CN), FAI (CN), ASRI (CN), SAERI (CN), BIAM (CN), ACTRI (CN), BUAA (CN), NPU (CN), PKU (CN), NUAA (CN), ZIU (CN)

Inria contact: Toan Nguyen

Abstract: The main objective of GRAIN2 is to focus its greening activities following the Flight Path 2050 Vision for Aircraft en route to the very ambitious challenge "Protecting the environment and the energy supply" in three major following lines: i) greening the air vehicle, ii) greening the Air transport System and iii) Reducing the carbon foot print of aviation via sustainable alternative fuels. GRAIN2 will identify innovative R & D methods, tools and HPC environments (supercomputers and GPGPUs) in the different KGTs according to the needs of major aeronautical industries to deeper understand the mechanism of engine exhaust emissions, to improve fuel efficiency and environmental performance, to lower noise for landing gear and high lift surfaces, to introduce new materials with multiple functions, to help significantly the development of biofuels for greenhouse gas emission reduction, etc.

http://www.cimne.com/grain2/

7.2.1.2. TraM3

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Objectif: NC

Duration: October 2010 - March 2016

Coordinator: Inria

Inria contact: Paola Goatin

Abstract: The project intends to investigate traffic phenomena from the macroscopic point of view, using models derived from fluid-dynamics consisting in hyperbolic conservation laws. The scope is to develop a rigorous analytical framework and fast and efficient numerical tools for solving optimization and control problems, such as queues lengths control or buildings exits design. See also: http://www-sop.inria.fr/members/Paola.Goatin/tram3.html

7.2.1.3. VELaSSCo

Type: FP7 (Strep)

Defi: ICT, Technologies for Digital Content and Languages

Instrument: Specific Targeted Research Project

Objectif: Scalable data analytics

Duration: January 2014-December 2016

Coordinator: Centre Internacional de Metodes Numerics en Enginyeria (Spain)

Partners: JOTNE (No.), SINTEF (No.), Fraunhofer IGD (D), ATOS (SP), Univ. Edinburgh (UK)

Inria contact: Toan Nguyen

Abstract: VELaSSCo aims at developing a new concept of integrated end-user visual analysis methods with advanced management and post-processing algorithms for engineering modelling applications, scalable for real-time petabyte level simulations [59]. The interface will enable real-time interrogation of simulation data, generating key information for analysis. Main concerns have to do with handling of large amounts of data of a very specific kind intrinsically linked to geometrical properties; how to store, access, simplify and manipulate billion of records to extract the relevant information; how to represent information in a feasible and flexible way; and how to visualise and interactively inspect the huge quantity of information they produce taking into account end-user's needs. VELaSSCo achieves this by putting together experts with relevant background in Big Data handling, advanced visualisation, engineering simulations, and a User Panel including research centres, SMEs and companies form key European industrial sectors such as aerospace, household products, chemical, pharmaceutical and civil engineering.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. ORESTE

Title: Optimal REroute Strategies for Traffic managEment

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (ÉTATS-UNIS)

Duration: 2012 - 2014

See also: http://www-sop.inria.fr/members/Paola.Goatin/ORESTE

ORESTE is an associated team between OPALE project-team at Inria and the Mobile Millennium / Integrated Corridor Management (ICM) team at UC Berkeley focused on traffic management. With this project, we aim at processing GPS traffic data with up-to-date mathematical techniques to optimize traffic flows in corridors. More precisely, we seek for optimal reroute strategies to reduce freeway congestion employing the unused capacity of the secondary network. The project uses macroscopic traffic flow models and a discrete approach to solve the corresponding optimal control problems. The overall goal is to provide constructive results that can be implemented in practice. Both teams have actively contributed to recent advances in the subject, and we think their collaboration is now mature enough to take advantage of the associate team framework. The Inria team and its theoretical knowledge complement the Berkeley team, with its engineering knowledge anchored in practice.

7.3.2. Participation In other International Programs

- Inria@SILICONVALLEY :

  ORESTE Associated Team with UC Berkeley takes part to the program.

- LIRIMA Team ANO 2010-2014:

  The agreement governing the creation of the International Laboratory for Research in Computer Science and Applied Mathematics (LIRIMA) was signed on 24th November 2009 in Yaoundé. LIRIMA enables cooperation between Inria research teams and teams in Africa (Sub-Saharan Africa and the Maghreb) to be reinforced. It is the continuation of the major operation undertaken by the SARIMA program (2004-08 Priority Solidarity Fund created by the French Ministry of Foreign & European Affairs).

  The LIRIMA team ANO : Numerical analysis of PDEs and Optimization is a partnership between Opale project and the EMI engineering college, Rabat / National Centre for Scientific and Technical Research (CNRST) Morocco. The Team leader is Prof. Rajae Aboulaïch, EMI. Other french participants are the Project Commands at Saclay, Palaiseau and the team-project DRACULA at Inria Lyon.

  The ANO team is composed of ten senior researchers from Morocco and ten senior researchers from France and more than fifteen PhD students.

  The themes investigated are biomathematics (Models for plants growth, cardiovascular and cerebral diseases, cardio image segmentation), mathematical finance (optimal portfolio, risk management, Islamic finance), multiobjective optimization in structural mechanics, and vehicle traffic and crowd motion. Refer to the website http://www.lirima.uninet.cm/index.php/en/ for more details on the LIRIMA Africa themes and teams.

- PHC PROCOPE Team *Transport Networks Modeling and Analysis*
  Duration : Jan. 2014- Dec. 2015
  Coordinator: P. Goatin (France), S. Göttlich (Germany)
  Other partner: University of Mannheim (Germany)
  Abstract: The proposed research cooperation focuses on the development and analysis of methods for time-dependent transport phenomena in complex systems. Such systems are given for example by traffic flow networks, production lines, gas and water networks, or chemical reactions. Our particular importance is to model physical processes according to their scale by suitable mathematical means. To this end a model hierarchy using a discrete description for the small scale effects and a continuous model to describe large scale phenomena is investigated. These novel and nonstandard approaches allow to incorporate detailed nonlinear dynamic behavior, which is currently not possible with the widely used classical mixed?integer linear approaches. Through the coupling of discrete and continuous models, both on the theoretical and the applied level, we will contribute to the quantification of uncertainty as well as on control problems for these systems. The modeling is achieved by first considering transport phenomena such as traffic, production, gas and water before controlling the systems. We analyze system properties and derive and implement efficient

numerical algorithms for simulation and optimization purposes. In this setting, the proposed project yields a significant contribution for tackling large dynamical problems not only restricted to traffic management but also in other engineering areas.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Senior Researchers

Pr. Rinaldo M. Colombo

Subject: Conservation laws with non-local flux function.

Institution: Brescia University , Brescia (Italy)

Pr. Simone Göttlich

Subject: Optimization of traffic flows on networks.

Institution: Mannheim University , Mannheim (Germany)

Pr. Moez Kallel

Subject: Data completion for heat-elasticity systems

Institution: ENIT, Tunis al Manar University (Tunisia)

7.4.1.2. Internships

- E. Bertino from Ecole Centrale de Nantes (uncertainty quantification in traffic flow models).
- C. Fiorini from Politecnico di Milano (multiple gradient descent algorithm applied to unsteady optimization).
- S. Scialanga from Roma La Sapienza University (traffic flow models with non-local velocity)

ORPAILLEUR Project-Team

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Participation In International Programs

8.1.1.1. Ciência Sem Fronteiras

Participant: Amedeo Napoli [contact person].

Program "Ciência Sem Fronteiras" is a Brazilian research fellowship which provides a funding for the stay of a visiting French researcher in Brazil at Universidade Federal Pernambuco Recife for three years. The on-going project is called "Formal Concept Analysis as a Support for Knowledge Discovery" and is aimed at combining FCA methods with numerical clustering methods used by Brazilian colleagues. This project is supervised in Brazil by Professor Francisco de A.T. de Carvalho (CIn/UFPE).

The project aims at developing and comparing classification and clustering algorithms for complex data (especially interval and multi-valued data). Two families of algorithms are studied, namely "clustering algorithms" based on the use of a similarity or a distance for comparing the objects, and "classification algorithms in Formal Concept Analysis (FCA)" based on attribute sharing between objects. The objectives here are to combine the facilities of both families of algorithms for improving the potential of each family in dealing with more complex and voluminous datasets.

8.1.1.2. Pronex Brasilia

Participant: Bernard Maigret [contact person].

In this research project, the goal is to identify, using virtual screening techniques that we developed, new compounds against tropical diseases (e.g. trypanosome, dengue and mycosis) in collaboration with several Brazilian laboratories among which the Department of Biology at University of Brasilia, together with the Harmonic Pharma start-up. Through this collaboration, several PhD and postdocs came to the lab for one year training with our home-developed virtual screening engine (VSM-G). This project is in part supported by the Brazilian CNPq agency. Fruitful results were already obtained leading to several papers in preparation and patents. These patents concern the discovery of new putative treatment of strong mycosis due to fungi particularly virulent in South America. These patents were funded by the University of Brasilia, Embrapa and Harmonic Pharma.

8.1.2. Inria Associate Team: Snowflake

Participants: Adrien Coulet [contact person], Gabin Personeni, Malika Smaïl-Tabbone.

Snowflake (http://snowflake.loria.fr/) is an Inria Associate Team which started in 2014. It is aimed at facilitating the collaboration between researchers from the Inria ORPAILLEUR team and the Stanford Center for Biomedical Informatics Research, Stanford University, USA. The main objective of Snowflake is to improve biomedical knowledge discovery by connecting Electronic Health Records (EHRs) with LOD (Linked Open Data). Such a connection could allow to complete domain knowledge w.r.t. EHRs. The initial focus of Snowflake is the identification and characterization of groups of patients w.r.t. reactions to drugs. Identifies features associated with such groups of patients could be used as predictors of over- or under-reactions to some drugs. The considered use case is related to pharmacogenomics drugs, i.e., drugs known to cause variable effects depending on the genetic profile of patients. Data associated with pharmacogenomics drugs and their mechanisms are available in LOD and, once connected to EHRs, they can be used to classify drugs and then patients presenting a specific reaction profile to a given group of drugs.

8.1.3. Explorer Programme

Participant: Chedy Raïssi [contact person].

Chedy Raïssi visited the MIT Lab (Massachusetts Institute of Technology, MIT http://web.mit.edu/) during one month between July and August 2014. The objective of this research visit was the following.

Over the last decade, the annual turnovers generated by the electronic entertainment industry went beyond those of both cinema and music industries, making video game production a highly profitable business. In parallel with the game industry growth, watching video-game live streams is becoming an increasingly popular way of entertainment. Given the shared interests, between Orpailleur team and the GameLab at MIT, in emerging broadcasting platforms for games and work on analytics, Chedy Raïssi started a productive collaboration with researchers from the GameLab at MIT where we he explored for one month the potential for future collaborations between the MIT and Inria on this interesting new topic.

8.1.4. Miscellaneous

Participants: Mehwish Alam, Aleksey Buzmakov, Melisachew Chekol, Victor Codocedo, Adrien Coulet, Elias Egho, Ioanna Lykourentzou, Amedeo Napoli [contact person], Chedy Raïssi, Jean-Sébastien Sereni, Mario Valencia.

- The team had a Fapemig – Inria research project between 2009 and 2013, called "Incorporating Knowledge Models into Scalable Data Mining Algorithms" (IKMSDM). The IKMSDM project involved researchers at Universidade Federal de Minas Gerais in Belo Horizonte –a group led by Prof. Wagner Meira– and the Orpailleur team at Inria Nancy Grand Est. In this project we were interested in the mining of large amount of data with two relevant application scenarios: text mining and graph mining. This year, contact and work was going on, focusing on the preparation of a joint publication on the notion of skylines for tensor data.
- An on-going collaboration involves the Orpailleur team and Sergei Kuznetsov at Higher School of Economics in Moscow (HSE). Amedeo Napoli visited HSE laboratory several times (with the support of HSE) while Sergei Kuznetsov visited Inria Nancy Grand Est several times too. The collaboration is materialized by the joint supervision of the thesis of Aleksey Buzmakov and the organization of scientific events, and in particular the workshop FCA4AI whose fourth edition will take place this year in July at IJCAI 2014 (see http://www.fca4ai.hse.ru).
- LEA STRUCO is an "Associated International Laboratory" of CNRS between IÚUK, Prague, and LIAFA, Paris. It focuses on high-level study of fundamental combinatorial objects, with a particular emphasis on comprehending and disseminating the state-of-the-art theories and techniques developed. The obtained insights shall be applied to obtain new results on existing problems as well as to identify directions and questions for future work. Jean-Sébastien Sereni is the contact person for LEA STRUCO which was initiated when Jean-Sébastien was a member of LIAFA.
- At present, Mario Valencia is the international coordinator of the MathAmSud project 13MATH-07 "Structural an algebraic problems on graph theory" (2013–2015). This project is funded by the following research institutes: CNRS in France, MinCyT in Argentina, CAPES in Brazil and CMM in Chile.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. HEREDIA

Participant: Jean-Sébastien Sereni [contact person].

HEREDIA (http://www.liafa.univ-paris-diderot.fr/~sereni/Heredia/) is an ANR JCJC ("Jeunes Chercheurs") focusing on hereditary properties of graphs, which provide a general perspective to study graph properties. Several important general theorems are known and the approach offers an elegant way of unifying notions and proof techniques. Further, hereditary classes of graphs play a central role in graph theory. Besides their theoretical appeal, they are also particularly relevant from an algorithmic point of view. With Jean-Sébastien Sereni, the HEREDIA project involves Pierre Charbit (LIAFA, Paris), Louis Esperet (G-SCOP, Grenoble) and Nicolas Trotignon (LIP, Lyon).

8.2.1.2. Hybride

Participants: Adrien Coulet, Luis-Felipe Melo, Amedeo Napoli, Matthieu Osmuk, Chedy Raïssi, My Thao Tang, Mohsen Sayed, Yannick Toussaint [contact person].

The Hybride research project (http://hybride.loria.fr/) aims at combining Natural Language Processing (NLP) and Knowledge Discovery in Databases (KDD) for text mining. A key idea is to design an interacting and convergent process where NLP methods are used for guiding text mining and KDD methods are used for guiding the analysis of textual documents. NLP methods are mainly based on text analysis and extraction of general and temporal information. KDD methods are based on pattern mining, e.g. patterns and sequences, formal concept analysis and graph mining. In this way, NLP methods applied to texts extract "textual information" that can be used by KDD methods as constraints for focusing the mining of textual data. By contrast, KDD methods extract patterns and sequences to be used for guiding information extraction from texts and text analysis. Experimental and validation parts associated with the Hybride project are provided by an application to the documentation of rare diseases in the context of Orphanet.

The partners of the Hybride consortium are the GREYC Caen laboratory (pattern mining, NLP, text mining), the MoDyCo Paris laboratory (NLP, linguistics), the INSERM Paris laboratory (Orphanet, ontology design), and the Orpailleur team at Inria NGE (FCA, knowledge representation, pattern mining, text mining).

8.2.1.3. ISTEX

Participants: Luis-Felipe Melo, Amedeo Napoli, Yannick Toussaint [contact person].

ISTEX is a so-called "Initiative d'excellence" managed by CNRS and DIST ("Direction de l'Information Scientifique et Technique"). ISTEX aims at giving to the research and teaching community an on-line access to scientific publications in all the domains. Thus ISTEX is in concern with a massive acquisition of documentation such as journals, proceedings, corpus, databases...ISTEX-R is one research project within ISTEX in which is involved the Orpailleur team, with two other partners, namely the ATILF laboratory and the INIST Institute (both in Nancy). ISTEX-R aims at developing new tools for querying full-text documentation, analyzing content and extracting information. A platform is currently under development to provide robust NLP tools for text processing, as well as methods in text mining and domain conceptualization.

8.2.1.4. Kolflow

Participants: Jean Lieber [contact person], Alice Hermann, Amedeo Napoli, Emmanuel Nauer, My Thao Tang, Yannick Toussaint.

Kolflow (http://kolflow.univ-nantes.fr/) is a 3-year basic research project taking place from February 2011 to November 2014, funded by French National Agency for Research (ANR), program ANR CONTINT. The aim of the project is to investigate man-machine collaboration in continuous knowledge-construction flows.

Kolflow partners are GDD (LINA Nantes), Silex (LIRIS Lyon), Orpailleur (Inria NGE/LORIA), Coast (Inria NGE/LORIA), and Wimmics (Inria Sophia Antipolis).

8.2.1.5. PEPSI: Polynomial Expansions of Protein Structures and Interactions

Participants: David Ritchie [contact person], Marie-Dominique Devignes, Malika Smaïl-Tabbone, Seyed Ziaeddin Alborzi.

The PEPSI ("Polynomial Expansions of Protein Structures and Interactions") project is a collaboration with Sergei Grudinin at Inria Grenoble (project Nano-D) and Valentin Gordeliy at the Institut de Biologie Structurale (IBS) in Grenoble. This four-year project funded by the ANR "Modèles Numériques" program involves developing computational protein modeling and docking techniques and using them to help solve the structures of large molecular systems experimentally (http://pepsi.gforge.inria.fr).

8.2.1.6. Termith

Participants: Luis-Felipe Melo, Yannick Toussaint [contact person].

Termith (http://www.atilf.fr/ressources/termith/) is an ANR Project which involves the following laboratories: ATILF, LIDILEM, LINA, INIST, Inria Saclay and Inria Nancy Grand Est. It aims at indexing documents belonging to different domain of Humanities. Thus, the project focuses on extracting candidate terms (information extraction) and on disambiguation.

In the Orpailleur team, we are mainly concerned by information extraction using Formal Concept Analysis techniques, but also pattern and sequence mining. The objective is to define "contexts introducing terms", i.e. finding textual environments allowing a system to decide whether a textual element is actually a candidate term and its corresponding environment.

8.2.1.7. Trajcan: a study of patient care trajectories

Participants: Elias Egho, Nicolas Jay [contact person], Amedeo Napoli, Chedy Raïssi.

Since 30 years, many patient classification systems (PCS) have been developed. These systems aim at classifying care episodes into groups according to different patient characteristics. In France, the so-called "Programme de Médicalisation des Systèmes d'Information" (PMSI) is a national wide PCS in use in every hospital. It systematically collects data about millions of hospitalizations. Though it is used for funding purposes, it includes useful information for public health domains such as epidemiology or health care planning.

The objective of the Trajcan project was to represent and analyze "patient care trajectories" (patient suffering from cancer limited to breast, colon, rectum, and lung cancers) and the associated healthcares (it should be noticed that the Trajcan Project ended at the beginning of 2014). The data are related to patients receiving hospital cares in the "Bourgogne" region and using data from PMSI. Such an analysis involves various data, e.g. type of cancer, number of visits, type of stays, hospitalization services, therapies used, and demographic factors such as age, gender, place of residence.

Elias Egho defended a Phd thesis on this subject in July 2014 [15]. Combining knowledge discovery and knowledge representation methods for improving the definition of patients as temporal objects (sequential data mining), he successfully developed different approaches for characterizing Patient Care Trajectories (PCT). A first characterization is based on sequential pattern structures, extending Formal Concept Analysis techniques to multidimensional sequential data. A second one, involves an algorithm called MMISP for "Mining Multidimensional Itemsets Sequential Patterns" and makes use of external knowledge to improve the mining process and discover sequential patterns at different levels of granularity [62]. Finally, a new similarity measure was developed for comparing sequences of itemsets and for applying clustering methods to classify patients having similar healthcare trajectories. This later work was distinguished by a forthcoming publication in Data Mining and Knowledge Discovery.

8.2.2. Other National Initiatives and Collaborations

8.2.2.1. Towards the discovery of new nonribosomal peptides and synthetases

We have initiated a collaboration with researchers from the LIFL and Université Lille Nord de France on the NRPS toolbox. Data was cleaned and integrated from various public and specific analysis programs. The resulting database should facilitate the process of knowledge discovery of new nonribosomal peptides and synthetases. Actual results of this research collaboration were published in [21].

8.2.2.2. FUI Poqemon

Participant: Chedy Raïssi [Contact Person].

The POQEMON project aims at developing new pattern mining methods and tools for guiding knowledge discovery from mobile phone networks for monitoring purposes. The main idea is to develop sound approaches that handle the trade-off between privacy of data and the power of analysis.

8.3. Regional Initiatives

8.3.1. Le Bois Santé (LBS)

Participants: Marie-Dominique Devignes [contact person], Malika Smaïl-Tabbone.

The project "LBS – Le Bois Santé – #38017" is funded by the European Regional Development Fund (FEDER) and the French "Fonds Unique Interministériel (FUI)" in the framework of the BioProLor consortium. This project is coordinated by "Harmonic Pharma", a start-up specialized in the identification of active principles in natural products. The aim of LBS is to exploit wood products in the pharmaceutical and nutriment domains. Concerned people in the team are working on data management and knowledge discovery about new therapeutic applications.

8.3.2. PEPS Mirabelle EXPLOD-Biomed

Participants: Adrien Coulet [contact person], Marie-Dominique Devignes, Gabin Personeni, Malika Smaïl-Tabbone.

This project has initiated a collaboration with geneticists from the Hospital of Nancy, namely Philippe Jonveaux and Céline Bonnet. The aim of the EXPLOD-Biomed project is to propose novel knowledge discovery methods applied to Linked Open Data for discovering gene that could be responsible for intellectual deficiencies. Linked Open Data are available on-line, interconnected and encoded in a format which can be straightforwardly mapped to ontologies. Thus they offer novel opportunities for knowledge discovery in biomedical data. Here, geneticists play the role of experts and guide the knowledge discovery process at different steps.

8.3.3. Hydreos

Participant: Jean-François Mari [contact person].

Hydreos is a state organization –actually a so-called "Pôle de compétitivité"– aimed at evaluating the quality of water (http://www.hydreos.fr/fr). Actually, water resources rely on many agronomic variables, including land use successions. Accordingly, one objective of our participation in Hydreos is to have a better understanding of the changes in the organization of a territory. The data to be analyzed are obtained by surveys or by satellite images and describe the land use at the level of the agricultural parcel. Then there is a search for detecting changes in land use and for correlating these changes to groundwater quality.

The systems ARPEnTAge (see § 5.2.2) and CarottAge (see § 5.2.1) are used in this context, especially by agronomists of INRA (ASTER Mirecourt http://www6.nancy.inra.fr/sad-aster.

This year, our research work focused on implementing various display tools to have a better understanding of the clustering results that a stochastic modeling provide http://www.loria.fr/~jfmari/App/Arpentage/Yar.avi.

8.3.4. Contrat Plan État Région" (CPER)

A part of the links between the Regional Administration and Inria Nancy Grand Est/LORIA are materialized through the so-called "Contrat Plan État Région" (CPER) which is running from 2015 to 2020. There is an associated scientific program in which the Orpailleur team is involved.

Some members of the Orpailleur team participated to the definition of a project in one of the two tracks of the interdisciplinary scientific program called "Santé et Vieillissement". The other track called "Innovations Technologiques, Modélisation et Médecine Personnalisée (IT2MP)" is coordinated by Pr. Zannad (CHU-Nancy). We proposed a project called "Simulation et Modélisation pour l'Extraction de Connaissances (SMEC)" which gathers physicians, bio-statisticians, chemists and computer scientists. The objective of this project is to design innovative methodologies for analyzing cohort data and make progress towards personalized medicine.

PANAMA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Labex Comin Labs projetcs

ComInLabs is a Laboratoire d'Excellence funded by the PIA (Programme Investissements d'Avenir) in the broad area of telecommunications.

8.1.1.1. HEMISFER

Participant: Rémi Gribonval.

http://www.hemisfer.cominlabs.ueb.eu/

Research axis: 3.1

CominLabs partners : EPI VISAGES; EPI HYBRID; EPI PANAMA

External partners : EA 4712 team from University of Rennes I; EPI ATHENA, Sophia-Antipolis;

Coordinator: Christian Barillot, EPI VISAGES

Description: The goal of HEMISFER is to make full use of neurofeedback paradigm in the context of rehabilitation and psychiatric disorders. The major breakthrough will come from the use of a coupling model associating functional and metabolic information from Magnetic Resonance Imaging (fMRI) to Electro-encephalography (EEG) to "enhance" the neurofeedback protocol. We propose to combine advanced instrumental devices (Hybrid EEG and MRI platforms), with new man-machine interface paradigms (Brain computer interface and serious gaming) and new computational models (source separation, sparse representations and machine learning) to provide novel therapeutic and neuro-rehabilitation paradigms in some of the major neurological and psychiatric disorders of the developmental and the aging brain (stroke, attention-deficit disorder, language disorders, treatment-resistant mood disorders, . . .).

Contribution of PANAMA: PANAMA, in close cooperation with the VISAGES team, contributes to a coupling model between EEG and fMRI considered as a joint inverse problem addressed with sparse regularization. By combining both modalities, one expects to achieve a good reconstruction both in time and space. This new imaging technique will then be used for improving neurofeedback paradigms in the context of rehabilitation and psychiatric disorders, which is the final purpose of the HEMISFER project.

Hybrid Eeg-MrI and Simultaneous neuro-feedback for brain Rehabilitation

8.1.1.2. TEPN

Participant: Rémi Gribonval.

http://www.tepn.cominlabs.ueb.eu/

Research axis: 3.1

CominLabs partners : IRISA OCIF - Telecom Bretagne; IETR SCN; IETR SCEE; EPI PANAMA

Coordinator: Nicolas Montavont, IRISA OCIF - Telecom Bretagne

Description: As in almost all areas of engineering in the past several decades, the design of computer and network systems has been aimed at delivering maximal performance without regarding to the energy efficiency or the percentage of resource utilization. The only places where this tendency was questioned were battery-operated devices (such as laptops and smartphones) for which the users accept limited (but reasonable) performance in exchange for longer use periods. Even though the end users make such decisions on a daily basis by checking their own devices, they have no way of minimizing their energy footprint (or conversely, optimize the network resource usage) in the supporting infrastructure. Thus, the current way of dimensioning and operating the infrastructure supporting the user services, such as cellular networks and data centers, is to dimension for peak usage. The problem with this approach is that usage is rarely at its peak. The overprovisioned systems are also aimed at delivering maximal performance, with energy efficiency being considered as something desired, but non-essential. This project aims at making the network energy consumption proportional to the actual charge of this network (in terms of number of served users, or requested bandwidth). An energy proportional network can be designed by taking intelligent decisions (based on various constraints and metrics) into the network such as switching on and off network components in order to adapt the energy consumption to the user needs. This concept can be summarized under the general term of Green Cognitive Network Approach.

Contribution of PANAMA: PANAMA, in close cooperation with the SCEE team at IETR (thesis of Marwa Chafii), focuses on the design of new waveforms for multi carrier systems with reduced Peak to Average Power Ratio (PAPR).

Toward Energy Proportional Networks

8.1.2. OSEO-FUI: S-POD: "Assistance à personnes en danger potentiel"

Participants: Frédéric Bimbot, Romain Lebarbenchon, Ewen Camberlein.

Duration: August 2012-November 2016

Research axis: 3.2

Partners: ERYMA, CAPT/FOTON, CASSIDIAN, KAPTALIA, KERLINK, le LOUSTIC and Telecom Bretagne

Coordinator: ERYMA

Description: S-POD gathers research teams and industrial partners to that aim at setting up a framework to process and fuse audio, physiological and contextual data. The goal is to design an embedded autonomous system able to detect situations of potential danger arising in the immediate environment of a person (military, police, CIT, fire, etc.)

Contribution of PANAMA: PANAMA is in charge of R&I activities related to the qualitative and quantitative analysis of information from the acoustic environment (intensity, direction of arrival, nature of noise sounds, properties of voices, etc.) as well as to the exploitation of these analyses. The need for real-time embedded processing induces specific constraints.

8.1.3. Action de Développement Technologique: FASST

Participants: Nancy Bertin, Frédéric Bimbot, Jules Espiau de Lamaestre, Nathan Souviraà -Labastie.

Duration: 2 years (2012–2014).

Research axis: 3.2.2

Partners: Inria Teams Parole (Nancy) and Texmex (Rennes)

Description: This Inria ADT aims to develop a new version of our FASST audio source separation toolbox in order to facilitate its large-scale dissemination in the source separation community and in the various application communities. A specific effort will be made towards the speech processing community by developing an interface with existing speech recognition software. The software was publicly released in January 2014.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. ERC-StG: PLEASE (Projections, Learning, and Sparsity for Efficient Data Processing)

Participants: Rémi Gribonval, Srdan Kitic, Pierre Machart, Cagdas Bilen, Luc Le Magoarou, Nancy Bertin, Nicolas Keriven, Yann Traonmilin, Laurent Albera, Gilles Puy.

Duration: January 2012 - December 2016

Research axis: 3.1

Principal investigator: Rémi Gribonval

Program: ERC Starting Grant

Project acronym: PLEASE

Project title: Projections, Learning and Sparsity for Efficient data processing

Abstract: The Please ERC is focused on the extension of the sparse representation paradigm towards that of sparse modeling, with the challenge of establishing, strengthening and clarifying connections between sparse representations and machine learning

Web site: https://team.inria.fr/panama/projects/please/

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

PANAMA has strong recurrent collaborations with the LTS2 lab at EPFL, the Center for Digital Music at Queen Mary University of London, the Institute for Digital Communications at the University of Edimburgh.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Mike Davies, in November, Professor of Signal and Image Processing, University of Edinburgh
- Pierre Vandergheynst, in November, Professor of Signal and Image Processing, EPFL
- Karin Schnass, in July, University of Innsbruck Department of Mathematics
- Gilles Blanchard, in May, Professor, University of Postdam
- Ivan Dokmanic, in January, Assistant Professor, EPFL, Lausanne

8.4.1.1. Internships

- Thomas Aubert, from April until June, University of Rennes1
- Theo Dabreteau, from June until August, Insa of Rennes
- Melanie Ducoffe, from February until June, ENS Rennes
- Anh-tho Le, from April until June, University of Hanoi
- Maxime Lecoq, from April until July, University of Rennes 1

PAREO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

We participate in the "Logic and Complexity" part of the GDR–IM (CNRS Research Group on Mathematical Computer Science), in the projects "Logic, Algebra and Computation" (mixing algebraic and logical systems) and "Geometry of Computation" (using geometrical and topological methods in computer science).

We are also involved in the GDR-GPL (CNRS Research Network on Software Engineering), as a member of the FORWAL group and member of the Scientific Board of the GDR.

7.2. European Initiatives

7.2.1. Collaborations in European Programs, except FP7 & H2020

Program: PHC Polonium

Project title: Expressing concurrency through control operators

Duration: January 2015 - December 2016

Coordinator: Sergueï Lenglet

Other partner: Institute of Computer Science, University of Wrocław, Poland

Abstract: The goal of this project is to explore the interplay between concurrency, continuations, and control operators at a fundamental level. We do not restrict ourselves to a specific programming language, but we use more general and well established formal models, namely process calculi (such as the π-calculus) for concurrency, and the λ-calculus (a model of sequential functional programming) for continuations and control operators. We want to find new connections between concurrency and control operators, and especially new ways of implementing concurrent and distributed programs with the help of control operators.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

7.3.1.1. Internships

Nauval Atmaja

Subject: Property Based Testing

Date: from Feb 2014 until Jun 2014

Institution: Erasmus Mundus MSc in Dependable Software Systems

PARIETAL Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. iConnectom project

Participants: Bertrand Thirion [Correspondant], Gaël Varoquaux, Elvis Dohmatob.

This is a Digiteo project (2014-2017).

Mapping brain functional connectivity from functional Magnetic Resonance Imaging (MRI) data has become a very active field of research. However, analysis tools are limited and many important tasks, such as the empirical definition of brain networks, remain difficult due to the lack of a good framework for the statistical modeling of these networks. We propose to develop population models of anatomical and functional connectivity data to improve the alignment of subjects brain structures of interest while inferring an average template of these structures. Based on this essential contribution, we will design new statistical inference procedures to compare the functional connections between conditions or populations and improve the sensitivity of connectivity analysis performed on noisy data. Finally, we will test and validate the methods on multiple datasets and distribute them to the brain imaging community.

8.1.2. SUBSAMPLE Digiteo chair

Participants: Bertrand Thirion [Correspondant], Gaël Varoquaux, Alexandre Abraham.

Parietal is associated with this Digiteo Chair by Dimitris Samaras, in which we will address the probabilistic structure learning of salient brain states (PhD of Alexandre Abraham, 2012-2015).

Cognitive tasks systematically involve several brain regions, and exploratory approaches are generally necessary given the lack of knowledge of the complex mechanisms that are observed. The goal of the project is to understand the neurobiological mechanisms that are involved in complex neuro-psychological disorders. A crucial and poorly understood component in this regard refers to the interaction patterns between different regions in the brain. In this project we will develop machine learning methods to capture and study complex functional network characteristics. We hypothesize that these characteristics not only offer insights into brain function but also can be used as concise features that can be used instead of the full dataset for tasks like classification of healthy versus diseased populations or for clustering subjects that might exhibit similarities in brain function. In general, the amount of correlation between distant brain regions may be a more reliable feature than the region-based signals to discriminate between two populations e.g. in schizophrenia. For such exploratory methods to be successful, close interaction with neuroscientists is necessary, as the salience of the features depends on the population and the observed effects of psychopathology. For this aim we propose to develop a number of important methodological advances in the context of prediction of treatment outcomes for drug addicted populations, e.g. for relapse prediction.

8.1.3. Medilearn/braincodes Inria-MSR project

Participants: Bertrand Thirion [Correspondant], Gaël Varoquaux, Andrés Hoyos Idrobo.

Neuroimaging is accumulating large functional MRI datasets that display –among artefacts and noise– brain activation patterns giving access to a meaningful representation of brain spatial organization. This ongoing accumulation is intensified via new large-scale international initiatives such as the *Human Connectome Project* (www.humanconnectomeproject.org). but also to existing open repositories of functional neuroimaging datasets (https://openfmri.org/) or http://www.fmridc.org/. These datasets represent a very significant resource for the community, but require new analytic approaches in order to be fully exploited. The MediLearn/BrainCodes project strives to provide a synthetic picture of the brain substrate of human cognition and its pathologies. In practice, this can be achieved by learning from large-scale datasets a brain atlas that summarizes adequately these functional activation maps drawing from a large number of protocols and subjects. Once learned, such an atlas is extremely useful to understand the large-scale functional organization of the brain: it is a tool for understanding *brain segregation*, the different encoding of many cognitive parameters into different brain regions, as well as *brain integration*, *i.e.* how remote brain regions co-activate across subjects and experiments.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. BrainPedia project

Participants: Bertrand Thirion [Correspondant], Gaël Varoquaux, Yannick Schwartz, Virgile Fritsch.

BrainPedia is an ANR JCJC (2011-2015) which addresses the following question: Neuroimaging produces huge amounts of complex data that are used to better understand the relations between brain structure and function. While the acquisition and analysis of this data is getting standardized in some aspects, the neuroimaging community is still largely missing appropriate tools to store and organize the knowledge related to the data. Taking advantage of common coordinate systems to represent the results of group studies, coordinate-based meta-analysis approaches associated with repositories of neuroimaging publications provide a crude solution to this problem, that does not yield reliable outputs and looses most of the data-related information. In this project, we propose to tackle the problem in a statistically rigorous framework, thus providing usable information to drive neuroscientific knowledge and questions.

8.2.1.2. IRMgroup project

Participants: Bertrand Thirion [Correspondant], Alexandre Gramfort, Michael Eickenberg.

This is a joint project with Polytechnique/CMAP http://www.cmap.polytechnique.fr/: Stéphanie Allassonnière and Stéphane Mallat (2010-2014).

Much of the visual cortex is organized into visual field maps, which means that nearby neurons have receptive fields at nearby locations in the image. The introduction of functional magnetic resonance imaging (fMRI) has made it possible to identify visual field maps in human cortex, the most important one being the medial occipital cortex (V1,V2,V3). It is also possible to relate directly the activity of simple cells to an fMRI activation pattern and Parietal developed some of the most effective methods. However, the simple cell model is not sufficient to account for high-level information on visual scenes, which requires the introduction of specific semantic features. While the brain regions related to semantic information processing are now well understood, little is known on the flow of visual information processing between the primary visual cortex and the specialized regions in the infero-temporal cortex. A central issue is to better understand the behavior of intermediate cortex layers.

Our proposition is to use our mathematical approach to formulate explicitly some generative model of information processing, such as those that characterize complex cells in the visual cortex, and then to identify the brain substrate of the corresponding processing units from fMRI data. While fMRI resolution is still too coarse for a very detailed mapping of detailed cortical functional organization, we conjecture that some of the functional mechanisms that characterize biological vision processes can be captured through fMRI; in parallel we will push the fMRI resolution to increase our chance to obtain a detailed mapping of visual cortical regions.

8.2.1.3. Niconnect project

Participants: Bertrand Thirion, Gaël Varoquaux [Correspondant], Alexandre Abraham.

- **Context:** The NiConnect project (2012-2016) arises from an increasing need of medical imaging tools to diagnose efficiently brain pathologies, such as neuro-degenerative and psychiatric diseases or lesions related to stroke. Brain imaging provides a non-invasive and widespread probe of various features of brain organization, that are then used to make an accurate diagnosis, assess brain rehabilitation, or make a prognostic on the chance of recovery of a patient. Among different measures extracted from brain imaging, functional connectivity is particularly attractive, as it readily probes the integrity of brain networks, considered as providing the most complete view on brain functional organization.
- **Challenges:** To turn methods research into popular tool widely usable by non specialists, the NiConnect project puts specific emphasis on producing high-quality open-source software. NiConnect addresses the many data analysis tasks that extract relevant information from resting-state fMRI datasets. Specifically, the scientific difficulties are *i)* conducting proper validation of the models and tools, and *ii)* providing statistically controlled information to neuroscientists or medical doctors. More importantly, these procedures should be robust enough to perform analysis on limited quality data, as acquiring data on diseased populations is challenging and artifacts can hardly be controlled in clinical settings.
- **Outcome of the project:** In the scope of computer science and statistics, NiConnect pushes forward algorithms and statistical models for brain functional connectivity. In particular, we are investigating structured and multi-task graphical models to learn high-dimensional multi-subject brain connectivity models, as well as spatially-informed sparse decompositions for segmenting structures from brain imaging. With regards to neuroimaging methods development, NiConnect provides systematic comparisons and evaluations of connectivity biomarkers and a software library embedding best-performing state-of-the-art approaches. Finally, with regards to medical applications, the NiConnect project also plays a support role in on going medical studies and clinical trials on neurodegenerative diseases.
- **Consortium**
  - Parietal Inria research team: applied mathematics and computer science to model the brain from MRI
  - LIF INSERM research team: medical image data analysis and modeling for clinical applications
  - CATI center: medical image processing center for large scale brain imaging studies
  - Henri-Mondor hospital neurosurgery and neuroradiology: clinical teams conducting research on treatments for neurodegenerative diseases, in particular Huntington and Parkinson diseases
  - Logilab: consulting in scientific computing

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. HBP

Type: FP7

Defi: Future and Emerging Technologies

Instrument: Collaborative Project with Coordination and Support Action

Objectif: FET Flagships

Duration: October 2013 - March 2016

Coordinator: Henry Markram (EPFL, Switzerland)

Partners: 86 partners, https://www.humanbrainproject.eu/fr/discover/the-community/partners

Inria contact: Olivier Faugeras

Abstract:

Understanding the human brain is one of the greatest challenges facing 21st century science. If we can rise to the challenge, we can gain profound insights into what makes us human, develop new treatments for brain disease and build revolutionary new computing technologies. Today, for the first time, modern ICT has brought these goals within sight.

Convergence of ICT and Biology The convergence between biology and ICT has reached a point at which it can turn the goal of understanding the human brain into a reality. This realization motivates the Human Brain Project – an EU Flagship initiative in which over 80 partners will work together to realize a new "ICT-accelerated" vision for brain research and its applications.

One of the major obstacles to understanding the human brain is the fragmentation of brain research and the data it produces. Our most urgent need is thus a concerted international effort that uses emerging emerging ICT technologies to integrate this data in a unified picture of the brain as a single multi-level system.

Research Areas The HBP will make fundamental contributions to neuroscience, to medicine and to future computing technology.

In *neuroscience*, the project will use neuroinformatics and brain simulation to collect and integrate experimental data, identifying and filling gaps in our knowledge, and prioritizing future experiments.

In *medicine*, the HBP will use medical informatics to identify biological signatures of brain disease, allowing diagnosis at an early stage, before the disease has done irreversible damage, and enabling personalized treatment, adapted to the needs of individual patients. Better diagnosis, combined with disease and drug simulation, will accelerate the discovery of new treatments, drastically lowering the cost of drug discovery.

In *computing*, new techniques of interactive supercomputing, driven by the needs of brain simulation, will impact a vast range of industries. Devices and systems, modeled after the brain, will overcome fundamental limits on the energy-efficiency, reliability and programmability of current technologies, clearing the road for systems with brain-like intelligence.

The Future of Brain Research

Applying ICT to brain research and its applications promises huge economic and social benefits. But to realize these benefits, the technology needs to be made accessible to scientists – in the form of research platforms they can use for basic and clinical research, drug discovery and technology development. As a foundation for this effort, the HBP will build an integrated system of ICT-based research platforms, building and operating the platforms will require a clear vision, strong, flexible leadership, long-term investment in research and engineering, and a strategy that leverages the diversity and strength of European research. It will also require continuous dialogue with civil society, creating consensus and ensuring the project has a strong grounding in ethical standards.

The Human Brain Project will last ten years and will consist of a ramp-up phase (2013-2016) followed by an operational phase (2016-2023). Bertrand Thirion is responsible for the 2.1.1 task, *Anatomo-functional mapping of the human brain*.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Gaspar Pizarro made a three months internship (January-March 2014), funded by Inria Chile and Conycit. His research topic was *Improving the fit of functional MRI data through the use of sparse linear models.*.

8.4.1.2. Other visitors

Danilo Bzdok (Forschungszentrum Jülich, institue of neuroscience and medicine) visited Parietal several months in 2014 (February-March, then September-), to develop collaborations on the use of machine learning techniques to model behavioral variables and find data-driven characterization of brain diseases.

8.4.2. Visits to International Teams

8.4.2.1. Research stays abroad

As part of the SubSample Digiteo chair, Alexandre Abraham spent six months in the USA at Stony Brook University and Nathan Klein Institute.

PARKAS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

ANR WMC project (program “jeunes chercheuses, jeunes chercheurs”), 2012–2016, 200 Keuros. F. Zappa Nardelli is the main investigator.

ANR Boole project (program “action blanche”), 2009-2014.

ANR CAFEIN, 2013-2015. Marc Pouzet.

7.1.2. Investissements d’avenir

Sys2Soft contract (Briques Génériques du Logiciel Embarqué). Partenaire principal: Dassault-Systèmes, etc. Inria contacts are Benoit Caillaud (HYCOMES, Rennes) and Marc Pouzet (PARKAS, Paris).

ManycoreLabs contract (Briques Génériques du Logiciel Embarqué). Partenaire principal: Kalray. Inria contacts are Albert Cohen (PARKAS, Paris), Alain Darte (COMPSYS, Lyon), Fabrice Rastello (CORSE, Grenoble).

7.1.3. Others

Marc Pouzet is scientific advisor for the Esterel-Technologies/ANSYS company.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. COPCAMS

Type: ARTEMIS JU

Defi: NC

Instrument: ASP

Objectif: NC

Duration: April 2013 - March 2016

Coordinator: Christian Fabre

Partner: CEA LETI, Grenoble, France

Inria contact: Albert Cohen

Abstract: Cognitive cameras on manycore platforms

7.2.1.2. EMC2

Type: ARTEMIS JU

Defi: NC

Instrument: AIPP

Objectif: NC

Duration: April 2014 - March 2917

Coordinator: Werner Weber

Partner: Infineon, Munich ,Germany

Inria contact: Albert Cohen

Abstract: Embedded multicrical systems on multicores

7.2.1.3. ITEA2

Type: ITEA2

Defi: NC

Instrument: NC

Objectif: NC

Duration: September 2012 - November 2015

Coordinator: Daniel Bouskela (EDF)

Partner: Dassault-Systèmes, EDF, Modelon, DLR (Germany)

Inria contact: Benoit Caillaud, Marc Pouzet

Abstract: Model Driven Physical Systems Operation

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. POLYFLOW

Title: Polyhedral Compilation for Data-Flow Programming Languages

International Partner (Institution - Laboratory - Researcher):

IISc Bangalore (INDE)

Duration: 2013 - 2015/12

See also: http://polyflow.gforge.inria.fr

Polyhedral techniques for program transformation are now used in several proprietary and open source compilers. However, most of the research on polyhedral compilation has focused on imperative languages such as C, where computation is specified in terms of statements with zero or more nested loops and other control structures around them. Graphical data-flow languages, where there is no notion of statements or a schedule specifying their relative execution order, have so far not been studied using a powerful transformation or optimization approach. These languages are extremely popular in system analysis, modeling and design, in embedded reactive control. They also underline the construction of many domain-specific languages and compiler intermediate representations. The copy and execution semantics of data-flow languages impose a different set of challenges. We plan to bridge this gap by studying techniques that could enable extraction of a polyhedral representation from data-flow programs, transform them, and synthesize them from their equivalent polyhedral representation.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Prof. Cesare Tinelli, was invited by ENS in the PARKAS team.

Date: June 2014 (one month)

Institution: Iowa State University, USA.

7.4.1.1. Internships

Siddharth Prusty Siddharth

Date: May 2014 - Jul 2014

Institution: IITK (India)

Vijay Keswani Vijay

Date: May 2014 - Jul 2014

Institution: IITK (India)

Quentin Bunel

Date: May 2014 - Jul 2014

Institution: UPMC (France)

Abhishek Jain

Date: May 2014 - Jul 2014 and Dec 2014 - Jan 2015

Institution: IITD (India)

Yabin Hu

Date: Jun 2014 - Jul 2014

Institution: China Nat. Univ. of Defense and Technology (China)

PARSIFAL Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 & H2020 Projects

Title: ProofCert: Broad Spectrum Proof Certificates

Duration: January 2012 - December 2016

Type: IDEAS

Instrument: ERC Advanced Grant

Coordinator: Dale Miller

Abstract: There is little hope that the world will know secure software if we cannot make greater strides in the practice of formal methods: hardware and software devices with errors are routinely turned against their users. The ProofCert proposal aims at building a foundation that will allow a broad spectrum of formal methods—ranging from automatic model checkers to interactive theorem provers—to work together to establish formal properties of computer systems. This project starts with a wonderful gift to us from decades of work by logicians and proof theorist: their efforts on logic and proof has given us a *universally accepted* means of communicating proofs between people and computer systems. Logic can be used to state desirable security and correctness properties of software and hardware systems and proofs are uncontroversial evidence that statements are, in fact, true. The current state-of-the-art of formal methods used in academics and industry shows, however, that the notion of logic and proof is severely fractured: there is little or no communication between any two such systems. Thus any efforts on computer system correctness is needlessly repeated many time in the many different systems: sometimes this work is even redone when a given prover is upgraded. In ProofCert, we will build on the bedrock of decades of research into logic and proof theory the notion of *proof certificates*. Such certificates will allow for a complete reshaping of the way that formal methods are employed. Given the infrastructure and tools envisioned in this proposal, the world of formal methods will become as dynamic and responsive as the world of computer viruses and hackers has become.

7.2. International Initiatives

Members of the team have applied for the following three international projects. All three are still pending, the final results are not currently know.

1. A generic ANR proposal for collaboration between several French sites and the University of Bologna.
2. A proposal to ANR and JCJC (Japan).
3. A proposal to the Ministry of Education, Singapore for collaboration with the Nanyang Technological University.

7.3. International Research Visitors

- Chuck Liang (Professor from Hofstra University, NY, USA) visited for three weeks 26 May – 20 June 2014 and for another week starting 15 December.
- Gopalan Nadathur (Professor from the University of Minnesota) visited 2 - 11 July.
- Mary Southern (PhD candidate at the University of Minnesota, USA), May – Aug 2014
  Internship supervised by K. Chaudhuri.
- Yuting Wang (PhD candidate at the University of Minnesota, USA), May – Aug 2014

PERCEPTION Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

6.1.1.1. MIXCAM

Type: ANR BLANC

Duration: March 2014 - February 2016

Coordinator: Radu Horaud

Partners: 4D View Solutions SAS

Abstract: Humans have an extraordinary ability to see in three dimensions, thanks to their sophisticated binocular vision system. While both biological and computational stereopsis have been thoroughly studied for the last fifty years, the film and TV methodologies and technologies have exclusively used 2D image sequences, including the very recent 3D movie productions that use two image sequences, one for each eye. This state of affairs is due to two fundamental limitations: it is difficult to obtain 3D reconstructions of complex scenes and glass-free multi-view 3D displays, which are likely to need real 3D content, are still under development. The objective of MIXCAM is to develop novel scientific concepts and associated methods and software for producing live 3D content for glass-free multi-view 3D displays. MIXCAM will combine (i) theoretical principles underlying computational stereopsis, (ii) multiple-camera reconstruction methodologies, and (iii) active-light sensor technology in order to develop a complete content-production and -visualization methodological pipeline, as well as an associated proof-of-concept demonstrator implemented on a multiple-sensor/multiple-PC platform supporting real-time distributed processing. MIXCAM plans to develop an original approach based on methods that combine color cameras with time-of-flight (TOF) cameras: TOF-stereo robust matching, accurate and efficient 3D reconstruction, realistic photometric rendering, real-time distributed processing, and the development of an advanced mixed-camera platform. The MIXCAM consortium is composed of two French partners (Inria and 4D View Solutions). The MIXCAM partners will develop scientific software that will be demonstrated using a prototype of a novel platform, developed by 4D Views Solutions, and which will be available at Inria, thus facilitating scientific and industrial exploitation.

6.2. European Initiatives

6.2.1. FP7 & H2020 Projects

6.2.1.1. EARS

Type: FP7

Challenge: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project

Objectif: Robotics, Cognitive Systems and Smart Spaces, Symbiotic Interaction

Duration: January 2014 - December 2016

Coordinator: Friedrich Alexander Universiteit (Germany)

Partners: Inria (France), Ben Gurion University (Israel), Imperial College (UK), Humboldt University Berlin (Germany), and Aldebaran Robotics (France)

Inria contact: Radu Horaud

Abstract: The success of future natural intuitive human-robot interaction (HRI) will critically depend on how responsive the robot will be to all forms of human expressions and how well it will be aware of its environment. With acoustic signals distinctively characterizing physical environments and speech being the most effective means of communication among humans, truly humanoid robots must be able to fully extract the rich auditory information from their environment and to use voice communication as much as humans do. While vision-based HRI is well developed, current limitations in robot audition do not allow for such an effective, natural acoustic human-robot communication in real-world environments, mainly because of the severe degradation of the desired acoustic signals due to noise, interference and reverberation when captured by the robot's microphones. To overcome these limitations, EARS will provide intelligent *ears* with close-to-human auditory capabilities and use it for HRI in complex real-world environments. Novel microphone arrays and powerful signal processing algorithms shall be able to localize and track multiple sound sources of interest and to extract and recognize the desired signals. After fusion with robot vision, embodied robot cognition will then derive HRI actions and knowledge on the entire scenario, and feed this back to the acoustic interface for further auditory scene analysis. As a prototypical application, EARS will consider a welcoming robot in a hotel lobby offering all the above challenges. Representing a large class of generic applications, this scenario is of key interest to industry and, thus, a leading European robot manufacturer will integrate EARS's results into a robot platform for the consumer market and validate it. In addition, the provision of open-source software and an advisory board with key players from the relevant robot industry should help to make EARS a turnkey project for promoting audition in the robotics world.

6.2.1.2. VHIA

Type: FP7

Instrument: ERC Advanced Grant

Duration: February 2014 - January 2019

Principal Investigator: Radu Horaud

Abstract: The objective of VHIA is to elaborate a holistic computational paradigm of perception and of perception-action loops. We propose to develop a completely novel twofold approach: (i) learn from mappings between auditory/visual inputs and structured outputs, and from sensorimotor contingencies, and (ii) execute perception-action interaction cycles in the real world with a humanoid robot. VHIA will launch and achieve a unique fine coupling between methodological findings and proof-of-concept implementations using the consumer humanoid NAO manufactured in Europe. The proposed multimodal approach is in strong contrast with current computational paradigms that are based on unimodal biological theories. These theories have hypothesized a modular view of perception, postulating that there are quasi-independent and parallel perceptual pathways in the brain. VHIA takes a radically different view than today's audiovisual fusion models that rely on clean-speech signals and on accurate frontal-images of faces; These models assume that videos and sounds are recorded with hand-held or head-mounted sensors, and hence there is a human in the loop whose intentions inherently supervise both perception and interaction. Our approach deeply contradicts the belief that complex and expensive humanoids (often manufactured in Japan) are required to implement research ideas. VHIA's methodological program addresses extremely difficult issues, such as how to build a joint audiovisual space from heterogeneous, noisy, ambiguous and physically different visual and auditory stimuli, how to properly model seamless interaction based on perception and action, how to deal with high-dimensional input data, and how to achieve robust and efficient human-humanoid communication tasks through a well-thought tradeoff between offline training and online execution. VHIA bets on the high-risk idea that in the next decades robot technology will have a considerable social and economical impact and that there will be millions of humanoids, in our homes, schools and offices, which will be able to naturally communicate with us.

6.3. International Initiatives

6.3.1. Inria International Partners

6.3.1.1. Declared Inria International Partners

- The Czech Technical University in Prague (Dr. Jan Cech)
- The Technion (Prof. Yoav Schechner)
- Queen Mary University London (Dr. Miles Hansard)
- Bar Ilan University (Prof. Sharon Gannot)
- University of Cordoba (Prof. Manuel Jesus Marin Jimenez)
- University of Patras (Prof. Manolis Psarakis)
- Oxford Brookes University (Dr. Fabio Cuzzolin)

6.4. International Research Visitors

6.4.1. Visits of International Scientists

- Prof. Sharon Gannot (Bar Ilan University)
- Prof. Manuel Jesus Marin Jimenez (Cordoba University)

PHOENIX Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. HomeAssist: Platform for Assisted Living

The objective of this project is to provide an open platform of digital assistance dedicated to aging in place. This project is in collaboration with researchers in Cognitive Science (Bordeaux University) and the UDCCAS Gironde (Union Départementale des Centres Communaux d'Action Sociale) managing elderly care. This project includes a need analysis, the development of assistive applications and their experimental validation.

This work is funded by CARSAT Aquitaine ("Caisse d'Assurance Retraite et de la Santé au Travail"), Aquitaine Region and Conseil Général de la Gironde.

7.1.2. Cognitive Assistance for Supporting the Autonomy of Persons with Intellectual Disabilities

The objective of this project is to develop assistive technologies enabling people with intellectual disabilities to gain independence and to develop self-determined behaviors, such as making choices and taking decisions. This project is in collaboration with the "Handicap et Système Nerveux" research group (EA 4136, Bordeaux University), the TSA Chair of UQTR (Université du Québec à Trois-Rivières) in Psychology and the Association Trisomie 21 Gironde (Down Syndrome). The TSA chair has recently designed and built a smart apartment that is used to conduct experimental evaluation of our assistive technologies in realistic conditions.

7.1.3. Certification of an open platform

The purpose of this project is to define concepts and tools for developing certifying open platforms. This certification process must ensure a set of critical properties (e.g., safety, confidentiality, security) by certifying each tier application. These guarantees are essential to ensure that openness does not come at the expense of the user's well-being. To preserve the innovation model of open platforms, this certification process should also be as automatic as possible. Indeed, the success of open platforms is mainly due to the low development cost of a new application. The case study of this thesis will be the domain of home automation. The results of this thesis will be put into practice in the DiaSuiteBox open platform.

This project is funded by Aquitaine Region.

7.1.4. ANDDI

Five percent of the population have Intellectual Disabilities (ID). Individuals with ID have significant socio-adaptive limitations in a variety of daily activities, at home (task planification and execution, medication, home safety, etc.) as well as outside (route planning, itinerary in public transportation, etc.). Individuals with ID, their families, health institutions, caregiving services, and dedicated organizations strive to find ways in which these individuals can live as independently as possible, while promoting their social inclusion in every respect of their life (housing, professional training, employment, leisure, culture, etc.).

The research project ANDDI leverages the abilities of individuals with ID and the recent technological advances to develop a variety of assistive services addressing their daily needs. These services draw on our expertise in cognitive science and computer science, dedicated to assisting users with technologies. In particular, we use our platform, named HomeAssist, dedicated to the independently living of older adults. This platform relies on DiaSuite, our suite of tools for developing applications that orchestrate networked objects, and DiaSuiteBox, our platform that runs an open-ended set of applications, sensors, actuators and web services.

ANDDI addresses users with Down syndrome aiming to live independently; it pursues the following goals:

1. determining the key obstacles to perform daily activities autonomously and collecting the needs in assistive support expressed by individuals with ID and their family and caregivers;
2. developing and adapting assistive services available in HomeAssist across an iterative assessment (period of 6 months) of experiences of each individual;
3. evaluating the efficacy of our developed assistive services across the stages experienced by individuals progressively becoming independent in their daily life (pre-post comparison after 12 months of HomAssist intervention).

This project is funded by the “Conseil Régional d’Aquitaine” and “Trisomie 21”.

7.2. National Initiatives

7.2.1. Objects’ World: design-driven development of large-scale smart spaces

The goal of this project is to develop an innovative communication technology, allowing the emergence of a new economic sector for large-scale smart spaces. Our objective is to propose concepts and tools for developing reliable applications orchestrating large-scale smart spaces of networked entities. The industrial partners of the Objects’ World project will provide us with real-size case studies in various application domains (e.g., smart cities, tracking of vehicles, healthcare, energy management).

This work is funded by the OSEO national agency.

7.2.2. School Inclusion for Children with Autism

The objective of this project is to provide children with assistive technologies dedicated to the school routines. This project is in collaboration with the “Handicap et Système Nerveux” research group (EA 4136, Bordeaux University), the PsyCLÉ research center (EA 3273, Provence Aix-Marseille University) and the “Parole et Langage” research laboratory (CNRS, Provence Aix-Marseille University).

This work is funded by the French Ministry of National Education.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. OPALI

Title: OPen Assistive-technology platform for independent LIving

International Partner (Institution - Laboratory - Researcher):

Université du Québec à Trois Rivières (CANADA)

Duration: 2013 - 2015

See also: http://phoenix.inria.fr/opali

The goal of the OPALI project is to develop an Open Platform for Assisted Living targeting users with cognitive disabilities. It is a cross-disciplinary project combining expertise in (1) Computer Science focusing in development of applications orchestrating networked devices and (2) Psychology focusing in assistive technologies for users with cognitive disabilities. Furthermore, this project will leverage a unique research vehicle created by the University of Trois-Rivières consisting of a full-fledged apartment equipped with a range of networked devices and dedicated to experimental studies. The outcome of the project will include a large catalog of assistive applications allowing to match each user’s project life.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Catherine Plaisant visited the Phoenix team during the month of November 2014. Catherine Plaisant is a Senior Research Scientist at the University of Maryland Institute for Advanced Computer Studies and Associate Director of the Human-Computer Interaction Lab.

PI.R2 Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

Alexis Saurin (coordinator) and Yann Régis-Gianas are members of the four-year RAPIDO ANR project accepted in 2014 and starting in January 2015. RAPIDO aims at investigating the use of proof-theoretical methods to reason and program on infinite data objects. The goal of the project is to develop logical systems capturing infinite proofs (proof systems with least and greatest fixed points as well as infinitary proof systems), to design and to study programming languages for manipulating infinite data such as streams both from a syntactical and semantical point of view. Moreover, the ambition of the project is to apply the fundamental results obtained from the proof-theoretical investigations (i) to the development of software tools dedicated to the reasoning about programs computing on infinite data, *e.g.* stream programs (more generally coinductive programs), and (ii) to the study of properties of automata on infinite words and trees from a proof-theoretical perspective with an eye towards model-checking problems. Other permanent members of the project are Christine Tasson from PPS, David Baedle from LSV, ENS-Cachan, and Pierre Clairambault, Damien Pous and Colin Riba from LIP, ENS-Lyon.

Pierre-Louis Curien (coordinator), Yves Guiraud and Philippe Malbos are members of the three-years Focal project of the IDEX Sorbonne Paris Cité, started in June 2013. This project, giving the support for the PhD grant of Cyrille Chenavier, concerns the interactions between higher-dimensional rewriting and combinatorial algebra. This project is with members of the LAGA (Laboratory of Mathematics, Univ. Paris 13).

Pierre-Louis Curien (coordinator), Yves Guiraud and Philippe Malbos are members of the four-years Cathre ANR project, started in January 2014. This project investigates the general theory of higher-dimensional rewriting, the development of a general-purpose library for higher-dimensional rewriting, and applications in the fields of combinatorial algebra, combinatorial group theory and theoretical computer science.

Matthieu Sozeau, Hugo Herbelin, Lourdes del Carmen González Huesca and Yann Régis-Gianas are members of the ANR Paral-ITP started in November 2011. Paral-ITP is about preparing the Coq and Isabelle interactive theorem provers to a new generation of user interfaces thanks to massive parallelism and incremental type-checking.

Hugo Herbelin is the coordinator of the PPS site for the ANR Récré accepted in 2011, which started in January 2012. Récré is about realisability and rewriting, with applications to proving with side-effects and concurrency.

Matthieu Sozeau is member of the ANR Typex (Types and certification for XML) and is coordinator of one of the tasks of the project on formalisation and certification of XML tools. The project kicked-off in January 2012 and is a joint project with LRI, PPS and Inria Grenoble.

Yann Régis-Gianas collaborates with Mitsubishi Rennes on the topic of differential semantics. This collaboration led to the CIFRE grant for the PhD of Thibaut Girka.

Matthieu Sozeau is a member of the CoqHoTT project led by Nicolas Tabareau (Ascola team, École des Mines de Nantes), funded by an ERC Starting Grant.

6.2. European Initiatives

6.2.1. Collaborations with Major European Organisations

Pierre-Louis Curien, Yves Guiraud and Philippe Malbos are collaborators of the Applied and Computational Algebraic Topology (ACAT) networking programme of the European Science Foundation.

6.3. International Initiatives

6.3.1. Inria International Partners

The project-team has collaborations with Wroclaw University (Poland), University of Aarhus (Denmark), University of Oregon, University of Tokyo, University of Sovi Sad, University of Nottingham, Institute of Advanced Study, MIT and University of Cambridge.

6.3.2. Participation In other International Programs

Pierre-Louis Curien participates to the ANR International French-Chinese project LOCALI (coordinated by Gilles Dowek), and to a MathAmSud project in algebraic operads with the university of Talca (Chile).

6.4. International Research Visitors

6.4.1. Visits of International Scientists

Beta Ziliani (MPI Saarbrücken) visited πr^2 for one week in November 2014 to collaborate with Yann Régis-Gianas and Matthieu Sozeau.

Peter Aczel (Manchester Univ.), Steve Awodey (Carnegie Mellon University), Thierry Coquand (Univ. Göteborg), and Vladimir Voevodsky (Institute for Advanced Study) were Inria funded invited professors for the thematic IHP trimester Semantics of Proofs and Certified Mathemtatics.

6.4.1.1. Internships

Akira Yoshimizu is an international Inria intern, working on abstract machines for quantum programmming languages inspired from game semantics and linear logic.

6.4.2. Visits to International Teams

6.4.2.1. Research stays abroad

Pierre-Louis Curien visited Chili (Univ. of Talca) in March 2014 (collaborative work with Maria Ronco in operad theory).

POEMS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives - ANR

- ANR project *PROCOMEDIA: Propagation d'ondes en milieux complexes*
  Partners: ESPCI, Laboratoire d'Acoutique de l'Université du Maine, Departamento de Fisica de la Universidad de Chile.
  Start : 04/01/2011, End : 03/30/2014. Administrator : CNRS. Coordinator for POEMS : Jean-François Mercier.
- ANR project *METAMATH: modélisation mathématique et numérique pour la propagation des ondes en présence de métamatériaux.* Partners: EPI DEFI (Inria Saclay), IMATH-Université de Toulon, LJLL-Paris 6 University.
  Start : 12/01/2011, End : 11/30/2016. Administrator : Inria. Coordinator : Sonia Fliss.
- ANR project *CHROME: Chauffage , réflectométrie et Ondes pour les plasmas magnétiques*
  Partners: Université Pierre et Marie Curie (Paris 6), Université de Lorraine
  Start : 10/01/2012, End : 10/01/2015 Administrator : Inria Coordinator for POEMS: Eliane Bécache
- ANR project *SODDA: Diagnostic de défauts non francs dans les réseaux de câbles*
  Partners: CEA LIST, ESYCOM, LGEP (Supelec)
  Start : 10/01/2012, End : 10/01/2015 Administrator : Inria Coordinator for Poems: Patrick Joly
- ANR project *RAFFINE: Robustesse, Automatisation et Fiabilité des Formulations INtégrales en propagation d'ondes : Estimateurs a posteriori et adaptivité*
  Partners: EADS, IMACS, ONERA, Thales
  Start : January 2013. End : december 2016. Administrator : Inria. Coordinator: Marc Bonnet.
- ANR project *ARAMIS: Analyse de méthodes asymptotiques robustes pour la simulation numérique en mécaniques*
  Partners: Université de Pau, Université technologique de Compiègne
  Start : january 2013. End : december 2016. Administrator : Université de Pau. Participant for POEMS: Marc Bonnet

8.2. European Initiatives - FP7 & H2020 Projects

8.2.1. SIMPOSIUM

Type: FP7

Defi: ICT for the Enterprise and Manufacturing

Instrument: Integrated Project

Objectif: PPP FoF: Digital factories: Manufactoring design and product lifecycle management

Duration: September 2011 - August 2014

Coordinator: Steve MAHAUT, CEA/LIST

Inria contact: P. Joly, E. Lunéville

Abstract: Gathering together industrial companies, research centres and universities, the purpose of the SIMPOSIUM project is the integration in a unique platform of interoperable Non Destructive Evaluation simulation tools, to make possible virtual testing of parts at the early stages of manufacturing and design. The role of POEMS team is to develop a new finite element library (XLiFE++) with specific tools dedicated to propagation in waveguides. The library is now available and simulations of propagation in composite (anistropic elastic medium) waveguide have been done and compared to simulations provided by CIVA platform.

8.2.2. BATWOMAN

Type: FP7 Marie Curie

Objectif: Basic Acoustics Training - & Workprogram On Methodologies for Acoustics - Network

Duration: September 2013 - August 2017

Coordinator: Martin Wifling, VIRTUAL VEHICLE (AT)

Inria contact: P. Joly

Abstract: The BATWOMAN ITN aims at structuring research training in basic and advanced acoustics and setting up a work program on methodologies for acoustics for skills development in a highly diverse research field offering multiple career options.

8.3. International Initiatives

8.3.1. Inria International Partners

Wilkins Aquino (Duke University)

George Biros (University of Texas, Austin)

Fioralba Cakoni (University of Delaware)

Eric Chung (Chinese University of Hong Kong)

Dan Givoli (Technion - Israel Institute of Technology)

Nabil Gmati (Ecole Nationale d'Ingénieurs de Tunis)

Bojan Guzina (University of Minnesota)

Manfred Kaltenbacher (Technische Universitat Wien)

Sergei Nazarov (Saint-Petersburg University)

Jeronimo Rodriguez (University of Santiago de Compostela)

Kersten Schmidt (Technische Universitat Berlin)

Chrysoula Tsogka (University of Crete)

Ricardo Weder (Universidad Nacional Autonoma, Mexico)

Wensheng Zhang (Institute of Computational Mathematics, Beijing)

8.3.2. Participation In other International Programs

Groupement De Recherche Européen : GDRE-US

This European Research Network (GDRE) entitled *Wave Propagation in Complex Media for Quantitative and Non Destructive Evaluation* aims at giving opportunities for interactions between researchers on the occasion of informal meetings, workshops and colloquia, alternatively in France and in the UK. It linked groups of academics and researchers in Ultrasonic Wave Phenomena with each other, and with industrial research centres and companies. The teams involved focused particularly on the theoretical end of the research spectrum, and include mathematicians, physicists and engineers.

8.3.3. Visits of International Scientists

Ricardo Weder, Institute of Applied Mathematics and Systems, Universidad Nacional Autonoma, Mexico (June 2014).

Wensheng Zhang, Institute of Computational Mathematics, Beijing (September 2014).

Eric Chung, Department of Mathematics, Chinese University of Hong Kong (November 2014).

Shravan Veerapaneni, Department of Mathematics, University of Michigan (December 2014).

8.3.4. Visits to International Teams

Gary Cohen visited Prof. Wensheng Zhang at LSEC, Institute of Computational Mathematics, Chinese Academy of Sciences (CAS) in Beijing January 5-13.

Gary Cohen visited Dr. Eric Chung at Department of Mathematics in The Chinese University of Hong Kong (CUHK). They continued their collaboration on staggered discontinuous Galerkin methods and started a collaboration on mortar elements for hybrid meshes for the Maxwell's system.

POLSYS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- **ANR Grant (international program) EXACTA (2010-2013): Exact/Certified Algorithms with Algebraic Systems.**
  The main objective of this project is to study and compute the solutions of nonlinear algebraic systems and their structures and properties with selected target applications using exact or certified computation. The project consists of one main task of basic research on the design and implementation of fundamental algorithms and four tasks of applied research on computational geometry, algebraic cryptanalysis, global optimization, and algebraic biology. It will last for three years (2010-2013) with 300 person-months of workforce. Its consortium is composed of strong research teams from France and China (KLMM, SKLOIS, and LMIB) in the area of solving algebraic systems with applications.
- **ANR Grant HPAC: High Performance Algebraic Computing (2012-2016).** The pervasive ubiquity of parallel architectures and memory hierarchy has led to a new quest for parallel mathematical algorithms and software capable of exploiting the various levels of parallelism: from hardware acceleration technologies (multi-core and multi-processor system on chip, GPGPU, FPGA) to cluster and global computing platforms. For giving a greater scope to symbolic and algebraic computing, beyond the optimization of the application itself, the effective use of a large number of resources (memory and specialized computing units) is expected to enhance the performance multi-criteria objectives: time, resource usage, reliability, even energy consumption. The design and the implementation of mathematical algorithms with provable, adaptive and sustainable performance is a major challenge. In this context, this project is devoted to fundamental and practical research specifically in exact linear algebra and system solving that are two essential "dwarfs" (or "killer kernels") in scientific and algebraic computing. The project should lead to progress in matrix algorithms and challenge solving in cryptology, and should provide new insights into high performance programming and library design problems (J.-C. Faugère [contact], L. Perret, G. Renault, M. Safey El Din).
- **ANR Grant GeoLMI: Geometry of Linear Matrix Inequalities (2011-2015).** GeoLMI project aims at developing an algebraic and geometric study of linear matrix inequalities (LMI) for systems control theory. It is an interdisciplinary project at the border between information sciences (systems control), pure mathematics (algebraic geometry) and applied mathematics (optimisation). The project focuses on the geometry of determinantal varieties, on decision problems involving positive polynomials, on computational algorithms for algebraic geometry, on computational algorithms for semi-definite programming, and on applications of algebraic geometry techniques in systems control theory, namely for robust control of linear systems and polynomial optimal control (Participants: J.-C. Faugère, M. Safey El Din [contact], E. Tsigaridas).

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. A3

Type: PEOPLE

Defi:

Instrument: Career Integration Grant

Objectif: NC
Duration: May 2013 - April 2017
Coordinator: Jean-Charles Faugère
Partner: Institut National de Recherche en Informatique et en Automatique (Inria), France
Inria contact: Elias Tsigaridas
Abstract: The project Algebraic Algorithms and Applications (A3) is an interdisciplinary and multidisciplinary project, with strong international synergy. It consists of four work packages The first (Algebraic Algorithms) focuses on fundamental problems of computational (real) algebraic geometry: effective zero bounds, that is estimations for the minimum distance of the roots of a polynomial system from zero, algorithms for solving polynomials and polynomial systems, derivation of non-asymptotic bounds for basic algorithms of real algebraic geometry and application of polynomial system solving techniques in optimization. We propose a novel approach that exploits structure and symmetry, combinatorial properties of high dimensional polytopes and tools from mathematical physics. Despite the great potential of the modern tools from algebraic algorithms, their use requires a combined effort to transfer this technology to specific problems. In the second package (Stochastic Games) we aim to derive optimal algorithms for computing the values of stochastic games, using techniques from real algebraic geometry, and to introduce a whole new arsenal of algebraic tools to computational game theory. The third work package (Non-linear Computational Geometry), we focus on exact computations with implicitly defined plane and space curves. These are challenging problems that commonly arise in geometric modeling and computer aided design, but they also have applications in polynomial optimization. The final work package (Efficient Implementations) describes our plans for complete, robust and efficient implementations of algebraic algorithms.

7.3. International Initiatives

7.3.1. Inria International Labs

We are involved in the ECCA (Exact/Certifed Computation with Algebraic Systems) Team of LIAMA. Our partners are mainly from the Chinese Academy of Sciences and Beihang Univ. Our research focuses mainly on polynomial system solving and its applications.

7.3.2. Inria Associate Teams

7.3.2.1. QOLAPS

Title: Hybrid Methodologies for Quantifier Elimination, Global Optimization, Linear Algebra and Polynomial System Solving
International Partner (Institution - Laboratory - Researcher):
North Carolina State University (ÉTATS-UNIS)
Duration: 2012 - 2014
See also: http://www-polsys.lip6.fr/QOLAPS/index.html
Reliable and certified computing is a major issue in computer science motivated by huge needs in engineering sciences and in the industry (aeronautics, railway transports, etc.). At the same time, the need for high-performance computational routines is constantly increasing. It is tackled on the one hand by designing asymptotically fast algorithms which often have the feature to be randomized and/or approximate and/or probabilistic and on the other hand by developing high performance implementations. Our goal is to conciliate high-performance computing with certification and/or validation issues. We will mainly focus on algebraic problems, and precisely on linear and non-linear systems of equations and/or inequalities. In this context, hybrid methodologies combining exact and numeric computation are traditionally used in two separate ways: either exact computation is used to analyze the robustness of numerical schemes or numerical computation is used to speed up computations. Our viewpoint is to mix these trends in hybrid methodologies by exploiting the scientific continuum from linear algebra to quantifier elimination and global optimization through Grobner bases computations for polynomial system solving.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Éric Schost, Univ. Western Ontario, Canada.

Nitin Saxena, IIT Kanpur, India.

Danilo Gligoroski, NTNU, Norway.

7.4.1.1. Internships

Ivan Bannwarth

Date: Mar 2014 – Aug 2014

Institution: Université de Versailles – Saint-Quentin-en-Yvelines (France)

Matías Bender

Date: Sep 2014 – Feb 2015

Institution: Universidad de Buenos Aires (Argentine)

Anca Nitulescu

Date: Mar 2014 – Aug 2014

Institution: Université Paris Diderot (France)

Ulrick Severin

Date: Sep 2013 – Mar 2014

Institution: Dassault Systèmes (France)

POMDAPI Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

GT Elfic (Labex DigiCosme, 2014–2016): "Programmes d'éléments finis formellement vérifiés", with TOCCATA (Inria Saclay - Île-de-France), LIX (École Polytechnique), CEA LIST, LIPN (Université de Paris 13), and LMAC (Université de Technologie de Compiègne).

7.2. National Initiatives

ANR DEDALES (2014–2017): "Algebraic and Geometric Domain Decomposition for Subsurface Flow". The project aims at developing high performance software for the simulation of two phase flow in porous media. The project will specifically target parallel computers where each node is itself composed of a large number of processing cores, such as are found in new generation many-core architectures. The partners are HIEPACS, Laboratoire Analyse, Géométrie et Application, Maison de la Simulationand Andra. The coordinator of the project is M. Kern.

ANR GEOPOR (2014–2017): "Geometrical approach for porous media flows: theory and numerics", with Laboratoire Jacques-Louis Lions (Université de Paris 6).

ANR MANIF (2011–2014): "Mathematical and numerical issues in first-principle molecular simulation", with CERMICS (École Nationale des Ponts et Chaussées), and Laboratoire Jacques-Louis Lions (Université de Paris 6).

C2S@Exa (Computer and Computational Sciences at Exascale, 2011–2015) is an Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. This project supports in particular the PhD of N. Birgle, supervised by. J. Jaffré, which is part of an Inria-Andra collaboration.

Projet P (2011–2015) is funded by the French FUI (*Fonds Unique Interministériel*). Project P aims at supporting the model-driven engineering of high-integrity embedded real-time systems by providing an open code generation framework. The contribution of project-team Pomdapi is in the domain of language translation and block-schema modelization semantics. This project supports the work of C. Franchini, under the supervision of P. Weis.

7.3. European Initiatives

7.3.1. Collaborations in European Programs, except FP7 & H2020

Program: Research, Development and Innovation Council of the Czech Republic

Project acronym: MORE

Project title: Implicitly constituted material models: from theory through model reduction to efficient numerical methods

Duration: September 2012–September 2017

Coordinator: Josef Málek, Charles University in Prague

Other partners: Institute of Mathematics, Academy of Sciences of the Czech Republic; Oxford Centre for Nonlinear Partial Differential Equations, Great Britain.

Abstract: A multidisciplinary project on nonlinear Navier–Stokes flows with implicit constitutive laws. It focuses on development of accurate, efficient, and robust numerical methods for simulations of the new class of implicit models, see http://more.karlin.mff.cuni.cz/.

7.4. International Initiatives

7.4.1. Participation In other International Programs

Pomdapi is part of the EuroMediterranean 3+3 program with the project HYDRINV (2012–2015): Direct and inverse problems in subsurface flow and transport. Besides Inria, institutions participating in this project are: Universitat Politècnica de Catalunya (Barcelona, Spain), Universidad de Sevilla (Spain), École Mohamedia d'Ingénieurs (Rabat, Morocco), Université Ibn Tofaïl (Kenitra, Morocco), University Centre of Khemis Miliana (Algeria), École Nationale d'Ingénieurs de Tunis (Tunisia).

7.5. International Research Visitors

7.5.1. Visits of International Scientists

Todd Arbogast, professor, Center for Subsurface Modeling, The University of Texas at Austin. September 2014.

Peter Bastian, professor, Interdisciplinary Center for Scientific Computing, University of Heidelberg. June 2014.

H. Ben Ameur, professor at IPEST and member of ENIT-Lamsin, Tunis, Tunisia. June and December 2014.

G. D. Veerappa Gowda, professor, Tata Institute for Fundamental Research, Center for Applicable Mathematics, Bengalore. November-December 2014.

7.5.1.1. Internships

E. Ahmed, from École Nationale d'Ingénieurs de Tunis (Tunisia), has visited Pomdapi for nine months on the subject *Modélisation d'écoulements diphasiques dans un milieu poreux fracturé*.

F. Cheikh, from École Nationale d'Ingénieurs de Tunis (Tunisia), has visited Pomdapi for six months on the subject *Identification de failles dans un milieu poreux par une méthode d'indicateurs*.

M. H. Riahi, from École Nationale d'Ingénieurs de Tunis (Tunisia), has visited Pomdapi for six months on the subject *Identification de paramètres hydrogéologiques dans un milieu poreux*.

7.5.2. Visits to International Teams

7.5.2.1. Research stays abroad

M. Vohralík, April 1st–May 9th. Research stay in the framework of the project MORE "Implicitly constituted material models: from theory through model reduction to efficient numerical methods", Charles University in Prague, see http://more.karlin.mff.cuni.cz/.

POPIX Team

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. FP7 & H2020 Projects

The Drug Disease Model Resources (DDMoRe) consortium will build and maintain a universally applicable, open source, model-based framework, intended as the gold standard for future collaborative drug and disease modeling and simulation.

The DDMoRe project is supported by the Innovative Medicines Initiative (IMI), a large-scale public-private partnership between the European Union and the pharmaceutical industry association EFPIA.

Marc Lavielle is leader of WP6: "New tools for Model Based Drug Development".

DDMoRe website: http://www.ddmore.eu

Duration: 2010 - 2015

Project members: Uppsala Universitet, Sweden; University of Navarra, Spain; Universiteit Leiden, Netherlands; Université Paris Diderot, France; Universita degli Studi di Pavia, Italy; UCB Pharma , Belgium; Simcyp, UK; Pfizer, UK; Optimata , Israel; Novo Nordisk , Denmark; Novartis, Switzerland; Merck Serono, Switzerland; Takeda, Switzerland; Mango Business Solutions , UK; Lixoft, France; Interface Europe, Belgium; Institut de Recherches Internationales Servier, France; Inria, France; GlaxoSmithKline Research and Development, UK; Freie Universitat Berlin, Germany; F. Hoffmann - La Roche , Switzerland; EMBL - European Bioinformatics Institute, UK; Eli Lilly , UK; Cyprotex Discovery, UK; Consiglio Nazionale delle Ricerche, Italy; AstraZeneca, Sweden.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

POPIX has a collaboration with the Faculty of Pharmacy of Manchester University (UK). Marc Lavielle is invited every year to give a one day course about mixed effects models and the MONOLIX software.

POPIX has a collaboration with the Faculty of Pharmacy of Buffalo university (USA). Marc Lavielle is invited every year to give a 2 days course about mixed effects models and the MONOLIX software.

8.2.2. Participation In other International Programs

Indo French Centre for the promotion of advanced research (CEFIPRA): Marc Lavielle was invited to participate to the the IFCAM Workshop in Statistics and Mathematical Biology, in Bangalore (August 2014).

POSTALE Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- **CALIFHA project (DIM Digiteo 2011)**: CALculations of Incompressible Fluid flows on Heterogeneous Architectures. Funding for a PhD student. Collaboration with LIMSI/CNRS. Participants: Marc Baboulin (Principal Investigator), Joel Falcou, Yann Fraigneau (LIMSI), Laura Grigori, Olivier Le Maître (LIMSI), Laurent Martin Witkowski (LIMSI)

7.2. National Initiatives

- **EDF**: Contract with EDF on improving performance and designing algorithms of iterative solvers on parallel machines with accelerators (Marc Baboulin). This contract enables to hire a postdoc researcher in October 2014.
  Participants: Marc Baboulin, Amal Khabou.
- **Lal/In2P3/CERN** The collaboration with CERN and LAL/IN2P3 + LRI focuses on LHCb and Atlas tracker code optimization. Those experiments must analyze results in realtime (10ms for analyzing particle trajectography). Early results show that these tracking algorithms can run in real time on SIMD multicore General Purpose Processor and on Xeon-Phi.
  Participant: Lionel Lacassagne.
- **Inserm** Contract with Paris X / INSERM U669 (Christophe Genolini) in the R++ project. R++ is an open source effort to modernize and increase performance of the R language used by scientists to develop statistical analysis tools. Funding for one research engineer has been received to support this project.
  Participant: Joël Falcou.
- **followup of the ANR Cosinus project PetaQCD - Towards PetaFlops for Lattice Quantum ChromoDynamics** Collaboration with Lal (Orsay), LPT (Orsay), LABRI (Bordeaux). About the design of architecture, software tools and algorithms for Lattice Quantum Chromodynamics.
  Participants: Christine Eisenbeis, Michael Kruse, Konstantin Petrov.

7.3. European Initiatives

7.3.1. ITEA

Program: ITEA

Project acronym: MANY

Project title: Many-core Programming and Resource Management for High-Performance Embedded Systems

Duration: 09/2011 - 08/2014

Coordinator: XDIN

Other partners: France: Thales Communications and Security, CAPS Entreprise, Telecom SudParis; Spain: UAB; Sweden: XDIN; Korea: ETRI, TestMidas, SevenCore; Netherlands: Vector Fabrics, ST-Ericsson, TU Eindhoven; Belgium: UMONS.

Abstract: Adapting Industry for the for the disruptive landing of many-core processors in Embedded Systems in order to provide scalable, reusable and very fast sofware development.
Participants: Lénaïc Bagnères, Cédric Bastoul, Taj Muhammad Khan.

7.4. International Initiatives

7.4.1. Inria Associate Teams

Participants: Marc Baboulin, Jack Dongarra.

R-LAS is an Inria associate team with University of Tennessee,(https://www.lri.fr/~baboulin/r-las.html), 2014-2017.

This project is proposed in the context of developing a class of fast algorithms based on randomization for numerical linear algebra solvers. The funding was used in 2014 to cover exchange visits for researchers and PhD students from Inria and University of Tennessee.

7.4.1.1. Informal International Partners

- **Lawrence Berkeley National Laboratory** - USA: collaboration of Marc Baboulin with Sherry Li on application of randomization techniques to the solution of large sparse linear systems using direct methods (joint publications and co-organizations of mini-symposia for SIAM conferences).
- **Old Dominion University** - USA: Collaboration with Pr. Masha Sosonkina on locality optimization for numerical linear algebra solvers (joint publication) and preconditioned Krylov subspace methods (PhD thesis of Aygül Jamal, starting in October 2014).
- **Louisiana State University** - USA: collaboration of Joel Falcou with the STELLAR team in the framework of the HPX project (Hartmut Kaiser). It is mainly related to the design and implementation of a C++ asynchronous runtime system. In this framework, the STELLAR team hosted 2 PhD students of the Postale team for extended visits in 2013 and 2014.
- **Texas A&M University** - USA: collaboration of Joel Falcou with the PARASOL team in the framework of the STAPL project (Lawrence Rauchwerger). It is mainly related to the applicability of parallel skeletons inside STAPL on large scale parallel machines.
- **University of Illinois at Urbanna Champaign** (UIUC) - USA, in the context of the Inria Joint Laboratory for Petascale computing. Since 2011, we have initiated collaborations with researchers from UIUC (Wen-mei Hwu, Karl Rupp) in the area of numerical software.
- **University of Manchester**: collaboration with Professors Nick Higham and Françoise Tisseur on random orthogonal matrices and fault-tolerant linear algebra algorithms (Amal Khabou).
- **University of California - Irvine**: collaboration of Christine Eisenbeis with Professor Jean-Luc Gaudiot on Application Characterization for Modern Multicore Architectures

7.4.2. Participation In other International Programs

Stic AmSud: BioCloud-EEAmSud **Participants:** Christine Eisenbeis, Alessandro Ferreira Leite, Claude Tadonki.

BioCloud-EEAmSud is a cooperation project integrated by Brazil, Chile and France following the 2012 STIC-AmSud call. Partners in Brazil are Universidade de Brasilia, Universidade Federal Fluminense, and EMBRAPA-Genetic Resources and Biotechnology (CENARGEN), through the support of the Coordination of Improvement of Senior Staff of the Ministry of Education in Brazil (CAPES). In Chile, the main partner is Universidad de Santiago de Chile, through the support of the National Commission for Scientific and Technological Research of Chile (CONICYT). In France, the institutions involved are Mines ParisTech (CRI) and Inria-Saclay, through the support of the Ministry of Foreign and European Affairs (MAEE). The international project coordinator is Pr. Maria Emília Machado Telles Walter (UnB). Alessandro Ferreira Leite' thesis work is a joint University of Brazilia - université Paris-Sud 11 thesis and is partially supported by BioCloud-EEAmSud. Maria Emilia Machado Telles Walter and Alba Cristian de Melo visited Grand-Large in 2013, as well as Taina Rajol.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Masha Sosokina (Professor, Old Dominion University, USA), June 10-13, 2014.
- Tingxing Tim Dong (PhD student, University of Tennessee, USA), August 25-26, 2014.
- Anthony Danalis (University of Tennessee, USA), December 15-16, 2014.
- Tetsuya Sakurai (University of Tsukuba, Japan), December 15-16, 2014.
- Jose Roman (University of Valencia, Spain), December 15-16, 2014.
- Jean-Luc Gaudiot, UCLA, Irvine, March 3rd, September 4th, November 24th, 2014.

POTIOC Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Cap Sciences:

- Potioc has strong relationships with the Cap Sciences museum (http://www.cap-sciences.net/), especially through its Living Lab.

Immersion:

- Potioc has strong relationships with Immersion. In 2014, Immersion and Potioc notably co-supervised a Master student (Dennis Wobrock) on the topic "Using brain and physiological signals to assess 3D User Interfaces".

8.2. National Initiatives

ANR Project ISAR:

- duration: 2014-2017
- coordinator: Martin Hachet
- partners: LIG-CNRS (Grenoble), Diotasoft (Paris)
- acronym: Interaction en Réalité Augmentée Spatiale / Interacting with Spatial Augmented Reality
- The ISAR project (Interaction with Spatial Augmented Reality) focuses on the design, implementation, and evaluation of new paradigms to improve interaction with the digital world when digital content is directly projected onto physical objects (e.g. a ball on the figure). It opens new perspectives for exciting tomorrow's applications, beyond traditional screen-based applications.
- website: http://isar.imag.fr/

Inria ADT OpenViBE-NT:

- duration: 2012-2014
- partners: Inria teams Hybrid, Neurosys and Athena
- coordinator: Anatole Lécuyer (Inria Rennes Bretagne Atlantique)
- funded by Inria (Technological Development Project)
- The aim of this project is to further develop OpenViBE, notably in order to (1) make the software evolve towards a new version that fits better current and future needs from its users, (2) to offer new and original functionalities and (3) to keep ensuring OpenViBE support and dissemination. The final objective is to further increase OpenViBE usability and appeal, in order to strengthen the users' community surrounding the software and enable us to make it as viable and useful as possible, on the long term. The developments will also enable the Inria teams involved (Potioc, Hybrid, Neurosys and Athena) to explore new research directions on BCI, such as adaptive BCI, hybrid BCI, that combines EEG with other physiological sensors (e.g., heart rate, galvanic skin response, gaze, etc.), or new coupling between BCI and virtual reality in order to improve human training for BCI, thanks to new immersive feedback types.
- website: http://openvibe.inria.fr

Inria ADT OpenViBE-X:

- duration: 2014-2016
- partners: Inria teams Hybrid and Athena
- coordinator: Maureen Clerc (Inria Sophia Antipolis)
- This is the follow-up project of OpenViBE-NT
- website: http://openvibe.inria.fr

Inria Project Lab BCI-LIFT:

- partners: Inria team Athena (Inria Sophia-Antipolis), Inria team Hybrid (Inria Rennes), Inria team Neurosys (Inria Nancy), LITIS (Université de Rouen), Inria team DEMAR (Inria Sophia-Antipolis), Inria team MINT (Inria Lille), DyCOG (INSERM Lyon)
- coordinator: Maureen Clerc (Inria Sophia Antipolis)
- Project around BCI in the evaluation process, first meeting with all the partners was in October 2013
- The aim is to reach a next generation of non-invasive Brain-Computer Interfaces (BCI), more specifically BCI that are easier to appropriate, more efficient, and suit a larger number of people. With this concern of usability as our driving objective, we will build non-invasive systems that benefit from advanced signal processing and machine learning methods, from smart interface design, and where the user immediately receives supportive feedback. What drives this project is the concern that a substantial proportion of human participants is currently categorized “BCI-illiterate” because of their apparent inability to communicate through BCI. Through this project we aim at making it easier for people to learn to use the BCI, by implementing appropriate machine learning methods and developping user training scenarios.
- website: http://bci-lift.inria.fr/

AIBLE-Helios:

- duration: 2014-2015
- partners: SATT Nancy Grand Est, Université de Lorraine
- coordinator: Stṕhanie Fleck (Université de Lorraine)
- The AIBLE project (Augmented, Inquiry-Based, Learning, Environment) aims to provide a methodology and innovative media for the improvement of learning of basic astronomical phenomena for school groups (8-11 years). As part of this project, Potioc will focus on the development of the final application for augmented reality based and 3D manipulation, for providing a high-fidelity prototype.

PIA ville numérique "Villes transparentes":

- duration: 2012-2014
- partners: Pages Jaunes/Mappy, Vectuel/Virtuelcity
- In the context of the call for proposal Ville numérique (Digital city) by the Investissement d’Avenir Program, the Potioc team was selected for the project “Villes transparentes” (Transparent city) in collaboration with Mappy (Pages Jaunes group) and Vectuel. In this project of a duration of two years, the Potioc team focused on the development of innovative interaction techniques for the navigation in urban 3D environments.

DRAO:

- duration: 2012-2014
- partners: Inria teams Reves, manao, In-Situ
- ANR Young Researcher Program (Adrien Bousseau, Reves team)
- DRAO is a research project dedicated to the creation of drawing. Its first focus is on the understanding of how people draw through studies and interviews with professionals.The second goal is the automation of some parts of the drawing process. Finally, the third goal is the creation of tools to teach drawing with digital tools.
- website: https://www-sop.inria.fr/members/Adrien.Bousseau/drao/index.html

Interco3D:

- partners: IRIT Toulouse
- Recognized as official working group by AFIHM
- The objective of this working group is to unite a community of actors involved in the design and use of interaction techniques for 3D spaces, ie perceive, understand, manipulate and move within virtual 3D spaces.
- website: http://www.irit.fr/INTERCO3D/

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7 & H2020

Program: DGA-DSTL Project

Project title: Assessing and Optimising Human-Machine Symbiosis through Neural signals for Big Data Analytics

Duration: 2014-2018

Coordinators: Ulster University (Nothern Ireland, UK), Inria Bordeaux Sud-Ouest (France)

Abstract: This project's objective is to design new tools for Big Data analysis, and in particular visual analytics tools that tap onto human cognitive skills as well as on Brain-Computer Interfaces. The goal is to enable the user to identify and select relevant information much faster than what can be achieved by using automatic tools or traditional human-computer interfaces. More specifically, this project will aim at identifying in a passive way various mental states (e.g., different kinds of attention, mental workload, relevant stimulus perception, etc.) in order to optimize the display, the arrangement or the selection of relevant information.

8.3.2. Collaborations with Major European Organizations

Collaboration with the University of Bristol, BIG (UK), Bristol Interaction and Graphics (BIG) group, UK (Head: Pr. Sriram Subramanian)

We have strong relationships with Sriram Subramanian. This has led to joint paper publications, numerous visits and a co-supervision of a PhD thesis (Camille Jeunet)

Bordeaux Idex project "Conception de Système d'interfaces cerveau-ordinateur prenant en compte les facteurs humains afin d'optimiser l'apprentissage de l'utilisateur" for international PhD project

partners: Bordeaux Segalen University (Handicap & Système nerveux team), Bristol University (BIG team)

duration: October 2013 - September 2016

LIRA Stress and Relaxation project: LIfe-style Research Association, Lifestyle Management: Stress and Relaxation

Accord cadre Européen

Coordinator: Frederic Alexandre

Other partners: Philips (Netherlands), Fraunhofer (Germany), Inria teams Hybrid and Mimetic

Abstract: The Stress and Relaxation project aims at offering services to a user, at home or at work, to help this user evaluate and control his level of stress

duration: 2011 - 2021

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- Pr. Roger N'KAMBOU, department of Computer Sciences at the UQAM (Université du Québec à Montréal) who is a specialist of Intelligent Tutoring Systems (ITS). We are setting up a collaboration with him to develop such a system in order to optimise human learning in Brain-Computer Interfaces (BCI), and thus improve the performances with such systems. We visited Pr. N'Kambou and UQAM in May in Montreal, and he visited us at Inria in December, where we organized a Workshop on human learning and computer sciences.
- We are collaborating with Dr. Cuntai Guan (I2R, Singapore), Pr. Jonathan Bromberg (Kansas University, USA) and Pr. Gerwin Schalk (Wadsworth center, USA) on ElectroCorticoGraphic (ECoG) signal analysis.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

This year, the Potioc team has hosted two international PhD students :

- Flavio Bertini, University of Bologna, Italy (December 2013-February 2014)
- Nicholaos Katzakis, Osaka University, Japan (September 2014 until November 2014)

Potioc has also hosted an international Master student :

- Julia Schumacher, Technische Universitaet Berlin, Germany (April 2014 - October 2014)

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

Camille Jeunet was working at the University of Bristol, UK, in the BIG (Bristol Interaction and Graphics) groups of Pr. Sriram Subramanian, from July to September 2014.

PRIMA Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. CATRENE Project AppsGate - Smart Home Application Gateway

Duration: june 2012 - June 2015

Coordinator: ST Microelectronics

Other partners: Pace, Technicolor, NXP, Myriad France SAS, 4MOD Technology, HI-IBERIA Ingenieria y Proyectos, ADD Semiconductor, Video Stream Network, SoftKinetic, Optrima, Fraunhofer, Vsonix, Evalan, University UJF/LIG, and Institut Telecom.

The Prima Project team has worked with 15 other partners to develop a new generation of set-top box for smart home applications. In close collaboration with ST Microelectronics and Immotronics, Prima has developed the core middleware components for plug and play integration of smart home devices for distributed smart home services, as well as interactive tools for End User Development of Smart Home services.

AppsGate has developed an Open Platform to provide integrated home applications to the consumer mass market. The set-top box is the primary point of entry into the digital home for television services including cable TV, satellite TV, and IPTV. AppsGate will transform the set-box into a residential gateway, capable of delivering multiple services to the home, including video, voice and data. PRIMA is involved in designing End User Development tools dedicated for the Smart Home

7.1.2. ICTLabs Smart Energy Systems Activity 11831 Making Energy Visible

Participants: Sabine Coquillart, James Crowley [correspondant], Patrick Reignier, Mayeul de Werbier d Antigneul.

Smart energy Systems, Smart Grids

Within Activity 11831 Open SES Experience Labs, PRIMA is responsible for the A1405 "Making Energy Visible" within the Smart Energy Systems action line of ICTlabs. The objective of this task is to design, implement and evaluate tools for online and offline interaction with energy usage. The group works with Immotronics to define an open middleware that will enable logging, aggregation and interactive visualization of data and information on energy consumption and on environmental parameters that define comfort. The open middleware will include an SQL Data base, web socket and an xml markup language to define a common naming scheme, tools for assigning location in both space (geometry coordinates) and place (functional places), as well as data aggregation tools.

The open middleware will serve as a common software platform that will be used for the Inria Rapid Deployment mini-kit as well as for data acquisition by other partners using other sensors. Univ Bologna will provide (sell) copies of their new energy measurement meter for integration into the system. Univ of Bologna, Fraunhofer, Fortis and Inria will construct tools for offline and online visualization. The system will be deployed and evaluated by social scientists at the living lab of Politechnico Turin. Turin will specify requirements for visualisation of energy and comfort for smart grid applications, and perform user studies and evaluations on the resulting systems.

Visualisation includes on-line and offline exploration, as well as tools for html web interface, Mobile augmented reality tools, apps for display on mobile devices, 3D visual interaction, and immersive interaction with an oculus Rift.

7.2. National Initiatives

7.2.1. EquipEx AmiQual4Home - Ambient Intelligence for Quality of Life

Participants: Stan Borkowski, Sabine Coquillart, Joelle Coutaz, James Crowley [correspondant], Alexandre Demeure, Thierry Fraichard, Amaury Negre, Patrick Reignier, Dominique Vaufreydaz, Nicolas Bonnefond, Rémi Pincent, Mayeul de Werbier d Antigneul, Rémi Barraquand, David Lombard.

Ambient Intelligence, Equipment d'Excellence, Investissement d'Avenir

The AmiQual4Home Innovation Factory is an open research facility for innovation and experimentation with human-centered services based on the use of large-scale deployment of interconnected digital devices capable of perception, action, interaction and communication. The Innovation Factory is composed of a collection of workshops for rapid creation of prototypes, surrounded by a collection of living labs and supported by a industrial innovation and transfer service. Creation of the Innovation Factory has been made possible by a 2.140 Million Euro grant from French National programme "Investissement d'avenir", together with substantial contributions of resources by Grenoble INP, Univ Joseph Fourier, UPMF, CNRS, Schneider Electric and the Commune of Montbonnot. The objective is to provide the academic and industrial communities with an open platform to enable research on design, integration and evaluation of systems and services for smart habitats.

The AmiQual4Home Innovation Factory is a unique combination of three different innovation instruments: (1) Workshops for rapid prototyping of devices that embed perception, action, interaction and communication in ordinary objects based on the MIT FabLab model, (2) Facilities for real-world test and evaluation of devices and services organised as open Living Labs, (3) Resources for assisting students, researchers, entrepreneurs and industrial partners in creating new economic activities. The proposed research facility will enable scientific research on these problems while also enabling design and evaluation of new forms of products and services with local industry.

The core of the AmiQual4Home Innovation Factory is a Creativity Lab composed of a collection of five workshops for the rapid prototyping of devices that integrate perception, action, interaction and communications into ordinary objects. The Creativity Lab is surrounded by a collection of six Living Labs for experimentation and evaluation in real world conditions. The combination of fabrication facilities and living labs will enable students, researchers, engineers, and entrepreneurs to experiment in co-creation and evaluation. The AmiQual4Home Innovation Factory will also include an innovation and transfer service to enable students, researchers and local entrepreneurs to create and grow new commercial activities based on the confluence of digital technologies with ordinary objects. The AmiQual4Home Innovation Factory will also provide an infrastructure for participation in education, innovation and research activities of the European Institute of Technology (EIT) KIC ICTLabs.

The AmiQual4Home Innovation Factory will enable a unique new form of coordinated ICT-SHS research that is not currently possible in France, by bringing together expertise from ICT and SHS to better understand human and social behaviour and to develop and evaluate novel systems and services for societal challenges. The confrontation of solutions from these different disciplines in a set of application domains (energy, comfort, cost of living, mobility, well-being) is expected to lead to the emergence of a common, generic foundation for Ambient Intelligence that can then be applied to other domains and locations. The initial multidisciplinary consortium will progressively develop interdisciplinary expertise with new concepts, theories, tools and methods for Ambient Intelligence.

The potential impact of such a technology, commonly referred to as "Ambient Intelligence", has been documented by the working groups of the French Ministry of Research (MESR) [32] as well as the SNRI (Stratégie Nationale de la Recherche et de l'Innovation).

In 2013 our efforts were focused on specifying the requirements for major components of the project, and on finalising contractual issues with ANR. We defined the layout and arrangement of the Creativity Lab workshops, we started the specification of the instrumentation needed for the Living Labs, and developed a first version of a set of easy-deployable wireless sensors for infield data acquisition, that we call the Rapid

Deployment Minikit. A set of CNC machines was purchased, including a Fused Filament Fabrication 3D printer, a CO2 Laser cutter and engraver, and a CNC mill.

Following the kickoff meeting of the project held in October 2013, we received positive feedback and interest form local industry and research institutions, and several national project proposals submitted in 2013 identified AmiQual4Home as an important ressource.

7.2.2. FUI PRAMAD

Participants: Claudine Combe, Lucas Nacsa, Maxime Portaz, Amaury Negre, Dominique Vaufreydaz [correspondant].

Pramad is a collaborative project about *Plateforme Robotique dÁssistance et de Maintien à Domicile*. There are seven partners:

- R&D/industry: Orange Labs (project leader) and Covéa Tech (insurance company),
- Small companies: Interaction games (game designer, note that Wizardbox, the original partner was bought by Interaction games) and Robosoft (robot).
- Academic labs: Inria/PRIMA, ISIR (Paris VI) and Hôpital Broca (Paris).

The objectives of this project are to design and evaluate robot companion technologies to maintain frail people at home. Working with its partners, PRIMA research topics are:

- social interaction,
- robotic assistance,
- serious game for frailty evaluation and cognitive stimulation.

7.2.3. Inria Project-Teams PAL

Participants: Rémi Barraquand, Thierry Fraichard, Patrick Reignier, Amaury Negre, Dominique Vaufreydaz [correspondant].

The 12 Inria Project-Teams (IPT) participating in a Large-scale initiative action Personally Assisted Living (PAL http://pal.inria.fr) propose to work together to develop technologies and services to improve the autonomy and quality of life for elderly and fragile persons. The goal of this program is to unite these groups around an experimental infrastructure, designed to enable collaborative experimentations.

PAL is organized arround 12 IPT:

> Demar, E-Motion, Flowers, Hephaistos, Lagadic, Lagadic-Sophia, Maia, Madynes, Phoenix, Prima, Stars and Reves.

The role of PRIMA within this project is to develop new algorithms mainly along two research axes:

- assessing frailty degree of the elderly,
- social interaction.

7.3. International Research Visitors

7.3.1. Visits to International Teams

7.3.1.1. Sabbatical programme

> Fraichard Thierry, Sabbatical Visit to BIU, ISRAEL, from May 2014 - May 2015

7.3.1.2. Research stays abroad

> Varun Jain, 6 month visit to Carnegie-Mellon University, Pittsburgh PA, on a Region Rhone-Alpes ExploraDoc Grant from January 2014 to July 2014

PRIVATICS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Privamov'

Title: Privamov'

Type: Labex IMU.

Duration: September 2013 - 2015.

Coordinator: LIRIS.

Others partners: EVS-ITUS, Inria Urbanets.

Abstract: The objective of this project is to provide researchers the IMU community traces of urban mobility allowing further their research and validate their assumptions and models. Indeed , many communities need to know the modes of urban transport : sociologists, philosophers , geographers, planners or computer scientists. If these traces are an important feature for researchers or industrial, they are more for users who have helped to build: attacks jeopardize the privacy of users. Anonymization techniques developed within the project will make available to the greatest number of these traces, while ensuring that the entire process (from collection to data analysis) will be made in respect of the privacy of users involved.

7.1.2. SCCyPhy

Title: SCCyPhy

Type: Labex Persyval.

Duration: September 2013 - 2015.

Coordinator: Institut Fourier.

Others partners: Inria MOAIS, Verimag, CEA/LETI, LIG, GIPSA-Lab, TIMA.

Abstract: A main motivation of this action-team is to provide a structure to the Grenoble community in computer security and cryptography in the spirit of the PERSYVAL-lab Labex. Our emphasize, within the PCS workpackage, is around complementary areas of research with high impact for science and technology, with the following target applications: embedded systems (including smartphones and sensors network), at both software and hardware levels, distributed architectures (including "cloud" and "sky"), privacy and protection of information systems against cyberattacks of various origins.

7.2. National Initiatives

7.2.1. FUI

7.2.1.1. XDATA

Title: XDATA.

Type: FUI.

Duration: April 2013 - April 2015.

Coordinator: Data Publica

Others partners: Inria, Orange, EDF, LaPoste, Hurance, Cinequant, IMT.

See also: http://www.xdata.fr/.

Abstract: The X-data project is a “projet investissements d’avenir” on big data with Data Publica (leader), Orange, La Poste, EDF, Cinequant, Hurence and Inria (Indes, Privatics and Zenith) . The goal of the project is to develop a big data plaftform with various tools and services to integrate open data and partners’s private data for analyzing the location, density and consuming of individuals and organizations in terms of energy and services. In this project, the Zenith team leads the workpackage on data protection and anonymization.

7.2.2. ANR

7.2.2.1. BIOPRIV

Title: Application of privacy by design to biometric access control.

Type: ANR.

Duration: April 2013 - March 2017.

Coordinator: Morpho (France).

Others partners: Morpho (France), Inria (France), Trusted Labs (France).

See also: http://planete.inrialpes.fr/biopriv/.

Abstract: The objective of BIOPRIV is the definition of a framework for privacy by design suitable for the use of biometric technologies. The case study of the project is biometric access control. The project will follow a multidisciplinary approach considering the theoretical and technical aspects of privacy by design but also the legal framework for the use of biometrics and the evaluation of the privacy of the solutions.

7.2.2.2. BLOC

Title: Analysis of block ciphers dedicated to constrained environments.

Type: ANR.

Duration: October 2013 - September 2015.

Coordinator: INSA-Lyon (France).

Others partners: CITI Laboratory XLIM Laboratory, University of Limoges, Inria Secret, CryptoExperts (PME).

See also: http://bloc.project.citi-lab.fr/.

Abstract: BLOC aims at studying the design and analysis of block ciphers dedicated to constrained environments. The four milestones of BLOC are: security models and proofs, cryptanalysis, design and security arguments and performance analyzes and implementations of lightweight block ciphers. The aims of the project are the following ones: Security models and proofs Cryptanalysis Design C library of lightweight block ciphers We also aim at providing at the end of the project a lightweight block cipher proposal.

7.2.2.3. pFlower

Title: Parallel Flow Recognition with Multi-Core Processor.

Type: ANR.

Duration: March 2011 - September 2014.

Coordinator: LISTIC Université de Savoie.

Others partners: ICT-CAS Insititute of Computing Technology (China), LISTIC Université de Savoie.

Abstract: The main objective of this project is to take advantage of powerful parallelism of multi-thread, multi-core processors, to explore the parallel architecture of pipelined-based flow recognition, parallel signature matching algorithms.

7.2.3. Other

7.2.3.1. MOBILITICS

Title: MOBILITICS

Type: joint project.

Duration: January 2012 - Ongoing.

Coordinator: CNIL.

Others partners: CNIL.

Abstract: Platform for mobile devices privacy evaluation. This project strives to deploy an experimental mobile platform for studying and analyzing the weaknesses of current online (smartphone) applications and operating systems and the privacy implications for end-users. For instance, one of the objectives is to understand trends and patterns collected when they are aimed at obtaining general knowledge that does not pertain to any specific individual. Examples of such tasks include learning of commuting patterns, inference of recommendation rules, and creation of advertising segments.

7.2.3.2. CAPPRIS

Title: CAPPRIS

Type: Inria Project Lab

Duration: January 2011 - 2014.

Coordinator: PRIVATICS

Others partners: Inria (CIDRE, Comete, Secsi,Smis), Eurecom, LAAS and CRIDS

Abstract: Cappris (Collaborative Action on the Protection of Privacy Rights in the Information Society) is an Inria Project Lab initiated in 2013. The general goal of Cappris is to foster the collaboration between research groups involved in privacy in France and the interaction between the computer science, law and social sciences communities in this area.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. PRIPARE

Title: Preparing industry to privacy-by-design by supporting its application in research.

Type: COOPERATION (ICT).

Instrument: Support Action (SA).

Duration: October 2013 - September 2015.

Coordinator: Trialog (France).

Others partners: American University of Paris (France), Atos (Spain), Fraunhofer SIT (Germany), Galician Research and Development Center in Advanced Telecommunications (Spain), Inria (France), KU Leuven (Belgium), Trialog (France), Trilateral Research (UK), Universidad Politecnica de Madrid (Spain), University of Ulm (Netherlands), Waterford Institute of Technology (UK).

Abstract: the general goal of PRIPARE is to facilitate the application of privacy by design. To this aim, PRIPARE will support the practice of privacy by design by the ICT research community (to prepare for industry practice) and foster risk management culture through educational material targeted to a diversity of stakeholders. The project will specify a privacy by design software and systems engineering methodology combining a multidisciplinary expertise involving legal, engineering and business viewpoints. The project will also provide best practices material and educational material focusing on risk management of privacy for different target audiences (general public, policy makers, users, ICT students and professional). The project will also pave the way for future research by identifying gaps and providing recommendations for a research agenda for privacy by design.

7.3.1.2. PARIS

Title: Privacy preserving infrastructure for surveillance.

Type: COOPERATION (ICT).

Instrument: Specific Targeted Research Project (STREP).

Duration: January 2013 - December 2015.

Coordinator: Trialog (France).

Others partners: AIT (Austria), Inria (France), KU Leuven (Belgium), Trialog (France), Universidad de Malaga (Spain), Université de Namur (Belgium), Thales (France), Visual Tools (Spain).

See also: http://www.paris-project.org/.

Abstract: PARIS will define and demonstrate a methodological approach for the development of surveillance infrastructure which enforces the right of citizens for privacy, justice and freedom and takes into account the evolving nature of such rights (e.g. aspects that are acceptable today might not be acceptable in the future), and the social and ethical nature of such rights (e.g. perception of such rights varies). The methodological approach will be based on two pillars, first a theoretical framework for balancing surveillance and data protection which fully integrates the concept of accountability, and secondly an associated process for the design of surveillance systems which takes from the start privacy (i.e. Privacy by Design) and accountability (i.e. Accountability by Design).

7.3.2. Collaborations in European Programs, except FP7

7.3.2.1. FI-WARE

Title: Future Internet Ware.

Type: COOPERATION (ICT).

Defi: PPP FI: Technology Foundation: Future Internet Core Platform.

Instrument: Integrated Project (IP).

Duration: May 2011 - April 2014.

Coordinator: Telefonica. (Spain)

Others partners: SAP (Germany), IBM (Israel, Switzerland), Inria (France), Thales Communications (France), Telecom Italia (Italy), France Telecom (France), Nokia Siemens Networks (Germany, Hungary, Finland), Deutsche Telekom (Germany), Technicolor (France), Ericsson (Sweden), Atos Origin (Spain), Ingeneria Informatica (Italy), Alcatel-Lucent (Italy, Germany), Siemens (Germany), Intel (Ireland), NEC (United Kingdom), Fraunhofer Institute (Germany), University of Madrid (Spain), University of Duisburg (Germany), University of Roma La Sapienza (Italy), University of Surrey (United Kingdom).

See also: http://www.fi-ware.eu/.

Abstract: The goal of the FI-WARE project is to advance the global competitiveness of the EU economy by introducing an innovative infrastructure for cost-effective creation and delivery of services, providing high QoS and security guarantees. FI-WARE is designed to meet the demands of key market stakeholders across many different sectors, e.g., healthcare, telecommunications, and environmental services. The project unites major European industrial actors in an unique effort never seen before. The key deliverables of FI-WARE will deliver an open architecture and implementation of a novel service infrastructure, building upon generic and reusable building blocks developed in earlier research projects. This infrastructure will support emerging Future Internet (FI) services in multiple Usage Areas, and will exhibit significant and quantifiable improvements in the productivity, reliability and cost of service development and delivery - building a true foundation for the Future Internet.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. CLOUDY

Title: Secure and Private Distributed Data Storage and Publication in the Future Internet

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (ÉTATS-UNIS)

Duration: 2012 - 2014

See also: http://planete.inrialpes.fr/cloudy-associated-team/

Cloud computing is a form of computing where general purpose clients (typically equipped with a web browser) are used to access resources and applications managed and stored on a remote server. Cloud applications are increasingly relied upon to provide basic services like e-mail clients, instant messaging and office applications. The customers of cloud applications benefit from outsourcing the management of their computing infrastructure to a third-party cloud provider. However, this places the customers in a situation of blind trust towards the cloud provider. The customer has to assume that the "cloud" always remains confidential, available, fault-tolerant, well managed, properly backed-up and protected from natural accidents as well as intentional attacks. An inherent reason for today's limitations of commercial cloud solutions is that end users cannot verify that servers in the cloud and the network in between are hosting and disseminating tasks and content without deleting, disclosing or modifying any content. This project seeks to develop novel technical solutions to allow customers to verify that cloud providers guarantee the confidentiality, availability and fault-tolerance of the stored data and infrastructure.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Explorer programme

Cunche Mathieu

Date: Oct 2014 - Nov 2014

Institution: NICTA (Australia)

PROSECCO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. ProSe

Title: ProSe: Security protocols : formal model, computational model, and implementations (ANR VERSO 2010.)

Other partners: Inria/Cascade, ENS Cachan-Inria/Secsi, LORIA-Inria/Cassis, Verimag.

Duration: December 2010 - December 2014.

Coordinator: Bruno Blanchet, Inria (France)

Abstract: The goal of the project is to increase the confidence in security protocols, and in order to reach this goal, provide security proofs at three levels: the symbolic level, in which messages are terms; the computational level, in which messages are bitstrings; the implementation level: the program itself.

7.1.1.2. AJACS

Title: AJACS: Analyses of JavaScript Applications: Certification and Security

Other partners: Inria-Rennes/Celtique, Inria-Saclay/Toccata, Inria-Sophia Antipolis/INDES, Imperial College London

Duration: October 2014 - March 2019.

Coordinator: Alan Schmitt, Inria (France)

Abstract: The goal of the AJACS project is to provide strong security and privacy guarantees for web application scripts. To this end, we propose to define a mechanized semantics of the full JavaScript language, the most widely used language for the Web, to develop and prove correct analyses for JavaScript programs, and to design and certify security and privacy enforcement mechanisms.

7.1.2. FUI

7.1.2.1. Pisco

Title: PISCO

Partners: Bull, Cassadian, CEA, CS, Saferiver, Serpikom, Telecom Paristech

Duration: January 2013 - December 2014.

Coordinator: Liliana Calabanti, Bull (France)

Abstract: The goal of the project is to develop a prototype of a new secure applicance based on a virtual machine architecture accessing an HSM. The role of PROSECCO is to contribute to the analysis of security http://www.systematic-paris-region.org/en/projets/pisco

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. CRYSP

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Objectif: NC

Duration: November 2010 - October 2015

Coordinator: Karthikeyan Bhargavan

Partner: Inria (France)

Inria contact: Valérie Boutheon

Abstract: The goal of this grant is to develop a collaborative specification framework and to build incremental, modular, scalable verification techniques that enable a group of collaborating programmers to build an application and its security proof side-by-side. We propose to validate this framework by developing the first large-scale web application and full-featured cryptographic protocol libraries with formal proofs of security.

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. Informal International Partners

- Microsoft Research (Cambridge, Redmond): Joint research and development on F*, miTLS, and JavaScript with Cedric Fournet, Markulf Kohlweiss, and Nikhil Swamy
- University of Pennsylvania, Portland State University, Harvard University: Joint research on Micro-Policies: Formally Verified Low-Level Tagging Schemes for Safety and Security
- Imperial College (London): Joint research on web application security with Sergio Maffeis
- University of Venice Ca'Foscari: Joint research on security APIs

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Nikhil Swamy, Limin Jia, Benjamin Pierce, Cedric Fournet visited our group and gave seminars.
- Matteo Maffei, Dominique Unruh, Gilles Barthe, François Dupressoir, came to teach at the Joint EasyCrypt-F*-CryptoVerif School.

7.4.1.1. Internships

Cairns Kelsey

Date: Mar 2014 - May 2014

Institution: Washington State University (USA)

Paraskevopoulou Zoi

Date: Apr 2014 - Sep 2014

Institution: National Technical University of Athens (Greece)

Giannarakis Nikolaos

Date: Apr 2014 - Sep 2014

Institution: National Technical University of Athens (Greece)

Azevedo De Amorim, Arthur

Date: Mar 2014 - Aug 2014

Institution: University of Pennsylvania (USA)

Jindal Shubham

Date: May 2014 - Jul 2014

Institution: Indian Institute of Technology Delhi (India)

Thomson Susan

Date: Jun 2014 - Aug 2014

Institution: University of Bristol (UK)

QUANTIC Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. Towards QUANTIC project-team / PSL structuring project TOCOSUQI*

In the framework of the creation of the QUANTIC project-team, we have continued our going collaboration with the non-Inria members of this future project-team (not yet official members of QUANTIC). Indeed, we have a close collaboration with the experimental physicists Benjamin Huard and Françlis Mallet at ENS and applied mathematician Pierre Rouchon at Mines Paristech. These collaborations include all the subjects introduced in the above research program. In the framework of these collaborations, we have also benefited from a 2-year PSL* funding from september 2013 to August 2015. The funding was, in particular, used for the 6 months visit of Ananda Roy, PhD student at Yale university. The PSL* project TOCOSUQI (Tools of the control of superconducting quantum circuits) aims at developing new system theory tools for preparing, manipulating and protecting non-classical states of a microwave field in the framework of quantum Josephson circuits and circuit quantum electrodynamics, and applying them directly in the experiments.

6.1.2. ANR project EPOQ2

This young researchers ANR project, entitled "Estimation problems for quantum and quantum-like systems" and led by Mazyar Mirrahimi, was run between October 2009 and June 2014. This project had contributed to the development of a system theory approach in quantum engineering, with applications, in particular, within the field of quantum information processing. After important and fruitful collaborations with the physicists at Laboratoire Kastler-Brossel, ENS, our activities turned towards the feedback control of quantum systems taking into account the destructive character of quantum measurements. This later on led to new collaborations with the Physicists at Yale university which will be detailed in the sequel. EPOQ2 was highlighted in the 2013 annual report of Agence Nationale de la Recherche.

6.1.3. ANR project GEARED

This three-year collaborative ANR project, entitled "Reservoir engineering quantum entanglement in the microwave domain" and coordinated by Mazyar Mirrahimi, started on October 2014. The participants of the project are Daniel Esteve and Fabien Portier (Quantronics group, CEA Saclay), François Mallet and Benjamin Huard (Laboratoire Pierre Aigrain, ENS), Nicolas Roch and Olivier Buisson (Institut Neel, Grenoble) and Mazyar Mirrahimi (Inria). This project deals with robust generation of entanglement as a key resource for quantum information processing (quantum simulation, computation and communication). The entangled states are difficult to generate and sustain as interaction with a noisy environment leads to rapid loss of their unique quantum properties. Through Geared we intend to investigate different complementary approaches to master the entanglement of microwave photons coupled to quantum superconducting circuits.

6.2. European Initiatives

6.2.1. Collaborations with Major European Organizations

Partner 1: University of Padova

Alain Sarlette has been pursued a fruitful collaboration with the group of Francesco Ticozzi on "dynamical systems aspects of quantum systems": besides concluding their work on "symmetrization and quantum consensus", mainly initiated before A.S. joined Inria, a novel line of work in the direction of quantum thermalization and quantum random walks has been explored. Further joint work for the future is planned about among others generalized Markovian feedback and weak reservoir engineering.

Partner 2: Ghent University.

A. Sarlette is establishing a collaboration with applied mathematicians interested in quantum control at UGent (Dirk Aeyels and Lode Wylleman) in the framework of thesis co-supervisions. One PhD student is co-supervised with Dirk Aeyels in the framework of Belgian Inter-University Attraction Poles “Dynamical Systems, Control and Optimization” network 2013-2017. A second PhD student is also co-supervised with Dirk Aeyels in the framework of Chinese Scholarship Council and Flanders Research Fund grant "Developing control mechanisms to counter biases and drifts in coordination", 2013-2015. Finally, benefiting from a UGent starting grant on "Coordination control algorithms inspired from nonlinear PDEs and lattices", 2013-2017, Alain Sarlette also supervises a third PhD student at Ghent University.

6.3. International Initiatives

6.3.1. Inria International Partners

6.3.1.1. Declared Inria International Partners

The collaborations with the teams of Michel H. Devoret, Robert J. Schoelkopf, Liang Jiang and Steven M. Girvin, enforced through a two year sabbatical visit of Mazyar Mirrahimi at Yale university, have led to a set of contributions ranging from the theoretical analysis and performance optimization of ongoing experiments on weak quantum measurements [2] and preparation of non-classical field states through single photon Kerr effect [3] to the design of new experiments on single qubit cooling [1] and stabilization of maximally entangled states of superconducting qubits [8] by reservoir engineering techniques. Through these collaborations, Mazyar Mirrahimi and his former PhD student, Zaki Leghtas, currently a postdoc with Michel H. Devoret’s group, have introduced a new direction for hardware-efficient universal quantum computation [4], [5]. These theoretical proposals have already led to groundbreaking experiments [10], [9].

6.4. International Research Visitors

6.4.1. Visits of International Scientists

Ananda Roy, Yale university, Department of Applied Physics, PhD student from the groups of A. Douglas Stone and Michel H. Devoret, has visited us for sixth month from February through July 2014.

6.4.2. Visits to International Teams

6.4.2.1. Research stays abroad

Mazyar Mirrahimi spent four months in the Quantronics Laboratory of Michel H. Devoret and in the Rob Schoelkopf Lab at Yale University.

RAP Project-Team

6. Partnerships and Cooperations

6.1. International Research Visitors

RAP team has received the following people:

- Louigi Addario-Berry (McGill)
- Shankar Bhamidi (University of North Carolina at Chapel Hill)
- Christina Goldschmidt (Oxford)
- Ross Hemsley (Inria Sophia)
- Stefan Langerman (UL Bruxelles)
- Gabor Lugosi (Pompeu Fabra)
- Ahmed Kharroubi (Casablanca, Marrocco)
- Juan Pablo Vigneaux (Santiago, Chile)
- Cecile Mailler (University of Bath)

6.2. National Research Visitors

RAP team has received the following people:

- Nicolas Gast (Inria Grenoble)
- Olivier Devillers (Inria Sophia)
- Marie Albenque (Ecole Polytechnique)

REALOPT Project-Team

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Inria Associate Teams

8.1.1.1. SAMBA

Title: Combinatorial optimization problems

International Partner (Institution - Laboratory - Researcher):

Pontifícia Universidade Católica do Rio de Janeiro, Brazil

Universidade Federal Fluminense (UFF), Brazil

Universidad Adolfo Ibañez, Chile

Duration: 2014 - 2017

See also: https://wiki.bordeaux.inria.fr/realopt/pmwiki.php/Project/Samba

The renewed project builds on our previous SAMBA output with new emphasis on 4 axis:

1. **Algorithmic Performance Enhancements:** In the line of the considerable algorithmic speed-up that we obtained recently in SAMBA by developping stabilization techniques, warm-starting techniques (with memorized basis to initialize the node of the enumeration tree), and strong branching techniques (that limit the size of the enumeration tree), we aim to develop intensive preprocessing techniques building on contraint propagation. Further contibutions shall consist in integrating dynamic aggregation-disagregation techniques.
2. **Extending the Dantzig-Wolfe reformulation paradigm**. The current SAMBA project has lead to finalizing a technique called “column generation for extended formulations” which can be understood as a generalization of Dantzig-Wolfe reformulation: To favour early convergence, the Dantzig-Wolfe reformulation is lifted into an extended variable space where the recombination of solutions arises. Further extension is built in the proposal of Goycoolea et al.
3. **Combining Dantzig-Wolfe decomposition with Benders’:** In a stochastic environement, a numerically realistic approach in to build solutions that resists to worst case perturbations drawn within a contrained uncertainty set. In such context, bilevel optimization naturally arises: the second level models the worst case reaction of the system, along with our recourse, considering as fixed, the decisions of the first level of optimization. The model constraints are therefore decomposed into first level and second level, suited for Benders approach. When the first stage is a multiple resource planning applications, a strong model leading to good continuous approximation can be obtained by reformulating the problem in terms of variables that encode a work allocation for an individual resource (this is known as the Dantzig-Wolfe decomposition approach).
4. **Build-up our BAPCOD software platform for new benchmarks and industrial transfer:** the aim is to translate our research output into efficient code, to develop high level interface that free the end users from the expert knowledge normally required for complex decomposition based solution.

8.2. International Research Visitors

8.2.1. Visits of International Scientists

- B. Stevens, Carleton University (Canada), has visited the University of Bordeaux for one year.
- Shunji Tanaka, Associate professor at Kyoto University, has visited the University of Bordeaux for one week in September 2014.
- Marcos Goycoolea visited us in Bordeaux on the first week of September 2014.

8.2.2. Visits to International Teams

8.2.2.1. Research stays abroad

- Ruslan Sadykov visited Alexander Lazarev of Institute of Control Sciences of Russian Academy of Sciences, Moscow, Russia, for one week in february 2014.
- Arnaud Pêcher has visited the University of Rosario, Rosario, Argentina, for two weeks in December 2014.
- Pierre Pesneau visited Luis Gouveia of the University of Lisbon, Portugal, for one week in July 2014.

REGAL Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Labex SMART - (2012–2019)

Members: ISIR (UPMC/CNRS), LIP6 (UPMC/CNRS), LIB (UPMC/INSERM), LJLL (UPMC/CNRS), LTCI (Institut Mines-Télécom/CNRS), CHArt-LUTIN (Univ. Paris 8/EPHE), L2E (UPMC), STMS (IRCAM/CNRS).

Funding: Sorbonne Universités, ANR.

Description: The SMART Labex project aims globally to enhancing the quality of life in our digital societies by building the foundational bases for facilitating the inclusion of intelligent artifacts in our daily life for service and assistance. The project addresses underlying scientific questions raised by the development of Human-centered digital systems and artifacts in a comprehensive way. The research program is organized along five axes and Regal is responsible of the axe "Autonomic Distributed Environments for Mobility."

The project involves a PhD grant of 100 000 euros over 2,5 years.

7.1.2. InfraJVM - (2012–2015)

Members: LIP6 (Regal), Ecole des Mines de Nantes (Constraint), IRISA (Triskell), LaBRI (LSR).

Funding: ANR Infra.

Objectives: The design of the Java Virtual Machine (JVM) was last revised in 1999, at a time when a single program running on a uniprocessor desktop machine was the norm. Today's computing environment, however, is radically different, being characterized by many different kinds of computing devices, which are often mobile and which need to interact within the context of a single application. Supporting such applications, involving multiple mutually untrusted devices, requires resource management and scheduling strategies that were not planned for in the 1999 JVM design. The goal of InfraJVM is to design strategies that can meet the needs of such applications and that provide the good performance that is required in an MRE.

The coordinator of InfraJVM is Gaël Thomas, who left the team in 2014. Infra-JVM brings a grant of 202 000 euros from the ANR to UPMC over three years.

7.1.3. Nuage - (2012–2014)

Members: Non Stop Systems (NSS), Oodrive, Alphalink (Init SYS), CELESTE, DotRiver, NewGeneration, LIP6 (Regal et Phare)

Funding: Fonds National pour la Société Numérique, CDC

Objectives: The Nuage project aims at designing and building an open source, energy-aware, cloud based on OpenStack. In this project, the Regal group contributes on the storage axis. In clouds, virtualization forms the basis to ensure flexibility, portability and isolation. However, the price to pay for flexibility and isolation is memory fragmentation. We thus propose to pool unused memory by allowing nodes to use memory of other nodes to extend their cache, at the kernel level.

It involves a grant of 153 000 euros over 2,5 years.

7.1.4. ODISEA - (2011–2014)

Members: Orange, LIP6 (Regal), UbiStorage, Technicolor, Institut Telecom

Funding: FUI project, Ile de France Region

Objectives: ODISEA aims at designing new on-line data storage and data sharing solutions. Current solutions rely on large data centers, which induce many drawbacks: (i) a high cost, (ii) proprietary solutions, (iii) inefficiency (one single location, not necessarily close to the user). The goal is to tackle these issues by designing a distributed/decentralized solution that leverage edge resources like set-top boxes.

It involves a grant of 159 000 euros from Region Ile de France over three years.

7.1.5. Richelieu - (2012–2014)

Members: LIP6 (Regal), Scilab Entreprise, Silkan, OCaml Pro, Inria Saclay, Arcelor Mittal, CNES, Dassault Aviation.

Funding: FUI.

Objectives: The goal of Richelieu is to design a new runtime for the Scilab language based on VMKit. Scilab is a scientific language and its runtime relies on a costly interpretation loop. In the Richelieu project, we propose to replace the interpretation loop by VMKit, which provides both an efficient Just In Time Compiler and advanced memory management techniques.

It involves a grant of 135 000 euros from Region Ile de France over two years.

7.1.6. MyCloud (2011–2014)

Members: Inria Rhones-Alpes (SARDES), LIP6 (REGAL), EMN, WeAreCloud, Elastic Cloud.

Funding: MyCloud project is funded by ANR Arpège.

Objectives: Cloud Computing is a paradigm for enabling remote, on-demand access to a set of configurable computing resources. The objective of the MyCloud project is to define and implement a novel cloud model: SLAaaS (SLA aware Service). Novel models, control laws, distributed algorithms and languages will be proposed for automated provisioning, configuration and deployment of cloud services to meet SLA requirements, while tackling scalability and dynamics issues. It involves a grant of 155 000 euros from ANR to LIP6 over three years.

7.1.7. ConcoRDanT (2010–2014)

Members: Inria Regal, project leader; LORIA, Université de Nantes, Universdade Nova de Lisboa.

Funding: ConcoRDanT is funded by ANR Blanc.

Objectives: CRDTs for consistency without concurrency control in Cloud and Peer-To-Peer systems. Massive computing systems and their applications suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone. The ConcoRDanT project investigates a promising new approach that is simple, scales indefinitely, and provably ensures eventual consistency. A Commutative Replicated Data Type (CRDT) is a data type where all concurrent operations commute. If all replicas execute all operations, they converge; no complex concurrency control is required. We have shown in the past that CRDTs can replace existing techniques in a number of tasks where distributed users can update concurrently, such as co-operative editing, wikis, and version control. However CRDTs are not a universal solution and raise their own issues (e.g., growth of meta-data). The ConcoRDanT project engages in a systematic and principled study of CRDTs, to discover their power and limitations, both theoretical and practical. Its outcome will be a body of knowledge about CRDTs and a library of CRDT designs, and applications using them. We are hopeful that significant distributed applications can be designed using CRDTs, a radical simplification of software, elegantly reconciling scalability and consistency. ConcoRDanT involves a grant of 192 637 euros from ANR to Inria over three and a half years.

7.1.8. STREAMS (2010–2014)

Members: LORIA (Score, Cassis), Inria (Regal, ASAP), Xwiki.

Funding: STREAMS is funded by ANR Arpège.

Objectives: Solutions for a peer-To-peer REAl-tiMe Social web The STREAMS project proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that eliminate the disadvantages of centralised architectures. These solutions are meant to replace a central authority-based collaboration with a distributed collaboration that offers support for decentralisation of services. The project aims to advance the state of the art on peer-to-peer networks for social and real-time applications. Scalability is generally considered as an inherent characteristic of peer-to-peer systems. It is traditionally achieved using replication techniques. Unfortunately, the current state of the art in peer-to-peer networks does not address replication of continuously updated content due to real-time user changes. Moreover, there exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issues in social applications is how to balance collaboration with access control to shared objects. Interaction is aimed at making shared objects available to all who need them, whereas access control seeks to ensure this availability only to users with proper authorisation. STREAMS project aims at providing theoretical solutions to these challenges as well as practical experimentation. It involves a grant of 57 000 euros from ANR to Inria over three and a half years.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. SyncFree

Type: COOPERATION

Challenge: Pervasive and Trusted Network and Service Infrastructures

Instrument: Specific Targeted Research Project

Objectives: ICT-2013.1.2 “Software Engineering, Services and Cloud Computing,” ICT-2013.1.6 “Connected and Social Media”

Duration: October 2013 - September 2016

Coordinator: Marc Shapiro (Inria)

Partners: Inria (Regal & Score), Basho Technologies Inc., Trifork A/S, Rovio Entertainment Oy, U. Nova de Lisboa, U. Catholique de Louvain, Koç U., Technische U. Kaiserslautern.

Inria contact: Marc Shapiro

Abstract: The goal of SyncFree is to enable large-scale distributed applications *without global synchronisation*, by exploiting the recent concept of *Conflict-free Replicated Data Types* (CRDTs). CRDTs allow unsynchronised concurrent updates, yet ensure data consistency. This radical new approach maximises responsiveness and availability; it enables locating data near its users, in decentralised clouds.

Global-scale applications, such as virtual wallets, advertising platforms, social networks, online games, or collaboration networks, require consistency across distributed data items. As networked users, objects, devices, and sensors proliferate, the consistency issue is increasingly acute for the software industry. Current alternatives are both unsatisfactory: either to rely on synchronisation to ensure strong consistency, or to forfeit synchronisation and consistency altogether with ad-hoc eventual consistency. The former approach does not scale beyond a single data centre and is expensive. The latter is extremely difficult to understand, and remains error-prone, even for highly-skilled programmers.

SyncFree avoids both global synchronisation and the complexities of ad-hoc eventual consistency by leveraging the formal properties of CRDTs. CRDTs are designed so that unsynchronised concurrent updates do not conflict and have well-defined semantics. By combining CRDT objects from a standard library of proven datatypes (counters, sets, graphs, sequences, etc.), large-scale distributed programming is simpler and less error-prone. CRDTs are a practical and cost-effective approach.

The SyncFree project will develop both theoretical and practical understanding of large-scale synchronisation-free programming based on CRDTs. Project results will be new industrial applications, new application architectures, large-scale evaluation of both, programming models and algorithms for large-scale applications, and advanced scientific understanding.

7.2.2. Collaborations in European Programs, except FP7 & H2020

Program: COST Action IC1001

Project acronym: Euro-TM

Project title: Transactional Memories: Foundations, Algorithms, Tools, and Applications

Duration: 2011–2015

Coordinator: Dr. Paolo Romano (INESC)

Other partners: Austria, Czech Republic, Denmark, France, Germany, Greece, Israel, Italy, Norway, Poland, Portugal, Serbia, Spain, Sweden, Switzerland, Turkey, United Kingdom.

Inria contact: Marc Shapiro

Abstract: Parallel programming (PP) used to be an area once confined to a few niches, such as scientific and high-performance computing applications. However, with the proliferation of multicore processors, and the emergence of new, inherently parallel and distributed deployment platforms, such as those provided by cloud computing, parallel programming has definitely become a mainstream concern. Transactional Memories (TMs) answer the need to find a better programming model for PP, capable of boosting developers' productivity and allowing ordinary programmers to unleash the power of parallel and distributed architectures avoiding the pitfalls of manual, lock based synchronization. It is therefore no surprise that TM has been subject to intense research in the last years. This Action aims at consolidating European research on this important field, by coordinating the European research groups working on the development of complementary, interdisciplinary aspects of Transactional Memories, including theoretical foundations, algorithms, hardware and operating system support, language integration and development tools, and applications.

7.2.3. Collaborations with Major European Organizations

Ecole Polytechnique Fédérale de Lausanne, Distributed Programming Laboratory (Switzerland)

Caracterization of the weakest failure detector for eventual consistency

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. ARMADA

Title: hARnessing MAssive DAta flows

International Partner (Institution - Laboratory - Researcher):

Universidad Tecnica Federico Santa Maria (CHILI)

Duration: 2014 - 2016

See also: http://web.inria-armada.org

The ARMADA project aims at designing and implementing a reliable framework for the management and processing of massive dynamic dataflows. The project is two-pronged: fault-tolerant middleware support for processing massive continuous input, and a redundant storage service for mutable data on a massive scale.

7.3.2. Inria International Partners

7.3.2.1. Declared Inria International Partners

7.3.2.1.1. PHC MAIMONIDE

Title: Application Dependent Intrusion (Byzantine) Detection in Dynamic Cloud Systems

International Partner (Institution - Laboratory - Researcher):

Technion, Haifa (Israel)

Duration: 2014 – 2015

The goal of this project is to study the ability to detect intrusions, and more broadly Byzantine failures, in standard cloud services. The goal is to provide a formal model and a corresponding formal definition of Byzantine failure detection in dynamic cloud environments, and provide formally provable implementations of these detectors. We also intend to study how to combine such Byzantine failure detectors in standard open source cloud building blocks, such as ZooKeeper, Hadoop, and Cassandra, and harden them in order to make them resilient to such attacks.

7.3.3. Participation In other International Programs

Luciana Arantes and Olivier Marin participated to the STIC-AmSud project RESPOND, which ended with a workshop in Punta Arenas, Chile, from November 17th to November 21st, 2014

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Serdar Tasiran

Date: 07/2014 – 09/2014

Institution: Koç University (Turkey)

Anubis Graciela de Moraes Rossetto

Date: 03/2014 – 05/2014

Institution: Federal University of Rio Grande do Sul Porto Alegre (Brazil)

Vivien Quéma

Date: 01/2014 – 08/2014

Institution: LIG (FRANCE)

7.4.1.1. Internships

Dastagiri Reddy Malikireddy

Date: May–Aug 2014

Institution: IIT Kharagpur, India.

REGULARITY Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Regularity has strong collaborations with Nantes University (Anne Philippe) [40] and Rennes University (Ronan Le Guével) [42].

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

- Regularity collaborates with St Andrews University (Prof. Kenneth Falconer) on the study of multistable processes.
- Regularity collaborates with Acadia University (Prof. Franklin Mendivil) on the study of fractal strings, certain fractals sets, and the study of the regularization dimension.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Pr. Franklin Mendivil, from Acadia University was invited for one month in the team.

REO Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. ANR Project "EXIFSI"

Participants: Benoit Fabrèges, Miguel Ángel Fernández Varela [Principal Investigator], Mikel Landajuela Larma, Marina Vidrascu.

Period: 2012-2016
The aim of this project, coordinated by Miguel Ángel Fernández Varela, is to study mathematically and numerically new numerical methods for incompressible fluid-sructure interaction.

8.1.1.2. ANR Project "CARDIOXCOMP"

Participants: Muriel Boulakia, Damiano Lombardi, Jean-Frédéric Gerbeau [Principal Investigator], Fabien Raphel, Eliott Tixier.

Period: 2013-2013.
This project, coordinated by Jean-Frédéric Gerbeau, is carried out in the framework of a joint laboratory ("LabCom" call of ANR) with the software company NOTOCORD. The focus is the mathematical modeling of a device measuring the electrical activity of cardiomyocytes. The overall objective of CardioXcomp is to enrich NOTOCORD's software with modelling and simulation solutions and provide to pharmacology research a completely new set incorporating state of the art signal processing and numerical simulation.

8.1.1.3. ANR Project "iFLOW"

Participants: Chloé Audebert, Jean-Frédéric Gerbeau, Irène Vignon-Clementel [co-Principal Investigator].

Period: 2013-2017.
This ANR-TecSan, co-managed by Eric Vibert (Paul Brousse Hospital) and Irene Vignon-Clementel, aims at developing an Intraoperative Fluorescent Liver Optimization Workflow to better understand the relationship between architecture, perfusion and function in hepatectomy.

Other partners: DHU Hepatinov - Hôpital Paul Brousse, Inria Mamba, Fluoptics, IfADo, MID.

8.1.1.4. Participation to other ANR projects

- Céline Grandmont is a member of the ANR TecSan Oxhelease
- Marina Vidrascu is a member of the ANR ARAMIS

8.1.2. Inria initiatives

8.1.2.1. ADT Project "MENAMES "

Participants: Miguel Ángel Fernández Varela [Principal Investigator], Axel Fourmont, Marina Vidrascu.

Period: 2014-2016
The aim of this project, coordinated by Miguel Ángel Fernández Varela, is to implement in the FELiScE library several algorithms included in the shelddon library, in particular shell elements and domain decomposition methods.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. REVAMMAD

Participants: Matteo Aletti, Jean-Frédéric Gerbeau [correspondant], Damiano Lombardi.

Type: FP7-PEOPLE

Instrument: Marie Curie Initial Training Network

Duration: April 2013 - March 2017

Coordinator: Andrew Hunter, University of Lincoln (UK)

Partner: See the http://revammad.blogs.lincoln.ac.uk/partners/ web site

Inria contact: J-F Gerbeau

Abstract: http://revammad.blogs.lincoln.ac.uk REVAMMAD is a European Union project aimed at combatting some of the EU's most prevalent chronic medical conditions using retinal imaging. The project aims to train a new generation of interdisciplinary scientists for the academic, clinical and industrial sectors, and to trigger a new wave of biomedical interventions. The role of REO team within this consortium is to propose a mathematical model and a simulation tool for the retina hemodynamics.

8.3. International Initiatives

8.3.1. Inria International Labs

Participants: Céline Grandmont, Jessica Oakes, Irène Vignon-Clementel [correspondant].

Period: 2014-2015

Jessica Oakes was awarded an Inria@SiliconValley Grant for a post-doc at UC Berkeley to work on aerosol deposition in the lung.

8.3.2. Trans-Atlantic Network of Excellence for Cardiovascular Research

Participants: Grégory Arbia, Jean-Frédéric Gerbeau, Sanjay Pant, Irène Vignon-Clementel [correspondant].

Period: 2010-2015

This network, funded by the Leducq fondation, is working on the multi-scale modeling of single ventricle hearts for clinical decision support.

Other partners: see http://modelingventricle.clemson.edu/home.

8.3.3. German BMBF national project Lungsys II

Participant: Irène Vignon-Clementel.

Period: 2012-2015

"Systems Biology of Lung Cancer: Dynamic Properties of Early Spread and Therapeutic Options". In collaboration with Dirk Drasdo (EPI Mamba).

Other partners: see http://www.lungsys.de.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Stephanie Lindsey, PhD student at Cornell University (USA), Aug 2013 - February 2014 & 2 weeks in May 2014
- Weiguang Yang, Engineering research associate, Departments of Pediatrics and Cardiology, Stanford University (USA), May 20th-June 18th 2014
- Andrew Blaber, Carole Leguy, Joke Keijsers, Kouhyar Tavakolian, Simon Fraser University (Vancouver, Canada), May 26 - May 30, 2014

REVES Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR ALTA

Participants: Emmanuelle Chapoulie, Stefan Popov, George Drettakis.

The ANR ALTA project started in October 2011, and focuses on the development of novel algorithms for realistic and efficient global illumination. The project is coordinated by the Grenoble Inria group ARTIS (N.Holzschuch), and the Bordeaux Inria group MANAO (X. Granier) is also a partner. Our participation is the study of error bounds for these algorithms and the development of interactive global illumination, and the development of the new global illumination algorithm described in Sec. 6.2.5 .

8.1.2. ANR DRAO

Participants: Emmanuel Iarussi, Adrien Bousseau.

https://www-sop.inria.fr/members/Adrien.Bousseau/drao/

The ANR DRAO is a young researcher project coordinated by Adrien Bousseau, in collaboration with the InSitu project team at Inria Saclay - Ile de France (W. Mackay and T. Tsandilas) and the MANAO project team (P. Barla and G. Guennebaud) and POTIOC project team (M. Hachet) at Inria Bordeaux - Sud Ouest. The goal of this collaboration is to develop novel drawing tools for amateurs as well as for expert designers and illustrators, combining expertise in Computer Graphics (REVES and MANAO) and Human-Computer Interaction (InSitu, POTIOC). This ANR project funds the PhD of Emmanuel Iarussi.

The first part of the project will be to observe how people draw with existing tools. To do so we will conduct observational studies where we will interview designers and illustrators and collect data by videotaping drawing sessions and by recording drawings with digital pens. In the second part of the project we will deduce from our observations new user interfaces and rendering algorithms that automate part of the drawing process and enrich 2D drawings with realistic rendering capabilities. We will combine computer vision and computer graphics techniques to estimate geometric information from sketches. We will then use this information to guide rendering algorithms that generate plausible depictions of material and lighting over the drawing. In the third part of the project, we plan to develop computer-assisted drawing lessons to teach amateurs how to draw from photographs and 3D models. We will apply image analysis algorithms to estimate the structure of a photograph and use that structure as guidance for drawing. To summarize, the goal of the ANR DRAO project is to make amateurs more confident in their drawing skills and to allow expert designers to produce complex illustrations more effectively.

The ANR DRAO has resulted in two publications this year on 3D modeling from sketches [17] and on vectorization of photographs [16].

8.1.3. ANR SEMAPOLIS

Participant: George Drettakis.

This ANR project started in October 2013. The goal is to use semantic information to improve urban reconstruction and rendering. The consortium is led by ENPC (R. Marlet) and includes the Inria Willow team and the GREY-C laboratory on image processing. Our contribution will be in the rendering part.

8.2. European Initiatives

8.2.1. VERVE

Title: VERVE

Type: COOPERATION (ICT)

Defi: Services to promote E-inclusion using socially realistic virtual environments

Instrument: Integrated Project (IP)

Duration: October 2011 - September 2014

Coordinator: Trinity College - Dublin (Ireland)

Others partners: DFKI (Germany), CNRS-ParisTech (France), CNRS-IRCAM (France), U. of Zaragoza (Spain), Testaluna (IT), KAINOS (UK)

See also: http://www.verveconsortium.eu/

Abstract

Social exclusion has many causes, but major factors are the fear and apathy that often accompany a disability. The European e-Inclusion policy stresses the importance of ICT in improving the quality of life in potentially disadvantaged groups, including older people and persons with disabilities. In this project, we will develop ICT tools to support the treatment of people who are at risk of social exclusion due to fear and/or apathy associated with a disability. These tools will be in the form of personalised VR scenarios and serious games specifically designed for therapeutic targets and made broadly available via a novel integration of interactive 3D environments directly into Web browsers. We will perform cutting edge research into rendering and simulating personalised and populated VR environments, 3D web graphics, and serious games. These technical efforts will be underpinned by our clinical/laboratory and industry partners, who will be fully involved throughout in the requirements, design and evaluation of VERVE, and liaison with the stakeholders (i.e., participants, carers/family, and health professionals). They will implement the VERVE interventions in three use-cases, each targeting a different group of participants: fear of falling, apathy related to cognitive decline and behavioural disturbances, and other emotional disturbances linked to anxiety. While developing clinical assessment methods and interventions for the first two patient groups is our primary focus, our results will be applicable to a much wider range of potentially disadvantaged individuals.

8.2.2. CR-PLAY – Capture Reconstruct Play

Type: COOPERATION (ICT)

Instrument: Specific Targeted Research Project

Objectif: Creativity

Duration: November 2013 - October 2016

Coordinator: Testaluna SA (IT)

Partner: TU Darmstadt (DE), UC London (UK), U. Patras (GR), Miniclip UK, Cursor Oy (FI)

Inria contact: George Drettakis

Abstract: The goal of this project is to use image- and video-based rendering and relighting techniques in the context of games and in particular mobile or casual games. The computer graphics and vision partners (UCL, TUD) are leaders in their fields, and have developed algorithms allowing easy capture of scenes using images and video, and reconstruction using vision algorithms. UCL and Inria have developed image- and video-based rendering algorithms which can be useful for games. These tools need to be perfected, reducing artifacts and difficulty of use so that they can be useful and productive for games companies. For evaluation, the HCI lab of the University of Patras will provide cutting-edge methodologies to make the resulting systems useable. The consortium is led by the games company Testaluna, based in Genova Italy, with whom we have a solid working

relationship from our previous VERVE project (see above). Other industrial partners include Cursor Oy (a regional group of games companies in Finland, which is a leader in Europe in Casual games) and Miniclip, which is one of the major players in the online game market.

We have started specific scientific collaborations with TUD on capture guidance and UCL on video-based rendering, which will continue in 2015.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. CRISP2

Title: Creating and Rendering Images based on the Study of Perception

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley

Duration: 2011 - Present

See also: http://www-sop.inria.fr/reves/crisp/

The CRISP collaboration aims at developing novel techniques to create and manipulate effective numerical imagery. We adopt a multidisciplinary approach, focusing on understanding how people create and perceive images, on developing new rendering algorithms based on this understanding, and on building interactive tools that enable users to efficiently produce the images they have in mind. The participants of CRISP share complementary expertise in computer graphics, human computer interaction and human visual perception.

After a very productive year in 2013, we continued our work on drawing and manipulating materials in vector graphics in 2014. This work was published in the Computer Graphics Forum journal and presented at the Eurographics Symposium on Rendering (EGSR) [16]. We are currently working on two collaborative projects in the context of CRISP. One project is on light transport simulation (with Ravi Ramamoorthi, now at UC San Diego), the other project is on appearance transfer between photographs (with Alyosha Efros, who recently joined UC Berkeley). We also have several project ideas to start with Martin S. Banks (Human Vision Science).

8.3.2. Informal International Partners

8.3.2.1. France-USA

Participants: Gaurav Chaurasia, Emmanuel Iarussi, Adrien Bousseau, George Drettakis.

Beyond the CRISP associate team, we have an ongoing collaboration with Adobe Research (Sylvain Paris) and MIT (Fredo Durand) on parallel image-proccessing languages and global illumination (Fredo Durand). We also have another collaboration with Adobe Research (Wilmot Li) on jewelry design. Emmanuel Iarussi did a 3-months visit at Adobe in the context of this collaboration.

8.3.2.2. France-Canada

Participant: Adrien Bousseau.

We collaborate with K. Singh (University of Toronto) and Alla Scheffer (U. British Columbia, Vancouver), on sketching techniques for designers (see Sec. 6.4.4).

8.3.2.3. France-Greece

Participant: George Drettakis.

We are collaborating with the Technical University of Crete on visual attention, in the context of the Ph.D. of George Koulieris, supervised by Prof. Katerina Mania and the Un. of Cottburg (D. Cunningham) (see Sec. 6.3.2 and 6.3.1).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Visitors

We hosted several researchers this year:

- Gordon Wetzstein (MIT), in January
- Wendy McKay and Theophanis Tsandilas in February
- Kenneth Vanhoey (Univ. de Strasbourg), in February
- Fredo Durand (MIT), in February
- Jean Ponce (ENS), in February
- Marcus Magnor (TU Braunschweig), in February
- Christian Theobalt (Max Planck Institut), in February
- Markus Gross (ETH Zurich), in April
- Abdelaziz Djelouah (Inria Grenoble), in May
- Indira Thouvenin (UT Compiegne), in June
- Josef Sivic (Inria and ENS), in July
- Wenzel Jakob (ETH Zurick), in September
- Marty Banks (Berkeley part of EA CRISP), in June and November
- Gaurav Chaurasia (MIT), in November

8.4.1.2. Internships

Arora Rahul

Date: May 2014 - July 2014

Institution: IITK (India)

Ayush Tewari

Date: June 2014 - Aug 2014

Institution: IIIT

Uditha Kasthuriarachchi

Date: April 2014 - Sept 2014

Institution: UNSA

RITS Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. COCOVEA

Title: Coopération Conducteur-Véhicule Automatisé

Instrument: ANR

Duration: November 2013 - April 2017

Coordinator: Jean-Christophe Popieul (LAMIH - University of Valenciennes)

Partners: LAMIH, IFSTTAR, Inria, University of Caen, COMETE, PSA, CONTINENTAL, Valeo, AKKA Technologies, SPIROPS

Inria contact: Fawzi Nashashibi

Abstract: CoCoVeA project aims at demonstrating the need to integrate from the design of the system, the problem of interaction with the driver in resolving the problems of sharing the driving process and the degree of freedom, authority, level of automation, prioritizing information and managing the operation of the various systems. This approach requires the ability to know at any moment the state of the driver, the driving situation in which he finds himself, the operating limits of the various assistance systems and from these data, a decision regarding activation or not the arbitration system and the level of response.

8.1.2. FUI

8.1.2.1. Sinetic

Title: Système Intégré Numérique pour les Transports Intelligents Coopératifs

Instrument: FUI

Duration: December 2014 - May 2017

Coordinator: Thomas Nguyen (Oktal)

Partners: Oktal, ALL4TEC, CIVITEC, Dynalogic, Inria, EURECOM, Renault, Armines, IFSTTAR, VeDeCoM

Inria contact: Jean-Marc Lasgouttes

Abstract: The purpose of the project SINETIC is to create a complete simulation environment for designing cooperative intelligent transport systems with two levels of granularity: the system level, integrating all the components of the system (vehicles, infrastructure management centers, etc.) and its realities (terrain, traffic, etc.) and the component-level, modeling the characteristics and behavior of the individual components (vehicles, sensors, communications and positioning systems, etc.) on limited geographical areas, but described in detail.

8.1.3. Competitivity Clusters

RITS team is a very active partner in the competitivity clusters, especially MOV'EO and System@tic. We are involved in several technical committees like the DAS SUR of MOV'EO for example. RITS is also the main Inria contributor in the VeDeCoM institute (IEED). VeDeCoM is financing the PhD theses of Pierre Merdrignac, Younes Bouchaala, Fernando Garrido Carpio and Zayed Alsayed.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. CATS

Type: FP7

Instrument: Specific Targeted Research Project

Duration: January 2010 - December 2014

Coordinator: Lohr Industrie (France)

Partner: Inria (France), CTL (Italy), EPFL (Switzerland), TECHNION (Israel), GEA (Switzerland), ERT (France), and the cities of Formello (Italy), Strasbourg (France) and Ploiesti (Romania).

Inria contact: Michel Parent

Abstract: CATS' aim is the full development and experimentation of a new urban transport service based on a new generation of vehicle. Its major innovation is the utilization of a single type of vehicle for two different uses: individual use or semi collective transport. This new transport service is aimed at filling the gap between public mass transport and private individual vehicles.

See also: http://www.cats-project.org

8.2.1.2. FURBOT

Type: FP7

Instrument: Specific Targeted Research Project

Duration: November 2011 - February 2015

Coordinator: Genova University (Italy

Partner: Bremach (Italy), ZTS (Slovakia), Universite di Pisa (Italy), Persico (Italy), Mazel (Spain), TCB (Portugal), Inria (France).

Inria contact: Fawzi Nashashibi

Abstract: The project proposes novel concept architectures of light-duty, full-electrical vehicles for efficient sustainable urban freight transport and will develop FURBOT, a vehicle prototype, to factually demonstrate the performance expected.

8.2.1.3. CityMobil2

Type: COOPERATION (TRANSPORTS)

Instrument: Large-scale integrating project

Duration: September 2012 - August 2016

Coordinator: University of Rome La Sapienza, CTL (Italy)

Partner: Inria (France), DLR (germany), GEA Chanard (Switzerland), POLIS (Belgium), ERT (Belgium), EPFL (Switzerland),...(45 partners!)

Inria contact: Fawzi Nashashibi

Abstract: The CityMobil2 goal is to address and to remove three barriers to the deployment of automated road vehicles: the implementation framework, the legal framework and the unknown wider economic effect. CityMobil2 features 12 cities which will revise their mobility plans and adopt wherever they will prove effective automated transport systems. Then CityMobil2 will select the best 5 cases (among the 12 cities) to organize demonstrators. The project will procure two sets of automated vehicles and deliver them to the five most motivated cities for a 6 to 8 months demonstration in each city. CityMobil2 will establish a workgroup that will deliver a proposal for a European Directive to set a common legal framework to certify automated transport systems.

See also: http://www.citymobil2.eu/en/

8.2.1.4. Mobility2.0

Title: Co-operative ITS systems for enhanced electric vehicle mobility

Type: COOPERATION (TRANSPORTS)

Duration: September 2012 - February 2015

Coordinator: Broadbit (Slovakia)

Partner: ETRA (Spain), Barcelona Digital (Spain), ICCS (Greece), MRE (Italy), Armines (France), University of Twente (Netherlands), Privé (Italy), NEC (United Kingdom)

Inria contact: Jean-Marc Lasgouttes

Abstract: Mobility2.0 will develop and test an in-vehicle commuting assistant for FEV mobility, resulting in more reliable and energy-efficient electro-mobility. In order to achieve a maximum impact, Mobility2.0 takes an integrated approach of addressing the main bottlenecks of urban FEV mobility: "range anxiety" related to the limited FEV range, scarcity of parking spaces with public recharging spots, and the congestion of urban roads. Our integrated approach means the application developed by Mobility2.0 will utilize co-operative systems to simultaneously consider these bottlenecks, so that such an optimization can be achieved which still guarantees reliable transportation for each FEV owner. Mobility2.0 will focus on assisting the daily urban commute, which represents the bulk of urban mobility.

See also: http://mobility2.eu/

8.2.1.5. DESERVE

Title: DEvelopment platform for Safe and Efficient dRiVE

Duration: September 2012 - August 2015

Coordinator: VTT (Finland)

Partner: CRF (Italy), Armines (France), CONTINENTAL AUTOMOTIVE FRANCE SAS (France), FICOSA (Italy), Inria (France), TRW (Great Britain), AVL (Austria), BOSCH (Germany), DAIMLER (Germany), VOLVO (Sweden),...(26 partners)

Inria contact: Fawzi Nashashibi

Abstract: To manage the expected increase of function complexity together with the required reduction of costs (fixed and variable) DESERVE will design and build an ARTEMIS Tool Platform based on the standardization of the interfaces, software (SW) reuse, development of common non-competitive SW modules, and easy and safety-compliant integration of standardized hardware (HW) or SW from different suppliers. With innovative design space exploration (DSE) methods system design costs can be reduced by more than 15%. Hence, DESERVE will build an innovation ecosystem for European leadership in ADAS embedded systems, based on the automotive R&D actors, with possible applications in other industrial domains.

See also: http://www.artemis-ju.eu/project/index/view?project=38

8.2.1.6. AutoNet2030

Title: Co-operative Systems in Support of Networked Automated Driving by 2030

Duration: November 2013 – October 2016

Coordinator: Andras KOVACS – BROADBIT (Hungary)

Partner: BROADBIT (Hungary), BASELABS (Germany), CRF (Italy), Armines (France), VOLVO (Sueden), HITACHI EUROPE (France), EPFL (Switzerland), ICCS (Greece), TECHNISCHE UNIVERSITAET DRESDEN (Germany) (9 partners)

Inria contact: Fawzi Nashashibi

Abstract: AutoNet2030 shall develop and test a co-operative automated driving technology, based on a decentralized decision-making strategy which is enabled by mutual information sharing among nearby vehicles. The project is aiming for a 2020-2030 deployment time horizon, taking into account the expected preceding introduction of co-operative communication systems and sensor based lane-keeping/cruise-control technologies. By taking this approach, a strategy can be worked out for the gradual introduction of fully automated driving systems, which makes the best use of the widespread existence of co-operative systems in the near-term and makes the deployment of fully automated driving systems beneficial for all drivers already from its initial stages.

See also: http://www.autonet2030.eu/

8.2.2. Collaborations with Major European Organizations

- RITS is member of the **euRobotics AISBL** and the Leader of *"People transport"* Topic. This makes from Inria one of the rare French robotics representatives at the European level.
- RITS is a full partner of **VRA**: VRA – Vehicle and Road Automation is a support action funded by the European Union to create a collaboration network of experts and stakeholders working on deployment of automated vehicles and its related infrastructure. VRA project is considered as the cooperation interface between EC funded projects, international relations and national activities on the topic of vehicle and road automation. It is financed by the European Commission DG CONNECT and coordinated by ERTICO – ITS Europe.
- RITS is member of the Working Group on Automation: **iMobility**. This group has been created and is animated by ERTICO ITS Europe. The Automation Working Group was formed under the iMobility Forum, with the initial high level aims of exploring and promoting the potential of highly automated vehicles and applications and working towards the development of a roadmap for the deployment of automated systems.

8.3. International Initiatives

8.3.1. Informal International Partners

In the following we are highlighting only some selected collaborations, partners with whom there are: signed MoU's, researchers exchanges, softwares and hardwares exchanges, scientific close collaboration, etc.

- *NAIST – Japan* The RITS team has a close cooperation with NAIST (Nara institute of Science and Technology), Japan since 2009. Based on this collaboration NAIST and Inria established the MoU agreement to accelerate and strengthen future research collaborations and the exchange of researchers and students (4 Japanese researchers were hosted by IMARA/RITS since 2012).
- *University of Zaragoza – Spain* The team has strong collaborations with University of Zaragoza, Spain, especially the Intelligent Networks and Information Technologies group (INIT) directed by Prof. Francisco J. Martinez Domingues. Professor Martinez and Professor Piedad had a 3 months stay at Inria in summer 2014 during which closer collaborations and joint publications and a workshop co-organization was agreed on.
- CNIT (Consorzio Nazionale Inter-unviversitario per le Telecomunicazioni), Italy, directed by Professor Paolo Pagano, and University of Western Ontario, especially the department of the Electrical & Computer Engineering.
- *SwRI – USA*: Since 2007, a collaboration agreement exists with the Southwest Research Institute (San Antonio, Texas, USA) for the joint development of autonomous vehicle technologies, focusing on the areas of perception, intelligence, command and control, communications, platforms and safety. SwRI is one of the oldest and largest nonprofit applied research and development organizations in the U.S. The partnership conducted joint researches and exchanged intellectual properties to foster rapid technology and system advancements in vehicle autonomy. A joint vehicle demonstration took place in 2009 during the ITS World Congress in London.

- *Shanghai Jiao Tong University (SJTU) – China*: Professor Ming Yang is now leading Department of Automation in SJTU. Previously he has been a Post-doc fellow at Inria (IMARA/RITS team) from 2003 to 2005. Thus he shares RITS research areas and his main research activities are around the development of intelligent Cybercars. Several researchers and graduate students from SJTU were hired by RITS in the past. Both teams are partners of several joint French-Asian collaborative projects (e.g., CityHome, PAMM,...). Prof. Ming Yang Lab, RITS and e-Motion are currently discussing seriously the creation of an Inria International Research Lab., a common lab focusing on the topic of mobile robotics (including Intelligent Vehicles and Assistive Robotics). M. Hao Li, recently awarded PhD from Mines ParisTech under the supervision of Fawzi Nashashibi (RITS), is also a former student of Prof. Yang. He will be helping in the coordination of this new partnership project.
- *MICA LAB – Vietnam*: a growing partnership is under construction with MICA Lab under the co-direction of M. Eric Castelli. Partners in joint French-Asian projects, RITS and MICA lab have submitted an application to the Vietnamese Program 911 to support the financing of a joint PhD thesis.
- Institut du transport avancé du Québec (ITAQ) – Canada ITAQ wishes to conduct a project on the guidance of electric and hybrid semi-autonomous and autonomous applications for off-road vehicles. They want to develop this project in close collaboration with several Quebec companies and universities / colleges in Quebec (University of Sherbrooke-CRVI), France (Inria) and the United States (MIT). ITAQ holds expertise in electric vehicles but wants to develop its capacity for research in robotics, artificial intelligence, autonomous vehicles, etc. For this reason, a partnership is under construction (MoU) with Inria and especially with RITS to identify all the ways in which we could work together closely in order to transfer knowledge and expertise.
- *International Chaire "GAT"*: Inria-RITS, Mines ParisTech, EPFL, Univ. of Berkeley (PATH Program) and Shanghai Jiao Tong Univ. (SJTU) are the academic partners of the international Chaire GAT, funded and supported by: Valeo Group, SAFRAN Group and MPSA Group (Peugeot-Citroën). A recent NDA has been signed recently. This Chaire will promote and fund academic activities related to Ground Automated Transportation and autonomous driving.
- *Technical University of Sophia – Bulgaria*: RITS is conducting a close partnership with the Technical University of Sophia (Department of Mechanical Engineering). Since 2009, Professor Plamen Petrov has been a visiting professor at Inria. He contributed in conducting common advanced researches with RITS researchers in the field of dynamic modeling and adaptive motion control for vehicles and robots. Joint works have been also driven to develop and validate platooning concepts for normal speed driving of automated vehicles. This collaboration will continue with further scientific challenges to tackle especially in the field of vehicle control and motion planning.

8.3.2. Participation In other International Programs

- *STIC-Asia – French-Asian cooperation*: in the context of the Asian-French projects CityHome and PAMM, very close collaboration were driven between Inria's IMARA/RITS and E-Motion project-teams and Asian laboratories such as: NTU (Singapore), Dept. of Computer Science and Electrical Engineering Graduate School of Science and Technology Kumamoto University (Japan), Department of Automation of the Shanghai Jiao Tong University (SJTU University, China) and the Information and Communication Engineering and the Intelligent Systems Research Center at the SungKyunKwan University (SKKU), (Korea). Two cooperation projects were conducted together: CityHome (ended in 2011) and PAMM (ended in 2014). A new collaborative project has been recently accepted under the coordination of F. Nashashibi, head of RITS (SIM-Cities project [0]).
- *ECOS NORD – Simon Bolivar University (Venezuela)*: RITS and University of Simon Bolivar have started an official privileged cooperation under the framework of the ECOS Nord international Program. This program started effectively in 2014 with the expected visit of two researchers and a

[0] Sustainable Intelligent Mobility for smart Cities

PhD student from each institute to the other institute. Collaborations between our institutions started already in 2012. Since this date, one researcher and 7 engineers (trainees) from SBU made several months stay each at RITS. They all worked in the field of intelligent control.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- **Prof. Plamen PETROV**: professor at the Technical University of Sofia (Bulgaria). He has been an invited professor at Inria from June to September 2014. Prof. Petrov's visit is the sixth of its kind since 2009. This close collaboration in the area of automatic control has very fruitful results and outcomes. This year's joint research topic dealt with the design and implementation of saturated control for automated parking maneuvers (cf. section 6.9). In validation to 2013 activities, two articles were published in 2014: [28] and [44].
- **Dr. Maria Piedad Garrido Picazo and Dr. Francisco Jose Martinez Dominguez**: assistant professors of the University of Zaragoza, invited from June until September 2014. During their visit, they worked on routing and multicast issues in VANET.

8.4.1.1. Internships

- **Wei Lin Ku**: master student at National Chiao Tung University (Hsinchu, Taiwan). He has been an Inria intership student from April until October 2014. During this period, he studied and developed several DPM based strategies to detect and classify road obstacles (cars, pedestrians,...).
- **Mickaël Bergem, Hugues Thomas, Roxane Delpeyrat, Laurent Laflèche**: 2nd year at ENPC. They had a group project on reactive path planning using potential fields from April to June 2014.
- **Carlos Eduardo Flores Pino, Giampaolo Otero Ridolfi, Luis Guillermo Roldao Jimenez, Jean Carlos Rivera Pabon**: they worked on different methods for improving energy consumption of urban vehicles.
- **Leopoldo Gonzalez Clarembaux**: He was in master 2 at Telecom Paris-Sud (Evry). He developed perception and control strategies for autonomous docking for the electric freight vehicle Furbot. His work was implemented in simulation and on our Cybus platform.

8.4.2. Visits to International Teams

8.4.2.1. Research stays abroad

Guy Fayolle has been invited two weeks (5-19 oct. 2014) at Heriot-Watt University, Edinburgh (Prof. S. Foss, math. dept.).

RMOD Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

We have signed a convention with the CAR team led by Noury Bouraqadi of Ecole des Mines de Douai. In such context we co-supervized two PhD students (Mariano Martinez-Peck, Nick Papoylias). Two co-supervisions are ongoing (Guillermo Polito, Max Mattone). The team is also an important contributor and supporting organization of the Pharo project.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. Cutter

Participants: Stéphane Ducasse [Correspondant], Nicolas Anquetil, Damien Pollet, Muhammad Bhatti, Andre Calvante Hora.

This partnernship is done with the following members from the LIRMM-D'OC-APR: Marianne Huchard, Roland Ducournau, Jean-Claude König, Rodolphe Giroudeau, Abdelhak-Djamel Seriai, and Rémi Watrigant.

CUTTER is a Basic Research project that addresses the problems of object-oriented system remodularization by developing, combining, and evaluating new techniques for analyzing and modularizing code. In particular, it will: (i) use concurrently and collaboratively four package decomposition techniques; and (ii) take into account different levels of abstractions (packages, classes).

The project started in march 2011 and ended this year in November just after the defense of PhD student André Hora

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

MEALS FP7 Marie Curie Research Staff Exchange Scheme

MEALS (Mobility between Europe and Argentina applying Logics to Systems) is a mobility project financed by the 7th Framework programme under Marie Curie's International Research Staff Exchange Scheme. It involves seven academic institutions from Europe and four from Argentina, and a total of about 80 researchers to be exchanged. The project started on the 1st of October, 2011, and it has a duration of 4 years. Nr: FP7-PEOPEL-2011-IRSES

http://www.meals-project.eu

8.3.2. Collaborations in European Programs, except FP7 & H2020

8.3.2.1. ERCIM Software Evolution

We are involved in the ERCIM Software Evolution working group since its inception. We participated at his creation when we were at the University of Bern.

8.4. International Initiatives

8.4.1. Inria International Labs

CIRIC Chile and Pleiad Team of University of Chile at Santiago

We are collaborating with ObjectProfile, a startup company which is hosted at Inria Chile. ObjectProfile is a collaborator within the PLOMO2 Associated Team and a contributor to both Pharo and Moose. http://objectprofile.com

The DeepIntoPharo book is a collaboration with the Pleiad Team of University of Chile at Santiago.

8.4.2. Inria Associate Teams

8.4.2.1. PLOMO2

Title: Infrastructure for a new generation of development tools

International Partner:

Universidad de Chile (Chile), DCC.

Duration: 2014 - 2016

See also: http://pleiad.cl/research/plomo2

Performing effective software development and maintenance are best achieved with effective tool support. Provided by a variety of tools, each one presenting a specific kind of information supporting the task at hand. The goal of the first PLOMO was to develop new meta tools to improve and bring synergy in the existing infrastructure of Pharo (for software development) and the Moose software analysis platform (for maintenance). With Plomo2, we want to build on top of this work and invent a new generation of tools to navigate and profile programs.

The hypotheses that Plomo2 will seek to verify are:

- Use of reflection enables new profiling techniques
- Use of visualization in a programming environment improves programmer performance

The overall objectives of Plomo2 are:

- Infrastructure for profiling programs and recording programmer activity.
- Visual software maps defined in a flexible and agile fashion
- Combining dynamic information with visualization to improve the development environment
- Empirical evaluation of this environment
- All the efforts will be performed on Pharo and Moose, two platforms heavily used by the RMoD and Pleiad teams.

The detailed work plan and the results of the first year can be found in the PLOMO2 report at http://pleiad.cl/research/plomo2.

8.4.3. Inria International Partners

8.4.3.1. Uqbar - Argentina

Participants: Marcus Denker [correspondant], Stéphane Ducasse [RMoD], Nicolas Anquetil [RMoD], Diego Garbervetsky [UBA,LAFHIS], Gabriela Arevalo [Universidad Nacional de Quilmes)], Nicolas Passerini [Uqbar].

Uqbar is a foundation of researchers teaching in several universities of the Buenos Aires area. Universidad Tecnologica Nacional (FRBA) Universidad Nacional de Quilmes, Universidad Nacional de San Martin,Universidad Nacional del Oeste. LAFHIS is a research laboratory from the University of Buenos Aires. More information at (http://www.uqbar-project.org).

8.4.3.2. Informal International Partners

Pharo in Research: We are building an ecosystem around Pharo with international research groups, universities and companies. Several research groups (such as Software Composition Group – Bern, and Pleaid – Santiago) are using Pharo. Many universities are teaching OOP using Pharo and its books. Several companies worldwide are deploying business solutions using Pharo.

8.4.4. Participation In other International Programs

8.4.4.1. STIC AmSud

Participants: Damien Cassou [correspondant], Gustavo Santos [RMoD], Martin Martin [RMoD], David Röthlisberger [UDP - Universidad Diego Portales, Santiago, Chile], Marcelo Almeida Maia [UFU - Federal University of Uberlândia, Brasil], Romain Robbes [Departamento de Ciencias de la Computación (DCC), Universidad de Chile, Santiago, Chile], Martin Monperrus [Spirals].

Project Partners: Inria RMOD, Inria Spirals, DCC Universidad de Chile, Universidad Diego Portale Chile, Federal University of Uberlândia, Brasil.

This project aims at facilitating the usage of frameworks and application programming interfaces (APIs) by mining software repositories. Our intuition is that mining reveals how existing projects instantiate these frameworks. By locating concrete framework instantiations in existing projects, we can recommend to developers the concrete procedures for how to use a particular framework for a particular task in a new system. Our project also tackles the challenge of adapting existing systems to new versions of a framework or API by seeking repositories for how other systems adapted to such changes. We plan to integrate recommendations of how to instantiate a framework and adapt to changes directly in the development environment. Those points taken together, considerably distinguish our approach from existing research in the area of framework engineering.

8.4.4.2. European Lab with Delft

We have a Lille Nord Europe European Lab with A. Bachelli from Delft University. We are working on infrastructure and tools for code reviewing. We have exchange of staff and got a paper accepted to SANER 2015.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

In the context of the PLOMO2 associated Team with the University of Chile:

- Ronie Saldago: 24/08/2014 until 07/09/2014. Subject was FFI and OSWindow.
- Miguel Campusano: 16/08/2014 until 11/09/2014. Subject was Slots and visual representation of code.
- Alexandre Bergel: 13/12/2014 until 01/01/2015. Subject: system support for advanced profiling.
- Juraj Kubelka: 06/12/2014 until 19/12/2014. First visit to RMoD to plan future collaboration.

In the context of MEALS:

- Guido Chari visited RMoD from November 2014.

Other visitors:

- Laurence Tratt, Software Development Team, King's College London (15-16/05/14)
- Johan Fabry, University of Chile, November 2014.
- Max Leske, University of Bern, Mar 2014.
- Miao Fang, Siemens, from Jun 2014 until Jul 2014.
- Alain Plantec, Univ. Bretagne Occidentale, Jan 2014

8.5.1.1. Internships

Pablo Herrero, Universidad de Buenos Aires (Argentina): *Compressed ASTs for Pharo*, from Oct 2013.

Lucas Godoy, Universidad de Buenos Aires (Argentina):*Tracking depeendencies between code changes.*, May 2014 - Oct 2014.

Baptiste Quide, Polytech Lille: *Package dependencies analysis*, from May 2014 until Aug 2014.

Hayatou Oumarou, Universite de Maroua, Cameroun:*Cost of Rules*, frome June 2014 to Oct 2014.

Clara Allende, Universidad Tecnológica Nacional, Buenos Aires (Argentina): *BreakPoints for Pharo*, from May 2014 until Oct 2014.

Max Mattone, École des Mines Douai: *VirtualCPU for Pharo*. From May 2014 until Oct 2014.

Mark Rizun, Ivan Franko National University of Lviv, Ukraine: *Refactoring Improvements*, from July 2014 until Aug 2014.

Kevin Lanvin, University Lille: *A web front-end for Moose*, from Jan until Apr 2014.

Leo Perard, University Lille: *Telescope: a new way to describe visualizations*, from Mar 2014 until Aug 2014.

8.5.2. Visits to International Teams

- Stéphane Ducasse visited LAM Research, Inc, USA for one week in December 2014.
- Stéphane Ducasse visited the University of Delft, 3 days, July 2014
- Stefan Marr visited the Software Composition Group at Universität Bern in Switzerland for two days in December 2014
- Stefan Marr visited the Institut für Systemsoftware at the JKU University Linz in Austria for three days in July 2014
- Stefan Marr visited the Software Development Team of Laurence Tratt at King's College London for two days in May 2014
- Martín Dias visited the University of Technology of Delft for one week in September, 2014.
- Martín Dias visited the University of Buenos Aires in January 2014.

ROMA Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

ANR White Project RESCUE (2010-2015), 4 years. The ANR White Project RESCUE was launched in November 2010, for a duration of 48 months (and was later extended for 6 additional months). It gathers three Inria partners (ROMA, Grand-Large and Hiepacs) and is led by ROMA. The main objective of the project is to develop new algorithmic techniques and software tools to solve the *exascale resilience problem*. Solving this problem implies a departure from current approaches, and calls for yet-to-be-discovered algorithms, protocols and software tools.

This proposed research follows three main research thrusts. The first thrust deals with novel *checkpoint protocols*. The second thrust entails the development of novel *execution models*, i.e., accurate stochastic models to predict (and, in turn, optimize) the expected performance (execution time or throughput) of large-scale parallel scientific applications. In the third thrust, we will develop novel *parallel algorithms* for scientific numerical kernels.

ANR Project SOLHAR (2013-2017), 4 years. The ANR Project SOLHAR was launched in November 2013, for a duration of 48 months. It gathers five academic partners (the HiePACS, Cepage, ROMA and Runtime Inria project-teams, and CNRS-IRIT) and two industrial partners (CEA/CESTA and EADS-IW). This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computers equipped with accelerators.

The proposed research is organized along three distinct research thrusts. The first objective deals with linear algebra kernels suitable for heterogeneous computing platforms. The second one focuses on runtime systems to provide efficient and robust implementation of dense linear algebra algorithms. The third one is concerned with scheduling this particular application on a heterogeneous and dynamic environment.

8.1.2. Inria Project Lab C2S@Exa - Computer and Computational Scienecs at Exascale

Participants: Olivier Aumage [RUNTIME project-team, Inria Bordeaux - Sud-Ouest], Jocelyne Erhel [SAGE project-team, Inria Rennes - Bretagne Atlantique], Philippe Helluy [TONUS project-team, Inria Nancy - Grand-Est], Laura Grigori [ALPINE project-team, Inria Saclay - Île-de-France], Jean-Yves L'excellent [ROMA project-team, Inria Grenoble - Rhône-Alpes], Thierry Gautier [MOAIS project-team, Inria Grenoble - Rhône-Alpes], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Michel Kern [POMDAPI project-team, Inria Paris - Rocquencourt], Stéphane Lanteri [Coordinator of the project], François Pellegrini [BACCHUS project-team, Inria Bordeaux - Sud-Ouest], Christian Perez [AVALON project-team, Inria Grenoble - Rhône-Alpes], Frédéric Vivien [ROMA project-team, Inria Grenoble - Rhône-Alpes].

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues

in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. SCORPIO

Type: FP7

Defi: Future and Emerging Technologies

Instrument: Specific Targeted Research Project

Objectif: Challenging current Thinking

Duration: June 2013 - May 2016

Coordinator: Nikolaos Bellas

Partners: CERTH, Greece; EPFL, Switzerland; RWTH Aachen University, Germany; The Queen's University of Belfast, UK; IMEC, Belgium

Inria contact: Frédéric Vivien

Abstract: A new computing paradigm that exploits uncertainty to design systems that are energy-efficient and scale gracefully under hardware errors by operating below the nominal operating point, in a controlled way, without inducing massive or fatal errors.

8.3. International Initiatives

8.3.1. Inria International Labs

In 2014, the University of Illinois at Urbana-Champaign, Inria, the French national computer science institute, Argonne National Laboratory, Barcelona Supercomputing Center, and Jülich Supercomputing Centre formed the Joint Laboratory on Extreme Scale Computing (JLESC), a follow-up of the Inria-Illinois Joint Laboratory for Petascale Computing. The Joint Laboratory is based at Illinois and includes researchers from Inria, and the National Center for Supercomputing Applications, ANL, BSC, and JSC. It focuses on software challenges found in extreme scale high-performance computers.

Research areas include:

- Scientific applications (big compute and big data) that are the drivers of the research in the other topics of the joint-laboratory.
- Modeling and optimizing numerical libraries, which are at the heart of many scientific applications.
- Novel programming models and runtime systems, which allow scientific applications to be updated or reimagined to take full advantage of extreme-scale supercomputers.
- Resilience and Fault-tolerance research, which reduces the negative impact when processors, disk drives, or memory fail in supercomputers that have tens or hundreds of thousands of those components.
- I/O and visualization, which are important part of parallel execution for numerical silulations and data analytics
- HPC Clouds, that may execute a portion of the HPC workload in the near future.

Several members of the ROMA team are involved in the JLESC joint lab through their research on resilience. Yves Robert is the scientific representant of Inria in JLESC.

8.3.2. Inria Associate Teams

The ALOHA associate-team is a joint project of the ROMA team and of the Information and Computer science Department of the University of Hawai'i (UH) at Mānoa, Honolulu, USA. Building on a vast array of theoretical techniques and expertise developed in the field of parallel and distributed computing, and more particularly application *scheduling*, we tackle database questions from a fresh perspective. To this end, this proposal includes:

- a group that specializes in database systems research and who has both industrial and academic experience, the group of Lipyeow Lim (UH);
- a group that specializes in practical aspects of scheduling problems and in simulation for emerging platforms and applications, and who has a long experience of multidisciplinary research, the group of Henri Casanova (UH);
- a group that specializes in the theoretical aspects of scheduling problems and resource management (the ROMA team).

The research work focuses on the following three thrusts:

1. Online, multi-criteria query optimization
2. Fault-Tolerance for distributed databases
3. Query scheduling for distributed databases

8.4. International Research Visitors

8.4.1. Visits to International Teams

8.4.1.1. Research stays abroad

Yves Robert has been appointed as a visiting scientist by the ICL laboratory (headed by Jack Dongarra) at the University of Tennessee Knoxville. He collaborates with several ICL researchers on high-performance linear algebra and resilience methods at scale.

RUNTIME Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

REGION AQUITAINE The Aquitaine Region Council is granting the PhD thesis of Andra Hugo about Composability of parallel software over hybrid architectures, from september 2011 to august 2014. REGION AQUITAINE

The Aquitaine Region Council is granting the PhD thesis of Bertrand Putigny about Performance Models for Heterogeneous Parallel Architectures.

REGION AQUITAINE - CEA The Aquitaine Region Council together with CEA is funding PhD thesis of Marc Sergent (2013-2016) on Scalability for Task-based Runtimes (See also Section Bilateral Grants with Industry)

8.2. National Initiatives

8.2.1. ANR

ANR SOLHAR (http://solhar.gforge.inria.fr/doku.php?id=start).

ANR MONU 2013 Program, 2013 - 2016 (36 months)

Identification: ANR-13-MONU-0007

Coordinator: Inria Bordeaux/LaBRI

Other partners: CNRS-IRIT, Inria-LIP Lyon, CEA/CESTA, EADS-IW

Abstract: This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computers equipped with accelerators. The ultimate aim of this project is to achieve the implementation of a software package providing a solver based on direct methods for sparse linear systems of equations. Several attempts have been made to accomplish the porting of these methods on such architectures; the proposed approaches are mostly based on a simple offloading of some computational tasks (the coarsest grained ones) to the accelerators and rely on fine hand-tuning of the code and accurate performance modeling to achieve efficiency. This project proposes an innovative approach which relies on the efficiency and portability of runtime systems, such as the StarPU tool developed in the runtime team (Bordeaux). Although the SOLHAR project will focus on heterogeneous computers equipped with GPUs due to their wide availability and affordable cost, the research accomplished on algorithms, methods and programming models will be readily applicable to other accelerator devices such as ClearSpeed boards or Cell processors.

ANR Songs Simulation of next generation systems (http://infra-songs.gforge.inria.fr/).

ANR INFRA 2011, 01/2012 - 12/2015 (48 months)

Identification: ANR-11INFR01306

Coordinator: Martin Quinson (Inria Nancy)

Other partners: Inria Nancy, Inria Rhône-Alpes, IN2P3, LSIIT, Inria Rennes, I3S.

Abstract: The goal of the SONGS project is to extend the applicability of the SIMGRID simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area.

ANR MOEBUS Scheduling in HPC (http://moebus.gforge.inria.fr/doku.php).

ANR INFRA 2013, 10/2013 - 9/2017 (48 months)

Coordinator: Denis Trystram (Inria Rhône-Alpes)

Other partners: Inria Bordeaux.

Abstract: This project focuses on the efficient execution of parallel applications submitted by various users and sharing resources in large-scale high-performance computing environments

8.2.2. ADT - Inria Technological Development Actions

ADT K'Star (http://kstar.gforge.inria.fr/#!index.md)

Participants: Olivier Aumage, Nathalie Furmento, Samuel Pitoiset, Samuel Thibault.

Inria ADT Campaign 2013, 10/2013 - 9/2015 (24 months)

Coordinator: Thierry Gautier (team MOAIS, Inria Montbonnot) and Olivier Aumage (team RUNTIME, Inria Bordeaux - Sud-Ouest)

Abstract: The Inria action ADT K'Star is a joint effort from Inria teams MOAIS and RUNTIME to design the KLANG-OMP source-to-source OpenMP compiler to translate OpenMP directives into calls to the API of MOAIS and RUNTIME respective runtime systems (XKaapi for MOAIS, StarPU for RUNTIME).

8.2.3. IPL - Inria Project Lab

C2S@Exa - Computer and Computational Sciences at Exascale **Participant:** Olivier Aumage.

Inria IPL 2013 - 2017 (48 months)

Coordinator: Stéphane Lantéri (team Nachos, Inria Sophia)

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. This collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

MULTICORE - Large scale multicore virtualization for performance scaling and portability

Participants: Emmanuel Jeannot, Denis Barthou [RUNTIME project-team, Inria Bordeaux - Sud-Ouest].

Multicore processors are becoming the norm in most computing systems. However supporting them in an efficient way is still a scientific challenge. This large-scale initiative introduces a novel approach based on virtualization and dynamicity, in order to mask hardware heterogeneity, and to let performance scale with the number and nature of cores. It aims to build collaborative virtualization mechanisms that achieve essential tasks related to parallel execution and data management. We want to unify the analysis and transformation processes of programs and accompanying data into one unique virtual machine. We hope delivering a solution for compute-intensive applications running on general-purpose standard computers.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. Mont-Blanc 2

Type: FP7

Defi: Special action

Instrument: Integrated Project

Objectif: Exascale computing platforms, software and applications

Duration: October 2013 - September 2016

Coordinator: Alex Ramirez (UPC)

Partner: UPC,Inria, Bull, ST, ARM, Gnodal, Juelich, BADW-LRZ, HLRS, CNRS, CEA, CINECA, Bristol, Allinea

Inria contact: Denis Barthou

Abstract: The Mont-Blanc project aims to develop a European Exascale approach leveraging on commodity power-efficient embedded technologies. The project has developed a HPC system software stack on ARM, and will deploy the first integrated ARM-based HPC prototype by 2014, and is also working on a set of 11 scientific applications to be ported and tuned to the prototype system. The rapid progress of Mont-Blanc towards defining a scalable power efficient Exascale platform has revealed a number of challenges and opportunities to broaden the scope of investigations and developments. Particularly, the growing interest of the HPC community in accessing the Mont-Blanc platform calls for increased efforts to setup a production-ready environment. The Mont-Blanc 2 proposal has 4 objectives:

- To complement the effort on the Mont-Blanc system software stack, with emphasis on programmer tools (debugger, performance analysis), system resiliency (from applications to architecture support), and ARM 64-bit support
- To produce a first definition of the Mont-Blanc Exascale architecture, exploring different alternatives for the compute node (from low-power mobile sockets to special-purpose high-end ARM chips), and its implications on the rest of the system
- To track the evolution of ARM-based systems, deploying small cluster systems to test new processors that were not available for the original Mont-Blanc prototype (both mobile processors and ARM server chips)
- To provide continued support for the Mont-Blanc consortium, namely operations of the original Mont-Blanc prototype, the new small scale prototypes and hands-on support for our application developers

Mont-Blanc 2 contributes to the development of extreme scale energy-efficient platforms, with potential for Exascale computing, addressing the challenges of massive parallelism, heterogeneous computing, and resiliency. Mont-Blanc 2 has great potential to create new market opportunities for successful EU technology, by placing embedded architectures in servers and HPC.

8.3.1.2. HPC-GA

Type: FP7

Defi: NC

Instrument: International Research Staff Exchange Scheme

Objectif: NC

Duration: January 2012 - December 2014

Coordinator: Jean-François Méhaut (UJF, France)

Partner: UFRGS, Inria, BRGM, BCAM et UNAM.

Inria contact: Jean-François Mehaut

Abstract: The design and implementation of geophysics applications on top of nowadays supercomputers requires a strong expertise in parallel programming and the use of appropriate runtime systems able to efficiently deal with heterogeneous architectures featuring many-core nodes typically equipped with GPU accelerators. The HPC-GA project aims at evaluating the functionalities provided by current runtime systems in order to point out their limitations. It also aims at designing new methods and mechanisms for an efficient scheduling of processes/threads and a clever data distribution on such platforms. The HPC-GA project is unique in gathering an international, pluridisciplinary consortium of leading European and South American researchers featuring complementary expertise to face the challenge of designing high performance geophysics simulations for parallel architectures.

8.3.2. Collaborations in European Programs, except FP7 & H2020

Program: **ITEA2**

Project acronym: COLOC

Project title: The Concurrency and Locality Challenge

Duration: November 2014 - November 2017

Coordinator: BULL

Other partners: BULL SA (France); Dassault Aviation (France) ; Enfeild AB (Sweden); Scilab entreprise (France); Teratec (France); Inria (France); Swedish Defebnse Research Agency - FOI (France); UVSQ (France).

Abstract: The COLOC project aims at providing new models, mechanisms and tools for improving applications performance and supercomputer resources usage taking into account data locality and concurrency.

——

Program: **COST**

Project acronym: NESUS

Project title:Network for Ultrascale Computing

Duration: April 2014 - April 2018

Coordinator: University Carlos III de Madrid

Other partners: More than 35 European Countries.

Abstract: Ultrascale systems are envisioned as large-scale complex systems joining parallel and distributed computing systems that will be two to three orders of magnitude larger that today's systems. The EU is already funding large scale computing systems research, but it is not coordinated across researchers, leading to duplications and inefficiencies. The goal of the NESUS Action is to establish an open European research network targeting sustainable solutions for ultrascale computing aiming at cross fertilization among HPC, large scale distributed systems, and big data management. The network will contribute to glue disparate researchers working across different areas and provide a meeting ground for researchers in these separate areas to exchange ideas, to identify synergies, and to pursue common activities in research topics such as sustainable software solutions (applications and system software stack), data management, energy efficiency, and resilience. Some of the most active research groups of the world in this area are members of this proposal. This Action will increase the value of these groups at the European-level by reducing duplication of efforts and providing a more holistic view to all researchers, it will promote the leadership of Europe, and it will increase their impact on science, economy, and society.

8.4. International Initiatives

8.4.1. Inria International Labs

JLPC Inria joint-Lab on Extreme Scale Computing:

Coordinators: Franck Cappello and Marc Snir.

Other partners: Argonne National Lab, Inria, University of Urbanna Champaign, Tokyo Riken, Jülich Supercomputing Center, Barcelona Supercomputing Center.

Abstract: The Joint Laboratory is based at Illinois and includes researchers from Inria, and the National Center for Supercomputing Applications, ANL, Riken, Jülich, and BSC. It focuses on software challenges found in extreme scale high-performance computers.

8.4.2. Inria Associate Teams

MORSE Matrices Over Runtime Systems at Exascale

Inria Associate-Teams program: 2011-2016

Coordinator: Emmanuel Agullo (Hiepacs)

Parners: Inria (Runtime & Hiepacs), University of Tennessee Knoxville, University of Colorado Denver and KAUST.

Abstract: The Matrices Over Runtime Systems at Exascale (MORSE) associate team has vocation to design dense and sparse linear algebra methods that achieve the fastest possible time to an accurate solution on large-scale multicore systems with GPU accelerators, using all the processing power that future high end systems can make available. To develop software that will perform well on petascale and exascale systems with thousands of nodes and millions of cores, several daunting challenges have to be overcome both by the numerical linear algebra and the runtime system communities. With Inria Hiepacs, University of Tennessee, Knoxville and University of Colorado, Denver.

8.4.3. Inria International Partners

8.4.3.1. Informal International Partners

We collaborate with the following team.

- INESC-ID, Lisbon, Portugal on appplication moldeling.
- UWLAX (Wisconsin) works with us on network topology modeling;
- we collaborate with ICL at University of Tennessee on instrumenting MPI applications and modeling platforms (works on HWLOC take place in the context of the OPEN MPI consortium) and MPI and process placement
- On the industrial side collaborate with Cisco Systems about network topologies and platform models and Intel on modeling many-core platforms and BULL on memory hierarchy modeling.
- ETH Zurich (Switzerland), on topology mapping;
- PPL (U. Illinois at Urbana Champaign) on topology-aware load-balancing (through the Inria-Urbana-Argonne Joint Lab).
- University of Tokyo and Riken on the adaptation of MPI and runtime systems to MIC processors.
- Oak Ridge National Laboratory on high-performance network programming interfaces.

8.4.4. Participation In other International Programs

ANR-JST FP3C Framework and Programming for Post Petascale Computing.

ANR-JST 2010 Program, 01/09/2010 - 31/03/2014

Identification: ANR-10-JST-002

Coordinator: Serge Petiton (Inria Saclay)

Other partners: CNRS IRIT, CEA DEN Saclay, Inria Bordeaux, CNRS-Prism, Inria Rennes, University of Tsukuba, Tokyo Institute of Technology, University of Tokyo, Kyoto University.

Abstract: Post-petascale systems and future exascale computers are expected to have an ultra large-scale and highly hierarchical architecture with nodes of many-core processors and accelerators. That implies that existing systems, language, programming paradigms and parallel algorithms would have, at best, to be adapted. The overall structure of the FP3C project represents a vertical stack from a high level language for end users to low level architecture considerations, in addition to more horizontal runtime system researches.

SEHLOC Scheduling evaluation in heterogeneous systems with hwloc

STIC-AmSud 2012 Program, 01/2013 - 12/2014 (24 months)

Coordinator: Brice Goglin

Other Partners: Universidad Nacional de San Luis (Argentina), Universidad de la Repúpublica (Uruguay).

Abstract: This project focuses on the development of runtime systems that combine application characteristics with topology information to automatically offer scheduling hints that try to respect hardware and software affinities. Additionally we want to analyze the convergence of the obtained performance from our algorithms with the recently proposed Multi-BSP model which considers nested levels of computations that correspond to natural layers of nowadays hardware architectures.

NextGN Preparing for Next Generation Numerical Simulation Platforms

PUF (Partner University Fund) - France USA, 01/2013 - 12-2016 (3 years)

Coordinator: Franck Capello, Marc Snir and Yves Robert

Other Partners: Inria, Argonne National Lab and University of Urbanna Chapaign

This PUF proposal builds on the existing successful joint laboratory between Inria and UIUC that has produced in past three years and half many top-level publications, some of which resulted in student awards; and several software packages that are making their way to production in Europe and USA. The proposal extends the collaboration to Argonne National Laboratory (ANL) and CNRS researchers who will bring their unique expertise and their skills to help addressing the scalability issue of simulation platforms.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

- Malik Muhammad Zaki Murtaza Khan from Dept. of Computer and Information Science (IDI), Norwegian University of Science and Technology, Trondheim, Norway visited us for one week in October.

SAGE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Brittany council: FRACINI project

Participants: Jean-Raynald de Dreuzy, Jocelyne Erhel, Géraldine Pichot.

Contract with Brittany council
Duration: one year from December 2013.
Title: European initiative towards models and numerical methods for simulations in fractured-porous geological media.
Coordination: Géraldine Pichot.
Partners: Geosciences Rennes.
Web page: http://www.irisa.fr/sage/
Abstract: FRACINI is an initiative funded by the Région Bretagne. It aims at gathering researchers from the European community working on models and numerical methods for simulations in fractured-porous media. Two international workshops were organized in 2014. These workshops ended up with a proposal submitted in response to the Future and Emerging Technology (FET) call of H2020 Funding.

7.2. National Initiatives

7.2.1. ANR-MN: H2MNO4 project

Participants: Édouard Canot, Jocelyne Erhel, Grégoire Lecourt, Lionel Lenôtre, Géraldine Pichot.

Contract with ANR, program Modèles Numériques
Duration: four years from November 2012.
Title: Original Optimized Object Oriented Numerical Model for Heterogeneous Hydrogeology.
Coordination: Jocelyne Erhel and Géraldine Pichot, with Fabienne Cuyollaa.
Partners: Geosciences Rennes, University of Poitiers, University of Lyon 1, Andra, Itasca.
International collaborations: University of San Diego (USA), UPC, Barcelona (Spain)
Web page: http://h2mno4.inria.fr/
Abstract: The project H2MNO4 develops numerical models for reactive transport in heterogeneous media. It defines six mathematical and computational challenges and three applications for environmental problems with societal impact (see 6.4 , 5.1.1). ANR organized a review of the project in December 2014.

7.2.2. Inria Project Lab: HEMERA project

Participants: Jocelyne Erhel, Géraldine Pichot.

Title: Hemera - developing large scale parallel and distributed experiments
Duration: September 2010 - July 2014
Coordination: C. Perez, Avalon team.
Partners: 22 Inria teams.
Webpage: http://www.grid5000.fr/mediawiki/index.php/Hemera
Abstract: Hemera is an Inria Project Lab, started in 2010, that aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid'5000 infrastructure, at animating the scientific community around Grid'5000 and at enlarging the Grid'5000 community by helping newcomers to make use of Grid'5000. The final evaluation was in December 2014.

The team Sage was the leader of the Scientific Challenge Hydro: Multi-parametric intensive stochastic simulations for hydrogeology. The objective was to run multiparametric large scale simulations (see 6.4).

7.2.3. Inria Project Lab: C2S@EXA project

Participants: Édouard Canot, Jocelyne Erhel, Géraldine Pichot.

Title: C2S@EXA - Computer and Computational Scienecs at Exascale
Duration: from January 2012.
Coordination: S. Lanteri, Nachos team.
Partners: Inria teams working on HPC; external partners: ANDRA and CEA.
Webpage: http://www-sop.inria.fr/c2s_at_exa/
Abstract: The C2S@Exa Inria Project Lab is concerned with the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society (see 6.2 , 6.4 , 6.5). The team participated in several workshops.

7.2.4. GENCI: project on advanced linear solvers

Participants: Édouard Canot, Jocelyne Erhel, Grégoire Lecourt, Lionel Lenôtre, Géraldine Pichot.

Title: Scalabilité de méthodes numériques pour l'hydrogéologie
Duration: 2012
Coordination: J. Erhel and G. Pichot.
Webpage: http://www.genci.fr/
Abstract: To run large scale simulations, we defined a project, based on the platform H2OLab. We obtained and used computing time on machines located at GENCI supercomputing centers. (see 6.2 , 6.4).

7.2.5. GDR MOMAS: project on reactive transport

Participant: Jocelyne Erhel.

Webpage: https://www.ljll.math.upmc.fr/cances/gdrmomas/

The working group MOMAS includes many partners from CNRS, Inria, universities, CEA, ANDRA, EDF and BRGM. It covers many subjects related to mathematical modeling and numerical simulations for nuclear waste disposal problems (see 6.4 , 6.5). The team participated in workshops.

7.3. European Initiatives

7.3.1. FP7 & H2020: EXA2CT project

Type: FP7
Challenge: Special action
Instrument: Specific Targeted Research Project
Objective: Exascale computing platforms, software and applications
Duration: September 2013 - August 2016
Coordinator: S. Ashby, IMEC, Belgium
Partners: 10 partners
Inria contact: Luc Giraud
Web page: https://projects.imec.be/exa2ct/
Abstract: The goal of this project is to develop novel algorithms and programming models to tackle what will otherwise be a series of major obstacles to using a crucial component of many scientific codes at exascale, namely solvers and their constituents. The results of this work will be combined in running programs that demonstrate the application-targeted use of these algorithms and programming models in the form of proto-applications.

7.3.2. Collaborations with Major European Organizations

UPC: Universitat Politècnica de Catalunya-UPC, Institute of Environmental Assessment and Water Research (Spain)

numerical simulations in hydrogeology, reactive transport in heterogeneous media, upscaling, scientific software platform (see 5.1.1).

UFZ: Helmholtz Centre for Environmental Research-UFZ, Hydrogeology group (Germany)

numerical simulations in hydrogeology, flow in porous fractured media, scientific software platform

HPCLab: University of Patras, High Performance Information Systems Laboratory (Greece)

cooperation with B. Philippe in writing a book, and in common research on low rank approximations of matrix functions.

ERCIM: working group on numerical algorithms, high performance computing.

7.4. International Initiatives

7.4.1. LIRIMA laboratory: momappli team (Cameroon)

Participant: Bernard Philippe.

Program: Laboratoire International de Recherche en Informatique et Mathématiques Appliquées

Title: Modélisation Mathématique et Applications

Inria principal investigator: Bernard Philippe

International Partner (Institution - Laboratory - Researcher): University of Yaoundé, Cameroon - Norbert Noutchegueme

Duration: 2010-2014

See also: http://www.lirima.uninet.cm/index.php/recherche/equipes-de-recherche/momappli

Abstract: The team deals with high performance scientific computing, with a focus on reliable tools for localizing eigenvalues of large sparse matrices.

7.4.2. LIRIMA laboratory: EPIC team (Tunisia)

Participants: Édouard Canot, Jocelyne Erhel, Sinda Khalfallah, Bernard Philippe.

Program: Laboratoire International de Recherche en Informatique et Mathématiques Appliquées

Title: Problèmes Inverses et Contrôle

Inria principal investigator: Houssem Haddar, Defi team

International Partner (Institution - Laboratory - Researcher): ENIT, University of Tunis, Tunisia - LAMSIN - Amel ben Abda

Duration: 2011-2015

See also: http://www.lirima.uninet.cm/index.php/recherche/equipes-de-recherche/epic

Abstract: The team deals with nonlinear and inverse problems.

7.4.3. ECOS Sud (Argentina): ARPHYMAT project

Participant: Édouard Canot.

Program: COFECUB

Title: Processus de formation et transformation de structures de combustion archéologique

Inria principal investigator: Édouard CANOT

International Partner (Institution - Laboratory - Researcher): University of Buenos Aires (Argentina)

Duration: Jan 2012 - Dec 2014

Abstract: the project concerns numerical simulations of prehistoric fires and comparison with archaeological data in South America.

7.4.4. ECOS Sud (Chili): ARPHYMAT project

Participant: Édouard Canot.

Program: CONICYT

Title: Processus de formation et transformation de structures de combustion archéologique : un regard interdisciplinaire

Inria principal investigator: Édouard CANOT

International Partner (Institution - Laboratory - Researcher): Universidad de Tarapaca (Chili)

Duration: Jan 2014 - Dec 2016

Abstract: Multidisciplinary study of prehistoric fire traces in South America, by means of different approaches: taphonomy of the soil, physical processes involved during the heat transfer, modeling and numerical simulations.

7.4.5. Inria Euromediterranean: HYDRINV project

Participants: Édouard Canot, Jocelyne Erhel, Sinda Khalfallah, Bernard Philippe.

Program: Euromediterranean 3+3

Title: Direct and inverse problems in subsurface flow and transport

Coordination: H. ben Ameur, ENIT, Tunisia and J. Jaffré, Inria, Paris

Inria-Rennes principal investigator: Jocelyne Erhel

International Partners (Institution - Laboratory - Researcher):

Université Ibn Tofail - Faculté des Sciences de Kénitra (Morocco) - Laboratoire Interdisciplinaire en Ressources Naturelles et en Environnement - Zoubida Mghazli

Ecole Nationale d'Ingénieurs de Tunis (Tunisia) - Laboratoire de Modélisation en Hydraulique et Environnement - Rachida Bouhlila

Universidad de Sevilla (Spain) - Department Ecuaciones Diferenciales y Anâlisis Numérico - Tomas Chacon Rebollo

Universitat Politècnica de Catalunya (Spain) - Department of Geotechnical Engineering and Geo-Sciences - Xavier Sànchez Vila

University Centre of KHEMIS MILIANA (Algeria) - Laboratoire de l'Energie et des Systèmes Intelligents - Mohammed Hachama

Ecole Mohammadia d'Ingénieurs (Morocco) - LERMA - Rajae Aboulaich

Ecole Nationale d'Ingénieurs de Tunis (Tunisia) - Laboratoire de Modélisation Mathématique et Numérique dans les Sciences de l'Ingénieur - Hend Ben Ameur

Duration: Jan 2012 - Dec 2015

The management of water resources is a problem of great importance in all countries, and is particularly acute around the Mediterranean sea. The goal is to find a reasonable balance between these resources and demand while preserving the quality of water. Towards this goal it is essential to understand and simulate flow and transport in the subsurface. The science corresponding to this topic is hydrogeology. Since models become more and more complicated and quantitative answers must be given, numerical modeling become more and more sophisticated and mathematicians must also be involved. This project brings together hydrogeologists and mathematicians from France, Spain, Algeria, Morocco and Tunisia in order to develop, analyze, and validate numerical methods for several problems arising from modeling flow and transport in the subsurface. The emphasis is put on direct nonlinear problems (air-water flow, density driven flow related to salinization, transport with chemistry) and on inverse problems.

7.4.6. Joint supervision of S. Khalfallah's PhD (Tunisia)

Participants: Jocelyne Erhel, Sinda Khalfallah.

Program: International joint supervision of PhD agreement

Title: Contribution à l'analyse mathématique et numérique de quelques problèmes issus de l'hydrogéologie

Inria principal investigator: Jocelyne Erhel

International Partner (Institution - Laboratory - Researcher): Ecole Nationale d'Ingénieurs de Tunis - LAMSIN (Tunisia) - Amel ben Abda

Duration: 2010 - 2014

Abstract: The objective is to solve data completion problems applied to hydrogeology (see 7.4.5 , 7.4.2).

7.4.7. Informal International Partners

University of Purdue (USA)

High Performance Scientific Computing

University of San Diego (USA)

Hydrogeology

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Emmanuel Kamgnia, University of Yaoundé, 2 months, March-April 2014
- Nabil Nassif, American University of Beirut, 1 week, May 2014
- Stratis Gallopoulos, Uiversity of Patras, 1 week, May 2014
- Ahmed Sameh, University of Purdue, 1 week, May 2014

7.5.2. Internships (Joint supervision of Ph-D students)

- Louis-Bernard Nguenang, University of Yaoundé, 4 months, April-July 2014
- Marwen ben Refifa, University of Tunis, 5 months, April-July and Sep 2014
- Salwa Mansour, Lebanese University, 8 months, Feb-Sep 2014

7.5.3. Visits to International Teams

- Édouard Canot, ENIT Tunis, Tunisia, 1 week, November 2014 (project HYDRINV)

SCALE Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Songs

Title: Simulation of Next Generation Systems

Program: Infra 13

Duration: January 2012 - December 2015

Coordinator: Inria (Nancy, Grenoble, Bordeaux)

Others partners: IN2P3 Villeurbanne, LSIIT Strasbourg, I3S Sophia-Antipolis, LINA Nantes

See also: http://infra-songs.gforge.inria.fr/

Abstract: SONGS (2012-2015) is the continuity of SIMGRID project (2009-2012), in the ANR INFRA program. The aim of SONGS is to continue the development of the SimGrid simulation platform for the study of large distributed architectures, including data grids, cloud computing facilities, peer-to-peer applications and HPC/exascale architectures.

8.1.2. FUI CloudForce (now OpenCloudWare)

Program: FSN, labelled by Minalogic, Systematic and SCS.

Duration: January 2012 - September 2015

Coordinator: France-Telecom Research

Others partners: ActiveEon, Armines, Bull, eNovance, eXo Platform, France Telecom (coordinator), Inria, IRIT-INP Toulouse, Linagora, OW2, Peergreen, Télécom Paris Tech, Télécom Saint Etienne, Thales Communications, Thales Services, Université Joseph Fourier, Université de Savoie - LISTIC, UShareSoft

See also: http://www.opencloudware.org/

Abstract: The OpenCloudware project aims at building an open software engineering platform for the collaborative development of distributed applications to be deployed on multiple Cloud infrastructures.

The results of OpenCloudware will contain a set of software components to manage the lifecycle of such applications, from modelling (Think), developing and building images (Build), to a multi-IaaS compliant PaaS platform (Run) for their deployment, orchestration, performance testing, self-management (elasticity, green IT optimisation), and provisioning. Applications will be deployed potentially on multi IaaS (supporting either one IaaS at a time, or hybrid scenarios).The results of the project will be made available as open source components through the OW2 Open Source Cloudware initiative.

8.1.3. Oseo-Isis Spinnaker

Duration: June 2011 - May 2015

Coordinator: Tagsys-RFID

Others partners: SMEs: Inside-Secure, STIC, Legrand; Academic: IPG, ENS des Mines de St Etienne, Un. du Maine, Un, F. Rabelais Tours, AETS ESEO Angers, Un. Marne la Vallée, Un. Paris 6, Un. Rennes 1, Inria.

See also: http://www.spinnaker-rfid.com/

Abstract: The objective of Spinnaker is to really allow RFID technology to be widely and easily deployed. The role of the OASIS team in this project is to allow the wide scale deployment and management of the specific RFID application servers in the cloud, so to build an end-to-end robust and flexible solution using GCM technology.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. FI-WARE

Type: COOPERATION

Defi: PPP FI: Technology Foundation: Future Internet Core Platform

Instrument: Integrated Project

Objectif: PPP FI: Technology Foundation:Future Internet Core Platform

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Others partners: Thales, SAP, Inria

Inria contact: Olivier Festor

See also: http://www.fi-ware.eu/

Abstract: FI-WARE will deliver a novel service infrastructure, building upon elements (called Generic Enablers) which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability, and production costs linked to Internet applications, building a true foundation for the future Internet.

8.2.1.2. DC4Cities

Type: COOPERATION

Defi: FP7 Smartcities 2013

Instrument: Specific Targeted REsearch Project

Objectif: ICT-2013.6.2: Data Centers in an energy-efficientand environmentally friendly Internet

Duration: September 2013 - February 2016

Coordinator: Freemind Consulting (BE)

Partners: U. Mannheim (DE), U. Passau (DE), HP Italy Innovation Center (IT), Create-Net (IT), ENEA (IT), CESCA Catalunia (ES), Gas Natural SA (ES), Inst. Munic. Informatica Barcelona (ES), Inria (FR)

Inria contact: Eric Madelaine

See also:

Abstract: Data centres play two different and complementary roles in Smart Cities' energy policies: as ICT infrastructures supporting Smart City resource optimization systems - more in general, delivering ICT services to the citizens - and as large energy consumers. Therefore there are huge expectations on data centres being able to run at the highest levels of renewable energy sources: this is the great challenge of DC4Cities project.
The goal of DC4Cities is to make existing and new data centres energy adaptive, without requiring any modification to the logistics, and without impacting the quality of the services provided to their users. Finally new energy metrics, benchmarks, and measurement methodologies will be developed and proposed for the definition of new related standards. DC4Cities will promote the data centres role as an " eco-friendly" key player in the Smart Cities energy policies, and will foster the integration of a network of local renewable energy providers (also interconnected with local Smart Grids and Micro Grids) to support the pursued increase of renewable energy share.

8.2.2. Collaborations with Major European Organizations

Program: EIT ICTLabs

Project acronym: Data Science programme, Activity 15 327 from Master School action line (MSL)

Project title: EIT ICT Labs Data Science Master

Duration: submitted in 2014, funded from 2014 onwards

Coordinator: Martin Klabbers, Technische Universiteit Eindhoven

Other partners (besides UNS, with Françoise Baude as local coordinator): Univ. Politechnico Madrid, Univ. Trento, Politechnico Milano, Tech. Univ. Berlin, KTH

Abstract: The activity aims to create a new major for the ICT Labs master called "Data Science", with the purpose of breeding a new generation of ICT professionals, equipped with advanced technical and entrepreunarial skills in the key area of data science and data engineering. There is a tremendous demand in industry/society for data scientists, and hence a huge market potential for DS programs. DS positions in the industry requires a different educational program, with next to technical skills, more emphasis on awareness of multifaceted challenges and improving business efficiency based on the challenge outcomes. Expected impact is that DS graduates will be quickly recruited for attractive positions as they can help EU ICT industry achieve a higher rate of innovation successes.

8.3. International Initiatives

8.3.1. Inria International Labs

8.3.1.1. CIRIC Chili

Ciric research line: Telecommunications

Inria principal investigator: Eric Madelaine

Duration: 2012 - 2021

This CIRIC activity is loosely coupled with our SCADA associated team with the Universidad de Chile (UdC). We have had some contacts with a software company in Santiago, and starting exploring some possible collaboration in the area of formal specification of distributed applications for Android systems, and generation of "safe by construction" android code. But the effective involvment of CIRIC manpower in this activity has not yet started.

8.3.1.2. LIAMA Shanghai

Liama project: HADES

Inria principal investigator: Robert de Simone

Oasis researchers involved: Eric Madelaine, Ludovic Henrio

Duration: 2013 - 2016

Modern computing architectures are becoming increasingly parallel, at all levels. Meanwhile, typical applications also display increasing concurrency aspects, specially streaming applications involving data and task parallelism. Cyber physical system interactions also add extra-functional requirements to this high degree of concurrency. The goal of best fitting applications onto architectures becomes a crucial problem, which must be tackled from any possible angle. Our position in the HADES LIAMA project is to consider modeling of applications using formal models of concurrent computation, and specialized model-driven engineering approaches to embody the design flow for such models (analysis, verification, mapping allocation, representation of non-functional properties and constraints). We build on various previous domains of expertise : synchronous languages for embedded system design, asynchronous languages for high-performance cloud computing, and real-time specification languages for cyber-physical interaction aspects.

8.3.2. Inria Associate Teams

8.3.2.1. DAESD

Title: Distributed/Asynchronous, Embedded/synchronous System Development

Inria principal investigator: Eric Madelaine

International Partner (Institution - Laboratory - Researcher):

East China Normal University (ECNU) Shanghai - SEI - Yixiang Chen

Duration: 2012 - 2014

See also: http://team.inria.fr/DAESD

The development of concurrent and parallel systems has traditionally been clearly split in two different families; distributed and asynchronous systems on one hand, now growing very fast with the recent progress of the Internet towards large scale services and clouds; embedded, reactive, or hybrid systems on the other hand, mostly of synchronous behaviour. The frontier between these families has attracted less attention, but recent trends, e.g. in industrial systems, in "Cyber-Physical systems", or in the emerging "Internet of Things", give a new importance to research combining them.

The aim of the DAESD associate team is to combine the expertise of the Oasis/Scale and Aoste teams at Inria, the SEI-Shone team at ECNU-Shanghai, and to build models, methods, and prototype tools inheriting from synchronous and asynchronous models. We plan to address modelling formalisms and tools, for this combined model; to establish a method to analyze temporal and spatial consistency of embedded distributed real-time systems; to develop scheduling strategies for multiple tasks in embedded and distributed systems with mixed constraints.

In 2014, the DAESD associated team co-organized a "Summer School" at ECNU Shanghai.

8.3.2.2. SCADA

Title: Safe Composition of Autonomic Distributed Applications

Inria principal investigator: Ludovic Henrio

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - NIC Chile Research Labs - Javier Bustos

Duration: 2012 - 2014

See also: http://team.inria.fr/scada

The SCADA project aims at promoting the collaboration between NIC LABS (Santiago - Chile) and OASIS team, now SCALE (Inria Sophia Antipolis - France) in the domain of the safe composition of applications. More precisely the project will extend existing composition patterns dedicated to parallel or distributed computing to ease the reliable composition of applications. The strong interactions between formal aspects and practical implementation are a key feature of that project, where formal methods, and language theory will contribute to the practical implementation of execution platforms, development and debugging tools, and verification environments. The composition models we focus on are algorithmic skeletons, and distributed components; and we will particularly focus on the programming and verification of non-functional features. Overall, from formal specification and proofs, this project should lead to the implementation of tools for the design and execution of distributed and parallel applications with a guaranteed behavior.

8.3.3. Inria International Partners

8.3.3.1. Informal International Partners

- Florian Kammuller, Middlesex University.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Min Zhang, ECNU Shanghai, from Sep. 25th to Nov. 9th

8.4.1.1. Internships

- Siqi Li, ECNU Shanghai, master internship, from Oct. 15 to Dec. 15th.

8.4.2. Visits to International Teams

- Eric Madelaine visited ECNU Shanghai July. 6-12th.
- Ludovic Henrio, Oleksandra Kulankhina, and Eric Madelaine visited ECNU Shanghai from Nov. 29th to Dec. 6th.

8.4.2.1. Research stays abroad

- Damian Vicino, ARS Laboratory at Carleton University, Ottawa, Canada, January 2014-December 2014 (12 months)

SECRET Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- **ANR BLOC** (10/11 → 09/15)
  Design and Analysis of block ciphers dedicated to constrained environments
  ANR program: Ingénierie numérique et sécurité
  Partners: INSA Lyon, Inria (project-team SECRET), University of Limoges (XLIM), CryptoExperts
  446 kEuros
  http://bloc.project.citi-lab.fr
  The BLOC project aims at providing strong theoretical and practical results in the domain of cryptanalysis and design of block ciphers.
- **ANR KISS** (12/11 → 12/15)
  Keep your personal Information Safe and Secure
  ANR program: Ingénierie numérique et sécurité
  Partners: Inria (project-teams SMIS and SECRET), LIRIS, Gemalto, University of Versailles-St Quentin, Conseil Général des Yvelines
  64 kEuros
  The KISS project builds upon the emergence of new portable and secure devices known as Secure Portable Tokens (e.g., mass storage SIM cards, secure USB sticks, smart sensors) combining the security of smart cards and the storage capacity of NAND Flash chips. The idea promoted in KISS is to embed, in such devices, software components capable of acquiring, storing and managing securely personal data.
- **ANR CLE** (10/13 → 10/17)
  Cryptography from learning with errors
  ANR program: Jeunes Chercheurs, SIMI2
  Coordinator: Vadim Lyubashevsky (Inria, project-team Cascade)
  The aim of this project is to combine algorithmic and algebraic techniques coming from asymmetric and symmetric cryptology in order to improve some attacks and to design some symmetric primitives which have a good resistance to side-channel attacks.
- **ANR BRUTUS** (10/14 → 09/18)
  Authenticated Ciphers and Resistance against Side-Channel Attacks
  ANR program: Défi Société de l'information et de la communication
  Partners: ANSSI, Inria (project-team SECRET and project-team MARELLE), Orange, University of Lille, University of Rennes, University Versailles-Saint Quentin
  160 kEuros
  The Brutus project aims at investigating the security of authenticated encryption systems. We plan to evaluate carefully the security of the most promising candidates to the Caesar competition, by trying to attack the underlying primitives or to build security proofs of modes of operation. We target the traditional black-box setting, but also more "hostile" environments, including the hardware platforms where some side-channel information is available.

8.1.2. Others

- **French Ministry of Defense** (10/12 → 09/15)
  Funding for the supervision of Audrey Tixier's PhD.
  30 kEuros.

- **PEPS IQC 2013** ($04/13 \rightarrow 03/14$)
  Topology and quantum codes
  coordinated by G. Zémor, Institut de Mathématiques de Bordeaux.
  http://www.cnrs.fr/mi/spip.php?article301
- **PEPS IQC 2013** ($04/13 \rightarrow 03/14$)
  Quantum Cryptography and distributed computing
  coordinated by Frédéric Grosshans, Laboratoire Aimé Cotton.
  http://www.cnrs.fr/mi/spip.php?article301

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

Program: COST

Project acronym: ICT COST Action IC1306

Project title: Cryptography for Secure Digital Interaction

Duration: January 2014 - November 2017

Coordinator: Claudio Orlandi, Aarhus University, Denmark

Other partners: see http://www.cost.eu/domains_actions/ict/Actions/IC1306

Abstract: The aim of this COST action is to stimulate interaction between the different national efforts in order to develop new cryptographic solutions and to evaluate the security of deployed algorithms with applications to the secure digital interactions between citizens, companies and governments.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

Title: Discrete Mathematics, Codes and Cryptography

International Partner (Institution): Indian Statistical Institute, Kolkata (India)

Duration: 2014

This collaboration investigates the three following topics: Quantum information and cryptography; Design and maintenance of primitives for symmetric cryptography; Low-cost cryptography designs from coding theory and combinatorics.

8.3.1.2. Informal International Partners

- Otto-von-Guericke Universität Magdeburg, Institut für Algebra und Geometrie (Germany):
  Study of Boolean functions for cryptographic applications
- Nanyang Technological University (Singapore): cryptanalysis of symmetric primitives.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Dimitrios Simos, SBA Research, Vienna, Austria, February 9-15, 2014;
- Marco Tomamichel, University of Sydney, Sydney, Australia, September 30-October 9, 2014;
- Markku-Juhani O. Saarinen, Norwegian University of Science and Technology, Norway, November 8-30, 2014;
- Céline Blondeau, Aalto University, Finland, November 12-13, 2014.

8.4.2. Internships

- Kaushik Chakraborty, ISI Kolkata (India), May 15-June 15, 2014
- Sébastien Duval, Telecom ParisTech, July-December 2014
- Adrien Hauteville, Univ. Limoges, March-August 2014

8.4.3. Visits to International Teams

- Simons Institute for the Theory of Computing, Berkeley, California, February - March, *Quantum Hamiltonian Complexity Program*: A. Chailloux and A. Leverrier;
- Université Catholique de Louvain-la-Neuve, Belgium, visiting Franoȷis-Xavier Standaert, March 10-11: G. Leurent;
- UAB, Barcelona, Spain, visiting Andreas Winter, October 26 - November 4: A. Chailloux;
- Nanyang Technological University, Singapore, visiting Thomas Peyrin, May 19-June 6: G. Leurent.

SELECT Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Pascal Massart is co-organizing a working group at ENS (Ulm) on Statistical Learning.

Christine Keribin is animating the bimensual rendez-vous SFdS "methods and Software".

Gilles Celeux and Christine Keribin has started a collaboration with the Pharmacoepidemiology and Infectious Diseases (PhEMI, INSERM).

8.2. National Initiatives

8.2.1. ANR

SELECT is participating to the ANR MixStatSeq.

8.3. International Initiatives

Gilles Celeux is one of the co-organizers of the international Working Group on Model-Based Clustering. This year this workshop took place in Dublin (Ireland).

Yves Rozenholc has been invited at the Department of Statistics of the University of Haifa for three weeks, at the Department of Mathematics of Eindhoven University for one week and at the Institut of statistic, biostatistic and actuarial sciences of the catholic University of Louvain.

SEMAGRAMME Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. SLAM: Schizophrenia and Language, Analysis and Modeling

Participants: Maxime Amblard [coordinator], Philippe de Groote, Sylvain Pogodalla, Karën Fort.

Schizophrenia is well-known among mental illnesses for the strength of the thought disorders it involves, and for their widespread and spectacular manifestations: from deviant social behavior to delusion, not to speak about affective and sensitive distortions. It aims at exploring a specific manifestation, namely disorders in conversational speech. This is an interdisciplinary research, both empirical and theoretical from several domains, namely psychology, philosophy, linguistic and computer science.

The SLAMproject starts for three years at the Maison des Sciences de l'Homme de Lorraine (MSH–Lorraine, USR 3261). While this year work was dedicated to the test protocol definition, the coming years will be devoted to building an open-access corpus of pathological uses of language.

The first transcriptions of pathological interviews are analyses. The management chain was implemented for disfluences and POS.

Other participants are: Denis Apotheloz (ATILF, Université de Lorraine),Valérie Aucouturier (Centre Léo Apostel, Université Libre de Bruxelles), Katarina Bartkova (ATILF, Université de Lorraine), Fethi Bretel (CHS Le Rouvray, Rouen), Michel Musiol (InterPSY, Université de Lorraine), Manuel Rebuschi (Archives Poincaré, Université de Lorraine).

The SLAM project was supported by the MSH–Lorraine, USR 3261, and won a PEPS project HuMaIn (mission pour l'interdisciplinarité du CNRS). The CNRS part of the budget allowed the organization of the second workshop which gather linguists, psychologists and computer scientists in december : http://discours.loria.fr

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. Polymnie: Parsing and synthesis with abstract categorial grammars. From lexicon to discourse

Participants: Maxime Amblard, Philippe de Groote, Aleksandre Maskharashvili, Sylvain Pogodalla [coordinator], Sai Qian.

POLYMNIE[0] is a research project funded by the French national research agency (ANR). It relies on the grammatical framework of Abstract Categorial Grammars (ACG). A feature of this formalism is to provide the same mathematical perspective both on the surface forms and on the more abstract forms the latter correspond to. As a consequence:

- ACG allows for the encoding of a large variety of grammatical formalisms such as context-free grammars, Tree Adjoining grammars (TAG), etc.
- ACG defines two languages: an abstract language for the abstract forms, and an object language for the surface forms.

Importantly, the notions of object language and abstract language are relative to each other. If we can naturally see surface forms as strings for instance and abstract forms as the associated syntactic trees, we can also consider to associate this abstract form to a first order logical formula as surface (object) form. This property is central in our project as it offers a unified approach to text analysis and text generation, in particular considering the underlying algorithms and their complexity.

[0] http://semagramme.loria.fr/doku.php?id=projects:polymnie

ACG definition uses type-theory and lambda-calculus. From this point of view, they smoothly integrate formal semantics models issuing from Montague's proposal. Theories that extend to the discourse level such as Discourse Representation Theory (DRT) and Dynamic Predicate Logic (DPL) were not initially formulated using lambda-calculus. But such formulations have been proposed. In particular, a formulation based on continuation semantics allows them to be expressed quite naturally in the ACG architecture. Dynamic effects of discourse, in particular those related to anaphora resultion or rhetorical relation inference, have then to be expressed by lexical semantics or computed from the syntactic rules as studied in the Inria Collaborative Research Project (ARC) CAuLD [0].

It has been shown that the discourse structure of texts plays a key role in their understanding. This is the case for both human readers and automatic processing systems. For instance, it can enhance text transformation systems such as the ones performing automatic summarization.

POLYMNIE focuses on studying and implementing the modelling of sentences and discourses in a compositional paradigm that takes into account their dynamics and their structures, both in parsing and in generation. To that end, we rely on the ACG framework. The kind of processing we are interested in relate to the automatic construction of summaries or to text simplification. This has to be considered in the limits of the modelling of the linguistic processes (as opposed to inferential processes for instance) these tasks involve.

The complexity of the phenomena, of their formal description, and of their interactions, require to set up a testing and development environment for linguistic modelling. It will consist in extending and stabilizing a software implementing the functionalities of the ACG framework. It will provide a tool for experimentation and validation of the approach.

Partners:

- Sémagramme people,
- Alpage (Paris 7 university & Inria Paris-Rocquencourt): Laurence Danlos (local coordinator), C. Braud, C. Roze, Éric Villemonte de la Clergerie,
- MELODI (IRIT, CNRS): Stergos Afantenos, Nicholas Asher (local coordinator), Juliette Conrath, Philippe Muller,
- Signes (LaBRI, CNRS): Jérôme Kirman, Richard Moot, Christian Retoré (local coordinator), Sylvain Salvati, Noémie-Fleur Sandillon-Rezer.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

On the occasion of the workshop in honor of Hans KAMP we have invited in Nancy:

- Nicholas ASHER, Université Paul Sabatier, France
- Paul DEKKER, Universiteit van Amsterdam, the Netherlands
- Bart GEURTS, Universiteit van Nijmegen, the Netherlands
- Irène HEIM, Massachusetts Institute of Technology, USA
- Klaus von HEUSINGER, Universität zu Köln, Germany
- Hans KAMP, Universität zu Stuttgart, Germany

[0] http://www.loria.fr/~pogodall/cauld/

7.3.2. Visits to International Teams

7.3.2.1. Sabbatical programme

Sylvain Pogodalla

Date: Aug 2014 - Jul 2015

Institution: Computational Linguistic Department of the University of Düsseldorf (Germany).

The objective of the research project deals with studying the syntax-semantics interface. It relies on two alternative approaches of this interface for mCSG: a unification based approach for Lexicalized Tree Adjoining Grammars (LTAG) [60], [61] as proposed in [57], [62], and a type-theoretic approach using Abstract Categorial Grammars (ACG) [80], [73], [74]. These two approaches provide the core mechanisms of structure mapping for the syntax-semantics interface. Because they both provide a perspective on the syntax-semantics interface for the same grammatical formalism, they offer an interesting meeting place for exchanges on the strength of each of the approaches. In the project, we focus on two of them: the role of lexical semantics and its interaction with the syntax-semantics design, and the integration of discourse related phenomena to the syntax-semantics interface. With that respect, the formal semantics expertise of the department in the modeling of tense and aspects plays is essential in enriching the approach.

SEQUEL Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Pierre Chainais and Hong-Phuong Dang are part of the ARCIR project *REPAR*, PARcimonious REpresentations, which is funded by the Region Nord-Pas de Calais for 2 years. This project is focused on sparsity based methods for signal and image processing. It has permitted to hire 1 postdoc for 1 year (2014-2015) who works on the use of sparse representation for video-tracking. The targetted application is in biological microscopy to track cellular vesiculas (collab. Laurent Héliot, Aymeric Leray, Univ. Lille 1).

8.2. National Initiatives

8.2.1. ANR BNPSI

Participants: Pierre Chainais, Hong-Phuong Dang, Clément Elvira, Emmanuel Duflos, Philippe Vanheeghe.

- *Title*: Bayesian Non Parametric approaches for Signal and Image Processing
- *Type*: National Research Agency no ANR-13-BS-03-0006-01
- *Coordinator*: Ecole Centrale Lille, LAGIS (P. Chainais)
- *Duration*: 2014-2018
- *Other Partners*: Inria Bordeaux, team ALEA, Université de Bordeaux, IMS, Institut de Recherche en Indormatique de Toulouse (IRIT), CEA-LIST Saclay.
- *Abstract*: Statistical methods have become more and more popular in signal and image processing over the past decades. These methods have been able to tackle various applications such as speech recognition, object tracking, image segmentation or restoration, classification, clustering, etc. We propose here to investigate the use of Bayesian nonparametric methods in statistical signal and image processing. Similarly to Bayesian parametric methods, this set of methods is concerned with the elicitation of prior and computation of posterior distributions, but now on infinite-dimensional parameter spaces. Although these methods have become very popular in statistics and machine learning over the last 15 years, their potential is largely underexploited in signal and image processing. The aim of the overall project, which gathers researchers in applied probabilities, statistics, machine learning and signal and image processing, is to develop a new framework for the statistical signal and image processing communities. Based on results from statistics and machine learning we aim at defining new models, methods and algorithms for statistical signal and image processing. Applications to hyperspectral image analysis, image segmentation, GPS localization, image restoration or space-time tomographic reconstruction will allow various concrete illustrations of the theoretical advances and validation on real data coming from realistic contexts.
- *Activity Report*: This ANR Project was accepted in 2013. It has started in february 2014 on a new area of research for signal and image processing and is supervised by Pierre Chainais. Three meetings have taken place in Lille (in February), Toulouse (in June) and Bordeaux (in November). One special session on Bayesian non parametric approaches has been submitted and accepted to the international conference EUSIPCO 2015. We have also been selected by the Franch National Signal & Image Processing Society (GRETSI) to organize the Peyresq 2016 Signal processing summer school. Two PhD students have been recruited in october 2014 thanks to this project: Clément Elvira works in Lille is co-supervised by P. Chainais and N. Dobigeon (Toulouse), Jessica Sodjo works in Bordeaux and is co-supervised by A. Giremus (IMS), N. Dobigeon (Toulouse) and F. Caron (Oxford). Moreover, Hong-Phuong Dang (PhD, 2nd year) has obtained new results on BNP for dictionary learning. The Indian Buffet Process permits to propose a method to learn a dictionary of which size automatically adapts to data. Several publications are in preparation. François Caron who is co-leading this project with Pierre Chainais has moved to Oxford University as an Assistant Professor so that we will benefit from strong connections with the Statistics Departmnt in Oxford University.

8.2.2. ANR ExTra-Learn

Participants: Alessandro Lazaric, Jérémie Mary, Rémi Munos, Michal Valko.

- *Title*: Extraction and Transfer of Knowledge in Reinforcement Learning
- *Type*: National Research Agency (ANR-9011)
- *Coordinator*: Inria Lille (A. Lazaric)
- *Duration*: 2014-2018
- *Abstract*: ExTra-Learn is directly motivated by the evidence that one of the key features that allows humans to accomplish complicated tasks is their ability of building knowledge from past experience and transfer it while learning new tasks. We believe that integrating transfer of learning in machine learning algorithms will dramatically improve their learning performance and enable them to solve complex tasks. We identify in the reinforcement learning (RL) framework the most suitable candidate for this integration. RL formalizes the problem of learning an optimal control policy from the experience directly collected from an unknown environment. Nonetheless, practical limitations of current algorithms encouraged research to focus on how to integrate prior knowledge into the learning process. Although this improves the performance of RL algorithms, it dramatically reduces their autonomy. In this project we pursue a paradigm shift from designing RL algorithms incorporating prior knowledge, to methods able to incrementally discover, construct, and transfer "prior" knowledge in a fully automatic way. More in detail, three main elements of RL algorithms would significantly benefit from transfer of knowledge. *(i)* For every new task, RL algorithms need exploring the environment for a long time, and this corresponds to slow learning processes for large environments. Transfer learning would enable RL algorithms to dramatically reduce the exploration of each new task by exploiting its resemblance with tasks solved in the past. *(ii)* RL algorithms evaluate the quality of a policy by computing its state-value function. Whenever the number of states is too large, approximation is needed. Since approximation may cause instability, designing suitable approximation schemes is particularly critical. While this is currently done by a domain expert, we propose to perform this step automatically by constructing features that incrementally adapt to the tasks encountered over time. This would significantly reduce human supervision and increase the accuracy and stability of RL algorithms across different tasks. *(iii)* In order to deal with complex environments, hierarchical RL solutions have been proposed, where state representations and policies are organized over a hierarchy of subtasks. This requires a careful definition of the hierarchy, which, if not properly constructed, may lead to very poor learning performance. The ambitious goal of transfer learning is to automatically construct a hierarchy of skills, which can be effectively reused over a wide range of similar tasks.
- *Activity Report*: ExTra-Learn started officially in October and one paper has been published at NIPS'14 and in the workshop on "Transfer and Multi-task Learning" at NIPS'14.

8.2.3. National Partners

- Laboratoire Paul Painlevé Université des Sciences et Technologies de Lille, France
  - Mylène Maïda *Collaborator*

    Ph. Preux has collaborated with M. Maïda and co-advised a student of the École Centrale de Lille. The motivation of this collaboration is the study of random matrices and the potential use of this theory in machine learning.
- CMLA - ENS Cachan.
  - Julien Audiffren *Collaborator*
    M. Valko, A. Lazaric, and M. Ghavamzadeh work with Julien on Semi-Supervised Apprenticeship Learning. We work on a maximum entropy algorithm that outperforms the approach without unlabeled data.
- Laboratoire Lagrange, Université de Nice, France.

  - Cédric Richard *Collaborator*
    We have had collaboration on the topic of *dictionary learning over a sensor network*.
- Laboratoire de Mécanique de Lille, Université de Lille 1, France.
  - Jean-Philippe Laval *Collaborator*
    We co-supervise a starting PhD student (Linh Van Nguyen) on the topic of *high resolution field reconstruction from low resolution measurements in turbulent flows*.
- Institut Carnot de Bourgogne, CNRS UMR 6303, Université de Bourgogne, Dijon, France.
  - Aymeric Leray *Collaborator*
    P. Chainais and A. Leray have written an article on the topic of *quantitative guarantees of a super resolution method via concentration inequalities*. A paper has been published in ICASSP 2014 proceedings and a journal article is submitted to IEEE Transactions on Image Processing.
- LAGIS (CRIStAL), Ecole Centrale Lille - Université de Lille 1, France.
  - Patrick Bas *Collaborator*
    P. Chainais and P. Bas have a collaboration on the topic of *adaptive quantization to optimize classification from histrograms of features with an application to the steganalysis of textured images*.
- University of Oxford (Great-Britain)
  - Dr. François Caron *Collaborators*
  - P. Chainais is co-leading the ANR BNPSI in collaboration with François Caron. Note that Rémi Bardenet will arrive in Lille as a CNRS researcher in feb. 2015 after a post-doc at Oxford University.
- LTCI, Institut Télécom-ParisTech, France.
  - Charanpal Dhanjal*Collaborator*
    We have a collaboration on the topic of *Matrix Factorization update* with application to sequential recommendation and sequential clustering. This collaboration has leaded to two publications this year: one in Neurocomputing journal [2], one at SDM'14 conference [14].

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. CompLACS

Type: FP7

Defi: Cognitive Systems, Interaction, Robotics

Instrument: Specific Targeted Research Project

Objectif: Cognitive Systems and Robotics

Duration: March 2011 - February 2015

Coordinator: John Shaw-Taylor

Partner: University College London, University of Bristol, Royal Holloway, University of London, Radboud Universiteit Nijmegen, Technische Universitat Berlin, Montanuniversitat Leoben, Institut National de Recherche en Informatique et en Automatique, Technische Universität Darmstadt

Inria contact: Rémi MUNOS

Abstract: One of the aspirations of machine learning is to develop intelligent systems that can address a wide variety of control problems of many different types. However, although the community has developed successful technologies for many individual problems, these technologies have not previously been integrated into a unified framework. As a result, the technology used to specify, solve and analyse one control problem typically cannot be reused on a different problem. The community has fragmented into a diverse set of specialists with particular solutions to particular problems. The purpose of this project is to develop a unified toolkit for intelligent control in many different problem areas. This toolkit will incorporate many of the most successful approaches to a variety of important control problems within a single framework, including bandit problems, Markov Decision Processes (MDPs), Partially Observable MDPs (POMDPs), continuous stochastic control, and multi-agent systems. In addition, the toolkit will provide methods for the automatic construction of representations and capabilities, which can then be applied to any of these problem types. Finally, the toolkit will provide a generic interface to specifying problems and analysing performance, by mapping intuitive, human-understandable goals into machine-understandable objectives, and by mapping algorithm performance and regret back into human-understandable terms.

8.4. International Initiatives

8.4.1. Inria International Partners

- Inria International partnership with Leoben, Austria; starting October 2014; duration: 4 years.
  - Ronald Ortner and Peter Auer: Montanuniversität Leoben (Austria).
  - Reinforcement learning (RL) deals with the problem of interacting with an unknown stochastic environment that occasionally provides rewards, with the goal of maximizing the cumulative reward. The problem is well-understood when the unknown environment is a finite-state Markov process. This collaboration is centered around reducing the general RL problem to this case.

    In particular, the following problems are considered: representation learning, learning in continuous-state environments, bandit problems with dependent arms, and pure exploration in bandit problems. On each of these problems we have successfully collaborated in the past, and plan to sustain this collaboration possibly extending its scopes.

8.4.1.1. Informal International Partners

- Technion - Israel Institute of Technology, Haifa, Israel.
  - Odalric-Ambrym Maillard *Collaborator*
    Daniil Ryabko has worked with Odalric Maillard on representation learning for reinforcement learning problems. It led to a paper in AISTATS [46].
- School of Computer Science, Carnegie Mellon University, USA.
  - Prof. Emma Brunskill *Collaborator*
  - Mohammad Gheshlaghi Azar, (now at Northwestern University in Chicago) *Collaborator*
    A. Lazaric continued his collaboration on transfer in multi-arm bandit and reinforcement learning which led to one publication at ICML'14. We have submitted an associate team project with E. Brunskill on the topic of multi-arm bandit applied to education.
- Technicolor Research, Palo Alto.
  - Branislav Kveton *Collaborator*
    Michal Valko and Rémi Munos worked with Branislav on Spectral Bandits aimed at recommendation for the entertainment content recommendation. Michal continued the ongoing research on online semi-supervised learning and this year delivered the algorithm for a challenging single picture per person setting. Victor Gabillon has spent 6 month at Technicolor as an intern to work on the sequential learning with submodularity, which resulted in 1 accepted paper at NIPS, 1 in ICML, and 1 in AAAI.

- University of Cambridge (UK)
  - Alexandra Carpentier *Collaborator*
  - Michal Valko collaborates with A. Carpentier on extreme event detection (such as network intrusion) with limited allocation capabilities.
- Politecnico di Milano (Italy)
  - Prof. Marcello Restelli and Prof. Nicola Gatti *Collaborators*
  - A. Lazaric continued his collaboration on transfer in reinforcement learning which leads to a publication in NIPS'14. Furthermore, we have submitted a journal version of an application of multi-arm bandit in sponsored search auctions which is currently under review.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

- Daniele Calandriello, student at Politecnico di Milano, Italy

  Period: April 2013 to May 2014.

  He was working with A. Lazaric on multi-task reinforcement learning.
- Jessica Chemali, Master, Carnegie Mellon University, May-August 2014

8.5.2. Visits to International Teams

8.5.2.1. Sabbatical programme

Ryabko Daniil

Date: Jan 2014 - Jan 2015

Institution: Centro de Modelamiento Matematico (Chile)

8.5.2.2. Research stays abroad

Munos Rémi

Date: Jul 2013 - June 2014

Institution: Microsoft Research New England (USA)

Munos Rémi

Date: October 2014 - now

Institution: Google Deepmind (UK)

Ghavamzadeh Mohammad

Date: September 2013 - now

Institution: Adobe Research (USA)

SERPICO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

ENSAI-CREST: Statistical methods and models for image registration, Vincent Briane PhD thesis is co-funded by Inria and ENSAI-CREST and co-supervised by Myriam Vimond (ENSAI-CREST)

BioGenOuest: Advisory committee of the Biogenouest engineer S. Prigent in charge of the organization of image processing services for Biogenouest bio-imaging facilities.

8.2. National Initiatives

8.2.1. ANR GreenSwimmers project

Participant: Charles Kervrann.

Biofilms are composed of spatially organized microorganisms (possibly including pathogens) embedded in an extracellular polymeric matrix. A direct time-lapse confocal microscopic technique was recently developed to enable the real-time visualization of biocide activity within the biofilm. It can provide information on the dynamics of biocide action in the biofilm and the spatial heterogeneity of bacteria-related susceptibilities that are crucial for a better understanding of biofilm resistance mechanisms. The approach is here to characterize the spatial and temporal exploration of the biofilm by microorganisms.

In this project, SERPICO develop methods and software for the computation of mean velocity as well as other descriptors of swimmers bacteria dynamics inside biofilm image sequences. We investigate spatio-temporal features and descriptors for comparison, classification, indexing and retrieval.

Funding: ANR, duration: 24 months
Partners: INRA, AgroParisTech, Naturatech company

8.2.2. France-BioImaging project

Participants: Charles Kervrann, Patrick Bouthemy, Tinaherinantenaina Rakotoarivelo, Thierry Pécot, Geoffrey Dieffenbach, Emmanuel Moebel, Perrine Paul-Gilloteaux.

The goal of the project is to build a distributed coordinated French infrastructure for photonic and electronic cellular bioimaging dedicated to innovation, training and technology transfer. High computing capacities are needed to exhaustively analyse image flows. We address the following problems: i) exhaustive analysis of bioimaging data sets; ii) deciphering of key steps of biological mechanisms at organ, tissular, cellular and molecular levels through the systematic use of time-lapse 3D microscopy and image processing methods; iii) storage and indexing of extracted and associated data and metadata through an intelligent data management system. SERPICO is co-head of the IPDM (Image Processing and Data Management) node of the FBI network composed of 6 nodes.

Funding: Investissement d'Avenir - Infrastructures Nationales en Biologie et Santé, ANR (2011-2016)
Partners: CNRS, Institut Jacques Monod, Institut Pasteur, Institut Curie, ENS Ulm, Ecole Polytechnique, INRA, INSERM

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

ESFRI Euro-BioImaging initiative: SERPICO participates in the ESFRI Euro-BioImaging project, one of the four new biomedical science projects in the roadmap of the European Strategic Forum on Research Infrastructures (ESFRI). The mission of Euro-BioImaging is to provide access, service and training to state-of-the-art imaging technologies and foster the cooperation and networking at the national and European level including multidisciplinary scientists, industry regional, national and European authorities. SERPICO also participates in the French counterpart, the so-called "France-BioImaging" (FBI) network which gathers several outstanding cellular imaging centers (microscopy, spectroscopy, probe engineering and signal processing) as described in Section 8.2.2 .

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

Collaboration with UT Southwestern Medical Center, Dallas (TX), Prof. G. Danuser, on object tracking in video-microscopy.

Collaboration with University of California - San Francisco (USA), J. Sedat and D. Agard, on image deconvolution in light microscopy.

Collaboration with Imaging Systems Lab, Department of Electrical Engineering, Indian Institute of Science, Bangalore, India (Prof. Muthuvel Arigovindan) on image deconvolution in fluorescence imaging.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

Deepak George Skariah: Internship, Imaging Systems Lab, Department of Electrical Engineering, Indian Institute of Science, Bangalore, India.

SHACRA Project-Team

7. Partnerships and Cooperations

7.1. National Collaborations

The team is collaborating with many national partners, such as:

- the Oscar Lambret Hospital in the context of the interactive inverse FEM simulation (Luis Shiapacasse, Nick Reynaert and Eric Lartigau),
- CHR Lille (Laurent Thines),
- the radiology department of Nancy Hospital within the IDeaS project,
- the TeamC research lab,
- the Inria ASCLEPIOS research team,
- the Inria EVASION research team,
- the Inria MARGRIT research team,
- the Inria LAGADIC research team.

7.2. National Initiatives

7.2.1. Sofa, OR

In December 2014, a new ADT national initiative started. The objective of this ADT is twofold: first, we aim at achieving a level of quality and robustness compatible with IEC 62304 for the core of SOFA and a reduced set of components. This does not include the certification of the code itself, but rather the implementation of a comprehensive development process that will enable the certification by companies wishing to integrate this code into their systems. The second objective is to add new features specific to the needs of using intra-operative: interoperability with equipment from the operating room, acquisition and real-time processing of full HD video streams, data assimilation and predictive filters, path planning, visualization for augmented reality, or user interfaces dedicated to the operating room.

7.2.2. RESET

At the end of the year, the team has been awarded a new ANR project: RESET. This project will start in March 2015. Its objective is to develop a high-fidelity training system for retinal surgery. Retina surgery is an increasingly performed procedure for the treatment of a wide spectrum of retinal pathologies. Yet, as most micro-surgical techniques, it requires long training periods before being mastered. This simulator will be built upon our strong scientific expertise in the field of real-time simulation, and our success story for technology transfer in the field of cataract surgery simulation (MSICS simulation developed for the HelpMeSee foundation).

7.2.3. Sofa, ADT

SOFA Large Scale Development Initiative (ADT) : the SOFA project (Simulation Open Framework Architecture) is an international, multi-institution, collaborative initiative, aimed at developing a flexible and open source framework for interactive simulations. This will eventually establish new grounds for a widely usable standard system for long-term research and product prototyping, ultimately shared by academic and industrial sites. The SOFA project involves 3 Inria teams, SHACRA, IMAGINE and ASCLEPIOS. The development program of the ADT started in 2007.

7.2.4. ANR Acoustic

The main objective of this project is to develop an innovative strategy based on models for helping decision-making process during surgical planning in Deep Brain Stimulation. Models will rely on different levels involved in the decision-making process; namely multimodal images, information, and knowledge. Two types of models will be made available to the surgeon: patient specific models and generic models. The project will develop methods for 1) building these models and 2) automatically computing optimal electrodes trajectories from these models taking into account possible simulated deformations occurring during surgery. The project belongs to the multidisciplinary domain of computer-assisted surgery (CAS). Computer assisted surgery aims at helping the surgeon with methods, tools, data, and information all along the surgical workflow. More specifically, the project addresses surgical planning and surgical simulation in Image Guided Surgery. It is related to the exponentially growing surgical treatment of Deep Brain Stimulation (DBS), originally developed in France by Pr. Benabid (Grenoble Hospital). The key challenges for this research project are 1) to identify, extract, gather, and make available the information and knowledge required by the surgeon for targeting deep brain structures for stimulation and 2) to realistically simulate the possible trajectories.

7.2.5. IHU, Strasbourg

Our team has been selected to be part of the IHU of Strasbourg. This new institute, for which funding (67M€) has just been announced, is a very strong innovative project of research dedicated to future surgery of the abdomen. It will be dedicated to minimally invasive therapies, guided by image and simulation. Based on interdisciplinary expertise of academic partners and strong industry partnerships, the IHU aims at involving several specialized groups for doing research and developments towards hybrid surgery (gesture of the surgeon and simulation-based guidance). Our group and SOFA have a important place in the project. Since September 2011 a part of our team is located within the IHU, to develop a number of activities in close collaboration with clinicians.

7.2.6. ANR IDeaS

IDeaS is a project targeted at per-operative guidance for interventional radiology procedures. Our main goal is to provide effective solutions for the two main drawbacks of interventional radiology procedures, namely: reduce radiation exposure and provide a fully 3D and interactive visual feedback during the procedure. To do so, our project relies on an original combination of computer vision algorithms and interactive physics-based medical simulation. Computer vision algorithms extract relevant information (like the actual projected shape of the guide-wire at any given time) from X-ray images, allowing adjusting the simulation to real data. Conversely, computer-based simulation is used as a sophisticated and trustful predictor for an improved initialization of computer vision tracking algorithms. Many outcomes may be expected both in scientific and clinical aspects. On the scientific side, we believe a better understanding of how real data and simulation should be merged and confronted must lead, as a natural by-product, to image-based figures of merit to actually validate computer-based simulation outputs against real and dynamic data. A more accurate identification of the factors limiting the realism of simulation should follow with a rebound impact on the quality of the simulation itself. An actual integration of a mechanical model into the loop will improve the tracking. We firmly believe mechanical constraints can supplement the image data such that dynamic single view reconstruction of the interventional devices will be possible. On the clinical side, using the prediction capabilities of the simulation may decrease the need for X-ray images at high rates, thus leading to lower exposure to radiations for the patients and surgical staff. Finally, the output of the simulation is the 3D shape of the tool (e.g. guide-wire or catheter), but not only. Additional information may be visualized, for instance pressure of the catheter on the arterial wall, to prevent vessel wall perforations, or reduce stress on the arterial wall to prevent spasm. More generally, richer information on the live procedure may help surgeons to reduce malpractice or medical errors.

7.3. European Initiatives

7.3.1. RASimAs

2014 was the first year of the RASimAs project (STREP project funded under FP7) during which we developed new models of the biomechanics of the leg and arm, as well as the simulation of the insertion of the anaesthesiology needle. Regional anaesthesia has been used increasingly during the past four decades. This is addressed to the perceived advantages of reduced postoperative pain, earlier mobility, shorter hospital stay, and significantly lower costs. Current training methods for teaching regional anaesthesia include cadavers, video teaching, ultrasound guidance, and simple virtual patient modeling. These techniques have limited capabilities and do not consider individual anatomy. The goal of this project is to increase the application, the effectiveness and the success rates of RA and furthermore the diffusion of the method through the development VPH models for anaesthesia. The goal of the SHACRA team is to provide the computational infrastructure for the physics-based simulation and to propose new methods for patient-specific modeling and simulation of soft tissues and their interaction with the needle, including its effect on nerve physiology.

See http://rasimas.imib.rwth-aachen.de for more details.

7.4. International Initiatives

7.4.1. Informal International Partners

The team is collaborating with:

- the King's College of London,
- Aachen University (Germany),
- Bangor University (United Kingdom),
- Universidad Rey Juan Carlos (Spain),
- Foundation for Research and Technology Hellas (Greece),
- SenseGraphics (Sweden).

SIERRA Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR: Calibration

Participant: Sylvain Arlot.

Titre: Statistical calibration

Coordinator: University Paris Dauphine

Leader: Vincent Rivoirard

Other members: 34 members, mostly among CEREMADE (Paris Dauphine), Laboratoire Jean-Alexandre Dieudonné (Université de Nice) and Laboratoire de Mathématiques de l'Université Paris Sud

Instrument: ANR Blanc

Duration: Jan 2012 - Dec 2015

Total funding: 240 000 euros

Webpage: https://sites.google.com/site/anrcalibration/

7.1.2. CNRS: Gargantua

Participants: Sylvain Arlot, Francis Bach, Simon Lacoste-Julien, Alexandre d'Aspremont.

Titre: Big data; apprentissage automatique et optimisation mathématique pour les données gigantesques

Coordinator: Laboratoire Jean Kuntzmann (UMR 5224)

Leader: Zaid Harchaoui

Other members: 13 members: S. Arlot, F. Bach, S. Lacoste-Julien, A. d'Aspremont and researchers from Laboratoire Jean Kuntzmann, Laboratoire d'Informatique de Grenoble (Universite Joseph Fourier) and Laboratoire Paul Painleve (Universite Lille 1).

Instrument: défi MASTODONS du CNRS

Duration: May 2013-Dec 2014

Total funding: 60 000 euros for the two years

Webpage: http://lear.inrialpes.fr/people/harchaoui/projects/gargantua/index.html

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. SIERRA

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Duration: December 2009 - November 2014

Coordinator: F. Bach

Abstract: Machine learning is now a core part of many research domains, where the abundance of data has forced researchers to rely on automated processing of information. The main current paradigm of application of machine learning techniques consists in two sequential stages: in the representation phase, practitioners first build a large set of features and potential responses for model building or prediction. Then, in the learning phase, off-the-shelf algorithms are used to solve the appropriate data processing tasks. While this has led to significant advances in many domains, the potential of machine learning techniques is far from being reached.

7.2.1.2. SIPA

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Objectif: NC

Duration: May 2011 - May 2016

Coordinator: A. d'Aspremont (CNRS)

Abstract: Interior point algorithms and a dramatic growth in computing power have revolutionized optimization in the last two decades. Highly nonlinear problems which were previously thought intractable are now routinely solved at reasonable scales. Semidefinite programs (i.e. linear programs on the cone of positive semidefinite matrices) are a perfect example of this trend: reasonably large, highly nonlinear but convex eigenvalue optimization problems are now solved efficiently by reliable numerical packages. This in turn means that a wide array of new applications for semidefinite programming have been discovered, mimicking the early development of linear programming. To cite only a few examples, semidefinite programs have been used to solve collaborative filtering problems (e.g. make personalized movie recommendations), approximate the solution of combinatorial programs, optimize the mixing rate of Markov chains over networks, infer dependence patterns from multivariate time series or produce optimal kernels in classification problems. These new applications also come with radically different algorithmic requirements. While interior point methods solve relatively small problems with a high precision, most recent applications of semidefinite programming in statistical learning for example form very large-scale problems with comparatively low precision targets, programs for which current algorithms cannot form even a single iteration. This proposal seeks to break this limit on problem size by deriving reliable first-order algorithms for solving large-scale semidefinite programs with a significantly lower cost per iteration, using for example subsampling techniques to considerably reduce the cost of forming gradients. Beyond these algorithmic challenges, the proposed research will focus heavily on applications of convex programming to statistical learning and signal processing theory where optimization and duality results quantify the statistical performance of coding or variable selection algorithms for example. Finally, another central goal of this work will be to produce efficient, customized algorithms for some key problems arising in machine learning and statistics.

7.2.1.3. SpaRTaN

Type: FP7

Defi: NC

Instrument: Initial Training Network

Duration: October 2014 to October 2018

Coordinator: Mark Plumbley (University of Surrey)

Inria contact: Francis Bach

Abstract: The SpaRTaN Initial Training Network will train a new generation of interdisciplinary researchers in sparse representations and compressed sensing, contributing to Europe's leading role in scientific innovation.

By bringing together leading academic and industry groups with expertise in sparse representations, compressed sensing, machine learning and optimisation, and with an interest in applications such as hyperspectral imaging, audio signal processing and video analytics, this project will create an interdisciplinary, trans-national and inter-sectorial training network to enhance mobility and training of researchers in this area.

SpaRTaN is funded under the FP7-PEOPLE-2013-ITN call and is part of the Marie Curie Actions — Initial Training Networks (ITN) funding scheme: Project number - 607290

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. STATWEB

Title: Fast Statistical Analysis of Web Data via Sparse Learning

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (ÉTATS-UNIS)

Duration: 2011 - 2014

See also: http://www.di.ens.fr/~fbach/statweb.html

The goal of the proposed research is to provide web-based tools for the analysis and visualization of large corpora of text documents, with a focus on databases of news articles. We intend to use advanced algorithms, drawing from recent progresses in machine learning and statistics, to allow a user to quickly produce a short summary and associated timeline showing how a certain topic is described in news media. We are also interested in unsupervised learning techniques that allow a user to understand the difference between several different news sources, topics or documents.

7.3.2. Inria International Partners

7.3.2.1. International Partners

IFCAM: Collaboration with Indian Institute of Science, Bangalore (Chiranjib Battacharya). 10000 Euros for visits from/to India.

7.4. International Research Visitors

7.4.1. Internships

Visit from Raman Sankaran Indian Institute of Science, Bangalore, May-Juky 2014.

SIROCCO Project-Team

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. FP7 & H2020 projects

8.1.1.1. FP7-PEOPLE-SHIVPRO

Participants: Olivier Le Meur, Zhi Liu.

- Title : Saliency-aware High-resolution Video Processing.
- Research axis : 6.1.1 .
- Partners : Visting professor from Shanghai University.
- Funding : EC-FP7 MC-IIF International Incoming Fellowships (IIF).
- Period : 08/2012-07/2014

The SHIVPRO project has been supporting the visit of Dr. Z. Liu, from Beijing University in the team from August 2012 to August 2014. The objective of this project was to propose an efficient spatio-temporal saliency model to predict salient regions in High-Resolution (HR) videos, and fully exploit it to ease the design and improve the performance of HR video compression and retargeting applications. With the aim to overcome the drawbacks of existing saliency models, based on a multiscale region representation, the proposed model systematically realizes statistical model saliency measuring, intra-scale saliency modification, inter-scale saliency propagation and flexible incorporation of top-down information, to generate a novel saliency representation form with scalability, saliency tree, from which a multiscale saliency fusion scheme is used to derive high-quality saliency maps at various scales.

8.2. International Research Visitors

8.2.1. Visits of International Scientists

Dr. Zhi Liu, from Shanghai University, has been visiting the team from August 2012 until August 2014. His stay has been funded by the FP7-PEOPLE-2011-IIF program. The funding scheme is the MC-IIF International Incoming Fellowships (IIF).

8.2.2. Visits to International Teams

8.2.2.1. Sabbatical programme

C. Guillemot has spent a six months sabbatical stay (Mar. 2014- Aug. 2014) at EPFL (Ecole Polytechnique Federale de Lausanne)

SISTM Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The team have strong links with Bordeaux CHU ("Centre Hospitalier Universitaire").

8.2. National Initiatives

8.2.1. Labex Vaccine Research Institute (VRI)

There are strong collaborations with immunologists involved in the Labex Vaccine Research Institute (VRI) as RT is leading the Biostatistics/Bioinformatics division.

8.2.2. Expert Appraisals

Coordination with Jean Weissenbach of the presidential plan of 100 M€ for “Systems biology” (RT)

Deputy director of the Institut de Recherche en Santé Publique IRESP (RT)

8.3. International Initiatives

8.3.1. Participation In other International Programs

RT is participating to the EUROCOORD network on HIV cohort collaborations as :

a member of the scientific committee of IWHOD International Workshop on HIV Observational Databases from 2013,

a project leader on defining references for the CD4 count response to antiretrovirals.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Following the RHOMEO project (ANR-BBSRC Systems biology 2007 call, 2007-2011) steered by RT, a strong collaboration has been established with Pr Robin Callard (UCL Immunology) who is visiting the team in Bordeaux one month each year, Andy Yates (Physicists, Glasgow Univ) and Ben Seddon (NIMR, UCL Immunology).

Also, several other international collaboration have been initiated through the Labex:

Steve Self and Peter Gilbert in Seattle (HVTN HIV vaccine Trial Network),

Marcus Altfeld (Immunologists, Hambourg & Harvard).

This group in collaboration with other teams in Europe is writing a response to the H2020 call PHC 2 – 2015: Understanding diseases: systems medicine.

8.4.2. Visits to International Teams

8.4.2.1. Sabbatical programme

BL is on sabbatical in Queensland University, Australia.

8.4.2.2. Research stays abroad

Chloé Pasin is visiting Steve Self at HVTN, Seattle.

Boris Hejblum visited François Caron at Oxford University, United-Kingdom.

SISYPHE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR project SODDA: Soft Defects Diagnosis in wired networks

Participants: Thomas Lepetit, Mohamed Oumri, Michel Sorine.

The need for detection, localization and characterization of defects in a cable network has led to the ANR projects SEEDS followed by 0-DEFECT in the automotive domain and INSCAN for cables along railways. These projects provide the foundations of diagnosis methods for cables – with a proof of feasibility in the case of hard defects (short-circuit, open circuit) – and some theoretical results on the associated inverse problems in the case of soft faults. They also made it possible to identify their limits. One of the principal limits of these methods, based on the principles of reflectometry, is the difficulty of detecting soft defects. If it was possible to detect and locate precisely these defects, that would help for preventive maintenance or prognosis. The objective of SODDA is to study the signatures of the soft defects, by combining theory and experiment, and to design and test innovative methods adapted to these signatures which are very difficult to detect. The project is run by an academic consortium, in close connection with an industrial board, responsible for keeping the work in realistic and relevant use cases. The Inria teams involved are I4S (Qinghua Zhang), POEMS and Sisyphe.

7.2. International Research Visitors

7.2.1. Visits to International Teams

7.2.1.1. Sabbatical programme

Bliman Pierre-Alexandre

Date: May 2014 - Apr 2015

Institution: Fundação Getulio Vargas, Brazil EMAp (Brazil)

SMIS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR KISS (Dec. 2011 - Dec. 2015)

Partners: Inria-SMIS (coordinator), Inria-SECRET, LIRIS, Univ. of Versailles, CryptoExperts, Gemalto, Yvelines district.
SMIS funding: 230k€.

The idea promoted in KISS is to embed, in trusted devices, software components capable of acquiring, storing and managing securely various forms of personal data (e.g., salary forms, invoices, banking statements, geolocation data, depending on the applications). These software components form a Personal Data Server which can remain under the holder's control. The scientific challenges include: embedded data management issues tackling regular, streaming and spatio-temporal data (e.g., geolocation data), data provenance-based privacy models, crypto-protected distributed protocols to implement private communications and secure global computations.

8.1.2. CAPPRIS Project-Lab (Dec. 2011 - Dec. 2015)

Inria Partners: PRIVATICS (coordinator), SMIS, PLANETE, CIDRE, COMETE.
External partners: Univ. of Namur, Eurecom, LAAS.
Funding: not associated to individual project-teams.

An Inria Project Lab (IPL) is a long-term multi-disciplinary project launched by Inria to sustain large scale risky research actions in line with its own strategic plan. CAPPRIS stands for "Collaborative Action on the Protection of Privacy Rights in the Information Society". The key issues that are addressed are: (1) the identification of existing and future threats to privacy, (2) the definition of formally grounded measures to assess and quantify privacy, (3) the definition of the fundamental principles underlying privacy by design and methods to apply them in concrete situations and (4) The integration of the social and legal dimensions. To assess the relevance and significance of the research results, they are confronted to three classes of case studies CAPPRIS partners are involved in: namely Online Social Networks, Location Based Services and Electronic Health Record Systems.

8.1.3. PEPS PAIP (Pour une Approche Interdisciplinaire de la Privacy) (Sept. 2013 - Sept. 2014)

Partners: ADIS and SMIS (co-organizers), CERDI, DANTE, COMETE, GRACE, TPT, LIMSI.
Funding: 30K€ from CNRS, not associated to individual project-teams.

The Digital Society Institute (DSI) is the UPSa IDEX catalyst for multidisciplinary research on societal challenges inherent to eLife/life digitization. DSI plans to be one of the European leading institutes fostering multidisciplinary research across ICTS and SHES. In 2013 DSI already hosts two kick-off major research projects : (1) Human and Machine Coevolution and (2) Privacy/digital identities. ADIS and SMIS are co-organizing project (2) on data privacy. The PEPS PAIP is part of project (2) and aims at fostering the cooperation between lawyers, economists and computer scientists on privacy issues, through the organization of brainstorming days and workshops and a study of possible joint experiments of privacy preserving applications.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. PDS4NRJ (Aug. 2013 - Aug. 2014)

Instrument: Marie Curie Intra-European Fellowships for Career Development

Duration: 2013 Aug. - 2014 Aug.

Inria contact: Philippe Bonnet

This project, called PDS4NRJ, is based on the insights that (a) secure personal data management can be radically improved with the advent of secure hardware embedded on personal devices at the edges of the Internet, and (b) that a secure personal data management infrastructure should be applied in the context of smart buildings. Our overall objective is to define a new form of decentralized infrastructure for sharing smart meter data with access and usage control guarantees. The PDS4NRJ project is a unique opportunity for Philippe Bonnet, currently associate professor at ITU (Denmark), to become a leading expert in the field of secure personal data management thanks to a tight cooperation with SMIS members.

8.2.2. Collaborations in European Programs, except FP7

Program: Danish Council for Independent Research (FTP call)

Project acronym: CLyDE

Project title: Cross-LaYer optimized Database Engine

Duration: 10/2011 - 10/2014

Partners: IT University of Copenhagen (Denmark), SMIS

Abstract: The goal is to explore how flash devices, operating system and database system can be designed together to improve overall performance. Such a co-design is particularly important for the next generation database appliances, or cloud-based relational database systems for which well suited flash components must be specified. More generally, our goal is to influence the evolution of flash devices and commodity database systems for the benefit of data intensive applications. The project should result in two complementary open-source software systems: (i) a bimodal flash device software component based on the idea from [30], and (ii) a database system optimized for bimodal flash devices. The project funding is managed by the IT University of Copenhagen and covers the expenses for two co-supervised PhD students (including regular visits to and from Denmark).

8.2.3. Collaborations with Major European Organizations

The SMIS members have developed tight European cooperations with the following persons/teams:

Philippe Bonnet (Associate Professor at the University of Copenhagen, Denmark)

Collaboration on Flash-based data management for high-end servers with Philippe Bonnet from IT University of Copenhagen and Björn Þór Jónsson from Reykjavík University (see Section 8.2.2). The study of flash devices started during a short sabbatical of Luc Bouganim (from April to August 2008) in Copenhagen.

Michalis Vazirgiannis (Athens University of Economics and Business)

Collaboration on Minimal Exposure in the context of Michalis' Digiteo Chair at LIX (Ecole Polytechnique).

8.3. International Research Visitors

Philippe Bonnet, associate professor at the IT University of Copenhagen, visited SMIS in the context of a Marie Curie grant from August 2013 until July 2014 (see Section 8.2.1.1).

SOCRATE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Equipex FIT- Future Internet of Things (2011-..., 1.064 k€)

The FIT projet is a national equipex (*equipement d'excellence*), headed by the Lip6 laboratory. As a member of Inria, Socrate is in charge of the development of an Experimental Cognitive Radio platform that should be used as test-bed for SDR terminals and cognitive radio experiments. This should be operational in 2013 for a duration of 7 years. To give a quick view, the user will have a way to configure and program through Internet several SDR platforms (MIMO, SISO, and baseband processing nodes).

8.1.2. ANR - Cormoran - "Cooperative and Mobile Wireless Body Area Networks for Group Navigation" (2012-2015, 150 keuros)

Cormoran project targets to figure out innovative communication functionalities and radiolocation algorithms that could benefit from inter/intra-BAN cooperation. More precisely, the idea is to enable accurate nodes/body location, as well as Quality of Service management and communications reliability (from the protocol point of view), while coping with inter-BAN coexistence, low power constraints and complying with the IEEE 802.15.6 standard. The proposed solutions will be evaluated in realistic applicative scenarios, hence necessitating the development of adapted simulation tools and real-life experiments based on hardware platforms. For this sake, Cormoran will follow an original approach, mixing theoretical work (e.g. modelling activities, algorithms and cross-layer PHY/MAC/NWK design) with more practical aspects (e.g. channel and antennas measurement campaigns, algorithms interfacing with real platforms, demonstrations).

8.1.3. ANR - MetalibM - "Automatic generation of function and filters" (2014-2017, 200 keuros)

The goal of the Metalibm project is to provide a tool for the automatic implementation of mathematical (libm) functions. A function f is automatically transformed into machine-proven C code implementing an polynomial approximation in a given domain with given accuracy. This project is led by Inria, with researchers from Socrate and AriC; PEQUAN team of Laboratoire d'Informatique de Paris 6 (LIP6) at Université Pierre et Marie Curie, Paris; DALI team from Université de Perpignan Via Domitia and Laboratoire d'Informatique, Robotique et Microélectronique de Montpellier (LIRMM); and SFT group from Centre Européen de Recherche Nucléaire (CERN).

8.1.4. FUI ECONHOME - "Energy efficient home networking" (2010-2014, 309 keuros)

The project aims at reducing the energy consumption of the home (multimedia) data networks, while maintaining the quality requirements for heterogeneous services and flows, and preserving, or even enhancing the overall system performance. the equipments under concern are residential gateways, set-top-boxes , PLC modules, Wifi extenders, NAS. The user equipment, such as smartphones, tablets or PCs are not concerned. The approach relies on combining both individual equipments IC and system level protocols that have to be eco-designed.

8.1.5. FUI SMACS - "SMart And Connected Sensors" (2013-2016, 267 keuros)

The SMACS projet targets the deployement of an innovating wireless sensor network dedicated to many domains sport, health and digital cities. The projet involves Socrate (Insavalor), HIKOB and wireless broadcasting company Euro Media France. The main goal is to develop a robust technologie enabling real-time localization of mobile targets (like cyclist for instance), at a low energy (more generaly low cost). The technology will be demonstrated at real cycling races (Tour de France 2013 and 2014). One of the goal is to include localisation information with new radio technology. Another subject of study is distributed wireless consensus algorithms for maintaining a neighborhood knowledge with a low energy budget that scales (more than 200 cycles together)

8.2. European Initiatives

8.2.1. Greentouch GTT project- "Interference Alignment" (2013-2014, 63 keuros)

The Greentouch GTT (Green transmission technology) project aims at proposiing new energy efficient transmission techniques, and focus specifically on the Energy efficiency - spectral efficiency (EE-SE) trade-off. Interference management is a critical issue and socrate aims at designing a dynamic and distributed approach allowing to cancel strong interfers by combining control theory and interference alignment principles.

8.3. International Initiatives

8.3.1. Inria International Partners

Socrate has strong collaborations with several international partners.

- **Princeton University**, School of Applied Science, Department of Electrical Engineering, NJ. USA. This cooperation with Prof. H. Vincent Poor is on topics related to decentralized wireless networks. Samir Perlaza has been appointed as Visiting Research Collaborator at the EE Department. Jean-Marie Gorce spent his Sabatical year at the EE Department. Scientific-Leader at Inria: Jean-Marie Gorce.
- **University of Sheffield**, Department of Automatic Control and Systems Engineering, Sheffield, UK. This cooperation with Prof. Inaki Esnaola is on topics related to information-driven energy systems. Scientific-in-charge at Inria: Samir Perlaza.
- **Virginia Tech**, Discovery Analytics Center, Department of Computer Science, Blacksburg, VA, USA. This cooperation with Prof. Ravi Tandon is on topics related to channel-output feedback in wireless networks. Scientific-Leader at Inria: Samir Perlaza.
- **University of Cyprus**, Department of Electrical and Computer Engineering, University of Cyprus (ECE), Nicosia, Cyprus. This cooperation with Prof. Ioannis Krikidis is on topics related to energy-harvesting and wireless communications systems. Scientific-Leader at Inria: Guillaume Villemaud.

8.3.1.1. Informal International Partners

- **Universidade Federal do Ceará**, Department of Tele-informatics, GTEL lab. A formal cooperation is currently under preparation but, exchange of researchers for seminars and courses already took place between 2012 and 2014. Mutual topics of interests include interference management and massive MIMO.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Sabbatical programme

Gorce Jean-Marie

Princeton University (USA). September 2013 - July 2014. CMIRA regional council Scholarship Programme.

8.4.1.2. Research stays abroad

Samir Perlaza spent few months visiting the following academic partners:

University of Sheffield (UK), May 2014 and October 2014.

Princeton University (UK), June - July 2014.

SPADES Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Projects

8.1.1.1. PiCoq (ANR project)

Participant: Jean-Bernard Stefani.

The goal of the PiCoq project is to develop an environment for the formal verification of properties of distributed, component-based programs. The project's approach lies at the interface between two research areas: concurrency theory and proof assistants. Achieving this goal relies on three scientific advances, which the project intends to address:

- Finding mathematical frameworks that ease modular reasoning about concurrent and distributed systems: due to their large size and complex interactions, distributed systems cannot be analysed in a global way. They have to be decomposed into modular components, whose individual behaviour can be understood.
- Improving existing proof techniques for distributed/modular systems: while behavioural theories of first-order concurrent languages are well understood, this is not the case for higher-order ones. We also need to generalise well-known modular techniques that have been developed for first-order languages to facilitate formalisation in a proof assistant, where source code redundancies should be avoided.
- Defining core calculi that both reflect concrete practice in distributed component programming and enjoy nice properties *w.r.t.* behavioural equivalences.

The project partners include Inria (CELTIQUE and SPADES teams), LIP (PLUME team), and Université de Savoie. The project runs from November 2010 to October 2014.

8.1.1.2. REVER (ANR project)

Participant: Jean-Bernard Stefani.

The REVER project aims to develop semantically well-founded and composable abstractions for dependable distributed computing on the basis of a reversible programming model, where reversibility means the ability to undo any program execution and to revert it to a state consistent with the past execution. The critical assumption behind REVER is that by combining reversibility with notions of compensation and modularity, one can develop systematic and composable abstractions for dependable programming.

The REVER work program is articulated around three major objectives:

- To investigate the semantics of reversible concurrent processes.
- To study the combination of reversibility with notions of compensation, isolation and modularity in a concurrent and distributed setting.
- To investigate how to support these features in a practical (typically, object-oriented and functional) programming language design.

The project partners are Inria (FOCUS and SPADES teams), Université de Paris VII (PPS laboratory), and CEA (List laboratory). The project runs from December 2011 to November 2015.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

Program: COST

Project acronym: IC1405

Project title: Reversible Computation

Duration: 2015-2019

Coordinator: I. Ulidowski (U. Leicester, UK)

Abstract: This recently launched COST Action aims to establisjh a research network of excellence on reversible commputation. Reversible computation is an emerging paradigm that extends the standard forward-only mode of computation with the ability to execute in reverse, so that computation can run backwards as naturally as it can go forwards. It aims to deliver novel computing devices and software. the potential benefits include the design of new reversible logic gates and circuits – leading to low-power computing –, and new conceptual frameworks, language abstractions and software tools for reliable and recovery-oriented distributed systems.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. RIPPES

Title: RIgorous Programming of Predictable Embedded Systems

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (USA)

University of Auckland (New Zealand)

Duration: 2013 - 2015

See also: https://wiki.inria.fr/rippes

The RIPPES associated teams gathers the SPADES team from Inria Grenoble Rhône-Alpes, the Ptolemy group from UC Berkeley (EECS Department), and the Embedded Systems Research group from U. Auckland (ECE Department). The planned research seeks to reconcile two contradictory objectives of embedded systems, more predictability and more adaptivity. We propose to address these issues by exploring two complementary research directions: (1) by starting from a classical concurrent C or Java programming language and enhancing it to provide more predictability, and (2) by starting from a very predictable model of computation (SDF) and enhancing it to provide more adaptivity.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

University of Bologna, Department of Computer Science (Italy)

Topics: reversibility in concurrent languages

TU Braunschweig, (Germany)

Topics: typical worst-case schedulability analysis

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- April 2014: Eugene Yip (PhD student, U. Auckland) visited Inria Grenoble to work on the semantics of the FOREC PRET programming language (RIPPES associated team).

- April 2014: David Broman (Ass. Prof. KTH Stockholm and UC Berkeley) visited Inria Grenoble to attend the RePP'14 workshop and to work on PRET programming (RIPPES associated team).
- September 2014: Ismail Assayad (Ass. Prof. U. Casablanca) visited Inria Grenoble to work on multi-criteria optimization and scheduling for embedded system.
- September 2014: Lilia Sfaxi (Ass. Prof. ENSI Tunis) and Imen Boudabous (PhD student, ENSI Tunis) visited Inria Grenoble to work on scheduling and energy optimization of data-flow applications on multi-core chips.
- November and December 2014: Partha Roop (Senior Lecturer, U. Auckland) and Hugh Wang (PhD student, U. Auckland) visited Inria Grenoble to work on the FOREC PRET programming language (RIPPES associated team).

8.4.2. Visits to International Teams

- Alain Girault visited UC Berkeley (USA) in February 2014 to work on the parametric dataflow model of computation and on PRET programming (RIPPES associated team).

SPECFUN Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Project **Coquelicot**, funded jointly by the Fondation de Coopération Scientifique "Campus Paris-Saclay" and Digiteo.
Goal: Create a new Coq library for real numbers of mathematics.
Leader: S. Boldo (INRIA Saclay, Toccata). Participant: A. Mahboubi.
Website: http://coquelicot.saclay.inria.fr/.

8.2. National Initiatives

8.2.1. ANR

ParalITP (ANR-11-INSE-001).
Goal: Improve the performances and the ergonomics of interactive provers by taking advantage of modern, parallel hardware.
Leader: B. Wolff (University of Orsay, Paris Paris-Sud). Participants: A. Mahboubi, C. Tankink, E. Tassi.
Website: http://paral-itp.lri.fr/.

FastRelax (ANR-14-CE25-0018).
Goal: Develop computer-aided proofs of numerical values, with certified and reasonably tight error bounds, without sacrificing efficiency.
Leader: B. Salvy (Inria, ÉNS Lyon). Participants: A. Mahboubi, Th. Sibut-Pinote.
Website: http://fastrelax.gforge.inria.fr/.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Claudio Sacerdoti Coen (associate professor at the University of Bologna) has been visiting three times a week during 2014. During his stays he collaborated with Enrico Tassi and Dale Miller (team Parsifal) on the design and implementation of a λ-Prolog-inspired programming language well suited to express type-inference algorithms and their extensions.

Fabian Immler (PhD candidate, TUM, Munich, Germany) is working on the formal certification of properties of differential systems, using the Isabelle proof assistant. He visited us for three days in December.

SPIRALS Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ADT eSurgeon

Participants: Maxime Colmant, Loïc Huertas, Romain Rouvoy [correspondant].

ADT eSurgeon (2013–15) is a technology development initiative supported by the Inria Lille - Nord Europe Center that aims at supporting the development of the POWERAPI software library (see Section 5.3) for measuring and monitoring the energy consumption of middleware and software systems.

8.1.2. ADT Spoon3R

Participants: Gérard Paligot, Martin Monperrus [correspondant].

ADT Spoon3R (2014–16) is a technology development initiative supported by the Inria Lille - Nord Europe Center that aims at supporting the development of the SPOON software library. (see Section 5.5) Spoon3R aims at extending SPOON with the features defined in the context of our research activities on automated software repair.

8.1.3. North European Lab SOCS

Participants: María Gómez Lacruz, Nicolas Haderer, Christophe Ribeiro, Romain Rouvoy [correspondant], Lionel Seinturier.

North European Lab SOCS (2013–15) is an international initiative supported by the Inria Lille - Nord Europe Center that takes place in the context of a well-established collaboration between Inria and *Universitetet i Oslo* (UiO) initiated in 2008. SOCS (Self-Optimization of Cyber-physical Systems) focuses on the self-optimization issues in cyber-physical systems. Cyber-Physical Systems (CPS) are complex systems-of-systems that blend hardware and software to fulfill specific missions. However, traditional CPS are statically configured to achieve predefined goals, which not only limit their sharing and their reuse, but also hinder their sustainability. We believe that this waste of resources stems from the lack of agility of CPS to adapt to change in their environment or objectives. The SOCS Inria Lab takes advantage of the technologies developed as part of the APISENSE® crowdsensing platform (see Section 5.1) to leverage the development of agile CPS.

8.1.4. LEDA

Participant: Philippe Merle [correspondant].

LEDA (2013–16) Laboratoire d'Expérimentation et de Démonstrations Ambiantes is a demonstration space allocated by the Inria Lille - Nord Europe Center whose goal is to show the scientific results of the Spirals team in the domains of distributed systems, adaptable middleware, software product lines, green computing, and ambiant computing. These results are illustrated around the scenario of a mock digital home.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ANR MOANO

Participant: Laurence Duchien [correspondant].

MOANO (Models & Tools for Pervasive Applications focusing on Territory Discovery) is a 46-month project of the ANR CONTINT program which started in December 2010. The partners are LIUPPA/University of Pau and Pays de L'Adour, University of Toulouse/IRIT, University of Grenoble/LIG, University Lille 1/LIFL. While going through a territory, mobile users often encounter problems with their handheld computers/mobiles. Some locally stored data become useless or unnecessary whereas other data is not included in the handheld computer. Some software components, part of the whole applications can become unnecessary to process some information or documents that the user did no plan to manage during his mission. In order to answer such difficulties, our project has three operational studies which are i) to enlarge the communication scale, ii) to provide people without computer-science skills with a toolset that will enable them to produce/configure mapping applications to be hosted on their mobile phone and iii) to process all the documents of interest in order to make their spatial and thematic semantics available to mobile users.

8.2.1.2. ANR YourCast

Participants: Laurence Duchien [correspondant], Clément Quinton, Daniel Romero Acero.

YourCast (Software Product Lines for Broadcasting Systems) is a 36-month ANR Emergence project that started in January 2012 and that involves University of Nice Sophia Antipolis, Valorpaca and University Lille 1. The project aims at defining an information broadcasting system by a dedicated software product line which will be used in schools or events, such as gatherings of scouts.

8.2.2. Competitivity Clusters

8.2.2.1. FUI Hermes

Participants: Laurence Duchien, Romain Rouvoy, Lionel Seinturier [correspondant].

Hermes is a 41-month project funded by FUI and labelized by the PICOM (Pôle des Industries du COMmerce) competitivity cluster which has started in August 2012. The goal of the project is to define a modular and context-aware marketing platform for the retail industry. The focus is put on the interactions with customers in order to extract and mine relevant informations related to shopping habits, and on a multi-device, cross-canal, approach to better match customer usages.

8.2.3. Programme Investissement d'Avenir (PIA)

8.2.3.1. PIA Datalyse

Participants: Filip Krikava, Romain Rouvoy, Lionel Seinturier [correspondant], Bo Zhang.

Datalyse is a 36-month project of the Programme Investissement d'Avenir Cloud Computing 3rd call for projects. The project started in May 2013. The partners are Business & Decision Eolas, Groupement des Mousquetaires, Université Grenoble 1, Université Lille 1, Inria, Université Montpellier 2. The project aims at defining an elastic cloud computing infrastructure for processing big volumes of data. The originality of the project is to consider jointly data generated by users and by the infrastructure, and to correlate data at these two levels.

8.2.3.2. PIA OCCIware

Participants: Romain Rouvoy, Philippe Merle [correspondant], Lionel Seinturier.

OCCIware is a 36-month project of the Programme Investissement d'Avenir Cloud Computing and Big Data 4th call for projects. The project started in Decembre 2014. The partners are Open Wide (leader), ActiveEon SA, CSRT, Institut Mines-Télécom/Télécom SudParis, Inria, Linagora GSO, Obeo, OW2 Consortium, Pôle Numérique, and Université Joseph Fourier - Grenoble. The project aims at defining a formal framework for managing every digital resources in the clouds, based on Open Cloud Computing Interface (OCCI) recommendations from Open Grid Forum (OGF).

8.2.4. Inria National Initiatives

8.2.4.1. Inria ADT AntDroid

Participants: María Gómez Lacruz, Nicolas Haderer, Christophe Ribeiro, Romain Rouvoy [correspondant].

ADT AntDroid (2012–14) is a technology development initiative supported by Inria that aims at pushing the results of Nicolas Haderer PhD thesis [12] into production. AntDroid therefore focuses on deploying and disseminating the APISENSE® crowdsensing platform (see Section 5.1) to the public and to support the users of the platform.

8.2.4.2. Inria ADT Focus CrowdLab

Participants: Clive Ferret-Canape, Julien Duribreux, María Gómez Lacruz, Christophe Ribeiro, Romain Rouvoy [correspondant], Antoine Veuiller.

The purpose of the ADT Focus CrowdLab (2014–2016) is to strengthen the technological part of the Metroscope consortium and to promote the APISENSE® crowdsensing platform (see Section 5.1) as a reference platform fo gathering mobile data within the scientific community. The CrowdLab project focuses on three stringent goals: (1) consolidating the current technological solutions, (2) technical and logistical support of the research activities initiated in different scientific domains, and (3) the improvement of security and anonymity of collected data. In addition to the Metroscope consortium, the Inria research teams participating of the ADT Focus CrowdLab project are: Spirals (coordinator), Madynes, Diana, Muse.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

Program: FP7 ICT.

Project acronym: PaaSage.

Project title: Model Based Cloud Platform Upperware.

Duration: October 2012–September 2016.

Coordinator: ERCIM.

Other partners: ERCIM (Fr), SINTEF (No), STFC (UK), U. of Stuttgart (De), Inria (Fr), CETIC (Be), FORTH (El), Be.Wan (Be), EVRY Solutions (No), SysFera (Fr), Flexiant (UK), Lufthansa Systems AG (De), Gesellschaft fur wissenschaftliche Datenverarbeitung mbh Gottingen (De), Automotive Simulation Center Stuttgart (De).

Abstract: Cloud computing is a popular and over-hyped concept in ICT. The concept of infinitely scalable elastic resources changing without complex systems administration and paying only for resources used is attractive. These benefits are not immediately realizable. Within organisation benefits are realizable at considerable cost. IaaS (*Infrastructure-as-a-Service*) public Clouds have different interfaces and conditions of use thus for an organisation to "scale out" requires considerable investment using skilled technical staff. The business need is to allow organisations to "scale out" from their private Cloud to public Clouds without a technical chasm between. This cannot easily be achieved. Aligned with the EU strategic direction of an open market for services, SOA (*Service-Oriented architecture*) offers a way to virtualize across heterogeneous public Clouds and organizational private Clouds. It opens a market for European SMEs to provide services to be utilized (and paid for) by business applications and for all organisations to benefit from a catalogue of services that can be used across the environment. PaaSage will deliver an open and integrated platform, to support both deployment and design of Cloud applications, together with an accompanying methodology that allows model-based development, configuration, optimisation, and deployment of existing and new applications independently of the existing underlying Cloud infrastructures. Specifically it will deliver an IDE (*Integrated Development Environment*) incorporating modules for design time and execution time optimisation of applications specified in the Cloud Modeling Language (Cloud ML), execution-level mappers and interfaces and a metadata database.

Participants: Laurence Duchien, Clément Quinton, Daniel Romero Acero [correspondant], Romain Rouvoy, Lionel Seinturier.

Program: FP7 FET.

Project acronym: DIVERSIFY.

Project title: More software diversity. More adaptivity in CAS.

Duration: 36 months (2013-16).

Coordinator: Inria.

Other partners: SINTEF (Norway), Trinity College Dublin (Ireland), University of Rennes 1 (France).

Abstract: DIVERSIFY explores diversity as the foundation for a novel software design principle and increased adaptive capacities in CASs (*Collective Adaptive Systems*). Higher levels of diversity in the system provide a pool of software solutions that can eventually be used to adapt to unforeseen situations at design time. The scientific development of DIVERSIFY is based on a strong analogy with ecological systems, biodiversity, and evolutionary ecology. DIVERSIFY brings together researchers from the domains of software-intensive distributed systems and ecology in order to translate ecological concepts and processes into software design principles.

Participants: Martin Monperrus [correspondant], Matias Martinez.

8.4. International Initiatives

8.4.1. Inria Associate Teams

Title: Service-Oriented Architecture anti-patterns in Mobile and Cloud Applications (SOMCA).

Inria principal investigator: Romain Rouvoy.

International Partner (Institution - Laboratory - Researcher):

Université du Québec à Montréal (Canada) - LATECE Laboratory

Duration: 2014–2016.

See also: http://seas.ifi.uio.no.

The long-term goal of this research program is to propose a novel and innovative methodology embodied in a software platform, to support the runtime detection and correction of anti-patterns in large-scale service-oriented distributed systems in order to continuously optimize their quality of service. One originality of this program lies in the dynamic nature of service-oriented environments, the application on emerging frameworks for embedded and distributed systems (e.g., Android/iOS for mobile devices, PaaS/SaaS for Cloud environments), and in particular mobile systems interacting with remote services hosted on the Cloud. To achieve this goal, we propose to follow a three-step methodology targeting three objectives: (1) Identify and specify service-oriented anti-patterns, (2) Develop an approach to detect automatically, at runtime, service-oriented anti-patterns, (3) Develop an approach to suggest refactorings and automatically, at runtime, correct service-oriented anti-patterns. The ongoing PhD thesis of Geoffrey Hecht, in co-supervision between Montréal and Lille, is part of this associated team.

Participants: Laurence Duchien, María Gómez Lacruz, Geoffrey Hecht, Philippe Merle, Romain Rouvoy [correspondant], Lionel Seinturier.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

8.4.2.1.1. University of Los Andes, Bogota, Colombia

We have a long term collaboration since 2005 with this university. Over the years, four PhD thesis (Carlos Noguera, Carlos Parra, Daniel Romero Acero, Gabriel Tamura) have been defended in our team with students who obtained their MSc in this university. The first three were full French PhD, whereas the last one was a co-tutelle with this university. Professor Rubby Casallas from University of Los Andes is frequently visiting our team. The most recently defended PhD thesis, that of Gabriel Tamura, deals with QoS (quality-of-service) contract preservation in distributed service-oriented architectures. A formal theory to perform, in a safe way, the process of self-adaptation in response to quality-of-service (QoS) contracts violation has been proposed. The results have been published in [121], [119] and in the PhD thesis document itself [118].

Participants: Laurence Duchien [correspondant], Clément Quinton, Daniel Romero Acero, Romain Rouvoy, Lionel Seinturier.

8.4.2.1.2. University of Oslo, Norway

The scientific collaboration with this international partner deals with complex distributed systems that have to seamlessly adapt to a wide variety of deployment targets. This is due to the fact that developers cannot anticipate all the runtime conditions under which these systems are immersed. A major challenge for these software systems is to develop their capability to continuously reason about themselves and to take appropriate decisions and actions on the optimizations they can apply to improve themselves. This challenge encompasses research contributions in different areas, from environmental monitoring to real-time symptoms diagnosis, to automated decision making. The collaboration has been supported by the SEAS Inria associated team (2012-14).

Participants: María Gómez Lacruz, Nicolas Haderer, Daniel Romero Acero, Romain Rouvoy [correspondant], Lionel Seinturier.

8.4.3. Participation In Other International Programs

8.4.3.1. OW2

Participants: Philippe Merle [correspondant], Fawaz Paraiso, Romain Rouvoy, Lionel Seinturier.

OW2, previously ObjectWeb, is an international consortium to promote high quality open source middleware. The vision of OW2 is that of a set of components which can be assembled to offer high-quality middleware systems. We are members of this consortium since 2002. Philippe Merle is the leader of both FRACTAL and FRASCATI projects, which are hosted by this consortium. Philippe Merle and Lionel Seinturier are members of the Technology Council of OW2.

8.4.3.2. ERCIM Working Group on Software Evolution

Participant: Laurence Duchien [correspondant].

The Working Group (WG) on Software Evolution is one of the working groups supported by ERCIM. The main goal of the WG is to identify a set of formally-founded techniques and associated tools to support software developers with the common problems they encounter when evolving large and complex software systems. With this initiative, the WG plans to become a Virtual European Research and Training Centre on Software Evolution.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Participant: Earl Barr.
Subject: Anti-fragility of Software Systems
Date: June 2014
Institution: University College London (UK)

8.5.1.1. Internships

Sebastian Lamelas Marcote
Subject: Automatic Software Repair
Date: from May 2014 until Oct 2014
Institution: University of Buenos Aires (Argentina)

Carolina Valdez Gandara
Subject: SmartGate: An Android-based Gateway for the Internet of Things
Date: from May 2014 until Nov 2014
Institution: University of Central Buenos Aires (Argentina)

Mohamed Lamine Berkane
Subject: Advanced Modularity Concepts in Distributed Applications
Date: from Jan 2014 until Sep 2014
Institution: University Constantine 2 (Algeria)

STARS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. MOVEMENT

Program: ANR CSOSG

Project acronym: MOVEMENT

Project title: AutoMatic BiOmetric Verification and PersonnEl Tracking for SeaMless Airport ArEas Security MaNagemenT

Duration: January 2014-June 2017

Coordinator: MORPHO (FR)

Other partners: SAGEM (FR), Inria Sophia-Antipolis (FR), EGIDIUM (FR), EVITECH (FR) and CERAPS (FR)

Abstract: MOVEMENT is focusing on the management of security zones in the non public airport areas. These areas, with a restricted access, are dedicated to service activities such as maintenance, aircraft ground handling, airfreight activities, etc. In these areas, personnel movements tracking and traceability have to be improved in order to facilitate their passage through the different areas, while insuring a high level of security to prevent any unauthorized access. MOVEMENT aims at proposing a new concept for the airport's non public security zones (e.g.customs control rooms or luggage loading/unloading areas) management along with the development of an innovative supervision system prototype.

8.1.1.2. SafEE

Program: ANR TESCAN

Project acronym: SafEE

Project title: Safe & Easy Environment for Alzheimer Disease and related disorders

Duration: December 2013-May 2017

Coordinator: CHU Nice

Other partners: Nice Hospital(FR), Nice University (CobTeck FR), Inria Sophia-Antipolis (FR), Aromatherapeutics (FR), SolarGames(FR), Taichung Veterans General Hospital TVGH (TW), NCKU Hospital(TW), SMILE Lab at National Cheng Kung University NCKU (TW), BDE (TW)

Abstract: SafEE project aims at investigating technologies for stimulation and intervention for Alzheimer patients. More precisely, the main goals are: (1) to focus on specific clinical targets in three domains behavior, motricity and cognition (2) to merge assessment and non pharmacological help/intervention and (3) to propose easy ICT device solutions for the end users. In this project, experimental studies will be conducted both in France (at Hospital and Nursery Home) and in Taiwan.

8.1.2. Investment of Future

8.1.2.1. Az@GAME

Program: DGCIS

Project acronym: Az@GAME

Project title: un outil d'aide au diagnostic médical sur l'évolution de la maladie d'Alzheimer et les pathologies assimilées.

Duration: January 2012- December 2015

Coordinator: Groupe Genious

Other partners: IDATE (FR), Inria(Stars), CMRR (CHU Nice) and CobTek(Nice University).

See also: http://www.azagame.fr/

Abstract: This French project aims at providing evidence concerning the interest of serious games to design non pharmacological approaches to prevent dementia patients from behavioural disturbances, most particularly for the stimulation of apathy.

8.1.3. Large Scale Inria Initiative

8.1.3.1. PAL

Program: Inria

Project acronym: PAL

Project title: Personally Assisted Living

Duration: 2010 -2014

Coordinator: COPRIN team

Other partners: AROBAS, DEMAR, E-MOTION, STARS, PRIMA, MAIA, TRIO, and LAGADIC Inria teams

See also: http://www-sop.inria.fr/coprin/aen/

Abstract: The objective of this project is to create a research infrastructure that will enable experiments with technologies for improving the quality of life for persons who have suffered a loss of autonomy through age, illness or accident. In particular, the project seeks to enable development of technologies that can provide services for elderly and fragile persons, as well as their immediate family, caregivers and social groups.

8.1.4. Other Collaborations

- G. Charpiat works with Yann Ollivier and Jamal Atif (TAO team) as well as Rémi Peyre (École des Mines de Nancy / Institut Élie Cartan) on the topic of image compression.
- G. Charpiat works with Giacomo Nardi, Gabriel Peyré and François-Xavier Vialard (Ceremade, Paris-Dauphine University) on the generalization of gradient flows to non-standard metrics.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. CENTAUR

Type: FP7

Defi: Computer vision

Instrument: Industry-Academia Partnerships and Pathway

Objective: a network of scientific excellence addressing research topics in computer vision

Duration: January 2013 - December 2016

Coordinator: Honeywell (CZE)

Partner: Neovison (CZE), Inria Sophia-Antipolis (CZE), Queen Mary University of London (UK) and EPFL in Lausanne (CH).

Inria contact: François Brémond

Abstract: CENTAUR aims at developing a network of scientific excellence addressing research topics in computer vision and advancing the state of the art in video surveillance. The cross fertilization of ideas and technology between academia, research institutions and industry will lay the foundations to new methodologies and commercial solutions for monitoring crowded scenes.Three thrusts identified will enable the monitoring of crowded scenes: (a) multi camera, multicoverage tracking of objects of interest, (b) Anomaly detection and fusion of multimodal sensors, c) activity recognition and behavior analysis in crowded environments.

8.2.1.2. PANORAMA

Type: FP7

Defi: Computer vision

Instrument: Industry-Academia Partnerships and Pathway

Objective: techniques and architectures for imaging applications

Duration: April 2012 - March 2015

Coordinator: Philips Healthcare (NL)

Partner :Medisys (FR), Grass Valley (NL), Bosch Security Systems (NL), STMicroelectronics (FR), Thales Angenieux (FR), CapnaDST (UK), CMOSIS (BE), CycloMedia (Netherlands), Q-Free (Netherlands), TU Eindhoven (NL) , University of Leeds (UK), University of Catania (IT), Inria(France), ARMINES (France), IBBT (Belgium).

Inria contact: François Brémond

Abstract: PANORAMA aims to research, develop and demonstrate generic breakthrough technologies and hardware architectures for a broad range of imaging applications. For example, object segmentation is a basic building block of many intermediate and low level image analysis methods. In broadcast applications, segmentation can find people's faces and optimize exposure, noise reduction and color processing for those faces; even more importantly, in a multi-camera set-up these imaging parameters can then be optimized to provide a consistent display of faces (e.g., matching colors) or other regions of interest. PANORAMA will deliver solutions for applications in medical imaging, broadcasting systems and security & surveillance, all of which face similar challenging issues in the real time handling and processing of large volumes of image data. These solutions require the development of imaging sensors with higher resolutions and new pixel architectures. Furthermore, integrated high performance computing hardware will be needed to allow for the real time image processing and system control. The related ENIAC work program domains and Grand Challenges are Health and Ageing Society - Hospital Healthcare, Communication & Digital Lifestyles - Evolution to a digital lifestyle and Safety & Security - GC Consumers and Citizens security (see also: http://www.panorama-project.eu/).

8.2.1.3. SUPPORT

Title: Security UPgrade for PORTs

Type: FP7

Defi: Port Security

Instrument: Industry-Academia Partnerships and Pathway

Objective: secure European ports

Duration: July 2010 - June 2014

Coordinator: BMT Group (UK)

Other partners: Inria Sophia-Antipolis (FR); Swedish Defence Research Agency (SE); Securitas (SE); Technical Research Centre of Finland (FI); MARLO (NO); INLECOM Systems (UK).

Inria contact: François Brémond

Abstract: SUPPORT is addressing potential threats on passenger life and the potential for crippling economic damage arising from intentional unlawful attacks on port facilities, by engaging representative stakeholders to guide the development of next generation solutions for upgraded preventive and remedial security capabilities in European ports. The overall benefit will be the secure and efficient operation of European ports enabling uninterrupted flows of cargos and passengers while suppressing attacks on high value port facilities, illegal immigration and trafficking of drugs, weapons and illicit substances all in line with the efforts of FRONTEX and EU member states.

8.2.1.4. Dem@Care

Title: Dementia Ambient Care: Multi-Sensing Monitoring for Intelligent Remote Management and Decision Support

Type: FP7

Defi: Cognitive Systems and Robotics

Instrument: Industry-Academia Partnerships and Pathway

Objective: development of a complete system providing personal health services to persons with dementia

Duration: November 2011-November 2015

Coordinator: Centre for Research and Technology Hellas (G)

Other partners: Inria Sophia-Antipolis (FR); University of Bordeaux 1(FR); Cassidian (FR), Nice Hospital (FR), LinkCareServices (FR), Lulea Tekniska Universitet (SE); Dublin City University (IE); IBM Israel (IL); Philips (NL); Vistek ISRA Vision (TR).

Inria contact: François Brémond

Abstract: The objective of Dem@Care is the development of a complete system providing personal health services to persons with dementia, as well as medical professionals, by using a multitude of sensors, for context-aware, multiparametric monitoring of lifestyle, ambient environment, and health parameters. Multisensor data analysis, combined with intelligent decision making mechanisms, will allow an accurate representation of the person's current status and will provide the appropriate feedback, both to the person and the associated medical professionals. Multi-parametric monitoring of daily activities, lifestyle, behaviour, in combination with medical data, can provide clinicians with a comprehensive image of the person's condition and its progression, without their being physically present, allowing remote care of their condition.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

8.3.1.1.1. Collaborations with Asia:

Stars has been cooperating with the Multimedia Research Center in Hanoi MICA on semantics extraction from multimedia data. Stars also collaborates with the National Cheng Kung University in Taiwan and I2R in Singapore.

8.3.1.1.2. Collaboration with U.S.A.:

Stars collaborates with the University of Southern California.

8.3.1.1.3. Collaboration with Europe:

Stars collaborates with Multitel in Belgium, the University of Kingston upon Thames UK, and the University of Bergen in Norway.

8.3.2. Participation in Other International Programs

- The ANR SafEE (see section 8.1.1.2 collaborates with international partners as Taichung Veterans General Hospital TVGH (TW), NCKU Hospital(TW), SMILE Lab at National Cheng Kung University NCKU (TW) and BDE (TW).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

ABDALLA OMAR
Date: from Apr 2014 until Sep 2014
Institution: Université Française du Caire (Egypt)

BOUATIRA Mohamed
Date: from Mar 2014 until Sep 2014
Institution: Ecole Mohammadia d'Ingénieurs (Marocco)

CAVERZASI Augustin
Date: until Feb 2014
Institution: Universidad Nacional de Córdoba, Facultad de Ciencias Exactas Físicas y Naturales, Argentina

GOMEZ URIA COVELLA Alvaro
Date: from Mar 2014 until Dec 2014
Institution: National University of Rosario, Argentina

MARTINS DE MELO Filipe
Date: from Apr 2014 until Sep 2014
Institution: Federal University of Penambucco, Brazil

NEGIN Farood
Date: from Apr 2014 until Nov 2014
Institution: Sabanci University, Turkey

NGUYEN Thi Lan Anh
Date: from Mar 2014 until Oct 2014
Institution: Dhai Nguyen Uiversity of Information and Communication Technology, Vietnam

PHAM Ngoc Hai
Date: from May 2014 until Nov 2014
Institution: Science and Technologu University of Hanoi, Vietnam

PUSIOL Pablo Daniel
Date: from Apr 2014 until Sep 2014
Institution: National University of Cordoba, Argentina

SARRAY Ines
Date: Apr 2014 - Oct 2014
Institution: ESPRIT (Ecole d'ingénieurs Tunis) (Tunisia)

STRUMIA Carola
Date: from Oct 2014
Institution: University of Genova, Italy

SUBRAMANIAN Kartick
Date: until August 2014
Institution: Nanyang Technological University, Singapore

ZHOU Kouhua
Date: from Jul 2014 until Sep 2014
Institution: Polytech University of Dalan, China

STEEP Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

In 2012, we started an informal collaboration with Serge Fenet from the University of Lyon (LIRIS lab), which among others accompanied Brindusa Smaranda's MSc thesis. In 2013, a project we submitted to the IXXI Complex Systems Institute of the Rhône-Alps region, together with the CERAG lab, was accepted. The project is about modeling and data mining applied to territorial ecology.

8.2. National Initiatives

8.2.1. ANR

CITiES (*Calibrage et valIdation de modèles Transport - usagE des Sols*)
Program: "*Modèles Numériques*" 2012, ANR
Duration: 2013 – 2016
Coordinator: Emmanuel Prados (STEEP)
Other partners: LET, IDDRI, IRTES-SET ("Systemes and Transports" lab of Univ. of Tech. of Belfort-Montbéliard), IFSTTAR-DEST Paris (formerly INRETS), LVMT ("*Laboratoire Ville Mobilité Transport*", Marne la Vallée), VINCI (Pirandello Ingenierie, Paris), IAU Île-De-France (Urban Agency of Paris), AURG (Urban Agency of Grenoble), MOISE (Inria project-team)
Abstract: Calibration and validation of transport and land use models.

8.2.2. FRB (Fondation pour la Recherche sur la Biodiversité)

ESNET (Futures of ecosystem services networks for the Grenoble region)
Program: "Modeling and Scenarios of Biodiversity" flagship program, Fondation pour la Recherche sur la Biodiversité (FRB). This project is funded by ONEMA (*Office National de l'Eau et des Milieux Aquatiques*).
Duration: 2013 – 2016
Coordinator: Sandra Lavorel (LECA)
Other partners: EDDEN (UPMF/CNRS), IRSTEA Grenoble (formerly CEMAGREF), PACTE (UJF/CNRS), ERIC (Lyon 2/CNRS)
Abstract: This project explores alternative futures of ecosystem services under combined scenarios of land-use and climate change for the Grenoble urban area in the French Alps. In this project, STEEP works in particular on the modeling of the land use and land cover changes, and to a smaller extent on the interaction of these changes with some specific services.

8.3. International Initiatives

8.3.1. Participation In other International Programs

TRACER (*TRANUS, analyse de la calibration et des erreurs, retours sur Grenoble et Caracas*)
Program: Ecos-NORD
Duration: 2012 – 2014
Coordinator: Mathieu Saujot (IDDRI)
Other partners: University of Caracas (Venezuela)

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Brian Morton

Date: May 2014 - Jul 2014

Institution: University of North Carolina at Chapel Hill (USA)

8.4.1.1. Internships

Jayasi Mehar

Date: May 2014 - Jul 2014

Institution: IIIT-D (Inde)

Solange Blundi

Date: Jul 2014 - Jan 2015

Institution: Universidad de Buenos Aires (Argentina)

Luciano Gervasoni

Date: Jun 2014 - Dec 2014

Institution: Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina)

Patricio Inzaghi

Date: Jul 2014 - Jan 2015

Institution: Universidad de Buenos Aires (Argentina)

Abdelrahman Ahmed Mohamed

Date: Mar 2014 - Jul 2014

Institution: Nile University (Egypt)

Iman Boukhriss

Date: Mar 2014 - Aug 2014

Institution: INSA (Lyon)

SUMO Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

ANR VACSIM: Validation of critical control-command systems by coupling simulation and formal analysis, 2011-2015, web site
Partners: EDF R&D, Dassault Systèmes, LURPA, I3S, LaBRI, and Inria SUMO.
The project aims at developing both methodological and formal contributions for the simulation and validation of control-command systems. SUMO contributes to quantitative analysis and its application to testing, monitoring of timed systems, and verification of communicating timed automata.

ANR Ctrl-Green: Autonomic management of green data centers, 2011-2014, web site
Partners: UJF/LIG, INPT/IRIT, Inria SUMO, EOLAS, Scalagent.
This project aims at developing techniques for the automatic optimal management of reconfigurable systems in the context of data centers using discrete controller synthesis methodology applied in the synchronous paradigm.

ANR ImpRo: Implementability and Robustness of Timed Systems, 2010-2014, web site
Partners: IRCCyN, LIP6, LSV, LIAFA, LIF, and Inria SUMO.
This project addresses the issues related to the practical implementation of formal models for the design of communicating embedded systems: such models abstract many complex features or limitations of the execution environment. The modeling of time, in particular, is usually ideal, with infinitely precise clocks, instantaneous tests or mode commutations, etc. Our objective is thus to study to what extent the practical implementation of these models preserves good properties that are satisfied by idealized models. Within ImpRo, members of SUMO mainly focus on robustness issues for timed models (timed automata, timed Petri nets,...), and diagnosis.

ANR STOCH-MC: Model-Checking of Stochastic Systems using approximated algorithms, 2014-2018, web site.
Led by SUMO.
Partners: Inria Project Team CONTRAINTES (Rocquencourt), LaBRI (Bordeaux), and LIAFA (Paris).
The aim of STOCH-MC is to perform model-checking of large stochastic systems, using controlled approximations. Two formalisms will be considered: Dynamic Bayesian Networks, which represent compactly large Markov Chains; and Markov Decision Processes, allowing non deterministic choices on top of probabilities.

8.1.2. National informal collaborations

We collaborate with Yliès Falcone (VaSCO - LIG) and Antoine Rollet (Labri) on the enforcement of timed properties.

We collaborate with Arnaud Sangnier (LIAFA) on the parameterized verification of probabilistic systems.

8.2. International Initiatives

8.2.1. Inria International Labs

Eric Badouel is member of the team Aloco (Architecture logicielle à composants) of LIRIMA, the Inria International Lab in Africa. This collaboration is on the development of artifact-centric business process models.

8.2.2. Inria Associate Teams

DISTOL (web site) is a joint project between the SUMO Team at Inria Rennes, the LogicA team at IRISA Rennes, the Chennai Mathematical Institute, the Institute of Mathematical Sciences at Chennai and the National University of Singapore.

The DISTOL project (Distributed systems, stochastic models and logics) aims at gathering researchers from Inria Rennes, two institutes in Chennai, India (CMI and IMSC) and National University of Singapore, working on formal modeling and verification of distributed systems. This project covers four main research directions. Each of these directions rely on specific and complementary competences:

- Robustness and time issues in distributed systems models (members of SUMO consider this problem with the Chennai Mathematical Institute)
- Applications of formal models & techniques to Web Services (members of SUMO consider this problem with the Chennai Mathematical Institute)
- Quantitative verification for distributed systems (members of SUMO consider this problem with researchers at NUS)
- Unification of Control Theory of Distributed Systems (This part is mainly addressed by the LogicA team in collaboration with the Institute of Mathematical Sciences)

8.2.3. Inria International Partners

8.2.3.1. Informal International Partners

We have long lasting relations with indian labs : The Chennai Mathematical Institute in Chennai (M. Mukund, N. Kumar), the Institute for Mathematical Sciences in Chennai (R. Ramanujam, K. Lodaya). We are extending these relations in India. S. Akshay holds a permanent position in IIT Bombay after his postdoc at IRISA. Our relation with our Indian partners has been formalized as associated teams (currently EA DISTOL 2012-2015).

We have started a collaboration with J. Mullins from Université Polytechnique de Montréal. The main theme of this collaboration is security properties in concurrency models. We have submitted a joint paper of variants of interference properties (information leakage) for partial order models.

We collaborate with Laurie Ricker (Mount Allison University, Canada) on the control of distributed systems and the enforcement of opacity.

8.2.4. Participation In other International Programs

AVeRTS is an Indo-French project on the algorithmic verification of real-time systems. The project is funded by CNRS on the french side, and by DST on the Indian side, under the CEFIPRA - Indo-French Program in ICST 2014-2016. From SUMO, Nathalie Bertrand and Blaise Genest are involved and contribute on stochastic timed games.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

This year, S. Akshay, from IIT Bombay visited us for a one month stay, from end of May to July. This visit was funded by Rennes 1 University. During this visit, he has worked with B. Genest and L. Hélouët on verification of extensions of Petri nets calle time Petri nets with restricted urgency, that can be used to model communication systems with threshold and latency in messages. The work performed this summer is currently under submission.

Christel Baier, professor at Dresden University, was also invited for a 2-week stay paid by Rennes 1 University. She has worked during her visit with N. Bertrand on long-run quantiles in Markov decision processes.

Doron Peled visited our team for a total duration of a month in Spring 2014. He worked with B. Genest on knowledge computation in distributed systems, a work currently under review.

Valentin Goranko, professor at Stockholm University, was invited for a 2-week stay paid by Rennes 1 University. He has worked during his visit with C. Morvan on first order properties of Rational Graphs.

Laurie Ricker (Mount Allison University) visited us during for 2 months [Mai-June 2014] on the control of distributed systems and the enforcement of opacity.

Robert Nsaibirni (University of Yaoundé) visited SUMO from July to August 2014 on the use of the Guarded Attribute Grammar formalism for the description of the workspaces of actors of a disease surveillance system.

8.3.1.1. Internships

Rishika Garg

Date: May 2014 - Jul 2014

Institution: IIT Kampur (India)

Engel Lefaucheux

Date: March 2014 - July 2014

Institution: ENS Cachan (France)

Ayush Maheshwari

Date: May 2014 - July 2014

Institution: IIT Kanpur (India)

Maroua Maalej

Date: Apr 2014 - July 2014

Institution: ENSI Tunis (Tunisia)

Sanaa Mairouch

Date: May 2014 - Aug 2014

Institution: ISTIC (France)

Aminatou Mohamadou

Date: Jun 2014 - July 2014

Institution: ISTIC (France)

Dhananjay Raju

Date: March 2014 - July 2014

Institution: CMI (India)

8.3.1.2. Research stays abroad

N. Bertrand spent two visits of one month each at Mons University (Belgium), pursuing a collaboration with Thomas Brihaye, and funded by the FNRS. The resulting work on stochastic timed automata with decisions was presented at the QEST conference [29].

TACOMA Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Pervasive_RFID

- Partner: IETR
- Starting: July 2013; ending: July 2016

Pervasive_RFID is a joint effort (within the CominLabs initiative, see http://www.cominlabs.ueb.eu/) started in July 2013 with IETR (institut d'électronique et de télécommunications de Rennes) to study and design innovative RFID reading protocols in the context of pervasive computing applications. Some limitations of existing RFID technology become challenging: unlike standard RFID application scenarios, pervasive computing often involves uncontrolled environment for RFID, where tags and reader have to operate in much more difficult situations that those usually encountered or expected for classical RFID systems.

7.1.2. GLIE - Guidage Lumineux par l'Intelligence de l'Environnement

- Partner: OyaLight
- Starting: December 2014; ending: December 2015

GLIE is a collaborative projet with OYALIGT and TACOMA group. The objective of the project is to design and demonstrate a new service combining connected LEDs provided by OYALIGHT and a software tool developed by TACOMA. By integrating and analyzing data transmitted by the sensors integrated into LEDs , the service must be able to detect a given context and to react accordingly.

TAO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **TIMCO (Technology for In Memory Computing applications)** FUI Project – 2012-2015 (432 kEuros)
  Coordinator: Bull SA
  Participants: Cécile GERMAIN(WP Algorithm adaptation: the paradigm shif coordinator)
- **ROM - Réduction de modèles et optmisisation multiphysiques** – 2014 (73 kEuros).
  Coordinator: IRT System X
  Participants: Marc Schoneuaer, François Gonard (PhD)
- **ISN** – 2013-2016 (105 kEuros).
  Related to Thomas Schmitt's PhD - A Collaborative Filtering Approach to Matching Job Openings and Job Seekers
  Participants: Michèle Sebag, Thomas Schmitt
- **AutoML - An empirical approach to Machine Learning** – 2014-2017 (104 kEuros).
  Related to Sourava Mishra's PhD.
  Participants: Michèle Sebag, Balazs Kégl, Sourava Mishra

8.2. National Initiatives

- **SIMINOLE** – 2010-2014 (1180kEuros, 250kEuros for TAO). Large-scale simulation-based probabilistic inference, optimization, and discriminative learning with applications in experimental physics, ANR project, Coordinator B. Kégl (CNRS LAL).

  Participants: Balázs Kégl, Nikolaus Hansen, Emmanuel Benazera, Michèle Sebag, Cécile Germain-Renaud
- **NUMBBO** – 2012-2016 (290kEuros for TAO). Analysis, Improvement and Evaluation of Numerical Blackbox Optimizers, ANR project, Coordinator Anne Auger, Inria. Other partners: Dolphin, Inria Lille, Ecole des Mines de Saint-Etienne, TU Dortmund
  Participants: Anne Auger, Nikolaus Hansen, Marc Schoenauer, Ouassim Ait ElHara
- **LOGIMA** – 2012-2016 (136kEuros for TAO). Logics, structural representations, mathematical morphology and uncertainty for semantic interpretation of images and videos, ANR project, Coordinator Céline Hudelot, MAS-ECP. Other partners: TAO , LTCI-Telecom ParisTech
  Local coordinator: Jamal Atif
- **ACTEUR** – 2014-2018 (236kEuros). Cognitive agent development for urban simulations, ANR project, Coordinator P. Taillandier (IDEES, Univ Rouen).

  Participants: Philippe Caillou

8.2.1. Other

- **POST** – 2014-2018 (1,220 MEuros, including 500 kEuros for a 'private' cluster). Platform for the optimization and simulation of trans-continental grids
  ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie)
  Coordinator: ARTELYS
  Participants: Olivier Teytaud, Marie-Liesse Cauwet, Jérémie Decock, Sandra Cecilia Astete Morales, David L. Saint-Pierre, J. Decock

- **E-LUCID** 2014-2017 (194 kEuros)
  Coordinator: Thales Communications & Security S.A.S
  Participants: Marc Schoenauer, Cyril Furtlehner

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. CitInES

Type: FP7

Defi: ICT for a low carbon economy

Instrument: Specific Targeted Research Project

Objectif: ICT systems for energy efficiency

Duration: October 2011 - March 2014

Coordinator: Artelys

Partners: Artelys (SME, France), Inria (Tao), AIT (Austria), Tupras (4 refineries, Turkey), Cesena (City, Italy), Ervet (Italy), Inesc-Porto (Portugal), Armines (France), Bologna (City, Italy)

Inria contact: Olivier Teytaud

Abstract: Design of a decision support tool for sustainable, reliable and cost-effective energy strategies in cities and industrial complexes

8.3.1.2. EGI-Inspire

Type: FP7

Defi: e-Infrastructure

Instrument: CP-CSA

Objectif: Integrated Sustainable Pan-European Infrastructure for Researchers in Europe

Duration: May 2010 - April 2014

Coordinator: EGI.eu foundation

Partner: Université Paris XI (France)

Inria contact: Cécile Germain-Renaud

Abstract: To support European science and innovation, a longer lasting operational model is now needed - both for coordinating the infrastructure itself and for delivering integrated services that cross national borders.The EGI-InSPIRE project will support the transition from a project-based system to a sustainable pan-European e-Infrastructure.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. INDEMA

Title: Intelligent Decision Making Mechanisms with Hidden Information, and Application to El ectricity Generation

International Partner (Institution - Laboratory - Researcher):

NUTN (TAIWAN)

Duration: 2012 - 2014

See also: http://www.lri.fr/~teytaud/indema.html

The objective of the project is three-fold:

- Objective 1: Designing consistent iterative realistic algorithms for partially observable 1-player or 2-player games.
  • Consistent algorithms (provably, asymptotically optimal in the computation time).
  • Iterative a.k.a. anytime algorithms, improving its results as the computational time allowed increases and requiring little time to yield a decent answer. Most algorithms which survive decades are iterative.
  • Realistic algorithms, i.e. suited to real-world settings.
- Objective 2: Impressive visible applications, e.g. applications in games or puzzles, such as Minesweeper (on which we believe that much progress is still possible), Chinese Dark Chess, Kriegspiel, Phantom-Go, or card games. Games and puzzles offer nice frameworks to assess and make our research highly visible.
- Objective 3: Big industrial applications. Having both mathematics and visible realizations in games and industrial applications might be considered as too ambitious. Yet, our strategy is to tackle e.g. the field of energy generation because: i) it is close from our past activities (thus reducing the warm-up time), yet with a new challenge, partial observability; ii) in real applications, many problems are simplified so that they boil down to fully observable problems, (e.g. through including tricks in the solvers); iii) our former achievements facilitate our contact with industry. Formally, we assume that mathematical analysis can be done on this (objective 1); that it will provide big results in games (objective 2) where many main programs are based on non-consistent algorithms; that these results will translate to real-world application.
  Our roadmap is:
  • Check on simple versions of energy production problems whether the fully observable approximation holds true. We guess that in many cases it does not; the next point is to assess the loss of performance incurred;
  • Experiment our algorithms on real industrial problems, considering both Taiwan-centered and Europe-Centered electricity generation problems in order to widen the scope of the analysis, enforcing the applicability of the approach.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

- Shinshu University (Professor Akimoto, Professor Tanaka, Professor Aguire). Partnership officialized via MOU signature between Inria and Shinshu University. Joint project funded by the Japanese governement.
- Dortmund University through the funded ANR project NumBBO.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Holger Hoos, Professor, Dept of Computer Science, University of British Columbia, from Oct. 1. to Dec. 31., funded by Microsoft-Inria Joint Lab.
- Daria La Rocca, PhD student at University Roma 3, Italy, from Oct. 2013 until Oct. 2014
- Luigi Malago, Post-Doc at University Shinshu, Japan, since Sept. 2014 (see Section 8.4.2.1).

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

- Olivier Teytaud, National University of Tainan and Dong Hwa University in Hualien, Taiwan (6 months).
- Jialin Liu, National University of Tainan and Dong Hwa University in Hualien, Taiwan (6 months).

- Marie-Liesse Cauwet, National University of Tainan and Dong Hwa University in Hualien, Taiwan (3 months).
- Constance Deperrois, National University of Tainan and Dong Hwa University in Hualien, Taiwan (1 month).
- Baptiste Roziere, National University of Tainan and Dong Hwa University in Hualien, Taiwan (2 months).
- Sandra Cecilia Astete Morales, National University of Tainan and Dong Hwa University in Hualien, Taiwan (1 month).
- Vincent Berthier, National University of Tainan and Dong Hwa University in Hualien, Taiwan (4 months).
- David L. Saint-Pierre, National University of Tainan and Dong Hwa University in Hualien, Taiwan (4 months).

TASC Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Atlanstic

Participants: Raphael Chenouard, Laurent Granvilliers, Christophe Jermann, Frédéric Lardeux, Éric Monfroy, Frédéric Saubion.

Title: Atlanstic project about problem modelisation, conversion, and transformation.

Duration: 2014-2015.

Budget: 8000 Euros.

Others partners: LERIA, IRCYNN.

Topic: modelling and model transformation.

8.1.2. EPOC

Participants: Nicolas Beldiceanu, Didier Lime, Gilles Madi Wamba, Jean-Marc Menaud, Olivier H. Roux.

Title: EPOC: Energy Proportional and Opportunistic Computing system.

Duration: 2014-2017.

Budget: founding for a PhD thesis.

Topic: an integrated approach combining time automata and constraint programming for modeling dynamic aspects of vm management in a data center.

8.2. National Initiatives

8.2.1. IBEX

Participants: Ignacio Araya, Clément Carbonnel, Gilles Chabert, Benoit Desrochers, Luc Jaulin, Bertrand Neveu, Jordan Ninin, Gilles Trombettoni.

Title: Development of IBEX.

Others partners: ENSTA Bretagne, ENPC PariTech, Lirmm, LAAS, University Federico Santa Maria, Chile.

Development of IBEX (see Section 6.3).

8.2.2. SUSTAIN

Participants: Charlotte Truchet, Bruno Belin.

Title: SUSTAINS.

Duration: 2010-2014.

Type: FUI.

Budget: 151400 Euros.

Others partners: Artefacto, Artelys, Areva TA, EPAMarne, LIMSI.

The SUSTAINS project (*Constraint-based Prototyping of Urban Environments*) aims at building decision support system for city development planning with evaluation of energy impacts. The project is focused on spatial allocation of typical units such as industrial areas, commercial areas and leaving areas with their respective appropriate infrastructure. Its integrates sustainability, transport and energy concerns.

8.2.3. ANR NetWMS2

Participants: Gilles Chabert, Ignacio Salas Donoso, Nicolas Beldiceanu.

Title: Networked Warehouse Management Systems 2: packing with complex shapes.

Duration: 2011-2014.

Type: cosinus research program.

Budget: 189909 Euros.

Others partners: KLS Optim and CONTRAINTES (Inria Rocquencourt).

This project builds on the former European FP6 Net-WMS Strep project that has shown that constraint-based optimisation techniques can considerably improve industrial practice for box packing problems, while identifying hard instances that cannot be solved optimally, especially in industrial 3D packing problems with rotations, the needs for dealing with more complex shapes (e.g. wheels, silencers) involving continuous values. This project aims at generalizing the geometric kernel *geost* for handling non-overlapping constraints for complex two and three dimensional curved shapes as well as domain specific heuristics. This will be done within the continuous solver IBEX, where discrete variables will be added for handling polymorphism (i.e., the fact that an object can take one shape out of a finite set of given shapes). In 2013 a filtering algorithm has been devised in the case of objects described by nonlinear inequalities and is now under testing with the Ibex library. This work has been presented in a workshop on interval methods & geometry in ENSTA Bretagne.

8.2.4. ANR INFRA-JVM

Participants: Xavier Lorca, Charles Prud'Homme.

Title: Towards a Java Virtual Machine for pervasive computing.

Duration: 2011-2015.

Type: **new project**.

Budget: 78000 Euros.

Others partners: Univ. Paris 6 (REGAL team), LaBRI (LSR team), IRISA (TRISKELL).

The INFRA-JVM project investigates how to enhance the design of Java virtual machines with new functionalities to better manage resources, namely resource reservation, scheduling policies, and resource optimization at the middleware level. TASC is concerned with this later aspect. The performance of CHOCO will be improved using the memory snapshot mechanism that will be developed.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

The GRACeFUL project (Global systems Rapid Assessment tools through Constraint FUnctional Languages) from the H2020-FETPROACT track has been accepted and will start in January 2015 for a period of three year. The abstract of the project is given below.

The making of policies coping with Global Systems is a process that necessarily involves stakeholders from diverse disciplines, each with their own interests, constraints and objectives. People play a central role in such collective decision making and the quest for solutions to a problem generally intertwines its very specification. Simulators can assist in this process provided they employ adequate high-level modelling to separate the political question from the underlying scientific details. Domain-specific Languages (DSL) embedded in Functional Programming (FP) languages offer a promising way to implement scalable and verifiable simulators. But the use of simulators is essentially a trial-and-error process too tedious for execution in a group session. A paradigm shift is needed towards active problem solving where stakeholders' objectives can be taken along from the very beginning. Constraint Programming (CP) has demonstrated to enable such a shift for e.g. managed physical systems like water and power networks. This project lays the base for a DSL aimed at building scalable Rapid Assessment Tools for collective policy making in global systems. This can be achieved through foundational scientific work at different levels: from the high-level, political modelling,

adapting the social discipline of Group Model Building (as used in business organizations), through visual forms of CP as well as gamification aspects, down to the needs for a host language, combining CP and FP. Special emphasis is put on domain-specific constraints, constraint composition, and composable solvers and heuristics. Results are applied and validated for the problem case of Climate-Resilient Urban Design, but the ambition is a general framework applicable to many other systems. The case study is assessed by an external multi-disciplinary Advisory Board of Stakeholders that guides the specification process and evaluates needs and usability of the tools.

8.3.2. Collaborations in European Programs, except FP7 & H2020

8.3.2.1. PHC Ulysses

Participants: Charlotte Truchet, Florian Richoux, Alejandro Reyes.

Title: Development and estimation analysis of massively parallel local search approaches to the k-medoids problem.
Duration: 2014.
Type: **new project**.
Budget: 2500 Euros.
Others partners: 4C (Cork, Ireland).

The goal of this project is to develop parallel local search techniques for solving large instances of the k-medoids problem, a location problem with several applications, in particular in optical fiber networks deployment.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. TASCMELB

Title: Synergy between Filtering and Explanations for Scheduling and Placement Constraints
International Partner (Institution - Laboratory - Researcher):
NICTA (AUSTRALIE)
Duration: 2014 - 2016
See also: http://www.normalesup.org/ truchet/TASCMELB.html
In the context of Constraint Programming and SAT the project addresses the synergy between filtering (removing values from variables) and explanations (explaining why values were removed in term of clauses) in order to handle in a more efficient way correlated resource scheduling and placement constraints. It combines the strong point of Constraint Programming, namely removing value that leads to infeasibility, with the strong point of SAT, namely taking advantage from past failure in order to quickly identify infeasible sub-problems.

8.4.1.2. BANANAS

- Partners: Inria-Lorraine, PUCV (Chili), UTFSM (Chili), Univ. Angers (LERIA), Univ. Nantes (TASC).
- Duration: 2012-2014.
- Topics: Autonomous constraint solving, SMT solvers.
- Budget: 15 KEuros per year for the project.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

- SICS, Sweden.
- Uppsala University, Sweden.
- 4C, Ireland.
- Univ. Austral de Chile, Valparaiso, Chile.

8.4.3. Participation In other International Programs

Ulysse (cooperation with 4C, Cork, Ireland).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Mats Carlsson (SICS, Sweden), *Automata constraints* (5 days).
- Philippe Codognet (Japanese-French Laboratory for Informatics at the University of Tokyo, Japan), *Prediction models of local search speed-up* (15 days).
- Pierre Flener, (Uppsala University, Sweden), *Automata constraints* (5 days).
- Justin Pearson, (Uppsala University, Sweden), *Automata constraints* (5 days).
- Helmut Simonis, (Insight Centre for Data Analytics, University College Cork, Ireland), *Learning constraint models* (3 months).

8.5.2. Visits to International Teams

8.5.2.1. Sabbatical programme

Thierry Petit is currently visiting the Foisie School of business of WPI (Worcester Polytechnic Institute, Massachusetts, USA), collaborating with Andrew C. Trapp on optimization problems, since July, 2014.

8.5.2.2. Research stays abroad

- Nicolas Beldiceanu, 4C Cork Ireland: work on *learning generic models* and work on *learning constraints in the context of EDF* with Helmut Simonis (two weeks).
- Nicolas Beldiceanu, Uppsala University and SICS: work on *automata and constraints* with Pierre Flener and Justin Pearson and Mats Carlsson (one month).
- Éric Monfroy, Univ. Austral de Chile, Valparaiso, Chile: work with Ricardo Soto.
- Florian Richoux visited the Japanese-French Laboratory for Informatics at the University of Tokyo, to work with Philippe Codognet on massively parallel combinatorial optimization algorithms and to start collaborations on Game AI, with Ruck Thawonmas from Ritsumeikan University (from the 1st of April till the 31st of August).

TEA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

Program: ANR

Project acronym: **VeriSync**

Project title: Vérification formelle d'un générateur de code pour un langage synchrone

Duration: Nov. 2010 - Oct. 2013

Coordinator: IRIT

Other partners: IRIT

URL: http://www.irit.fr/Verisync/

Abstract:

The VeriSync project aims at improving the safety and reliability assessment of code produced for embedded software using synchronous programming environments developed under the paradigm of Model Driven Engineering. This is achieved by formally proving the correctness of essential transformations that a source model undergoes during its compilation into executable code.

Our contribution to VeriSync consists of revisiting the seminal work of Pnueli et al. on translation validation and equip the Polychrony environment with updated verification techniques to scale it to possibly large, sequential or distributed, C programs generated from the Signal compiler. Our study covers the definition of simulation and bisimulation equivalence relations capable of assessing the correspondence between a source Signal specification and the sequential or concurrent code generated from it, as well as both specific abstract model-checking techniques allowing to accelerate verification and counter-example search techniques, to filter spurious verification failures obtained from excessive abstracted exploration.

——

Program: ANR

Project acronym: **Feever**

Project title: Faust Environment Everyware

Duration: 2014-2016

Coordinator:

Other partners:

URL: http://www.feever.fr

Abstract:

The aim of project FEEVER is to ready the Faust music synthesis language for the Web. In this context, we collaborate with Mines ParisTech to define a type system suitable to model music signals timed at multiple rates and to formally support playing music synthesised from different physical locations.

8.1.2. Competitivity Clusters

Program: FUI

Project acronym: P

Project title: Project P

Duration: March 2011 - Sept. 2015

Coordinator: Continental Automotive France

Other partners: 19 partners (Airbus, Astrium, Rockwell Collins, Safran, Thales Alenia Space, Thales Avionics...)

URL: http://www.open-do.org/projects/p/

Abstract:

The aim of project P is 1/ to aid industrials to deploy model-driven engineering technology for the development of safety-critical embedded applications, 2/ to contribute on initiatives such as ITEA2 OPEES and Artemisia CESAR to develop support for tools inter-operability, and 3/ to provide state-of-the-art automated code generation techniques from multiple, heterogeneous, system-levels models. The focus of project P is the development of a code generation toolchain starting from domain-specific modeling languages for embedded software design and to deliver the outcome of this development as an open-source distribution, in the aim of gaining an impact similar to GCC for general-purpose programming, as well as a kit to aid with the qualification of that code generation toolchain.

The contribution of project-team TEA in project P is to bring the necessary open-source technology of the Polychrony environment to allow for the synthesis of symbolic schedulers for software architectures modeled with P in a manner ensuring global asynchronous deterministic execution..

8.1.3. PAI CORAC

Program: CORAC

Project acronym: CORAIL

Project title: Composants pour l'Avionique Modulaire Étendue

Duration: July 2013 - May 2017

Coordinator: Thales Avionics

Other partners: Airbus, Dassault Aviation, Eurocopter, Sagem...

URL: http://www.corac-ame.com/

Abstract:

The CORAIL project aims at defining components for Extended Modular Avionics. The contribution of project-team TEA is to define a specification method and to provide a generator of multi-task applications.

8.2. International Initiatives

8.2.1. International Project Grants

8.2.1.1. USAF Office for Scientific Research – Grant FA8655-13-1-3049

Title: Co-Modeling of Safety-Critical Multi-threaded Embedded Software for Multi-Core Embedded Platforms

Inria principal investigator: Jean-Pierre Talpin

International Partner (Institution - Laboratory - Researcher):

Virginia Tech Research Laboratories, Arlington (United States)

Embedded Systems Group, Teschnische Universität Kaiserslautern (Germany)

Duration: 2013 - 2016

See also: http://www.irisa.fr/espresso/Polycore

Abstract: The aim of the USAF OSR Grant FA8655-13-1-3049 is to support collaborative research entitled “Co-Modeling of safety-critical multi-threaded embedded software for multi-core embedded platforms” between Inria project-team ESPRESSO, the VTRL Fermat Laboratory and the TUKL embedded system research group, under the program of the Polycore associate-project.

8.2.2. Inria International Partners

8.2.2.1. Declared Inria International Partners

8.2.2.1.1. The University of Hong Kong

Title: Virtual Prototyping of embedded software architectures

International Partner (Institution - Laboratory - Researcher):

The University of Hong Kong (Hong ,Kong)

Duration: 2012 - now

We collaborate with John Koo at the University of Hong Kong (HKU) and the LIAMA since two years through visiting grants of the Chinese Academy of Science and of the University of Rennes on the topics of heterogeneous time modelling and virtual prototyping. We submitted an ANR project proposal on this topic.

An engineer of SIAT, Riu Li, has developed a pilot project to evaluate Polychrony in the context of virtual prototyping and real-time simulation of automotive systems (the controller of a V6 turbo-charged engine model in LMS [0]). Our collaboration started in 2011 at the occasion of a joint Summer School on Embedded Systems organised by SIAT and LIAMA at SIAT. John Koo was invited scientist at Inria-Rennes in Summer 2012 and Jean-Pierre Talpin invited at SIAT by the Chinese Academy of Science from December 2012 to August 2013.

The partners submitted a PHC proposal and intend to resubmit a joint project proposal for the ANR-HK international program. A longer term goal of our collaboration is to setup, within the IET, a joint laboratory with Inria, in order to both disseminate formal methods for embedded system design on a specific Master program, and jointly contribute to an open-source system design platform with European and Asian industrial partners which are sponsoring the IET.

8.2.2.1.2. Virginia Tech Research Laboratories

Title: Models of computation for embedded software design

International Partner (Institution - Laboratory - Researcher):

Virginia Tech Research Laboratories (USA)

Duration: 2003 - now

Team TEA collaborates with Sandeep Shukla, Virginia Tech, since 2002. First, in the frame of the NSF-Inria program with Rajesh Gupta, UCSD, until 2004; Inria’s associated project BALBOA, until 2007; with the sabbatical of Sandeep Shukla at IRISA in 2008-2009 (funded by Inria-Rennes, the University of Rennes 1, Inria’s scientific board); and, from 2011 to 2013, in the context of the associate-project POLYCORE, together with the ESG group at TU Kaiserslautern.

Following up Sandeep’s sabbatical, the Fermat Laboratory was awarded a series of research grant by the US Air Force Research Laboratory (AFRL) to develop a modelling environment based on Polychrony. In this context, Virginia Tech hired a former PhD. of team ESPRESSO, Julien Ouy, to contribute and coordinate this project’s work. Since 2013, the scope of our collaboration has extended with the three years grant awarded to team TEA by the USAF Office for Scientific Research (AFOSR).

To date, our fruitful and sustained collaboration has yield the creation of the ACM-IEEE MEMOCODE conference series [0] in 2003, of the ACM-SIGDA FMGALS workshop series, and of a full-day tutorial at ACM-IEEE DATE’09 on formal methods in system design. We have jointly edited

[0] LMS by Siemens http://www.plm.automation.siemens.com/en_us/products/lms

[0] ACM-IEEE MEMOCODE conference series. http://memocode-conference.com

two books with Springer [00], two special issues of the IEEE Transactions on Computers and one of the IEEE Transactions on Industrial Informatics, and published more than 30 joint papers in international scientific journals and conferences.

8.2.2.2. Informal International Partners

8.2.2.2.1. Technische Universitaet Kaiserslautern (DE)

We collaborate with Klaus Schneider, leader of the ESG group at Uni. Kaiserslautern, since 2011 in the frame of the POLYCORE associate project. Our aim is to develop a joint, open-source, toolchain based on the Averest (ESG) and POP (TEA) environments. Our collaboration has been quite fruitful with several recent journal publications [00]. Numerous visits and exchanges of personnel between team TEA and the ESG have allowed us to develop ONYX, a cross-compiler between the Averest and POP environments.

Onyx mixes imperative Quartz modules and declarative Signal networks to specify multi-clocked systems. We intend to further its development by the submission of a joint ANR or European project. Our objective is to develop an environment capable of synthesising distributed, loosely synchronised executives from imperative Quartz modules whose schedules are specified by multi-clocked data-flow specifications. A new version of this front-end, developed by Sun Ke, will be integrated in the POP environment.

8.3. International Research Visitors

8.3.1. Visits to International Teams

8.3.1.1. Research stays abroad

Jean-Pierre Talpin was awarded a visiting researcher grant by the US Air Force Research Laboratories for collaborative research with the Virginia Tech Research Laboratories. In this context, he visited the Arlington and Falls Church VT campuses in Spring, Summer and Fall 2014 for a duration of two and a half months.

[0] *Formal methods and models for system design*, R. Gupta, S. Shukla, J.-P. Talpin, Eds. ISBN 1-4020-8051-4. Springer, 2004.

[0] *Synthesis of embedded systems*. S. Shukla, J.-P. Talpin, Eds. ISBN 978-1-4419-6399-4. Springer, 2010

[0] *Embedding polychrony into synchrony*. J. Brandt, M. Gemünde, K. Schneider, S. Shukla, and J.-P. Talpin. In Transactions on Software Engineering (TSE). IEEE, 2012.

[0] *Representation of synchronous, asynchronous, and polychronous components by clocked guarded Actions*. J. Brandt, M. Gemünde, K. Schneider, S. Shukla, and J.-P. Talpin. In Design Automation for Embedded Systems (DAES), Special Issue on Languages, Models and Model Based Design for Embedded Systems. Springer, 2012.

TEMPO Team

7. Partnerships and Cooperations

7.1. International Initiatives

7.1.1. Inria International Labs

The TEMPO project belongs to the LIAMA laboratory in China. The project is hosted by East China Normal University Software Engineering Institute.

7.1.2. Inria International Partners

7.1.2.1. Declared Inria International Partners

The projects is run in collaboration with East China Normal University Software Engineering Institute and Netherlands CWI.

7.1.3. Participation In other International Programs

The project is run within the context of China LIAMA laboratory.

TITANE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Grand Emprunt

Culture 3D Clouds (started in October 2012, duration 3 years) is a national project aimed at devising a cloud computing platform for 3D scanning, documentation, preservation and dissemination of cultural heritage.

Information and communication technologies in the world offer new possibilities for cultural exchange, creation, education and shared knowledge to greatly expand the access to culture and heritage. Culture 3D Cloud is part of a process that aims to create a technical rupture approach in the field of digitization of heritage artifacts to allow the emergence of new viable business models. Today the field of 3D scanning artifacts heritage evolves slowly and only provides resources for researchers and specialists and the technology and equipment used for 3D scanning are sophisticated and require highly specialized skills. The cost is significant and limits the widespread practice. Culture 3D Clouds project aims to give back the caption to the photographers and the distribution to the agencies and image banks that will develop a value chain to commercialize 3D reproductions demand for their customers and expand the market valuation of business assets (commercial publishers, public).

Partners: IGN, CMN , RMN, Inria, EISTI, CNRS-MAP, UCP-ETIS, CEA, HPC Project, ValEISTI, BeIngenious.

Web site: http://c3dc.fr/.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. IRON - Robust Geometry Processing

Type: IDEAS

Instrument: ERC Starting Grant

Duration: January 2011 - December 2015

Coordinator: Pierre Alliez

Inria contact: Pierre Alliez

Abstract: The purpose of this project is to bring forth the full scientific and technological potential of Digital Geometry Processing by consolidating its most foundational aspects. Our methodology will draw from and bridge the two main communities (computer graphics and computational geometry) involved in discrete geometry to derive algorithmic and theoretical contributions that provide both robustness to noisy, unprocessed inputs, and strong guarantees on the outputs. The intended impact is to make the digital geometry pipeline as generic and ironclad as its Digital Signal Processing counterpart.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Prof. Mathieu Desbrun, head of the Information Sciences and Mathematics Department of Caltech, obtained an Inria international Chair. We are collaborating on robust surface reconstruction, optimal transport and variational meshing.

TOCCATA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Coquelicot

Participants: Sylvie Boldo [contact], Catherine Lelay, Guillaume Melquiond.

Coquelicot is a 3-year Digiteo project that started in September 2011. http://coquelicot.saclay.inria.fr/. S. Boldo is the principal investigator of this project.

The Coquelicot project aims at creating a modern formalization of the real numbers in *Coq*, with a focus on practicality [101], [65], [100],[19]. This is sorely needed to ease the verification of numerical applications, especially those involving advanced mathematics.

Partners: team SpecFun from LIX (Palaiseau), University Paris 13

8.1.2. ELFIC

Participants: Sylvie Boldo [contact], Claude Marché, Guillaume Melquiond.

ELFIC is a working group of the Digicosme Labex. S. Boldo is the principal investigator.

Project ELFIC focuses on proving the correctness of the FELiScE (Finite Elements for Life Sciences and Engineering) C++ library which implements the finite element method for approximating solutions to partial differential equations. Finite elements are at the core of numerous simulation programs used in industry. The formal verification of this library will greatly increase confidence in all the programs that rely on it. Verification methods developed in this project will be a breakthrough for the finite element method, but more generally for the reliability of critical software relying on intricate numerical algorithms.

Partners: Inria team Pomdapi; Ecole Polytechnique, LIX; CEA LIST; Université Paris 13, LIPN; UTC, LMAC (Compiègne).

8.2. National Initiatives

8.2.1. ANR Ajacs

Participant: Arthur Charguéraud [contact].

The AJACS research project is funded by the programme “Société de l’information et de la communication” of the ANR, for a period of 42 months, starting on October 1st, 2014.

The goal of the AJACS project is to provide strong security and privacy guarantees on the client side for web application scripts implemented in JavaScript, the most widely used language for the Web. The proposal is to prove correct analyses for JavaScript programs, in particular information flow analyses that guarantee no secret information is leaked to malicious parties. The definition of sub-languages of JavaScript, with certified compilation techniques targeting them, will allow deriving more precise analyses. Another aspect of the proposal is the design and certification of security and privacy enforcement mechanisms for web applications, including the APIs used to program real-world applications. On the Toccata side, the focus will be on the formalization of secure subsets of JavaScript, and on the mechanization of proofs of translations from high-level languages into JavaScript.

Partners: team Celtique (Inria Rennes - Bretagne Atlantique), team Prosecco (Inria Paris - Rocquencourt), team Indes (Inria Sophia Antipolis - Méditerranée), and Imperial College (London).

8.2.2. ANR FastRelax

Participants: Sylvie Boldo [contact], Guillaume Melquiond.

This is a research project funded by the programme “Ingénierie Numérique & Sécurité” of the ANR. It is funded for a period of 48 months and it has started on October 1st, 2014. http://fastrelax.gforge.inria.fr/

Our aim is to develop computer-aided proofs of numerical values, with certified and reasonably tight error bounds, without sacrificing efficiency. Applications to zero-finding, numerical quadrature or global optimization can all benefit from using our results as building blocks. We expect our work to initiate a "fast and reliable" trend in the symbolic-numeric community. This will be achieved by developing interactions between our fields, designing and implementing prototype libraries and applying our results to concrete problems originating in optimal control theory.

Partners: team ARIC (Inria Grenoble Rhône-Alpes), team MARELLE (Inria Sophia Antipolis - Méditerranée), team SPECFUN (Inria Saclay - Île-de-France), Université Paris 6, and LAAS (Toulouse).

8.2.3. ANR Soprano

Participants: Sylvain Conchon [contact], Évelyne Contejean, Guillaume Melquiond.

The Soprano research project is funded by the programme “Sciences et technologies logicielles” of the ANR, for a period of 42 months, starting on October 1st, 2014.

The SOPRANO project aims at preparing the next generation of verification-oriented solvers by gathering experts from academia and industry. We will design a new framework for the cooperation of solvers, focused on model generation and borrowing principles from SMT (current standard) and CP (well-known in optimization). Our main scientific and technical objectives are the following. The first objective is to design a new collaboration framework for solvers, centered around synthesis rather than satisfiability and allowing cooperation beyond that of Nelson-Oppen while still providing minimal interfaces with theoretical guarantees. The second objective is to design new decision procedures for industry-relevant and hard-to-solve theories. The third objective is to implement these results in a new open-source platform. The fourth objective is to ensure industrial-adequacy of the techniques and tools developed through periodical evaluations from the industrial partners.

Partners: team DIVERSE (Inria Rennes - Bretagne Atlantique), Adacore, CEA List, Université Paris-Sud, and OCamlPro.

8.2.4. ANR CAFEIN

Participant: Sylvain Conchon [contact].

The CAFEIN research project is funded by the programme “Ingénierie Numérique & Sécurité” of the ANR, for a period of 3 years, starting on February 1st, 2013. https://cavale.enseeiht.fr/CAFEIN/.

This project addresses the formal verification of functional properties at specification level, for safety critical reactive systems. In particular, we focus on command and control systems interacting with a physical environment, specified using the synchronous language Lustre.

A first goal of the project is to improve the level of automation of formal verification, by adapting and combining existing verification techniques such as SMT-based temporal induction, and abstract interpretation for invariant discovery. A second goal is to study how knowledge of the mathematical theory of hybrid command and control systems can help the analysis at the controller’s specification level. Third, the project addresses the issue of implementing real valued specifications in Lustre using floating-point arithmetic.

Partners: ONERA, CEA List, ENSTA, teams Maxplus (Inria Saclay - Île-de-France), team Parkas (Inria Paris - Rocquencourt), Perpignan University, Prover Technology, Rockwell Collins.

8.2.5. ANR BWare

Participants: Sylvain Conchon [contact], Évelyne Contejean, Jean-Christophe Filliâtre, Andrei Paskevich, Claude Marché.

The BWare research project is funded by the programme “Ingénierie Numérique & Sécurité” of the ANR, a period of 4 years, starting on September 1st, 2012. http://bware.lri.fr.

BWare is an industrial research project that aims to provide a mechanized framework to support the automated verification of proof obligations coming from the development of industrial applications using the B method and requiring high guarantee of confidence. The methodology used in this project consists in building a generic platform of verification relying on different theorem provers, such as first-order provers and SMT solvers. The variety of these theorem provers aims at allowing a wide panel of proof obligations to be automatically verified by the platform. The major part of the verification tools used in BWare have already been involved in some experiments, which have consisted in verifying proof obligations or proof rules coming from industrial applications [109]. This therefore should be a driving factor to reduce the risks of the project, which can then focus on the design of several extensions of the verification tools to deal with a larger amount of proof obligations.

The partners are: Cedric laboratory at CNAM (CPR Team, project leader); teams Gallium and Deducteam (Inria Paris - Rocquencourt) ; Mitsubishi Electric R&D Centre Europe, ClearSy (the company which develops and maintains *Atelier B*), and the start-up OCamlPro.

8.2.6. ANR Verasco

Participants: Guillaume Melquiond [contact], Sylvie Boldo, Arthur Charguéraud, Claude Marché.

The Versaco research project is funded by the programme "Ingénierie Numérique & Sécurité" of the ANR, for a period of 4 years, starting on January 1st, 2012. Project website: http://verasco.imag.fr.

The main goal of the project is to investigate the formal verification of static analyzers and of compilers, two families of tools that play a crucial role in the development and validation of critical embedded software. More precisely, the project aims at developing a generic static analyzer based on abstract interpretation for the C language, along with a number of advanced abstract domains and domain combination operators, and prove the soundness of this analyzer using the *Coq* proof assistant. Likewise, it will keep working on the CompCert C formally-verified compiler, the first realistic C compiler that has been mechanically proved to be free of miscompilation, and carry it to the point where it could be used in the critical software industry.

Partners: teams Gallium and Abstraction (Inria Paris - Rocquencourt), Airbus avionics and simulation (Toulouse), IRISA (Rennes), Verimag (Grenoble).

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

Project acronym: ERC Deepsea

Project title: Parallel dynamic computations

Duration: Jun. 2013 - Jun. 2018

Coordinator: Umut A. Acar

Other partners: Carnegie Mellon University

Abstract:

The objective of this project is to develop abstractions, algorithms and languages for parallelism and dynamic parallelism with applications to problems on large data sets. Umut A. Acar (affiliated to Carnegie Mellon University and Inria Paris - Rocquencourt) is the principal investigator of this ERC-funded project. The other main researchers involved are Mike Rainey (Inria, Gallium team), who is full-time on the project, and Arthur Charguéraud (Inria, Toccata team), who works 40% of his time to the project. Project website: http://deepsea.inria.fr/.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

S. Conchon, A. Mebsout and F. Zaïdi (VALS group, LRI) collaborate with S. Krstic and A. Goel (Intel Strategic Cad Labs in Hillsboro, OR, USA), in particular around the development of the SMT-based model checker Cubicle (see above). This collaboration is partly supported by an academic grant by Intel.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- P. Roux (ISAE, Onera) visited for 7 months in order to collaborate with S. Boldo and G. Melquiond on the topic of formal verification of numerical algorithms.
- Bas Spitters visited for 3 months from April to June funded by a Digiteo grant. He worked with C. Paulin on the extension of the ALEA library to continuous structures and the use of "lower reals" (monotonic sequences of rationals). He also worked on adapting the Corn and Math-classes libraries to the new Coq release. During that time he published a final version of a paper presented at the Workshop on Quantum Physics and Logic in 2012 [119].
- Andrew Tolmach is a visiting researcher from Portland State University, on a one-year Digiteo Chair. His research project will initiate a new research effort to develop principles, techniques, and tools for large-scale proof engineering. It is focused on the Coq proof assistant and is designed to take advantage of the deep pool of expertise available in the Paris area (at Paris-Sud, LIX, Inria, etc.) concerning both the use and development of Coq. Initial results are expected to include: a precise description of requirements for large proof management; sample prototype tools addressing one or more of these requirements; and a technical survey of relevant proof representation options.

TONUS Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- ANR project "PEPPSI" in Programme Blanc SIMI 9 – Sciences de l'ingénierie (Edition 2012) started in 2013. Participants : Giovanni Manfredi (coordinator), Edwin Chacon Golcher, Sever Hirstoaga.

8.1.2. Euratom-CEA projects

- Michel Mehrenberger and Philippe Helluy are local coordinators of the project FR FCM (CNRS Federation on Magnetic Confinement Fusion), within Euratom-CEA association, Title:"Numerical Methods for GYSELA", the goal is to help improving the numerical algorithms used by the GYSELA code developed at CEA Cadarache for the simulation of turbulence in magnetic fusion plasmas.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

The members of the team were in the following EUROfusion research projects:

E. Frénod, P. Helluy, S. Hirstoaga, M. Mehrenberger, L. Navoret were members of the project *CfP-WP14-ER-01/IPP-03*:

Max-Planck Institute for Plasma Physics, Garching (PI: Eric Sonnendrücker)

"Verification of global gyrokinetic codes and development of new algorithms for gyrokinetic and kinetic codes"

E. Frénod was member of the project *CfP-WP14-ER-01/Swiss Confederation-01*

École Polytechnique Fédérale de Lausanne (PI: Paolo Ricci)

"Synergetic numerical-experimental approach to fundamental aspects of turbulent transport in the tokamak edge"

E. Franck was member of the EUROfusion Enabling Research Project

CEA Cadarache, IRFM/SIPP/GP2B (PI: Marina Becoulet)

"JOREK, BOUT++ non-linear MHD modelling of MHD instabilities and their control in existing tokamaks and ITER"

8.3. International Research Visitors

8.3.1. Visits to International Teams

8.3.1.1. Research stays abroad

Michel Mehrenberger was on secondment at the Max Planck Institute in Munich until September 1st, 2014.

Emmanuel Frénod was invited professor during May 2014 at the Institute of Natural Sciences, Shanghai Jiao Tong University, Shanghai - China.

TOSCA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- N. Champagnat, J. Claisse and D. Villemonais were members of the ANR MANEGE (Modèles Aléatoires eN Écologie, Génétique et Évolution, ending in April 2014) whose aim is to provide methodological and conceptual advances in the study of stochastic processes modeling ecology, population genetics and evolution of life. This work is sustained by regular exchanges with biologists from several teams in France. http://www.cmap.polytechnique.fr/~anr-manege/index_en.html
- N. Champagnat is member of the ANR NONLOCAL (Phénomènes de propagation et équations non locales, started in October 2014), aiming at understanding, in the greatest generality, the phenomena of propagation in non-local reaction-diffusion equations. These equations can present integral forms of diffusion operators, or speed that depend on integrals of the solution, memory effects, or long-range interactions in source terms. http://www.agence-nationale-recherche.fr/projet-anr/?tx_lwmsuivibilan_pi2[CODE]=ANR-14-CE25-0013
- A. Lejay is member of the ANR H2MNO4 (ANR Cosinus, 2012–2015) on Original Optimized Object Oriented Numerical Model for Heterogeneous Hydrogeology which started in November 2012 (directed by Joceyline Erhel, IRISA, Rennes).

8.1.2. Contract with ADEME

Participants: Mireille Bossy, Sélim Karia.

Modéol Since April 2013, M. Bossy was the coordinator of the MODÉOL collaboration project funded by the French Environment and Energy Agency (ADEME), and involving the IPSL (CNRS) and the French company Maïa Eolis. The overall goal of the project concerns the modeling and prediction of wind potential in France, in particular the quantification of uncertainties and the analysis of multi-scale variability.

Concerning the Inria workpackage, in collaboration with Antoine Rousseau, from the team LEMON, we have almost completed the SDM version with complex terrain description. We also improved the turbulence modelling to better take into account the shear effect near the ground.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

- J. Inglis is a member of the European project MatheMACS (European Union Seventh Framework Programme no. 318723).

8.3. International Initiatives

8.3.1. Inria International Labs

The CIRIC Team on *Stochastic Analysis of Renewable Energies: Ocean Energy and Wind Farms; dynamics and numerics* (2012-2014) is managed by TOSCA and ANESTOC (Univ Catolica, Santiago). It is composed of three main projects.

Mireille Bossy is managing the WINDPOS project, in collaboration with Antoine Rousseau (LEMON team) and two engineers of Inria Chile, Cristian Paris and Jacques Morice. Based on the stochastic Lagrangian modeling of the wind at small scale (see SDM SOFTWARE), WINDPOS aims to develop a wind farm simulator software, able to provide fine statistical information for the managing of electricity production.

This year the WINDPOS project focused on the improvement on wind mills modeling in the SDM software (see [28]). This modeling is based on our Lagrangian version of the actuator disc actuator line methods to take the mills into account. We evaluated and compared the case of non rotating and rotating actuator disc, and started to work on the validation of the approach by comparison with measurements.

8.3.2. Inria Associate Teams

8.3.2.1. ANESTOC-TOSCA

Title: Stochastic modelling of biology and renewable energies

International Partner (Institution - Laboratory - Researcher):

Pontificia Universidad Católica de Chile (CHILI)

Duration: 2013 - 2016

See also: http://www.anestoc.cl/es/?page_id=1112

This French-Chilean Associated Team deals with stochastic modeling and simulation issues for renewable energies (wind and waves) and neurosciences. It is a follow-up of a long collaboration in which each of the side takes benefit from the other side know-how and structures. In particular, a part of the Associated Team is strongly related to the CIRIC project "Stochastic Analysis of Renewable Energy". This project aims at transfering and valuing to Chilean companies the results of researches on renewable energies, mainly wind prediction at the windfarm's scale by developing and improving the Winpos software based on the downscaling methods, and waves energy potential of a site using video and developping stochastic models for the Wave Energy Converter called Oscillating Water Column.

The other part of this Associated Team is related to neurosciences, more specifically by considering applications to ion-channel dynamics through cell membranes (jointly with biophysicists of the CINV, Neuroscience Centre of Valparaíso).

8.3.3. Participation In other International Programs

8.3.3.1. Math Amsud project SIN

Participant: Etienne Tanré.

It is likely that the stochastic components play an important role in the functions of the neurons and of the networks they form. We describe and study the effect of the noise at different scales of neural activity, such that the level of the ionic channels and the level of neural networks, which are responsible for conveying and processing the information coded in sequences of spikes. The most popular models of this class are leaky integrate and fire (LIF) neural networks. We study the synchronization of neurons in those networks.

The Math Amsud project SIN (Stochastic, Inference, Neuroscience) started in 2013. We worked specifically in 2014 on stochastic modelling in neuroscience.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- M. Baar (Bonn University) has been visiting TOSCA Nancy for one week in September.
- L. Beznea (Simion Stoilow Institute of Mathematics of the Romanian Academy) has been visiting TOSCA Nancy one week in March and three weeks in July.
- The TOSCA *seminar* organized by J. Inglis in Sophia Antipolis has received the following speakers: Maxime Bonelli (TOSCA), Hector Olivero-Quinteros (Universidad de Chile), Jean-François Jabir (CIMFAV, Fac. de Ingenieria, Universidad de Valparaiso), Tony Lelièvre (École des Ponts ParisTech), Christophe Profeta (Université d'Evry-Val d'Essone), Xiaolu Tan (Ceremade, Univ. Dauphine), Pierre Patie (ORIE, Cornell University), Alexandre Richard (Inria, Regularity), Paola Cinnella (CMI, Université Aix Marseille), Caroline Bauzet (CMI, Université Aix Marseille), Laurent Mertz (Laboratoire J.A. Dieudonné, Univ. Nice – Sophia Antipolis), Charles-Edouard Bréhier (Cermics, École des Ponts).

8.4.1.1. Internships

BEDOUI Akram

Subject: Gestion du risque de portefeuille par la méthode des copules

Date: Feb 2014 - June 2014

Institution: EPT (Tunisie)

DEJAX Florian

Subject: Carbon and electricity markets

Date: from Jun 2014 until Aug 2014

Univ. Paris (France)

FOGUEN TCHUENDOM Rinel

Subject: Bayesian Inference via Markov Chain Monte Carlo methods: A financial case study

Date: March 2014 - August 2014

Institution: Université de Nice – Sophia Antipolis (France)

LALANNE Victor

Subject: Carbon and electricity markets

Date: from Jun 2014 until Aug 2014

Univ. Nice (France)

PAPIC-PONCE Alexis

Subject: Divergence of Euler numerical scheme for SDE with non Lipschitz coefficients

Date: March 2014

Institution: PUC (Chile)

PICCOLOMINI Tatiana

Subject: Probabilistic interpretation of non-linear PDEs with branching diffusion processes

Date: from March 2013 until July 2014

Institution: Universidad de Buenos Aires (Argentina)

TYREX Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Investissements d'avenir

CLAIRE

Title: Community Learning through Adaptive and Interactive multichannel Resources for Education

Call: Technologies for e-education

Duration: March 2012 - February 2014

Coordinator: OpenClassrooms, ex-SimpleIT

Others partners: LIRIS

See also: http://www.projet-claire.fr/

Abstract: Project CLAIRE aims at developing an open-source tool for collaborative authoring in an e-learning environment (Learning Content Management System), targeting teachers and students in high-school and universities. Its innovative features include:

- a platform for collaborative structured editing of rich media and "semantic" content, e.g.: tools for chaptering video, and for generating interactive evaluation tests
- processes for continuous enhancement of content, e.g.: social annotation, behaviour analysis, accessible multi-support publishing, e.g.: web, PDF, ODT, LaTeX, smartphones, tablets.

Datalyse

Title: Entrepôt Intelligent pour Big Data hétérogènes. Investissements d'Avenir Développement de l'Economie Numérique.

Call: Cloud Computing, num 3 – Big Data.

Duration: May 2013 - November 2016

Coordinator: Business & Decision Eolas

Others partners: Groupement des Mousquetaires, Inria Saclay (OAK EPC), LIG (Hadas and Erods teams), LIRMM (Montpellier), LIFL (Lille).

See also: http://www.datalyse.fr/

Abstract: Project Datalyse aims at designing and deploying an infrastructure for big data storage, collection, certification, integration, categorisation, enrichment and sharing over very large heterogeneous data sets. It relies on an industrial platform, to be made available on the cloud, and focuses on three flagship applications, showcasing three uses of big data over different data sets:

- Data-Center Monitoring: The goal of this application is to provide features such as traceability, reporting, optimisation and analysis of abnormal behaviour regarding energy efficiency and security issues. The application will be built with an existing application called ScopeBR (Eolas) and will be deployed in two different green data centers, those of Eolas and GDF SUEZ.
- "Territoire de données ouvertes et liées": This application aims at extracting and provisioning public open data collected from the city of Grenoble and its suburbs. The goal is to make public data available to third-party application developers and to federate local actors around a single platform.
- Real-time Business Intelligence for the management and processing of points of sale: this application will focus on real-time data analytics and will be deployed within "Groupement des Mousquetaires" in support of their business intelligence platforms.

7.1.2. ANR

Typex

Title: Typeful certified XML: integrating language, logic, and data-oriented best practices
Call: Programme Blanc
Duration: January 2012 - December 2014
Coordinator: PPS (CNRS - Paris 7 Diderot)
Others partners: LRI (Orsay)
See also: http://typex.lri.fr
Abstract: The highly ambitious and final goal of this project is to produce a new generation of XML programming languages stemming from the synergy of integrating three approaches into a unique framework:

- a logical approach based on solvers
- a programming language (PL) approach
- a data-oriented approach

These languages will feature precise and polymorphic type systems that merge PL typing techniques with logical-solver-based type inference. They will be implemented efficiently using the latest research on tree automata and formally certified using modern theorem prover technology. They will offer the capacity to specify and formally verify invariants, business rules, and data integrity, and will have a direct and immediate impact on standardization processes.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

VENTURI

Title: immersiVe ENhancemenT of User-woRld Interactions
Type: Cooperation (ICT)
Call: FP7-ICT-20111.5 Networked Media and Search Systems
Instrument: Specific Targeted Research Project (STREP)
Duration: October 2011 - September 2014
Coordinator: Fondazione Bruno Kessler (Italy)
Others partners: Fraunhofer Heinrich Hertz Institute (Germany), ST Microelectronics (Italy), ST-Ericsson (France), Metaio (Germany), e-Diam Interactive (Spain), Sony-Ericsson (Sweden)
See also: https://venturi.fbk.eu/
Abstract: Venturi aims to create a pervasive Augmented Reality paradigm, where available information will be presented in a user- rather than device-specific way. The goal is to create an experience that is always present whilst never obstructing. Venturi will exploit, optimize and extend current and next generation mobile platforms; verifying platform and QoE performance through life-enriching use cases and applications to ensure device-to-user continuity.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Prof. Boualem Benatallah, Professor at the School of Computer Science and Engineering (CSE), the University of New South Wales (UNSW) in Sydney, Australia, visited our group for one week in July 2014. The goal of this visit was to initiate common work on the formal verification of web services orchestration and verified API-driven web programming.

7.3.1.1. Internships

Martì Bosch Padros from Universitat Politècnica de Catalunya (UPC) Spain spent six months in the team to work on Automated Refactoring for Size Reduction of CSS Style Sheets.

Joel Ferreira Dos Santos from Universidade Federal Fluminense, UFF, Brasil is spending a one year sandwich PhD in the team to work on the formal verification of multimedia presentations.

URBANET Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- BQR INSA CROME 12/2013-12/2016
  Participants: Fabrice Valois
  The partners in this project are the CITI DynaMid team and LIRIS. The project studies the coordination of a fleet of mobile robots for the multi-view analysis of complex scenes.
- Labex IMU Priva'Mov 10/2013-10/2016
  Participants: Djamel Benferhat, Patrice Raveneau, Hervé Rivano, Razvan Stanica
  The partners in this project are DRIM LIRIS, Inria Privatics, INSA EVS, and LET ENTPE. The aim of this project is to develop and deploy a crowdsensing platform to collect mobility traces from a sample of real users equipped with android devices, while carrying research on privacy preservation issues. Our contribution consists on developing the platform and using the collected data to analyze cellular network offloading strategies.

8.2. National Initiatives

8.2.1. ANR

- ANR ABCD 10/2013-04/2017.
  Participants: Diala Naboulsi, Marco Fiore, Razvan Stanica
  The partners in the ANR ABCD project are: Orange Labs, Ucopia, Inria UrbaNet, UPMC LIP6 PHARE, Telecom ParisTech. The objective of ABCD is to characterize large-scale user mobility and content consumption in urban areas via mobile data mining, so as to achieve efficient deployment and management of cloud resources via virtual machines. Our contribution in the project consists on the characterization of human mobility and service consumption at a city scale, and the design of appropriate resource allocation techniques at the cellular network level.
- ANR IDEFIX 10/2013-04/2017.
  Participants: Soukaina Cherkaoui, Hervé Rivano, Fabrice Valois
  The partners in the ANR IDEFIX project are: Orange Labs, Alcatel Lucent - Bell Labs, Telecom Paris Tech, Inria UrbaNet, Socrate and Dyogene.

8.2.2. Pôle ResCom

- Ongoing participation (since 2006)
  Communication networks, working groups of GDR ASR, CNRS (http://rescom.inrialpes.fr). Hervé Rivano is member of the scientific committee of ResCom.

8.2.3. Common Laboratory Inria/Alcatel-Lucent Bell Labs

- ADR Green
  UrbaNet is part of the ADR Green of the common laboratory Inria/Alcatel-Lucent Bell Labs. This ADR provides the PhD grant of Soukaina Cherkaoui on the adaptation of wireless sensor network control protocols for optimizing the energy consumption of heterogeneous cellular LTE networks.

8.2.4. EquipEx

- SenseCity
  We have coordinated the participation of several Inria teams to the SenseCity EquipEx. Within the SenseCity project, several small reproduction of 1/3rd scale city surroundings will be built under a climatically controlled environment. Micro and nano sensors will be deployed to experiment on smart cities scenarios, with a particular focus on pollution detection and intelligent transport services. Urbanet will have the opportunity to tests some of its capillary networking solutions in a very realistic but controlled urban environment. The first deployment is scheduled early 2015.

8.2.5. Inria Project lab

- CityLab
  Urbanet is involved in the CityLab Inria Project Lab lead by Valérie Issarny. Within this project, Hervé Rivano is the networking referent for the PhD thesis of Raphael Ventura, advised by Vivien Mallet, in the Clime Inria team.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

- ReFleX 04/2014-03/2018.
  Participants: Marco Fiore
  ReFleX (http://www.wcsg.ieiit.cnr.it/Reflex/website/) is a European Union-funded project, within the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme (FP7/2007-2013) under Research Executive Agency grant agreement n.630211. ReFleX aims at characterizing in a comprehensive manner the topological features of large-scale urban vehicular networks built on top of DSRC-based V2V and V2I communication technologies. To that end, the project adopts a multidisciplinary approach, bringing together tools from vehicular networking, wireless communications, transportation theory, and complex network science.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- **Politecnico di Torino (Italy)**. Multiple publications co-authored with members of the Telecommunication Networks Group.
- **University of Waterloo (Ontario, Canada)**. Cooperation and joint publications on the optimization of wireless mesh networks.

8.5. International Research Visitors

8.5.1. Internships

- S. Ancona, MS thesis, Politecnico di Bari, Italy: Offloading Cellular Networks through Residential Wi-Fi Access Points (4 months).
- A. Hadji, MS thesis, SupCom, Tunis, Tunisia: Coordination Model for Fleets of Mobile Robots (5 months).
- O. Jimenez Hidalgo, intern, Simon Bolivar University, Caracas, Venezuela: Visualization of Mobile Data Statistics (3 months).
- I. Keskes, MS thesis, ENIT Tunis, Tunisia: Floating Car Data Resource Allocation in Mobile Vehicular Networks (5 months).
- D. Martella, intern, Politecnico di Torino, Italy: Performance Evaluation of Coordinated Mobility Algorithms with Connectivity Constraints (3 months).

- P. Mikulski, intern, University of Lodz, Poland: Combining DSRC and VLC in Safety Vehicular Networks (3 months).
- B. Mordzak, intern, University of Lodz, Poland: Offloading Capacity of Residential Wi-Fi Networks (3 months)
- C. Ortegon Barajas, intern, University Icesi, Cali, Colombia: Performance Evaluation of Coordinated Mobility Algorithms with Connectivity Constraints (3 months).
- A. Vaidya, intern, Nanyang Technological University, Singapore: Simulation of Vehicular Networks (5 months).

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

- **Razvan Stanica** and **Fabrice Valois** were visiting researchers at University of Yaoundé 1 (Cameroon), in June 2014 (one week).
- **Diala Naboulsi** was a visiting scholar within the Telecommunication Networks Group at Politecnico di Torino (Italy), between Sep 2013 and Jan 2014, under the CMIRA Explora'Doc programme.

VEGAS Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR PRESAGE

The white ANR grant PRESAGE brings together computational geometers (from the VEGAS and GEOMETRICA projects of Inria) and probabilistic geometers (from Universities of Rouen, Orléans and Poitiers) to tackle new probabilistic geometry problems arising from the design and analysis of geometric algorithms and data structures. We focus on properties of discrete structures induced by or underlying random continuous geometric objects.

This is a four year project, with a total budget of 400kE, that started on Dec. 31st, 2011. It is coordinated by Xavier Goaoc who moved from the Vegas team to Marne-la-Vallée university in 2013.

6.1.2. ANR SingCAST

The objective of the young-researcher ANR grant SingCAST is to intertwine further symbolic/numeric approaches to compute efficiently solution sets of polynomial systems with topological and geometrical guarantees in singular cases. We focus on two applications: the visualization of algebraic curves and surfaces and the mechanical design of robots.

After identifying classes of problems with restricted types of singularities, we plan to develop dedicated symbolic-numerical methods that take advantage of the structure of the associated polynomial systems that cannot be handled by purely symbolic or numeric methods. Thus we plan to extend the class of manipulators that can be analyzed, and the class of algebraic curves and surfaces that can be visualized with certification.

This is a 3.5 years project, with a total budget of 100kE, that started on March 1st 2014, coordinated by Guillaume Moroz.

In 2014, the project funded 6 months of internship for Olive Chakraborty and the beginning of the postdoc position of Rémi Imbach. We also organized the first meeting on subdivision methods for singular systems in Nantes in December, see the project website SingCAST.

6.2. International Research Visitors

6.2.1. Visits of International Scientists

6.2.1.1. Internships

Olive Chakraborty

Subject: Numerical algorithms for certified topological and geometrical description of singular curves.

Date: Jun-Dec 2014.

Institution: IIT Pilani, India.

VERIDIS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Participants: Jingshu Chen, Pablo Federico Dobal, Pascal Fontaine, Stephan Merz.

The PhD thesis of Pablo Federico Dobal benefits from joint funding by Région Lorraine since September 2014, complementing funding through the ANR-DFG project SMArT (section 8.2).

The post-doctoral research stay of Jingshu Chen was supported by joint funding by Région Lorraine and the Airbus Foundation.

8.2. National Initiatives

8.2.1. ANR-DFG Project SMArT

Participants: Haniel Barbosa, David Déharbe, Pablo Federico Dobal, Pascal Fontaine, Maximilian Jaroschek, Marek Košta, Stephan Merz, Thomas Sturm.

The SMArT (Satisfiability Modulo Arithmetic Theories) project is funded by *ANR-DFG Programmes blancs 2013*, a program of the Agence Nationale de la Recherche and the (German) Deutsche Forschungsgemeinschaft DFG. It started in April 2014. The partners are both the French and German parts of VeriDis and the Systerel company. The objective of the SMArT project is to provide advanced techniques for arithmetic reasoning beyond linear arithmetic for formal system verification, and particularly for SMT. Arithmetic reasoning is one strong direction of research at MPI, and the state-of-the-art tool Redlog (section 5.4) is mainly developed by Thomas Sturm. The SMT solver veriT (section 5.1), developed in Nancy, will serve as an experimentation platform for theories, techniques and methods designed within this project.

In September 2014, Pablo Federico Dobal has been hired as a PhD student in joint supervision with Saarland University, co-funded by the SMArT project and the Région Lorraine. More information on the project can be found on http://smart.gforge.inria.fr/.

8.2.2. ANR Project IMPEX

Participants: Manamiary Andriamiarina, Dominique Méry.

The ANR Project IMPEX is an INS ANR project that started in December 2013 for 4 years. It is coordinated by Dominique Méry, the other partners are IRIT/ENSEIHT, Systerel, Supelec and Telecom Sud Paris.

All software systems execute within an environment or context. Reasoning about the correct behavior of such systems is a ternary relation linking the requirements, system and context models. Formal methods are concerned with providing tool (automated) support for the synthesis and analysis of such models. These methods have quite successfully focused on binary relationships, for example: validation of a formal model against an informal one, verification of one formal model against another formal model, generation of code from a design, and generation of tests from requirements. The contexts of the systems in these cases are treated as second-class citizens: in general, the modeling is implicit and usually distributed between the requirements model and the system model. This project proposal is concerned with the explicit modeling of contexts as first-class citizens.

Several approaches aim at formalizing mathematical theories that are applicable in the formal developments of systems. These theories are helpful for building complex formalizations, expressing and reusing proof of properties. Usually, these theories are defined within contexts, that are imported and and/or instantiated. They usually represent the implicit semantics of the systems and are expressed by types, logics, algebras, etc. However, an implicit handling of contexts loses important information, and therefore is not expressive enough for ensuring that even a verified system is "correct". As a very simple example, take two formally developed systems that are composed to exchange currency data represented by a float. This system is no longer consistent if one system refers to Euros and the other to dollars. The objective of the IMPEX project is to build explicit formal models of contextual semantics and to extend proof-based techniques for handling such a stronger semantics [23].

8.2.3. Inria Development Action VeriT

Participants: Pablo Federico Dobal, Pascal Fontaine.

Inria funded this project (started in 2011) to support the development of the SMT solver veriT (see section 5.1), including added expressiveness, improved efficiency and code stability, and interfaces with tools that embed veriT as a backend solver. The project is coordinated by Pascal Fontaine and also includes Inria Rennes (Celtique) and Sophia Antipolis (Marelle). Pablo Federico Dobal was hired in 2012 on a position funded by this project and has in particular contributed to improvements in the code of the solver as well as of the testing platform that allows us to detect bugs and the impact of changes on the performance of the tool. He also contributed to the maintenance of the deltaSMT tool, which has been used by several other teams of SMT developers for debugging SMT solvers.

8.3. European Initiatives

8.3.1. MEALS

Type: PEOPLE

Instrument: International Research Staff Exchange Scheme

Objective: Exchange of scientists between Europe and Argentina

Duration: October 2011 - September 2015

Coordinator: Holger Hermanns, Universität des Saarlandes (Germany)

Partners: Universidad de Buenos Aires, Universidad Nacional de Córdoba, Universidad Nacional de Rio Cuarto, Instituto Tecnológico Buenos Aires

Inria contact: Catuscia Palamidessi

Abstract: The MEALS project funds exchanges between scientists in Europe (Saarland University, RWTH Aachen, TU Dresden, Inria, Imperial College, Univ. of Leicester, TU Eindhoven); it is structured in five work packages (Quantitative Analysis of Concurrent Program Behaviour, Reasoning Tasks for Specification and Verification, Security and Information Flow Properties, Synthesis in Model-based Systems Engineering, Foundations for the Elaboration and Analysis of Requirements Specifications). Our team mainly cooperates with the group led by Carlos Areces in Córdoba within work package 2. In 2014, the project funded visits by Stephan Merz to Córdoba and by Carlos Areces, Luciana Benotti, Raúl Fervari, and Guillaume Hoffmann to Nancy.

8.3.2. Cooperation with NUI Maynooth, Ireland

Participant: Dominique Méry.

We cooperate with Rosemary Monahan of NUI Maynooth on exchanges between techniques of software refinement and software verification. Our cooperation was financially supported in 2013 by a one-year project funded by PHC Ulysses. The verification of software requires the specification of preconditions and postconditions as well as other properties of the code. These properties are expressed as annotations and provide a detailed understanding of how the software is implemented. In program verification, the annotation process is often done *a posteriori*, with verification tools used to check that annotations are sound according to the semantics of the program. Determining the correct annotations to provide a complete specification is difficult, especially when specifying invariant properties of the code. *A priori* techniques for developing correct software are based on the correct-by-construction paradigm. The refinement-based approach is such a technique, providing for the construction of a correct program through the step-by-step refinement of an initial high-level model of the software. In this way, the program specification is developed alongside the code, discharging the conditions that need to be proved. We focus on combining these two software engineering techniques, to benefit from the strengths of both. We have proposed a framework for integrating the *a posteriori* paradigm Spec# and the *a priori* paradigm Event-B. This integration induces a methodology that bridges the gap between software modeling and program verification in the software development life cycle. During 2014, we have designed the Rodin plugin EB2RC that implements transformations of Event-B models into algorithms.

8.4. International Initiatives

8.4.1. Participation In International Programs

8.4.1.1. STIC AmSud MISMT

Participants: Carlos Areces, Haniel Barbosa, Luciana Benotti, Richard Bonichon, David Déharbe, Pablo Federico Dobal, Raúl Fervari, Pascal Fontaine, Guillaume Hoffmann, Stephan Merz, Claudia Tavares.

VeriDis has a close working relationship with two South American teams at Universidade Federal do Rio Grande de Norte (UFRN), Brazil (more specifically with Prof. David Déharbe), and at Universidad Nacional de Córdoba, Argentina (more specifically with Prof. Carlos Areces). The STIC AmSud MISMT project, including both teams and VeriDis, started in 2014. It complements the MEALS project (section 8.3) and extends it to cooperation with UFRN.

The project is centered around Satisfiability Modulo Theories, with a focus on applications to Modal Logic. Notably, the project sustains the development of the veriT solver (section 5.1), of which David Déharbe and Pascal Fontaine are the main developers. First results on using SMT for modal logic have been accepted for publication.

In February, Stephan Merz spent three weeks in Córdoba. David Déharbe stayed in Nancy until July, on a sabbatical from UFRN. A workshop with many participants from the project took place in Nancy in early July. Richard Bonichon and Claudia Tavares visited Nancy in September. At the end of the year, Haniel Barbosa (VeriDis PhD student in joint supervision with Natal) spent three months in Natal and visited Córdoba for two weeks.

More information on the STIC AmSud MISMT project is available on http://mismt.gforge.inria.fr/.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

David Déharbe from UFRN (Natal, Brazil) spent a sabbatical year with the VeriDis team in Nancy from August, 2013 to July, 2014.

8.5.1.1. Internships

Ignacio Martin Queralt

Subject: Symbolic transition checking for TLA$^+$

Date: April to September, 2014

Institution: Universidad Nacional de Córdoba (Argentina)

Clément Herouard

Subject: SMT techniques for modal logics and extensions

Date: May to July, 2014

Institution: Ecole Normale Supérieure de Rennes (France)

VIRTUAL PLANTS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Agropolis computational plant seminar

Participants: Yann Guédon, Thierry Fourcaud [CIRAD, AMAP], Christine Granier [INRA, LEPSE], Soazig Guyomarc'H [Montpellier 2 University, DIADE], Laurent Laplaze [IRD, DIADE].

Funding: Agropolis foundation (Contractor for Virtual Plants: CIRAD. From 2013 to 2016)

In the context of the creation of a world-level pole on plant science in the region Languedoc-Roussillon, we created a monthly seminar on plant modeling and its applications. The seminar is organized by Yann Guédon, Thierry Fourcaud (CIRAD, AMAP), Christine Granier (INRA, LESPE), Soazig Guyomarc'h (Montpellier 2 University, DIADE) and Laurent Laplaze (IRD, DIADE) with the support of Agropolis International and Agropolis Foundation. In 2014, we organized a two-day workshop devoted to the modeling of plant development from the cellular to the organ scale.

7.1.2. MecaFruit3D

Participants: Mik Cieslak, Frédéric Boudon, Christophe Godin, Nadia Bertin [PSH, Avignon].

Funding: Agropolis foundation (Contractor for Virtual Plants: INRA, from 2009 to 2012)

The fruit cuticle plays a major role in fruit development and shelf-life. It is involved in water losses, cracking, and protection against stress, and thus it may have major economic impacts. Objectives of the project are to better understand the multiple roles of the fruit cuticle in the control of fleshy fruit growth and quality. The project relies on a previously developed computational functional-structural tomato fruit model (Cieslak et al. 2011; 2012), that predicts the transport and accumulation of water and dry matter to various fruit tissues through a complex 3D vasculature network. This architecture-based model will serve as the backbone of a new approach for studying fruit development where interactions and feedback loops between turgor driven processes and cuticle mechanical constraints will be analysed and modelled. A collection of cuticle tomato mutants available at INRA Bordeaux will be used to validate the hypotheses.

Partners: PSH, INRA, Avignon; LCVN, IES, Université Sud de France, Montpellier.

7.1.3. RhizoScanHT

Participants: Julien Diener, Frédéric Boudon, Christophe Godin, Yann Guédon, Christophe Pradal.

Funding: Labex Numev (Contractor for Virtual Plants: UM2, from 2013 to 2014)

In this project, we extend the pipeline for 2D root system reconstruction from images developed in the RhizoPolis project (Agropolis foundation) to deal with large scale and high-thoughput analysis. For this we develop the project in the following directions:

1. make the analysis software more robust to various acquisition conditions using visual data mining technologies developped at Zenith.
2. Improve interoperability with other software and within the OpenAlea ecosystem.
3. Improve the reconstruction quality and its evaluation.

Partners: Zenith Inria Project Team, UMR AGAP, UMR BPMC and UMR LEPSE (Montpellier).

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. Morpholeaf

Participants: Christophe Godin, Maryam Aliee.

Funding: ANR (Contractor for Virtual Plants: Inria, From 2011 to 2014)

The goal of this project is to apply a systems biology approach combining biological investigation and modeling on leaf margin development to elucidate how gene networks and hormone signalling are translated into specific growth patterns and generate complex shapes. This project brings together three groups that have complementary expertises in biology, image analysis and modeling to provide new insights into the mechanisms of leaf margin development. We will specifically determine the dynamics of CUC/miR164A/auxin activities during leaf development and their interrelations, establish the contributions of cell proliferation and cell expansion to leaf serration and leaf shape and address the contribution of auxin and CUC2 to differential growth and hence to leaf serration and leaf shape.

Partners: RDP ENS-Lyon; INRA Versailles.

7.2.1.2. HydroRoot

Participants: Mikaël Lucas [IRD], Christophe Pradal, Christophe Godin, Yann Boursiac [BPMP], Christophe Maurel [BPMP].

Funding: ANR (Contractor for Virtual Plants: Cirad, From 2012 to 2015)

The HydroRoot project proposes a unique combination of approaches in the model plant Arabidopsis thaliana to enhance our fundamental knowledge of root water transport. Accurate biophysical measurements and mathematical modeling are used, in support of reverse and quantitative genetics approaches, to produce an integrated view of root hydraulics. The HydroRoot project will address as yet unknown facets of root water transport. It will lead to an integrated view of root hydraulics that considers both tissue hydraulics and root architecture and explains how these components are controlled at the molecular level by physiological and/or environmental cues. Because of its strong physiological and genetic background, this research may also directly impact on breeding programs, for production of crops with optimised water usage and stress responses.

7.2.2. Other national grants

7.2.2.1. OpenAlea 2.0

Participants: Julien Coste, Christophe Pradal, Christophe Godin, Didier Parigot [Inria, Zenith].

Funding: Inria ADT (Contractors for Virtual Plants: Inria from 2012 to 2014)

The goal of this project is to develop an integrated multi-paradigm software environment for plant modeling. This environnement will allow the user to draw, model, program or combine models interactively. In a first step, the component architecture of OpenAlea1 .0 will be extended to dynamically add plugin application. In a second step, we move to a decentralized architecture, capable of distributing simulations in the cloud and share virtual experiments on the web. Finally, the modeling environment to be adapted to run in a web browser using HTML5 and WebGL technology

Partners: EPI Zenith

7.2.2.2. MARS-ALT

Participants: Guillaume Baty, Christophe Pradal, Christophe Godin.

Funding: Inria ADT (Contractors for Virtual Plants: Inria from 2012 to 2014)

The goal of this project is to integrate in a single software platform all the software tools and algorithms that have been developed in various projects about meristem modeling in our teams. More precisely, we aim at building 3D models of meristem development at cellular resolution based on images obtained with confocal or multiphoton microscopy. This set of components will be used by biologists and modelers making it possible to build such meristem structures, to explore and to program them. This platform is embedded in the OpenAlea framework and is based on the imaging components of the platform MedInria.

Partners: EPI Asclepios, RDP ENS-Lyon/INRA, PHIV CIRAD

7.2.2.3. SCOOP

Participants: Pierre Fernique, Yann Guédon, Christophe Pradal, Frédéric Boudon, Jean-Baptiste Durand.

Funding: Inria ADT (Contractors for Virtual Plants: Inria from 2014 to 2016)

The goal of this project is to improve the software quality and the dissemination of Vplants components for plant phenotyping. Virtual Plants team has played a pioneering role in the development of methods for analyzing plant development that take account of the complexity of plant architecture. Numerous software components has been developed for more than 20 years and a profound re-engineering is now necessary to facilitate the collaborations with biologist and agronomists of CIRAD, INRA and IRD and to help the dissemination of ours methods in the scientific community.

7.2.2.4. Echap

Participants: Christophe Pradal, Christian Fournier, Corinne Robert [INRA, EGC].

Funding: ONEMA (Contractor for Virtual Plants: INRA, From 2012 to 2014)

The objective of the ECHAP project is to reduce the frequency of treatments and the doses of pesticides applied on crops by taking advantage of natural mechanisms of disease escape related to crop architecture and by optimizing interception of pesticides by plant canopies. It focuses on the development of an integrative, yet modular, modeling tool on the OpenAlea plateform that couples wheat architectural development, the interception and fate of fungicides and the dynamics of a pathogen. Various scenarios combining climate x architecture x fungicide treatment will be simulated to identify and propose efficient strategies of pesticide applications.

Partners: UMR EGC (Paris-Grignon), UMR LEPSE (Montpellier), ARVALIS (Institut du végétal, France), ALTERRA (Research Institute for the Green World, The Nederlands) , ADAS Intitute (UK), CNRS, and IRSTEA .

7.2.2.5. Morphogenetics

Participants: Christophe Godin, Frédéric Boudon, Christophe Pradal, Grégoire Malandain, François Faure, Jan Traas, François Parcy, Arezki Boudaoud.

Funding: Inria Project Lab (From 2013 to 2016)

Morphogenetics is an Inria transversal project gathering 3 Inria teams and two Inra teams. It aimed at understanding how flower shape and architecture are controlled by genes during development. Using quantitative live-imaging analysis at cellular resolution we will determine how specific gene functions affect both growth patterns and the expression of other key regulators. The results generated from these experiments will be integrated in a specially designed database (3D Atlas) and used as direct input to new predictive computational models for morphogenesis and gene regulation. Model predictions will then be further tested through subsequent rounds of experimental perturbation and analysis. A particular emphasis will be put on the modeling of mechanics in tissues for which different approaches will be developed.

Partners: ENS-Lyon; Imagine Inria Team (Grenoble); Morpheme Inria Team (Sophia-Antipolis), UMR PCV (Grenoble).

7.2.2.6. Rose

Participants: Christophe Godin, Frédéric Boudon, Christophe Pradal.

Funding: INRA - Projet de Pari Scientifique (From 2012 to 2014)

In this project we want to quantify and understand how sugars interfere with hormonal signals (auxin, cytokinins) to regulate lateral bud outgrowth of aerial stems of roses. Experiments will be made on Rose stems to test different levels of sugar conditions and hormonal concentrations on bud outgrowth. An extension of the recently published hormonal model of apical dominance will be made to take into account the role of carbon as a signaling molecule.

Partners: UMR SAGAH, Angers

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. Informal International Partners

There is currently a very active connection with the group of Malcolm Bennett, at the Centre for Plant Integrative Biology (CPIB) in Nottingham, UK. The CPIB invests in the development of OpenAlea at the tissue level. This collaboration is expressed recently through several publication, e.g. [57].

An important collaboration with the CIRAD reserach unit HortSys of et the Reunion island and in particular Frédéric Normand has been established for several years. The topic of the collaboration is the study of the phenology of mango tree. Three members of the team have been visiting our collaborators during the year. This is a tripartite collaboration that also involves Pierre-Eric Lauri of the AGAP/AFEF team.

We have for several years a strong partnership with Ted de Jong group at UC Davis concerning the influence of various agronomic practices (water stress, pruning) on fruit tree branching and production [24]. This is a tripartite collaboration that also involves Evelyne Costes of the AGAP/AFEF team.

A collaboration in plant phenotyping with the CSIRO and the INRA/Lepse team has been established for several years. The topic of the collaboration is to develop a full pipeline using OpenAlea 2.0 on plant phenotyping platforms. This is a joint collaboration with UMR LEPSE in Montpellier (François Tardieu).

A collaboration started in the last two years with the group of Henrik Jönsson of the Sainsbury Lab, Cambridge, UK. The collaboration is related to several modeling projects in the context of shoot apical and flower meristems development, with a particular focus on the use of quantitative 3D reconstructions of meristem structures. Yassin Refahi from the Sainsbury Lab is regularly paying visits to Montpellier. The Virtual Plants team is also regularly invited to Cambridge.

7.3.2. Participation In other International Programs

7.3.2.1. BioSensors

We propose to elucidate the basis for positional information by hormones during plant morphogenesis. While it is known that cell fate decisions require simultaneous input from multiple hormones, to-date a precise understanding of how these signals are coordinated and act together to drive morphogenesis does not exist. Our limited mechanistic understanding is largely due to the difficulty to quantify the distribution of these small molecules in space and time. To explore this fundamental question, we will exploit recent advances in synthetic biology to engineer an RNA-based biosensor platform applicable to a broad range of small molecules and in particular to hormones. Using live-imaging technologies, we will use the sensors to obtain quantitative dynamic 3D maps of hormone distributions and relate these maps to the spatio-temporal distribution of cell identities, both during normal morphogenesis and upon perturbations of hormone levels. This analysis will be done on the shoot apical meristem, one of the bestcharacterized developmental systems in higher plants. In this context, mathematical approaches will be essential to analyze and establish a predictive model for how multiple hormones influence cell fate in a spatio-temporal manner.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

The team received several visitors from foreign research groups in 2014:

- Farah Ben Naoum, from Sidi Bel Abbes University, Algeria, visited the team last summer for 1 month.
- Katarina Smolenova, from University of Göttingen, Germany, visited the team last fall for 2 weeks.
- Pierre Barbier, post-doc researcher at the University of Bern visited the team for a few days in February.
- Yoan Coudert, from University of Cambridge, UK, visited the team for a few days days in April.

- Xavier Sirault, from High Resolution Plant Phenomics Centre at CSIRO, visited the team for one week.
- David Ford, Professor at the University of Washington, USA, visited the team for a few days days in December.

7.4.2. Visits to International Teams

7.4.2.1. Research stays abroad

- During the year, Frédéric Boudon visited Frédéric Normand of the UR Hortsys at the CIRAD La Réunion five weeks in April.
- Sarah Cohen-Boulakia has spent one month at the University of Pennsylvania (Philadelphia, April 2014) and one week at the Humboldt University of Berlin (December 2014).

VISAGES Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Biogenouest

The VisAGeS team and the Neurinfo platform integrated the Biogenouest "Groupement d'Intérêt Scientifique (GIS)" in 2012.

Biogenouest is a Western France life science and environment core facility network. Research programmes are undertaken in the fields of Marine biology, Agriculture/Food-processing, Human health, and Bioinformatics. Set up in keeping with the inter-regional principle of complementarity, Biogenouest coordinates over twenty technological core facilities in both the Brittany and Pays de la Loire regions.

8.1.2. COREC projects

COREC is the "COmité de REcherche Clinique" of the University Hospital of Rennes. This comity proposes an annual project funding in the limit of 30k€ per project. In 2014, the Neurinfo platform as an incitative action for clinical research project emergence accompanied the COREC call by financially supporting the imaging part of the projects up to 50 MRI hours, i.e. 30k€. Two projects including brain MRI were selected. The EPMR-MA project led by the neuropsychologist Pierre-Yves Jonin, and co-funded by Fondation de l'avenir in 2014, will evaluate memory effects in healthy adults and in patients presenting cognitive impairments using BOLD fMRI, ASL and Diffusion MRI. The second project is a complementary funding for the project led by Dr Fabienne Pelé (see below).

8.1.3. Projet Fondation de France : PERINE

Participants: Elise Bannier, Isabelle Corouge, Olivier Commowick, Jean-Christophe Ferré, Christian Barillot.

This study evaluates the effect of prenatal exposure to neurotoxicants on the developing brain. Following previous studies in the PELAGIE cohort this MRI study involves ASL, Diffusion and working memory as well as motor inhibition BOLD fMRI together with neuropsychological tests in children. Inclusions have started in November 2014 and will continue over 2 years.

8.1.4. Fondation de l'Avenir - Depression, suicide and fMRI

Participants: Elise Bannier, Isabelle Corouge, Jean-Christophe Ferré, Christian Barillot.

initial duration: 12 months from November 2012. Project extended in 2014.

In collaboration with EA 4712 "Comportement et Noyaux Gris Centraux" of the University of Rennes I, a complementary funding (20 000€) was obtained to support an ongoing fMRI research project on emotions, impulsivity and suicide. The study protocol and the fMRI task was finalized. Inclusions started in early 2013. The project was extended in 2014 to recruit more patients.

8.1.5. Fondation de l'Avenir - Stroke, rehabilitation and fMRI

Participants: Elise Bannier, Isabelle Bonan, Isabelle Corouge, Jean-Christophe Ferré, Christian Barillot, Jean-Yves Gauvrit.

duration: 12 months from November 2012. Project extended in 2014.

A complementary funding (20 000€) was obtained to support a new research project on rehabilitation of stroke patients. The fMRI protocol was setup, the task developed and validation on volunteers is ongoing. Patient inclusions started in spring 2013. This project was also extended to 2014 to recruit more patients. Group analysis on the control group was performed and a paper will be submitted soon.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ANR "Neurological and Psychiatric diseases" NUCLEIPARK

Participants: Christian Barillot, Sylvain Prima.

NucleiPark project: In the context of the ANR-09-MNPS-016 Nucleipark project we develop a pipeline for detecting shape changes in Parkinson and Paralysis Supranuclear Progressive (PSP) diseases.The pipeline is based on the previous work of Benoit Combès et al. [35]. The pipeline was first validated on controlled synthetic data. For Parkinson disease, a total of 16 patients and 11 healthy controls were evaluated. The structuctures analyzed were: PPN, GPe, GPi, Caudate, Putamen, SN, STN, RN. Differences (uncorrected P <0.001) were found in the right putamen and caudate structures. And slight difference (uncorrected P<0.05) in the right GPe. No significant correlation was found in PPN, GPi, SN, STN, and RN structures. In the case of PSP disease, a total of 10 patients and 11 healthy controls were evaluated. the structures analyzed were: PPN, GPe, GPi, Caudate, Putamen, SN, STN, RN. Differences (uncorrected P <0.001) were found in the left caudate structure. No significant correlation was found in PPN,GPe, GPi, Putamen, SN, STN, and RN structures. This project involves three partners: NeuroSpin, Inria (Athena and Visages) and UPMC (University Pierre and Marie Curie, Paris) including Inserm U678 and the CENIR.

In the context of this project, we propose a statistical data analysis pipeline that uses the apparent diffusion coefficient (ADC) as biomarker. The ADC is computed considering the diffusion weighted signal as a scalar field on a 5-D manifold. This consideration allows to keep the information about direction of the ADC. We have tested the proposed pipeline on synthetic dataset with promising results. Other contributions were the implementation and minimization, in the 5-D non-euclidean space, of the total variation (in its dual formulation) inpainting problem as interpolation method used in the statistical pipeline.

8.2.1.2. TRANSLATE-MS-REPAIR

Participants: Laurence Catanese, Olivier Commowick, Isabelle Corouge, Jean-Christophe Ferré, Elise Bannier, Gilles Edan, Christian Barillot.

It is now commonly admitted that MS is not only an inflammatory disease but a neurodegenerative disease as well. This project is devoted to show that the olesoxime molecule is not only neuroprotective, but it has the ability to promote the maturation of oligodendrocyte progenitor cells (OPCs) into myelinating oligodendrocytes. However, before considering a large-scale clinical trial to assess efficacy. An important aspect is that to date, no treatment for neuroprotection / remyelination has reached the stage of clinical proof of concept that aims Trophos company who is leading this project. It appears that the best criteria for assessing neuroprotective/remyelinating effect of the drug candidate, are MRI criteria. However, these imaging criteria have not yet been validated for use in multicentre trials - so we will also check the feasibility of such measures under this condition. In addition to Trophos company, the partners of this project are AP-HM/CNRSCEMEREM-CRMBM, CHU Rennes, CHU Reims, and Inria-VISAGES.

8.2.2. Competitivity Clusters

8.2.2.1. The HEMISFER Project

Participants: Elise Bannier, Isabelle Bonan, Isabelle Corouge, Jean-Christophe Ferré, Jean-Yves Gauvrit, Pierre Maurel, Lorraine Perronnet, Christian Barillot.

The HEMISFER project ("Hybrid Eeg-MrI and Simultaneous neuro-FEedback for brain Rehabilitation") will be conducted at Inria Rennes with the support of the Cluster of Excellence "CominLabs" [0]. The goal of HEMISFER is to make full use of the neurofeedback paradigm in the context of rehabilitation and psychiatric disorders. The major breakthrough will come from the use of a coupling model associating functional and metabolic information from Magnetic Resonance Imaging (fMRI) to Electro-encephalography (EEG) to "enhance" the neurofeedback protocol. We propose to combine advanced instrumental devices

[0] https://iww.inria.fr/cominlabs-newsletter/april-2013-four-projects-selected/#hemisfer

(Hybrid EEG and MRI platforms), with new man-machine interface paradigms (Brain computer interface and serious gaming) and new computational models (source separation, sparse representations and machine learning) to provide novel therapeutic and neuro-rehabilitation paradigms in some of the major neurological and psychiatric disorders of the developmental and the aging brain (stroke, attention-deficit disorder, language disorders, treatment-resistant mood disorders, ...). This project will be conducted with the HYBRID and PANAMA Teams from Inria Rennes, the EA 4712 team from University of Rennes I and the ATHENA team from Inria Sophia-Antipolis. This work will benefit from the research 3T MRI and MRI-compatible EEG systems provided by the NeurInfo in-vivo neuroimaging platform on which these new research protocols will be set up. A budget of 500keuros will be provided by the CominLabs cluster in the next 3 years to support this project (through experimental designs, PhDs, Post-docs and Expert Engineers).

8.2.2.2. France Life Imaging (FLI)

Participants: Christian Barillot, Olivier Commowick, Florent Leray, Michael Kain, Yao Yao.

France Life Imaging (FLI) is a proposed large-scale research infrastructure project aimed at establishing a coordinated and harmonized network of biomedical imaging in France. This project was recently selected by the call "Investissements d'Avenir - Infrastructure en Biologie et Santé". One node of this project is the node Information Analysis and Management (IAM), a transversal node build by a consortium of teams that will contribute to the construction of a network for data storage and information processing. Instead of building yet other dedicated facilities, the IAM node will use already existing data storage and information processing facilities (LaTIM Brest; CREATIS Lyon; CIC-IT Nancy; Visages U746 Inria Rennes; CATI CEA Saclay; LSIIT/ICube Strasbourg) that will increase their capacities for the FLI infrastructure. Inter-connections and access to services will be achieved through a dedicated software platform that will be developed based on the expertise gained through successful existing developments. The IAM node has several goals. It aims first at building a versatile facility for data management that will inter-connect the data production sites and data processing for which state-of-the-art solutions, hardware and software, will be available to infrastructure users. Modular solutions are preferred to accommodate the large variety of modalities acquisitions, scientific problems, data size, and adapted for future challenges. Second, it aims at offering the latest development that will be made available to image processing research teams. The team VISAGES fulfills multiple roles in this nation-wide project. Christian Barillot is the chair of the node IAM, Olivier Commowick is participating in the working group workflow and image processing and Michael Kain the technical manager. Apart from the team members, software solutions like medInria and Shanoir will be part of the final software platform.

8.2.2.3. OFSEP

Participants: Justine Guillaumont, Elise Bannier, Christian Barillot, Olivier Commowick, Gilles Edan, Isabelle Corouge, Jean-Christophe Ferré, Michael Kain.

The French Observatory of Multiple Sclerosis (OFSEP) is one of 10 projects selected in January 2011 in response to the call for proposal in the "Investissements d'Avenir - Cohorts 2010" program launched by the French Government. It allows support from the National Agency for Research (ANR) of approximately € 10 million for 10 years. It is coordinated by the Department of Neurology at the Neurological Hospital Pierre Wertheimer in Lyon (Professor Christian Confavreux), and it is supported by the EDMUS Foundation against multiple sclerosis, the University Claude Bernard Lyon 1 and the Hospices Civils de Lyon. OFSEP is based on a network of neurologists and radiologists distributed throughout the French territory and linked to 61 centers. OFSEP national cohort includes more than 35,000 people with Multiple Sclerosis, approximately half of the patients residing in France. The generalization of longitudinal monitoring and systematic association of clinical data and neuroimaging data is one of the objectives of OFSEP in order to improve the quality, efficiency and safety of care and promote clinical, basic and translational research in MS. For the concern of data management, the Shanoir platform of Inria has been retained to manage the imaging data of the National OFSEP cohort in multiple sclerosis.

8.2.3. Collaboration with the CEA (Commissariat à l'Energie Atomique) : Imaging data quality control in the context of dementia

Participants: Elise Bannier, Christian Barillot, Isabelle Corouge, Jean-Christophe Ferré, Cédric Meurée.

duration: 12 months from September 2014.

Dementia, in particular Alzheimer Disease (AD), affects about 900,000 people in France. As an early and reliable diagnosis remains a difficult task, neuroimaging plays a crucial in assisted-diagnosis by analyzing structural and functional brain abnormalities associated wiht the disease. The "Centre pour l'Acquisition et le Traitement des Images (CATI)" has created a national network of neuroimaging centers in order to promote clinical research on MA using advanced imaging techniques. Visages and the Neurinfo platform are recognized in the CATI for their expertise in Arterial Spin Labeling, both on the acquisition and the post-processing sides. In this context and in the frame of the Alzheimer plan, a collaboration contract was signed between Inria and CEA, the coordinator for the CATI, in order to host an engineer at Inria for a year. This engineer develops control quality tools and advanced post-processing techniques for ASL to be used in nation-wide clinical studies coordinated by the CATI.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. EuroBioimaging

Type: CAPACITIES

Defi: Provide access and training in imaging technologies, and share the best practice and image data in order to make Euro-BioImaging an engine that will drive European innovation in imaging research and technologies

Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUPPORT ACTIONS

Objective: Euro-BioImaging is a large-scale pan-European research infrastructure project on the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap.

Duration: December 2010 - 2016

Coordinators: Jan Ellenberg (EMBL) and Oliver Speck (University of Magdeburg)

Partner: EMBL (Germany); Erasmus Medical Center (Netherlands) for WG11

Inria contact: C. Kervrann, C. Barillot

Abstract: Euro-BioImaging is a pan-European infrastructure project whose mission is to build a distributed imaging infrastructure across Europe that will provide open access to innovative biological and medical imaging technologies for European researchers. The project is funded by the EU and currently the consortium is finalizing the basic principles for the operation of future Euro-BioImaging organisation.

Euro-BioImaging will be governed by representatives of the European countries that will join Euro-BioImaging (Euro-BioImaging member states).

The infrastructure established by Euro-BioImaging will consist of a set of geographically distributed but strongly interlinked imaging facilities (Euro-BioImaging Nodes), which will be selected among the leading European imaging facilities based on an independent evaluation process.

Inria and the Visages team is involved through the FLI national infrastructure and contributes to the WG11 Working Group on Data Storage and Analysis. This WG performs a series of tasks to define a European Biomedical Imaging Data Storage and Analysis infrastructure plan for the construction phase.

8.3.2. Collaborations in European Programs, except FP7 & H2020

Program: COST

Project acronym: AID (oc-2010-2-8615)

Project title: Arterial spin labeling Initiative in Dementia

Acceptation date: 18/05/2011

Coordinator: X. Golay, UCL, London, UK

Other partners: Ghent University (BE), Liege University (BE), Hospital Cantonal de Geneve (CH), Fraunhofer MEVIS (D), Freiburg University (D), Max Planck Institute for Human Cognitive & Brain Sciences (D), Glostrup Hospital (DK), Hospital Santa Creu I Sant Pau (ES), Universidad Rey Juan Carlos (ES), University of Narvarra (ES), INSERM U836 Grenoble (FR), University of Rennes I (FR), Centro San Giovanni di Dio - Fatebenefratelli (IT), Fondazione Instituto Neurologico Besta (IT), Leiden University Medical Center (NL), UMC Utrecht (NL), VU University Medical Centre (NL), Instituto Superior Técnico (PT), University of Porto (PT), Lund University Hospital (SE), Uppsala University Hospital (SE), Skane University Hospital (SE), Bogazici University (TR), King's College London (UK), University College London (UK), University of Nottingham (UK), University of Oxford (UK)

Abstract: Dementia is a major clinical challenge with care costs approaching 1% of global GDP. Recent estimates suggest that delaying disease onset by 5 years would halve its prevalence. As new disease-modifying treatments will be specific to causative diseases, expensive and bear significant side effects, early diagnosis of dementia will be essential. Current diagnostic criteria include the use of image-based biomarkers using radiotracers. The AID Action aims at coordinating the development of an alternative and cost-effective tool based on an MRI technique, Arterial Spin Labeling (ASL), to obtain reproducible brain perfusion measurements in dementia patients by bringing together scientists and clinicians from across Europe through the flexibility of the COST mechanism. The scientific program is centered around four work packages and three workgroups aiming at developing standards, improving the reliability of the technique and as establishing it as a possible clinical trial outcome measure. Development of MRI methods, post-processing tools, protocols of cross-validation, statistical analyses and launch of clinical and comparative studies will be undertaken. The main benefit of this Action will be to provide a cost-effective alternative to radiotracer-based biomarkers, and help care providers throughout Europe balancing the need for early diagnosis of dementia with the necessary healthcare cost containment. The Visages team is involved in the workgroups ASL data acquisition (E. Bannier), ASL data analysis (C. Barillot, I. Corouge, P. Maurel) and clinical validation of ASL in cognitive impairment (J.-C. Ferré).

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. BARBANT

Title: Boston and Rennes, Brain image Analysis Team

International Partner (Institution - Laboratory - Researcher):

Boston Children's Hospital (ÉTATS-UNIS)

Duration: 2012 - 2014

See also: http://team.inria.fr/barbant/

This associated team is shared between Inria Visages team and the Computational Radiology Laboratory of the Children's hospital Boston at Harvard Medical School. We will address the topic of better understanding the behavior and evolution of neurological pathologies (such as neurodevelopmental delay or multiple sclerosis) at the organ and local level, and the modeling of normal and pathological groups of individuals (cohorts) from image descriptors. At term, this project will allow to introduce objective figures to correlate qualitative and quantitative phenotypic markers coming from the clinic and image analysis, mostly at the early stage of the pathologies. This will allow for the selection or adaptation of the treatment for patients at an early stage of the disease. In 2014, two workshops were organized (one in Rennes, one in Boston), and several publications were accepted /submitted in diffusion imaging. An extension for three more years has been applied for in December 2014.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Within the BARBANT associate team, P. Simon K. Warfield, Dr. Benoit Scherrer and Dr. Maxime Taquet (Computational Radiology Laboratory, Harvard Medical School) visited us for a workshop on multiple sclerosis and diffusion image processing.

8.5.2. Visits to International Teams

- Several members of the Visages team (Christian Barillot, Olivier Commowick, Renaud Hédouin, Yogesh Karpate) visited the Computational Radiology Laboratory (Harvard Medical School) for an associate team (BARBANT) meeting to discuss new research topics.
- From November 2014 to February 2015, Hrishikesh Deshpande visits Duke University (in Durham, North Carolina, United States) to collaborate with Professor Guillermo Sapiro on classification using Dictionary Learning. This visit was partially founded by a mobility grant from the doctoral school MATISSE.
- Maia Proisy was co-supervised by UCL and Visages (Pr Jean-Christophe Ferré), during her 6 months visit at UCL for her master research work. In this collaboration was investigated and implemented a pCASL sequence at 3T for measuring brain CBF in neonates at risk of hypoxic-ischemic encephalopathy. This work was also designed to establish a pCASL protocol for further study. Arterial Spin Labelling was a part of an ongoing study (The UCH Baby Brain Study - London), led by Prof Nicola Robertson and Dr Cristina Uria-Avellanal. Imaging data acquisition and processing was made by scientist from the UCL Institute of Neurology - London (Magdalena Sokolska and Prof Xavier Golay).

WHISPER Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

InfraJVM - (2012 - 2015)

Members: LIP6 (Regal-Whisper), Ecole des Mines de Nantes (Constraint), IRISA (Triskell), LaBRI (LSR).

Coordinator: Gaël Thomas

Whisper members: Julia Lawall, Gilles Muller

Funding: ANR Infra, 202 000 euros.

Objectives: The design of the Java Virtual Machine(JVM) was last revised in 1999, at atime when a single program running on a uniprocessor desktop machine was the norm. Today's computing environment, however, is radically different, being characterized by many different kinds of computing devices, which are often mobile and which need to interact within the context of a single application. Supporting such applications, involving multiple mutually untrusted devices, requires resource management and scheduling strategies that were not planned for in the 1999 JVM design. The goal of InfraJVM is to design strategies that can meet the needs of such applications and that provide the good performance that is required in an MRE.

Chronos network, Time and Events in Computer Science, Control Theory, Signal Processing, Computer Music, and Computational Neurosciences and Biology

Coordinator: Gerard Berry

Whisper member: Gilles Muller

Funding: ANR 2014, Défi "Société de l'information et de la communication".

The Chronos interdisciplinary network aims at placing in close contact and cooperation researchers of a variety of scientific fields: computer science, control theory, signal processing, computer music, neurosciences, and computational biology. The scientific object of study will be the understanding, modeling, and handling of time- and event-based computation across the fields.

Chronos will work by organizing a regular global seminar on subjects ranging from open questions to concrete solutions in the research fields, workshops gathering subsets of the Chronos researchers to address specific issues more deeply, a final public symposium presenting the main contributions and results, and an associated compendium.

8.1.2. Multicore Inria Project Lab

The Multicore IPL is an Inria initiative led by Gilles Muller, whose goal is to develop techniques for being able to deploy parallel programs on heterogeneous multicore machines while preserving scalability and performance. The IPL brings together researchers from the ALF, Algorille, CAMUS, Compsys, DALI, REGAL, Runtime and Whisper Inria Teams. These connections provide access to a diversity of expertise on open source development and parallel computing, respectively. In this context, we are working with Jens Gustedt of Inria Lorraine and on developing a domain-specific language that eases programming with the ordered read-write lock (ORWL) execution model. The goal of this work is to provide a single execution model for parallel programs and allow them to be deployed on multicore machines with varying architectures.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

Program: COST Action IC1001

Project acronym: Euro-TM

Project title: Transactional Memories: Foundations, Algorithms, Tools, and Applications

Duration: 2011 - 2014

Coordinator: Dr. Paolo Romano (INESC)

Whisper member: Gilles Muller, leader of the working group on Hardware's & Operating System's Supports

Other partners: Austria, Czech Republic, Denmark, France, Germany, Greece, Israel, Italy, Norway, Poland, Portugal, Serbia, Spain, Sweden, Switzerland, Turkey, United Kingdom.

Abstract: Parallel programming (PP) used to be an area once confined to a few niches, such as scientific and high-performance computing applications. However, with the proliferation of multicore processors, and the emergence of new, inherently parallel and distributed deployment platforms, such as those provided by cloud computing, parallel programming has definitely become a mainstream concern. Transactional Memories(TMs) answer the need to find a better programming model for PP, capable of boosting developer's productivity and allowing ordinary programmers to unleash the power of parallel and distributed architectures avoiding the pitfalls of manual, lock based synchronization. It is therefore no surprise that TM has been subject to intense research in the last years. This Action aims at consolidating European research on this important field, by coordinating the European research groups working on the development of complementary, interdisciplinary aspects of Transactional Memories, including theoretical foundations, algorithms, hardware and operating system support, language integration and development tools, and applications.

8.3. International Initiatives

8.3.1. Participation In other International Programs

Julia Lawall obtained the renewal of a Merlion collaboration grant, started in 2013, for collaboration with David Lo of Singapore Management University. This collaboration resulted in a two-week visit of Julia Lawall to Singapore Management University, a one-week visit of David Lo to the Whisper team, and a two-week visit of Lo's PhD student Ferdian Thung to the Whisper team. It also resulted in four publications during 2014 [26], [21], [23], [19].

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Julia Lawall supervised the remote internships of Himangi Saraogi (summer 2014) and Tapasweni Pathak (winter 2014, in progress) as part of the Gnome Outreach Program for Women (OPW). Both interns carried out projects related to Coccinelle and the Linux kernel. Julia Lawall has taken over the responsability for the coordination of the Linux kernel's participation in the OPW program in winter 2014.

Julia Lawall also supervised the internship of the undergraduate student (L2) Chi Pham from the University of Copenhagen. Pham developed a tool for transforming Coccinelle semantic patches to make them suitable for inclusion in the Linux kernel.

WILLOW Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Agence Nationale de la Recherche (ANR): SEMAPOLIS

Participants: Mathieu Aubry, Josef Sivic.

The goal of the SEMAPOLIS project is to develop advanced large-scale image analysis and learning techniques to semantize city images and produce semantized 3D reconstructions of urban environments, including proper rendering. Geometric 3D models of existing cities have a wide range of applications, such as navigation in virtual environments and realistic sceneries for video games and movies. A number of players (Google, Microsoft, Apple) have started to produce such data. However, the models feature only plain surfaces, textured from available pictures. This limits their use in urban studies and in the construction industry, excluding in practice applications to diagnosis and simulation. Besides, geometry and texturing are often wrong when there are invisible or discontinuous parts, e.g., with occluding foreground objects such as trees, cars or lampposts, which are pervasive in urban scenes. This project will go beyond the plain geometric models by producing semantized 3D models, i.e., models which are not bare surfaces but which identify architectural elements such as windows, walls, roofs, doors, etc. Semantic information is useful in a larger number of scenarios, including diagnosis and simulation for building renovation projects, accurate shadow impact taking into account actual window location, and more general urban planning and studies such as solar cell deployment. Another line of applications concerns improved virtual cities for navigation, with object-specific rendering, e.g., specular surfaces for windows. Models can also be made more compact, encoding object repetition (e.g., windows) rather than instances and replacing actual textures with more generic ones according to semantics; it allows cheap and fast transmission over low- bandwidth mobile phone networks, and efficient storage in GPS navigation devices.

This is a collaborative effort with LIGM / ENPC (R. Marlet), University of Caen (F. Jurie), Inria Sophia Antipolis (G. Drettakis) and Acute3D (R. Keriven).

8.2. European Initiatives

8.2.1. European Research Council (ERC) Advanced Grant: "VideoWorld" - Jean Ponce

Participants: Jean Ponce, Ivan Laptev, Josef Sivic.

WILLOW will be funded in part from 2011 to 2015 by the ERC Advanced Grant "VideoWorld" awarded to Jean Ponce by the European Research Council.
This project is concerned with the automated computer analysis of video streams: Digital video is everywhere, at home, at work, and on the Internet. Yet, effective technology for organizing, retrieving, improving, and editing its content is nowhere to be found. Models for video content, interpretation and manipulation inherited from still imagery are obsolete, and new ones must be invented. With a new convergence between computer vision, machine learning, and signal processing, the time is right for such an endeavor. Concretely, we will develop novel spatio-temporal models of video content learned from training data and capturing both the local appearance and nonrigid motion of the elements—persons and their surroundings—that make up a dynamic scene. We will also develop formal models of the video interpretation process that leave behind the architectures inherited from the world of still images to capture the complex interactions between these elements, yet can be learned effectively despite the sparse annotations typical of video understanding scenarios. Finally, we will propose a unified model for video restoration and editing that builds on recent advances in sparse coding and dictionary learning, and will allow for unprecedented control of the video stream. This project addresses fundamental research issues, but its results are expected to serve as a basis for groundbreaking technological advances for applications as varied as film post-production, video archival, and smart camera phones.

8.2.2. European Research Council (ERC) Starting Grant: "Activia" - Ivan Laptev

Participant: Ivan Laptev.

WILLOW will be funded in part from 2013 to 2017 by the ERC Starting Grant "Activia" awarded to Ivan Laptev by the European Research Council.
Computer vision is concerned with the automated interpretation of images and video streams. Today's research is (mostly) aimed at answering queries such as "Is this a picture of a dog?", "Is the person walking in this video?" (image and video categorisation) or sometimes "Find the dog in this photo" (object detection). While categorisation and detection are useful for many tasks, inferring correct class labels is not the final answer to visual recognition. The categories and locations of objects do not provide direct understanding of their function, i.e., how things work, what they can be used for, or how they can act and react. Neither do action categories provide direct understanding of subject's intention, i.e., the purpose of his/her activity. Such an understanding, however, would be highly desirable to answer currently unsolvable queries such as "Am I in danger?" or "What can happen in this scene?". Answering such queries is the aim of this project.

The main challenge is to uncover the functional properties of objects and the purpose of actions by addressing visual recognition from a different and yet unexplored perspective. The major novelty of this proposal is to leverage observations of people, i.e., their actions and interactions to automatically learn the use, the purpose and the function of objects and scenes from visual data. This approach is timely as it builds upon two key recent technological advances: (a) the immense progress in visual object, scene and human action recognition achieved in the last ten years, and (b) the emergence of massive amounts of image and video data readily available for training visual models. My leading expertise in human action recognition and video understanding puts me in a strong position to realise this project. ACTIVIA addresses fundamental research issues in automated interpretation of dynamic visual scenes, but its results are expected to serve as a basis for ground-breaking technological advances in practical applications. The recognition of functional properties and intentions as explored in this project will directly support high-impact applications such as prediction and alert of abnormal events and automated personal assistance, which are likely to revolutionise today's approaches to crime protection, hazard prevention, elderly care, and many others.

8.2.3. European Research Council (ERC) Starting Grant: "Leap" - Josef Sivic

Participant: Josef Sivic.

The contract has begun on Nov 1st 2014. WILLOW will be funded in part from 2014 to 2018 by the ERC Starting Grant "Leap" awarded to Josef Sivic by the European Research Council.
People constantly draw on past visual experiences to anticipate future events and better understand, navigate, and interact with their environment, for example, when seeing an angry dog or a quickly approaching car. Currently there is no artificial system with a similar level of visual analysis and prediction capabilities. LEAP is a first step in that direction, leveraging the emerging collective visual memory formed by the unprecedented amount of visual data available in public archives, on the Internet and from surveillance or personal cameras - a complex evolving net of dynamic scenes, distributed across many different data sources, and equipped with plentiful but noisy and incomplete metadata. The goal of this project is to analyze dynamic patterns in this shared visual experience in order (i) to find and quantify their trends; and (ii) learn to predict future events in dynamic scenes. With ever expanding computational resources and this extraordinary data, the main scientific challenge is now to invent new and powerful models adapted to its scale and its spatio-temporal, distributed and dynamic nature. To address this challenge, we will first design new models that generalize across different data sources, where scenes are captured under vastly different imaging conditions such as camera viewpoint, temporal sampling, illumination or resolution. Next, we will develop a framework for finding, describing and quantifying trends that involve measuring long-term changes in many related scenes. Finally, we will develop a methodology and tools for synthesizing complex future predictions from aligned past visual experiences. Our models will be automatically learnt from large-scale, distributed, and asynchronous visual data, coming from different sources and with different forms of readily-available but noisy and incomplete metadata such as text, speech, geotags, scene depth (stereo sensors), or gaze and body motion (wearable sensors). Breakthrough progress on these problems would have profound implications on our everyday lives as well as science and

commerce, with safer cars that anticipate the behavior of pedestrians on streets; tools that help doctors monitor, diagnose and predict patients' health; and smart glasses that help people react in unfamiliar situations enabled by the advances from this project.

8.2.4. EIT-ICT labs: Mobile visual content analysis (Inria)

Participants: Ivan Laptev, Josef Sivic.

The goal of this project within the European EIT-ICT activity is to mature developed technology towards real-world applications as well as transfer technology to industrial partners. Particular focus of this project is on computer vision technology for novel applications with wearable devices. The next generation mobile phones may not be in the pocket but worn by users as glasses continuously capturing audio-video data, providing visual feedback to the user and storing data for future access. Automatic answers to "Where did I leave my keys yesterday?" or "How did this place look like 100 years ago?" enabled by such devices could change our daily life while creating numerous new business opportunities. The output of this activity is new computer vision technology to enable a range of innovative mobile wearable applications.

This is a collaborative effort with S. Carlsson (KTH Stockholm) and J. Laaksonen (Aalto University).

8.3. International Initiatives

8.3.1. IARPA FINDER Visual geo-localization (Inria)

Participants: Josef Sivic, Petr Gronat, Relja Arandjelovic.

Finder is an IARPA funded project aiming to develop technology to geo-localize images and videos that do not have geolocation tag. It is common today for even consumer-grade cameras to tag the images that they capture with the location of the image on the earth's surface ("geolocation"). However, some imagery does not have a geolocation tag and it can be important to know the location of the camera, image, or objects in the scene. Finder aims to develop technology to automatically or semi-automatically geo-localize images and video that do not have the geolocation tag using reference data from many sources, including overhead and ground-based images, digital elevation data, existing well-understood image collections, surface geology, geography, and cultural information.

Partners: ObjectVideo, DigitalGlobe, UC Berkeley, CMU, Brown Univ., Cornell Univ., Univ. of Kentucky, GMU, Indiana Univ., and Washington Univ.

8.3.2. Inria Associate Team VIP

Participants: Ivan Laptev, Josef Sivic.

This project brings together three internationally recognized research groups with complementary expertise in human action recognition (Inria), qualitative and geometric scene interpretation (CMU) and large scale object recognition and human visual perception (MIT). The goal of VIP (Visual Interpretation of functional Properties) is to discover, model and learn functional properties of objects and scenes from image and video data.

Partners: Aude Oliva (MIT) and Alexei Efros (CMU / UC Berkeley). The project will be funded during 2012-2014.

8.3.3. Inria International Chair - Prof. John Canny (UC Berkeley)

Participants: John Canny [UC Berkeley], Jean Ponce, Ivan Laptev, Josef Sivic.

Prof. John Canny (UC Berkeley) has been awarded the Inria International chair in 2013. He has visited Willow during three months in 2014.

8.3.4. Inria CityLab initiative

Participants: Josef Sivic, Jean Ponce, Ivan Laptev, Alyosha Efros [UC Berkeley].

Willow participates in the ongoing CityLab@Inria initiative (co-ordinated by V. Issarny), which aims to leverage Inria research results towards developing “smart cities" by enabling radically new ways of living in, regulating, operating and managing cities. The activity of Willow focuses on urban-scale quantitative visual analysis and is pursued in collaboration with A. Efros (UC Berkeley).

Currently, map-based street-level imagery, such as Google Street-view provides a comprehensive visual record of many cities worldwide. Additional visual sensors are likely to be wide-spread in near future: cameras will be built in most manufactured cars and (some) people will continuously capture their daily visual experience using wearable mobile devices such as Google Glass. All this data will provide large-scale, comprehensive and dynamically updated visual record of urban environments.

The goal of this project is to develop automatic data analytic tools for large-scale quantitative analysis of such dynamic visual data. The aim is to provide quantitative answers to questions like: What are the typical architectural elements (e.g., different types of windows or balconies) characterizing a visual style of a city district? What is their geo-spatial distribution (see figure 1)? How does the visual style of a geo-spatial area evolve over time? What are the boundaries between visually coherent areas in a city? Other types of interesting questions concern distribution of people and their activities: How do the number of people and their activities at particular places evolve during a day, over different seasons or years? Are there tourists sightseeing, urban dwellers shopping, elderly walking dogs, or children playing on the street? What are the major causes for bicycle accidents?

Break-through progress on these goals would open-up completely new ways smart cities are visualized, modeled, planned and simulated, taking into account large-scale dynamic visual input from a range of visual sensors (e.g., cameras on cars, visual data from citizens, or static surveillance cameras).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Prof. Alexei Efros (UC Berkeley) has visited Willow for one month in 2014. Prof. John Canny (UC Berkeley) has visited Willow during three months in 2014 within the framework of Inria’s International Chair program.

8.4.1.1. Internships

Stefan Lee (Indiana University) has been a visiting PhD student at Willow since May 2014. Yumin Suh (Seoul National University) has been a visiting PhD student at Willow since Dec. 2014.

WIMMICS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. GéoIncertitude

Participant: Andrea Tettamanzi.

We participate in the CNRS PEPS GéoIncertitude, with researchers of the UMR 7300 ESPACE de Nice and of the IRIT of Toulouse on the modeling of uncertainty in Geography using fuzzy logic and possibility theory.

8.1.2. HCI Group of GLC I3S Laboratory

Participant: Alain Giboin.

This work is done in collaboration with Philippe Renevier-Gonin, Christian Brel, Anne-Marie Déry (I3S Rainbow team).

The HCI Group brings together researchers from GLC teams conducting or wishing to conduct research related to HCI. The group specifically addresses the issues of how to conduct user experiments to evaluate the UIs of the software developed in GLC. The group establishes collaborations between researchers in the design and implementation of experiments. Last year a collaboration was initiated between the teams Rainbow and Wimmics on the assessment of (1) an application composition process driven by the composition of UIs, and (2) the prototype OntoCompo supporting this process.

This year, too, a collaboration started to design visualization services assisting caregivers in their night watch tasks.

8.1.3. FUI PadDOC

Participant: Alain Giboin.

This work is done in colaboration with Karima Boudaoud and Marc Arnaert (I3S Rainbow team).

PadDOC goal is to contribute to accelerating the digital transition of citizen, local and regional authorities, administrations and enterprises, by : (1) developing an open standard and innovative software and hardware resources to facilitate nearby or distant administrative formalities and procedures; (2) improving the security of the holder's personal data by putting these data under the exclusive control of the holder; (3) by exploiting unmarked communicating supports (such as smartphones or tablets) for all chain actors. PadDOC partners are: Docapost BPO, Anyces, ABC SmartCard and the teams Rainbow, Media-Coding and Wimmics. Wimmics will contribute to: (1) the analysis, design and evaluation of the PadDOC security-oriented user interfaces; (2) the impact assessment of the chain of actors participating in the experiment to validate the viability of the PadDOC social system. The PadDOC project officially began in November 2014.

8.1.4. SyReMuse Project: collaboration Agorantic-Inria

Participants: Alain Giboin, Isabelle Mirbel, Serena Villata.

This work is done in collaboration with Bernard Senach (Hephaistos, Inria), Brigitte Trousse (Focus Lab, Inria), with Agorantic partners.

Started last year, the collaboration continued this year with ITCS and HSS teams from the Agorantic Federative Structure for Research of the Université d'Avignon et des Pays du Vaucluse. Distant and face-to-face meetings were organized to refine the so-called SyReMuse project, the goal of which is to analyze, design, and evaluate a system recommending visit tours to museum visitors (individuals and groups).

8.1.5. MSHS: Axis-2 ICT, Usage and Communities

Participants: Alain Giboin, Alexandre Monnin, Fabien Gandon.

This work is done in collaboration with Lise Arena and Bernard Conein (Gredeg).

Axis-2 of the "Maison des Sciences Humaines et Sociales (MSHS) du Sud-Est (Nice)" is interested in the relationships between ICT, Practices and Communities. Axis-2 objective is to make explicit two aspects of the relationship between digital technology and community building: (1) networks and (2) artifacts. Two Axis-2 groups-projects address these aspects: (1) the group-project "Social networks and digital networks" and the group-project "Artifacts and coordination".

The first group-project examines how the Internet allows reconstructing the dynamics of interaction networks by making explicit interaction phenomena that could not be observed and treated before the event of Big Data. The second group-project studies the impact of cognitive technologies on the social and cognitive coordination between individuals in organizational and community contexts. Wimmics was mainly involved in the second group-project. In this context, we co-organized the COOP 2014 conference and the COOP 2014 workshop on "The role of artefacts in social coordination".

8.2. National Initiatives

8.2.1. BPI funded project : AZKAR

AZKAR is a two years french project funded by BPI (Banque Publique d'Investissement), focused on *Fast Control of Mobile Robots over the Internet*, using web technologies such as WebRTC and semantic web technologies. The project started September 15th 2014. The first step of the project will be the evaluation/benchmarking of video and data solutions over internet, based on the WebRTC technology. The second step will consist in helping the robotic partner in the project (the Robosoft company) to implement these solutions on a real mobile robot that will be deployed in museums or in homes for helping seniors in their daily tasks. Semantic web technologies, will be used in the project for describing the services, the context of the application domain, the content transmitted, etc.

8.2.2. ANR LabCom SMILK

SMILK (Social Media Intelligence and Linked Knowledge) is a joint laboratory (LabCom, 2013-2016) between the Wimmics team and the Research and Innovation unit of VISEO (Grenoble). Natural Language Processing, Linked Open Data and Social Networks as well as the links between them are at the core of this LabCom. The purpose of SMILK is both to develop research and technologies in order to retrieve, analyze, and reason on textual data coming from Web sources, and to make use of LOD, social networks structures and interaction in order to improve the analysis and understanding of textual resources. Topics covered by SMILK include: use of data and vocabularies published on the Web in order to search, analyze, disambiguate and structure textual knowledge in a smart way, but also to feed internal information sources; reasoning on the combination of internal and public data and schemes, query and presentation of data and inferences in natural formats.

8.2.3. Ministry of Culture: DBpedia.fr

This project named "DBpedia.fr" proposes the creation of a French chapter of the base DBpedia used in many English applications, in particular for the publication of cultural collections. Because DBpedia is focused on the English version of Wikipedia it ignores some of the French topics and their data. This projects aims at extracting a maximum of RDF data from the French version and providing a stable and scalable end-point for them. We now consider means to improve both the quantity and the quality of the data. The DBpedia.fr project was the first project of the Semanticpedia convention signed by the Ministry of Culture, the Wikimedia foundation and Inria.

Web site: http://wimmics.inria.fr/projects/dbpedia

8.2.4. Ministry of Culture

Participant: Alexandre Monnin.

We organized a joint project between Inria and the Ministry of Culture from September 2013 to November 2014. The goal of this project was to discuss the Semantic Web with a special emphasis on cultural project. We organized three conference. The first, to get some feedback from the main projects that were launched the previous years (DBPedia, HDA-Lab and Joconde-Lab, Data.bnf.fr, Centre Pompidou Virtuel, MIMO, Hadoc, etc.), together with the feedback gathered from a major player in the field, the BBC. The second conference took place inside the Ministry of Culture. It raised the question of trust on the Web following Snowden's revelations and Tim Berners-Lee's campaign to re-decentralize the Web. Finally, the last session of the cycle, at Inria Sophia Antipolis, discussed the future of the Web, and presented the Semantic Web/Linked Data as providing some of the solutions that are currently needed to maintain the Web open, decentralized, trustful and safe.

8.2.5. Ministry of Culture: Group Cultural Metadata and Web 3.0 transition

Participant: Alain Giboin.

In order to develop a Transition-to-Web-3.0 cultural policy, the French Ministry of Culture and Communication defined 9 operational actions allowing cultural sector to take into account opportunities and challenges offered by Web 3.0 (also called "Semantic Web", or "Web of Data"), and set up 9 working groups for these actions. Wimmics contributed to the Working Group 5 "Cultural metadata and Transition to Web 3.0: Exploring the interaction modes with audiences using Web 3.0 potentialities".

8.2.6. ANR Kolflow

Kolflow is an ANR project (2011-2014), it proposes to extend collective intelligence with smart agents relying on automated reasoning. Smart agents can significantly reduce the overhead of communities in the process of continuously building knowledge. Consequently, continuous knowledge building is much more effcient. Kolflow aims at building a social semantic space where humans collaborate with smart agents in order to produce knowledge understandable by humans and machines.

Partners: Inria Orpailleur & Wimmics, Silex U. Claude Bernard Lyon, GDD U. of Nantes

Web site: http://kolflow.univ-nantes.fr

8.2.7. ANR OCKTOPUS

OCKTOPUS is an ANR project (2012-2015). The objective of OCKTOPUS is to increase the potential social and economic benefit of the large and quickly growing amounts of user-generated content, by transforming it into useful knowledge. We believe that it is possible to considerably improve upon existing generic Information Retrieval techniques by exploiting the specific structure of this content and of the online communities which produce it. Specifically, we will focus on a multi-disciplinary approach in order to address the problem of finding relevant answers to questions within forums and question-answer sites. To create metrics and predictors of content quality and use them to improve the search experience of a user, we will take advantage of:

- the experience of the CRG (the management research institute of Ecole Polytechnique and CNRS) to understand better the incentives of, and interactions between individuals who produce online content within large communities;
- the experience of the Wimmics research team to analyze the structural and temporal aspects of the complex typed social graphs found within these communities;
- the ability of Alcméon (a start-up developing a search application dedicated to user-generated content) to integrate and test the results of OCKTOPUS within a common demonstration framework, in order to assess their practical usefulness when applied to concrete large-scale datasets.

Partners: Alcméon, CRG, Inria Wimmics.

Web site: http://ocktopus.alcmeon.com

8.2.8. CNRS Mastodons CrEDIBLE

Participants: Olivier Corby, Catherine Faron Zucker, Alban Gaignard.

We participate to the CrEDIBLE research project funded by the MASTODONS program of the interdisciplinary mission of CNRS which objective is to bring together scientists from all disciplines involved in the implementation of systems sharing of distributed and heterogeneous medical imaging, provide an overview of this area and to evaluate methods of state of the art and technology that affect this area. In this framework, we participated to the organization of a 3-days workshop and we worked with members of the I3S Modalis team (Johan Montagnat) on the distribution of algorithms in the Corese/KGRAM engine.

Catherine Faron Zucker was chairman of one of its session and worked with members of the I3S Modalis team on a survey of existing approaches for the translation of relational data to RDF data.

Web site: https://credible.i3s.unice.fr

8.2.9. GDRI Zoomathia

Participants: Olivier Corby, Catherine Faron Zucker, Alexandre Monnin.

Wimmics is partner of International Research Group (GDRI) Zoomathia funded by two CNRS institutes: INEE and INSHS. It aims at studying transmission of zoological knowledge from Antiquity to Middle-Age through material resources (bio residues, artefacts), iconography and texts.

One of the goals of the project is to design a thesaurus and semantically annotate resources, capturing different types of knowledge: zoonyme, historical period, zoological speciality (ethology, anatomy, physiology, psychology, zootechnique, etc.), litterary genre or iconography.

We started to work on 1) the translation of manual annotations of middle-age structured texts from XML to RDF, 2) the automatic extraction of RDF annotations from text using NLP techniques and 3) the exploitation of these semantic metadata to help historians in their studies of knowledge transmission through these texts.

8.2.10. Inria Large Scale Initiative Action PAL (Personally Assisted Living)

Participants: Alain Giboin, Célia Ormea.

This work is done in collaboration with David Daney and Jean-Pierre Merlet (Coprin/Hephaistos), Patrick Rives (Lagadic).

Last year, Wimmics was involved in a socio-ergonomic field study to inform the design of a device (such as a robotic shopping trolley) assisting elderly and frail persons to do their shopping autonomously. This year this work was synthesized and published in [61].

Web site: http://pal.inria.fr

8.2.11. Carnot Project

Participants: Elena Cabrio, Serena Villata.

This project was just accepted this year on the topic of *Natural Language Argumentation on Twitter: Retrieval of Argumentative Structures and Reasoning*.

Partner : Vigiglobe.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7 & H2020

Program: CHIST-ERA

Project acronym: ALOOF

Project title: Autonomous Learning of the Meaning of Objects

Duration: October 2014 - October 2017

Coordinator: University of Rome La Sapienza Italy

Other partners: University of Birmingham United Kingdom, Technische Universität Wien Austria.

Abstract: The goal of ALOOF is to enable robots to tap into the ever-growing amount of knowledge available on the Web, by learning from there about the meaning of previously unseen objects, expressed in a form that makes them applicable when acting in situated environments. By searching the Web, robots will be able to learn about new objects, their specific properties, where they might be stored and so forth. To achieve this, robots need a mechanism for translating between the representations used in their real-world experience and those on the Web. We propose a meta-modal representation, composed of meta-modal entities and relations between them. A single entity is composed of modal features extracted from sensors or the Web. A modal completion supports perception in the absence of a complete set of features. The combined features link to the semantic properties associated to each entity. All entities are organized into a structured ontology, supporting formal reasoning. This is complemented with methods for detecting gaps in the knowledge of the robot, for planning where to effectively obtain the knowledge, and for extracting relevant knowledge from Web resources. By situating meta-modal representations into the perception and action capabilities of robots, we will achieve a powerful mix of Web-supported and physical-interaction-based open-ended learning. Our scenario consists of a home setting where robots have to find/retrieve objects while understanding their meaning and relevance in the assigned task. Our measure of progress will be how many gaps, i.e. incomplete information about objects, can be resolved autonomously given specific prior knowledge. We will integrate results on different mobile robot platforms ranging from smaller mobile platforms, over Metralabs Scitos to a home service robot HOBBIT.

8.4. International Initiatives

8.4.1. Inria Associate Teams

Program: International Initiatives

SEEMPAD

Social Exchanges and Emotions in Mediated Polemics - Analysis and Data

International Partner (Institution - Laboratory - Researcher):

University of Montréal, Heron Lab (Canada)

Duration: 2014 - 2017

See also: https://project.inria.fr/seempad/

Generating, annotating and analyzing a dataset that documents a debate. We aim at synchronizing several dimensions: social links (intensity, alliances, etc.); interactions happening (who talks to whom); textual content of the exchanged messages; social-based semantic relations among the arguments; emotions, polarity, opinions detected from the text; emotions, physical state detected from sensors.

During the first year, we have defined the protocol for the first experimental setting, which will represent the first stage of the proof-of-concept. The goal of the first experiment is to address a feasibility study of the annotation of a corpus of natural language arguments with emotions. The experiment involved a group of 20 participants, recruited by the Heron Lab. In particular, the first experiment has considered the following steps:

- Starting from an issue to be discussed provided by the animators, the aim of the experiment is to collect the arguments proposed by the participants.
- These arguments are then associated with the emotional component detected through apposite devices of the Heron Lab. More precisely, the workload/engagement emotional states and the facial emotions of the participants are extracted during the debate, using an EEG headset and a Face Emotion Recognition tool respectively.

- In a post-processing phase on the collected data, we have synchronized the arguments put forward at instant t with the emotional indexes we retrieved.
- The output of this post-processing phase (ongoing) will result in an argumentation graph representing each discussion addressed by the discussion groups. These argumentation graphs connect the arguments to each other by a support or an attack relation, and they will be labeled with the source that has proposed the argument, and the emotional state of the source itself and of the other participants at the time when the argument has been put on the table.

8.4.1.1. Declared Inria International Partners

Fabien Gandon acts as Inria representative at W3C.

We participate to W3C Data Shape WG, Linked Data Platform WG and Semantic Web Interfaces Community Group.

8.4.1.2. Informal International Partners

Software Engineering Laboratory (Head: Pierre Robillard), Polytechnique Montréal, Canada.

Topic of the collaboration: Modeling of software development processes and teams for quality assessment purposes.

8.4.2. Inria International Labs

We participate to the LIRIMA where we have a long term collaboration with University Gaston Berger at Saint-Louis, Senegal, with Moussa Lo. We host two PhD students in collaboration with UBG: Papa Fary Diallo and Oumy Seye.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Faten Ayachi is professor, director of Computer Science dept. at SUPCOM Engineering School in Tunis, Tunisia. Visit: august 25-31. *New security policies in RDBMS: retro-conception algorithms*.

Pr Liam J. Bannon (University of Limerick, Ireland), gave a talk about *Towards a More Human-centred Informatics? Examining the Role of HCI and CSCW in Computing*. It was an invited talk co-organized with the MSHS Project "Artefacts, coordination et communautés numériques", October 16th.

8.5.1.1. Internships

Cristian Adrián Cardellino

June – 2014

Universidad Nacional de Córdoba (Argentina)

Design and development of a data licensing framework for Linked Data

ZENITH Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Labex NUMEV, Montpellier

URL: http://www.lirmm.fr/numev

We are participating in the Laboratory of Excellence (labex) NUMEV (Digital and Hardware Solutions, Modelling for the Environment and Life Sciences) headed by University of Montpellier 2 in partnership with CNRS, University of Montpellier 1, and Inria. NUMEV seeks to harmonize the approaches of hard sciences and life and environmental sciences in order to pave the way for an emerging interdisciplinary group with an international profile. The NUMEV project is decomposed in four complementary research themes: Modeling, Algorithms and computation, Scientific data (processing, integration, security), Model-Systems and measurements. Florent Masseglia co-heads (with Pascal Poncelet) the theme on scientific data.

8.1.2. Institut de Biologie Computationnelle (IBC), Montpellier

URL: http://www.ibc-montpellier.fr

IBC is a 5 year project with a funding of 2Meuros by the MENRT ("Investissements d'Avenir" program) to develop innovative methods and software to integrate and analyze biological data at large scale in health, agronomy and environment. Patrick Valduriez heads the workpackage on integration of biological data and knowledge.

8.2. National Initiatives

8.2.1. PIA

8.2.1.1. Datascale (2013-2015), 250Keuros

Participants: Reza Akbarinia, Florent Masseglia, Saber Salah, Patrick Valduriez.

The Datascale project is a "projet investissements d'avenir" on big data with Bull (leader), CEA, ActiveEon SAS, Armadillo, Twenga, IPGP, Xedix and Inria (Zenith) . The goal of the project is to develop the essential technologies for big data, including efficient data management, software architecture and database architecture, and demonstrate their scalability with representative applications. In this project, the Zenith team works on data mining with Hadoop MapReduce.

8.2.1.2. Xdata (2013-2015), 125Keuros

Participants: Emmanuel Castanier, Julien Diener, Patrick Valduriez.

The X-data project is a "projet investissements d'avenir" on big data with Data Publica (leader), Orange, La Poste, EDF, Cinequant, Hurence and Inria (Indes, Planete and Zenith) . The goal of the project is to develop a big data plaftform with various tools and services to integrate open data and partners's private data for analyzing the location, density and consuming of individuals and organizations in terms of energy and services. In this project, the Zenith team heads the workpackage on data integration.

8.2.2. Others

8.2.2.1. RTRA Pl@ntNet (2009-2014), 1Meuros

Participants: Alexis Joly, Hervé Goëau, Julien Champ.

The Pl@ntNet project http://www.plantnet-project.org/ was launched in 2009 by a large international consortium headed by three groups with complementary skills (UMR AMAP [0], IMEDIA project team at Inria, and the French botanical network TelaBotanica [0]), with financial support from the Agropolis Foundation. Due to the departure of Nozha Boujemaa from the head of IMEDIA and the mobility of Alexis Joly in 2011, Zenith has been entrusted with the Inria's management and scientific coordination of the project in spring 2012. The objectives of the project are (i) to develop cutting-edge transdisciplinary research at the frontier between integrative botany and computational sciences, based on the use of large datasets and expertise in plant morphology, anatomy, agronomy, taxonomy, ecology, biogeography and practical uses (ii) provide free, easy-access software tools and methods for plant identification and for the aggregation, management, sharing and utilization of plant-related data (iii) promote citizen science as a powerful means to enrich databases with new information on plants and to meet the need for capacity building in agronomy, botany and ecology.

8.2.2.2. CIFRE INA/Inria (2013-2016), 100Keuros

Participants: Alexis Joly, Valentin Leveau, Patrick Valduriez.

This CIFRE contract with INA allows funding a 3-years PhD (Valentin Leveau). This PhD addresses research challenges related to large-scale supervised content-based retrieval notably in distributed environments.

8.2.2.3. CNRS INS2I Mastodons (2013-2014), 60Keuros

Participants: Alexis Joly, Florent Masseglia, Esther Pacitti [leader], Patrick Valduriez.

This project deals with the problems of big data in the context of life science, where masses of data are being produced, e.g. by Next Generation Sequencing technologies or plant phenotyping platforms. In this project, Zenith addresses the specific problems of large-scale data analysis and data sharing.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. CoherentPaaS

Project title: A Coherent and Rich Platform as a Service with a Common Programming Model
Instrument: Integrated Project
Duration: 2013 - 2016
Total funding: 5 Meuros (Zenith: 500Keuros)
Coordinator: U. Madrid, Spain
Partner: FORTH (Greece), ICCS (Greece), INESC (Portugal) and the companies MonetDB (Netherlands), QuartetFS (France), Sparsity (Spain), Neurocom (Greece), Portugal Telecom (Portugal).
Inria contact: Patrick Valduriez

Accessing and managing large amounts of data is becoming a major obstacle to developing new cloud applications and services with correct semantics, requiring tremendous programming effort and expertise. CoherentPaaS addresses this issue in the cloud PaaS landscape by developing a PaaS that incorporates a rich and diverse set of cloud data management technologies, including NoSQL data stores, such as key-value data stores and graph databases, SQL data stores, such as in-memory and column-oriented databases, hybrid systems, such as SQL engines on top on key-value data stores, and complex event processing data management systems. It uses a common query language to unify the programming models of all systems under a single paradigm and provides holistic coherence across data stores using a scalable, transactional management system. CoherentPaaS will dramatically reduce the effort required to build and the quality of the resulting cloud applications using multiple cloud data management technologies via a single query language, a uniform programming model, and ACID-based global transactional semantics. CoherentPaaS will design and build a working prototype and will validate the proposed technology with real-life use cases. In this project, Zenith is in charge of designing an SQL-like query language to query multiple databases (SQL, NoSQL) in a cloud and implementing a compiler/optimizer and query engine for that language.

[0] http://amap.cirad.fr/en/
[0] http://www.tela-botanica.org/

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. MUSIC

Title: MUltiSite Cloud (MUSIC) data management
Inria principal investigator: Esther Pacitti
International Partner (Institution - Laboratory - Researcher):

Laboratorio Nacional de Computaçao Cientifica, Petropolis (Brazil) - Fabio Porto

Universidade Federal do Rio de Janeiro (Brazil) - Alvaro Coutinho and Marta Mattoso

Universidade Federal Fluminense, Niteroi (Brazil) - Daniel Oliveira

Centro Federal de Educa cao Tecnologica, Rio de Janeiro (Brazil) - Eduardo Ogasawara

Duration: 2014 - 2016
See also: https://team.inria.fr/zenith/projects/international-projects/music/

The cloud has become a good match for managing big data since it provides unlimited computing, storage and network resources on demand. By centralizing all data in a large-scale data-center, the cloud significantly simplifies the task of system administration. But for scientific data, where different organizations may have their own data-centers, a distributed (multisite) cloud model where each site is visible from outside, is needed. The main objective of this research and scientific collaboration is to develop a multisite cloud architecture for managing and analyzing scientific data, including support for heterogeneous data; distributed scientific workflows, and complex big data analysis. The resulting architecture will enable scalable data management infrastructures that can be used to host a variety of scientific applications that benefit from computing, storage, and networking resources that span multiple data-centers.

8.4.1.2. BIGDATANET

Title: A hybrid P2P/cloud for big data
Inria principal investigator: Patrick Valduriez
International Partner :

University of California at Santa Barbara (USA) - Amr El Abbadi and Divy Agrawal

Duration: 2013 - 2015
See also: https://team.inria.fr/zenith/projects/international-projects/bigdatanet/

The main objective of this research and scientific collaboration is to develop a hybrid architecture of a computational platform that leverages the cloud computing and the P2P computing paradigms. The resulting architecture will enable scalable data management and data analysis infrastructures that can be used to host a variety of next-generation applications that benefit from computing, storage, and networking resources that exist not only at the network core (i.e., data-centers) but also at the network edge (i.e., machines at the user level as well as machines available in CDNs – content distribution networks hosted in ISPs).

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

We have regular scientific relationships with research laboratories in

- North America: Univ. of Waterloo (Tamer Özsu), Mc Gill, Montreal (Bettina Kemme).
- Asia: National Univ. of Singapore (Beng Chin Ooi, Stéphane Bressan), Wonkwang University, Korea (Kwangjin Park)
- Europe: Univ. of Amsterdam (Naser Ayat, Hamideh Afsarmanesh), Univ. of Madrid (Ricardo Jiménez-Periz), UPC Barcelona (Josep Lluis Larriba Pey, Victor Munoz)
- North Africa: Univ. of Tunis (Sadok Ben-Yahia)

8.4.3. Inria International Labs

The Bigdatanet associated team takes part of the Inria@SiliconValley lab.

8.4.4. Participation In other International Programs

We are involved in the following international actions:

- CNPq-Inria project Hoscar (HPC and data management, 2012-2015) with LNCC (Fabio Porto), UFC, UFRGS (Philippe Navaux), UFRJ (Alvaro Coutinho, Marta Mattoso) to work on data management in high performance computing environments.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Ruiming Tang (National University of Singapore) gave a seminar on "Quality and Price of Data" in January.

Xiao Bai (Yahoo Labs Barcelona) gave a seminar on "Improving the Efficiency of Multi-site Web Search Engines" in January.

Philippe Bonnet (IT University of Copenhagen) gave a seminar on CLyDE Mid-Flight: What we have learnt so far about the SSD-Based IO Stack in May.

Antoine Chambille and Romain Colle (QuartetFS, Paris) gave a seminar on "In-Memory Analytics: Accelerating Business Performance" in June.

Divy Agrawal and Amr El Abbadi (UCSB, USA) gave keynote talks on "Emerging Technologies for Big Data Management and Analytics" and "Consistent, Elastic and Fault-Tolerant Management of Big Data in the Cloud", respectively, in the Mastodons International Workshop on "Big Data Management and Crowd Sourcing towards Scientific Data" in Montpellier in June.

Bettina Kemme (McGill Univ., Canada) gave a seminar on "Multiplayer Games: a complex application in need for scalable replica management" in december.

Sihem Amer-Yahia (LIG) gave a seminar on "Task Assignment Optimization in Crowdsourci" in December.

8.5.2. Visits to International Teams

Patrick Valduriez visited the Inria-Chile center in Santiago in october, where he gave several talks.

Mohamed Reda Bouadjenek visited UCSB in november-december, in the context of the Bigdatanet associated team.