Activity Report 2012

Section Partnerships and Cooperations

ALGORITHMICS, PROGRAMMING, SOFTWARE AND ARCHITECTURE

PERCEPTION, COGNITION, INTERACTION

BYMOORE Exploratory Action (section vide)

<p style="text-align:center; color:red;">**POPIX Exploratory Action**</p>

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. FP7 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; 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.

ABSTRACTION Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. AbstractCell

Title: Formal abstraction of quantitative semantics for protein-protein interaction cellular network models

Instrument: ANR-Chair of Excellence (Junior, long term)

Duration: December 2009 - December 2013

Coordinator: Inria (France)

Others partners: None

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

Abstract: The overall goal of this project is to investigate formal foundations and computational aspects of both the stochastic and differential approximate semantics for rule-based models. We want to relate these semantics formally, then we want to design sound approximations for each of these semantics (by abstract interpretation) and investigate scalable algorithms to compute the properties of both the stochastic and the differential semantics. Jérôme Feret is the principal investigator for this project.

8.1.1.2. 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)

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.

8.1.1.3. 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 VERASCO advocates a mathematically-grounded solution to the issues of formal verifying compilers and verification tools. 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.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. 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: http://www.artemis-ia.eu/project/index/view/?project=29

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.

8.2.1.2. MemCad

Title: Memory Compositional Abstract Domains

Type: IDEAS ()

Instrument: ERC Starting Grant (Starting)

Duration: October 2011 - September 2016

Coordinator: Inria (France)

Others partners: none

See also: http://www.di.ens.fr/~rival/memcad.html

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

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Yanjun Wen is associate professor at the Department of Computer Science and Technology, College of Computer, National University of Defense Technology, Changsha, P. R. China. He has visited the team from June 2011 to May 2012 and is interested in the static analysis of parallel software by abstract interpretation.

Roberto Giacobazzi, professor at the University of Verona, Italy, visited the Team in May 2012.

Michael Hicks is associate professor at the Department of Computer Science, University of Maryland, USA. He has visited the team in October 2012 and is interested in abstract interpretation, software security, and differential privacy.

Tatjana Petrov is a PhD student at ETH Zürich. She has visited the team in February 2012 and is interested in the model reduction of stochastic systems.

8.3.1.1. Internships

David Delmas is an engineer at Airbus France on educational leave to pursue the 2nd year of the Parisian Master of Research in Computer Science (MPRI). He has visited the team from September 2011 to August 2012.

ALF Project-Team

8. Partnerships and Cooperations

8.1. European Initiatives

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

Participants: Pierre Michaud, Luis Germán García Morales, Nathanaël Prémillieu, Erven Rohou, André Seznec, Bharath Narasimha Swamy, Ricardo Andrés Velásquez, Arthur Pérais, Surya Narayanan, Arjun Suresh, Sajith Kalathingal, Kamil Kedzierski.

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.

8.1.2. HiPEAC3 NoE

Participants: François Bodin, Pierre Michaud, Erven Rohou, André Seznec.

F. Bodin, 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.

8.1.3. COST Action TACLe - Timing Analysis on Code-Level 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 is indispensable to ascertain whether these requirements are met. However, recent developments in hardware, especially multicore processors, and software organization make the analysis increasingly harder, thus challenging the evolution of timing analysis techniques. Principles for building "timing-composable" embedded systems are needed to make timing analysis tractable in the future. The furthering and consolidation of those principles require increased contacts within the timing analysis community as well as with the neighboring communities that deal with other forms of analysis, such as model checking and type inference, and with computer architectures and compilers. The goal of this COST Action (http://www.cost.eu/domains_actions/ict/Actions/IC1202) is to gather these forces in order to develop industrial strength code-level timing analysis techniques for future generation embedded systems.

Twelve countries are currently involved in this COST action.

8.2. Regional Initiative

8.2.1. Britanny region fellowship

Participants: Ricardo Andrés Velásquez, Pierre Michaud, André Seznec.

The Britanny region is funding a Ph.D. fellowship for Ricardo Velasquez on the topic "Fast hybrid multicore architecture simulation".

8.3. National Initiatives

8.3.1. ANR PetaQCD 01-2009/10-2012

Participants: Junjie Lai, André Seznec.

Simulation of Lattice QCD is a challenging computational problem that requires very high performance exceeding sustained Petaflops/s. The ANR PetaQCD project combines research groups from computer science, physics and two SMEs (CAPS Entreprise, Kerlabs) to address the challenges of the design of LQCD oriented supercomputer.

8.3.2. ANR W-SEPT

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.

8.3.3. Large Scale Initiative: Large scale multicore virtualization for performance scaling and portability

Participant: Erven Rohou.

An Inria Large Scale Initiative (Action d'Envergure) has been submitted and approved. 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.

8.3.4. ADT PADRONE 2012-2014

Participants: Erven Rohou, 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 re-optimization 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).

8.4. International Initiative

8.4.1. PHC Imhotep (Egypt): Code obfuscation through JIT compilation, Jan 2012 – Dec 2013

Participant: Erven Rohou.

Collaboration with Pr Ahmed El-Mahdy, Egypt-Japan University for Science and Technology (Alexandria, Egypt)

This project proposes to leverage JIT compilation to make software tamper-proof. The idea is to constantly generate different versions of an application, even while it runs, to make reverse engineering hopeless. A strong random number generator will guarantee that generated code is not reproducible – though the functionality is the same. Performance will not be sacrificed thanks to multi-core architectures: the JIT runs on separate cores, overlapping with the execution of the application.

AOSTE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CIM PACA

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

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 so far actively participating in the Design Platform (one of the three platforms launched in this context), of which Inria is a founding member.

This year our ANR proposal HOPE was labeled by the regional SCS Cluster, through its ARCSIS/CIM PACA branch for microelectronics design. The project was consequently accepted, and will benefit from support from CIM PACA Design platform to host prototype and commercial software from project members (Synopsys, Docea Power, and Magillem, see 8.2.1.3).

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. RT-Simex

Participants: Julien deAntoni, Frédéric Mallet.

The RT-Simex project is dedicated to the reverse engineering of analysis traces of simulation and execution back up to the source code, or in our case most likely into the original models in a MARTE profile representation. The prime contractor is OBEO, a software publishing company based in Nantes. The project ended in April 2012.

8.2.1.2. HeLP

Participants: Carlos Gomez Cardenas, Ameni Khecharem, Robert de Simone, Jean-Vivien Millo.

The ANR HeLP project deals with joint modeling of functional behavior and energy consumption for the design of low-power heterogeneous SoCs. Partners are ST Microelectronics and Docea Power (SME) as industrial; Inria, UNS (UMR LEAT), and VERIMAG (coordinator) as academics. Our goal in this project is twofold: first, combine SoC modeling with temporal behavior and logical time with energy/power modeling as extra annotations on MARTE models; second, compare the capacities of high-level SystemC TLM abstraction with that of Esterel seen as a multiclock formalism based on logical abstract time.

The PhD thesis of Carlos Gomez, while not formerly funded by this project, is closely linked to its results (by providing a MDE metamodel with non-functional multiview aspects, such as performance, power and temperature. Several transformation links were realized, towards AcePlorer tool by DOCEA POWER, partner of the project, or also (as part of Ameni Khecharem internship) towards Scilab for simulation execution. Some of this work will be continued in the forthcoming ANR HOPE project.

8.2.1.3. HOPE

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

This project was only recently started, with a kick-off meeting in November. Original proponents were UMR LEAT, Texas Instruments, Synopsys, Docea Power, Magillem, and ourselves. It seems that, due to internal reorganisation, TI might withdraw from the project. Other major semiconductor industrial partners in PACA are being approched for replacement (mainly Intel). The purpose of the HOPE project is to focus on high-level modeling and early estimation of hierarchical power management techniques, with potential synthesis in the end if feasible.

8.2.1.4. GeMoC

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

This project was only recently started, with a kick-off meeting in December. It 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 PARSEC

Participants: Dumitru Potop Butucaru, Thomas Carle, Zhen Zhang, Yves Sorel.

The PARSEC Project aims at providing development tools for critical real-time distributed systems requiring certification according to the most stringent standards such as DO-178B (avionics), IEC 61508 (transportation) or Common Criteria for Information Technology Security Evaluation. The approach proposed by PARSEC provides an integrated toolset that helps software engineers to meet the requirements associated to the certification of critical embedded software. Partners of the project are: Alstom, Thales, Ellidiss, OpenWide, Systerel, CEA, InriaS, Telecom ParisTech.

See also: http://www.systematic-paris-region.org/sites/default/files/exports/projets/fichiers/ProjetPARSEC_BookSystematic2012.pdf.

8.3. European Initiatives

8.3.1. ARTEMIS Projects

8.3.1.1. CESAR

Participant: Robert de Simone.

> Title: CESAR
>
> Duration: February 2009 - June 2012
>
> Coordinator: AVL - GmbH (Austria)

Others partners: AIRBUS Operations GbmH (Germany), AIRBUS Operations SAS (France), ABB AS (Norway), ABB AB (Sweden), AbsInt Angewandte Informatik GmbH (Germany), ACCIONA Infraestructuras S.A. (Spain), Ansaldo STS S.p.A. (Italy), ASTRIUM SAS (France), AIRBUS Operations Limited (United Kingdom), Aristotle University of Thessaloniki (Greece), Commissariat à l´Energie Atomique et aux Energies Alternatives (France), CNRS (France), Centro Ricerche Fiat S.C.p.A. (Italy), Critical Software S.A. (Poland), Danieli Automation S.p.A. (Italy), Delphi France SAS (France), Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany), Dassault Systemes (France), EADS Deutschland GmbH (Germany), Fondacion Tecnalia Research & Innovation (Italy), ESTEREL Technologies SA (France), Fraunhofer Gesellschaft zur Förderung der Angewandten Forschung e.V. (Germany)

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

Abstract: CESAR stands for Cost-efficient methods and processes for safety relevant embedded systems and is a European funded project from ARTEMIS JOINT UNDERTAKING (JU). The three transportation domains automotive, aerospace, and rail, as well as the automation domain share the need to develop ultra-reliable embedded systems to meet societal demands for increased mobility and ensuring safety in a highly competitive global market. To maintain the European leading edge position in the transportation as well as automation market, CESAR aims to boost cost efficiency of embedded systems development and safety and certification processes by an order of magnitude. CESAR pursuits a multi-domain approach integrating large enterprises, suppliers, SME's and vendors of cross sectoral domains and cooperating with leading research organizations and innovative SME's.

Upon completion, CESAR was awarded an ARTEMIS honorary mention for achievement.

8.3.1.2. PRESTO

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

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.

8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. ITEA2 Timmo2Use

Participants: Marie-Agnès Peraldi Frati, Julien DeAntoni, Arda Goknil, Jean-Vivien Millo, Yves Sorel.

Program: ITEA2

Project acronym: Timmo2Use

Project title: TIMing MOdel, TOols, algorithms, languages, methodology, and USE cases

Duration: October 2010 - October 2012

Coordinator: Volvo Technology AB (Sweden)

Other partners: AbsInt Angewandte Informatik GmbH (Germany), Arcticus Systems AB (Sweden), Chalmers University of Technology (Sweden), Continental Automotive GmbH (Germany), Delphi France SAS (France), dSPACE GmbH (Germany), INCHRON GmbH (Germany), Institut National de Recherche en Informatique et Automatique (France), Mälardalen University (Sweden), Rapita Systems Ltd. (United Kingdom), RealTime-at-Work (France), Robert Bosch GmbH (Germany), Symtavision GmbH (Germany), Technische Universität Braunschweig (Germany), Time Critical Networks (Sweden), Universität Paderborn (Germany).

See also: http://timmo-2-use.org/

Abstract: TIMMO develops different types of timing constraints and dynamic behaviour formalisms, to be used inside the supply chain and the complex development process in distributed real-time automotive system design. TIMMO-2-USE stands for TIMing MOdel - TOols, algorithms, languages, methodology, and USE cases which summarizes the main objectives of the project, i.e., the development of novel tools, algorithms, languages, and a methodology validated by use cases.

The project provides partial funding for the postdoctoral positions of Jean-Vivien Millo and Arda Goknil.

8.3.2.2. ITEA2 OPENPROD

Participants: Simon Nivault, Yves Sorel.

Program: ITEA2

Project acronym: OpenProd

Project title: Open Model-Driven Whole-Product Development and Simulation Environment

Duration: June 2009 - May 2012

Coordinator: Siemens Industrial TurboMachinery AB (Sweden)

Other partners: Appedge (France), Bosch Rexroth AG (Sweden), CEA LIST (France), EADS Innovation Works (France), Electricité De France (France), Equa Simulation AB (Sweden), ETH Zürich (Switzerland), Fachhochschule Bielefeld (Germany), Fraunhofer FIRST (Germany), IFP (France), Inria Rocquencourt (France), INSA Lyon (France), Linköping University (Sweden), LMS Imagine (France), MathCore Engineering AB (Sweden), Metso Automation (France), Nokia (Finland), Plexim GmbH (Germany), Pöyry Forest Industry (Finland), PSA Peugeot Citroen (France), Siemens AG, Sector Energy (Germany), SKF Sverige AB (Sweden), Technische Universität Braunschweig (Germany), TLK Thermo GmbH (Germany), VTT Technical Research Centre (Finland), XRG Simulation GmbH (Germany).

See also: http://www.ida.liu.se/~pelab/OpenProd/

Abstract: The OPENPROD project is developing an open whole-product, model-driven systems development, modelling and simulation (M&S) environment that integrates the leading open industrial software development platform Eclipse with open-source modelling and simulation tools such as OpenModelica and industrial M&S tools and applications. The project will enable a more formalised validation of production to cut time to market and ensure higher quality, using open solutions which will have a high impact, based on easy uptake and wide dissemination.

8.4. International Initiatives

8.4.1. Inria Associated Teams

8.4.1.1. DAESD

Title: Distributed/Asynchronous and Embedded/synchronous Systems Development

Inria principal investigator: Robert de Simone

International Partner (Institution - Laboratory - Researcher):

East China Normal University (China) - SEI-Shone - Yixiang Chen

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*, 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. In parallel with our research collaboration this Associate Team, the SEI-Shone lab is organizing a workshop in Shanghai, with a first edition in Nov. 2011, on "Distributed - Asynchronous and Embedded - synchronous Systems Development".

8.4.2. Participation In International Programs

8.4.2.1. LIAMA

Following the DAESD associated-team, a proposal for a LIAMA project with ECNU Shanghai, named HADES, has been presented recently at the LIAMA steering committee in December 2012. It is a joint proposal with the OASIS EPI.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Jagadish Suryadevara (IDT, Mälardalen University, Sweden) visited us for two months in May/June 2012.

8.5.1.1. Internships

Matias Ezequiel VARA LARSEN (from Mar 2012 until Jun 2012)

Subject: Study of the influence of Linux operating system on OpenMP applications performances on multicore processors

Institution: National University of La Plata (Argentina)

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR HPAC Project

Participants: Claude-Pierre Jeannerod, Nicolas Louvet, Nathalie Revol, Damien Stehlé, 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 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 and innovative high performance solutions for cryptology challenges.

8.1.2. ANR TaMaDi Project

Participants: Nicolas Brisebarre, Florent de Dinechin, Guillaume Hanrot, Vincent Lefèvre, Érik Martin-Dorel, Micaela Mayero, Jean-Michel Muller, Ioana Pasca, Damien Stehlé, Serge Torres.

The TaMaDi project (Table Maker's Dilemma, 2010-2013) is funded by the ANR and headed by Jean-Michel Muller. It was submitted in January 2010, accepted in June, and started in October 2010. The other French teams involved in the project are the MARELLE team-project of Inria Sophia Antipolis-Méditerranée, and the PEQUAN team of LIP6 lab., Paris.

The aim of the project is to find "hardest to round" (HR) cases for the most common functions and floating-point formats. In floating-point (FP) arithmetic having fully-specified "atomic" operations is a key-requirement for portable, predictable and provable numerical software. Since 1985, the four arithmetic operations and the square root are IEEE specified (it is required that they should be correctly rounded: the system must always return the floating-point number nearest the exact result of the operation). This is not fully the case for the basic mathematical functions (sine, cosine, exponential, etc.). Indeed, the same function, on the same argument value, with the same format, may return significantly different results depending on the environment. As a consequence, numerical programs using these functions suffer from various problems. The lack of specification is due to a problem called the Table Maker's Dilemma (TMD). To compute $f(x)$ in a given format, where x is a FP number, we must first compute an approximation to $f(x)$ with a given precision, which we round to the nearest FP number in the considered format. The problem is the following: finding what the accuracy of the approximation must be to ensure that the obtained result is always equal to the "exact" $f(x)$ rounded to the nearest FP number. In the last years, our team-project and the CACAO team-project of Inria Nancy-Grand Est designed algorithms for finding hardest-to-round cases. These algorithms do not allow to tackle with large formats. The TaMaDi project mainly focuses on three aspects:

- big precisions: we must get new algorithms for dealing with precisions larger than double precision. Such precisions will become more and more important (even if double precision may be thought as more than enough for a final result, it may not be sufficient for the intermediate results of long or critical calculations);

- formal proof: we must provide formal proofs of the critical parts of our methods. Another possibility is to have our programs generating certificates that show the validity of their results. We should then focus on proving the certificates;

- aggressive computing: the methods we have designed for generating HR points in double precision require weeks of computation on hundreds of PCs. Even if we design faster algorithms, we must massively parallelize our methods, and study various ways of doing that.

The various documents can be found at http://tamadiwiki.ens-lyon.fr/tamadiwiki/index.php/Main_Page.

8.2. International Initiatives

8.2.1. Inria Associate Teams

QOLAPS (Quantifier elimination, Optimization, Linear Algebra and Polynomial Systems) 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: Nathalie Revol and Gilles Villard.

8.2.2. Participation in International Programs

Joint CNRS-Royal Society grant with Cong Ling (Imperial College, London). Participants: Guillaume Hanrot and Damien Stehlé.

CNRS Associate Team (PICS) with the Cryptography groups of Macquarie University (Christophe Doche and Igor Shparlinski) and Monash University (Ron Steinfeld). Participants: Nicolas Brisebarre, Guillaume Hanrot, Fabien Laguillaumie, Adeline Langlois and Damien Stehlé.

Merlion grant, co-funded by the French Embassy in Singapore and NTU (Nanyang Technological University), with the cryptography group of NTU (San Ling, Khoa Nguyen and Huaxiong Wang). Participants: Adeline Langlois and Damien Stehlé.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Prof. Peter Kornerup (Odense University, Denmark): September 5–19.

Dr. Benoît Libert (Université de Louvain-la Neuve, Belgium), Inria invited researcher: May 28–July 13.

Prof. San Ling (Nanyang Technological University, Singapore), ENS Lyon invited professor: August 20–October 11.

Prof. Dave Saunders (University of Delaware, U.S.A.), ENS Lyon invited professor: April 15–July 25.

ATEAMS Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. 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.

6.1.2. 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.

6.1.3. Model-Driven Engineering in Digital Forensics

In this project ATEAMS works with the Dutch National Forensics Institute on next generation carving software for recovering evidence from damaged or erased data storage media.

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

This 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.

6.2. European Initiatives

6.2.1. FP7 Projects

OSSMETER aims to extend the state-of-the-art in the field of automated analysis and measurement of open-source software (OSS), and develop a platform that will support decision makers in the process of discovering, comparing, assessing and monitoring the health, quality, impact and activity of open-source software. The project started in October 2012. ATEAMS contributes to this project by focusing on software analysis and related areas.

6.3. International Research Visitors

6.3.1. Visits of International Scientists

- Michael W. Godfrey, PhD, Associate professor - David R. Cheriton School of Computer Science, University of Waterloo, Waterloo, Canada. (full year visit)
- Alex Loh - University of Texas, Austin, U.S.A. (three month internship for excellent PhD students)
- William Cook - University of Texas, Austin, U.S.A.
- Erik Meijer - Microsoft Research, Seattle, U.S.A.
- Oege de Moor - Semmle & Oxford University
- Krzystof Czarnecki - University of Waterloo, Canada
- Stéphane Ducasse - Inria Lille, France
- Ralf Lämmel - University of Koblenz-Landau, Germany
- Magne Haveraaen - University of Bergen, Norway

- Anya Helene Bagge, PhD - University of Bergen, Norway
- Vlad Rusu - Inria Lille, France
- Ted Kaminsky - University of Minnesota, U.S.A.
- Anthony Cleve - FUNDP, Namur, Belgium
- Anthony Sloane - Macquarie University, Australia
- Elizabeth Scott - RHUL, London, England
- Peter Mosses - University of Swansea, Wales
- Adrian Johnstone - RHUL, London, England

6.3.1.1. Internships

- Douwe Kasemier
- Arnoud Roo
- Jasper Timmer
- Wietse Venema
- Ashim Shahi
- Jouke Stoel
- Dennis van Leeuwen
- Jeroen Lappenschaar
- Luuk Stevens
- Floris Looijesteijn
- Pieter Brantwijk

6.3.2. Visits to International Teams

- Tijs van der Storm visited University of Texas Austin for two weeks in November.
- Paul Klint visited University of London and University of Swansea
- Paul Klint visited University of Swansea
- Paul Klint visited FUNDP in Namur
- Jurgen Vinju and Tijs van der Storm visited RMOD at Inria Lille
- Jurgen Vinju visited VUB, Brussels, Belgium
- Vadim Zaytsev visited Universität Koblenz-Landau, Germany

<p style="text-align:center; color:red;">**CAIRN Project-Team**</p>

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. 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: Fmextiles
>
> Duration: Oct. 2011 - Sep. 2014
>
> 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.

7.1.2. FP7 ALMA

Participants: Steven Derrien, Romuald Rocher, Olivier Sentieys, Maxime Naullet, 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 - Aug. 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.

7.1.3. Collaborations with Major European Organizations

Imec (Belgium), Scenario-based fixed-point data format refinement to enable energy-scalable of Software Defined Radios (SDR)

Lund University (Sweden), Constraints programming approach application in the reconfigurable data-paths synthesis flow

Code and Cryptography group of University College Cork (Ireland), Arithmetic operators for cryptography and WSN for health monitoring

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

Technical University of Madrid - UPM (Spain), Optimization of systems using fixed-point arithmetic

Technical University of Tampere, University of Oulu (Finland), Reconfigurable Video Coding

Hervé Yviquel spent 4 months in the group of Jarmo Takala at Tampere University of Technology, Finland, from March.

7.2. National Initiatives

The CAIRN team has currently some collaboration with the following laboratories: CEA List, SATIE ENS Cachan, LEAT Nice, Lab-Sticc (Lorient, Brest), LIRMM (Montpellier, Perpignan), ETIS Cergy, LIP6 Paris, IETR Rennes, Ireena Nantes; and with the following Inria project-teams: Aric, Compsys, Swing, Symbiose, TexMex.

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. See http://www2.lirmm.fr/~w3mic/SOCSIP/index.php. CAIRN is the leader of the group on reconfigurable architectures.

- 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

7.2.1. ANR Blanc - PAVOIS (2012–2016)

Participants: Arnaud Tisserand, Emmanuel Casseau, Romuald Rocher, Philippe Quémerais, Jérémie Métairie.

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.

7.2.2. 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.anr-faon.fr/. Faon involves Orange Labs, CEA-LETI, University of South Brittany (Lab-STICC laboratory) and University of Rennes 1 (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.

7.2.3. Equipex FIT - Future Internet (of Things)

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

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.

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

Participants: Sébastien Pillement, 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.

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

Participants: Emmanuel Casseau, Steven Derrien, Sébastien Pillement.

COMPA (model oriented design of embedded and adaptive multiprocessor) is a project which involves CAIRN, IETR (Institut d'Electronique et de Télécommunications de Rennes), Lab-STICC (University of Bretagne Sud), CAPS Entreprise, Modae Technologies and Texas Instruments. The goal of the project is to design adaptive multiprocessor embedded systems from dataflow models. Reconfigurable video coding (RVC) standard will be targeted as application use case. We will then more specifically focus on the use of the portable and platform-independent RVC-CAL language to describe the applications. We will propose transformations in order to refine, optimize and translate the application model into software and hardware components. Task mapping, instructions and processor allocation, and constrained scheduling will also be investigated for runtime execution and reconfiguration.

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

Participants: Olivier Sentieys, Daniel Menard, Romuald Rocher, Nicolas Simon.

DEFIS (Design of fixed-point embedded systems) is a project which involves CAIRN, LIP6 (University of Paris VI), 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.

7.2.7. *ANR ARPEGE - GRECO (2010-2013)*

Participants: Olivier Sentieys, Olivier Berder, Arnaud Carer, Trong-Nhan Le.

Sensor network technologies and the increase efficiency of photovoltaic cells show that it is possible to reach communicating objects solutions with low enough power consumption to foresee the possibility of developing autonomous objects. Greco (GREen wireless Communicating Objects) is a project on the design of autonomous communicating object platforms (i.e. self-powered sensor networks). The aim is to optimize the power consumption based on (i) a modeling of the performance and power of the required blocks (RF front-end, converters, modem, peripherals, digital architecture, OS, software, power generator, battery, etc.) (ii) heterogeneous simulation models and tools, and (iii) the use of a real-time global "Power Manager". The final validation will be performed on various case studies: a monitoring system and an audio communication between firemen. A HW/SW prototyping (based on an CAIRN's PowWow platform with energy harvesting) and a simulation associating a precise modeling (virtual platform) of an object inserted in a network simulator-like environment will be developed as demonstrators. Greco involves Thales, Irisa-CAIRN, CEA List, CEA Leti, Im2nP, LEAT, Insight-SiP. For more details see http://greco.irisa.fr.

7.2.8. *S2S4HLS*

Participants: Emmanuel Casseau, Steven Derrien, Daniel Menard, Olivier Sentieys, Antoine Morvan, Chenglong Xiao, Jean-Charles Naud.

NANO2012 Program - S2S4HLS (2008-2012)

High-level synthesis (HLS) tools start to be used for industrial designs. HLS is analogous to software compilation transposed to the hardware domain. From an algorithmic behavior of the specification, HLS tools automate the design process and generate a register transfer level RTL architecture taking account of user-specified constraints. However, design performance still depends on designer's skill to write the appropriate source code. The S2S4HLS (Source-to-Source for High-Level Synthesis) project intends to process source code transformations to guide synthesis hence leading to more efficient designs, and aims at providing a toolbox for automatic C code source-to-source transformations. The project is focused on three complementary goals to push the limits of existing HLS tools: loop transformations for performance optimization and a better resource usage, automatic floating-point to fixed-point conversion and synthesis of multi-mode architectures. S2S4HLS is organized into three sub-projects targeting these three objectives. The project is in close collaboration with STMicroelectronics and Compsys team at Inria Rhône-Alpes, within the overall Inria-ST partnership agreement. It is financed by the Ministry of Industry in the Nano2012 program. CAIRNis responsible of the project and involved in the three workpackages.

7.2.9. NANO2012 Program - RecMotifs (2008-2012)

Participants: François Charot, Antoine Floc'h, Christophe Wolinski.

The RecMotifs project aims at the generation of application specific extensions targeting the STxP70 processor from STMicroelectronics. CAIRNwill study advanced technologies algorithms for graph matching and graph merging together with constraints programming methods. The project is in close collaboration with STMicro-electronics within the overall Inria-ST partnership agreement. It is financed by the Ministry of Industry in the Nano2012 program.

7.2.10. ANR Architectures du Futur Open-People (2009-2012)

Participants: Daniel Chillet, Robin Bonamy, Olivier Sentieys.

The Open-People (Open Power and Energy Optimization PLatform and Estimator) project aims at defining a complete platform for power estimation and optimization. The platform will be composed of hardware boards to support measurements for the applications. End-users will be able to upload their applications through a web portal, and to control the power measurements of the execution of their applications on a specific electronic board. The Open-People project will also propose a complete power component model library which allows end-users to estimate the power consumption of some parts of the applications without making measurements. This will allow to quickly evaluate the different design choices regarding the power consumption. Finally, through the web portal http://www.open-people.fr, Open-People will propose software tools to apply power optimizations. In this project, CAIRN team will develop power model for FPGA components using dynamic reconfiguration. Open-People involves LabSticc (Lorient), Trio (Nancy), CAIRN (Rennes/Lannion) and Dart (Lille/Valenciennes) teams from Inria, Leat at Nice, Thales (Colombes) and InPixal (Rennes). CAIRNis in charge of power models and optimization for reconfigurable architectures.

7.2.11. Images and Networks competitiveness cluster - 100GFlex project (2010-2013)

Participants: Olivier Sentieys, Arnaud Carer, Remi Pallas, Pascal Scalart.

Speed and flexibility are quickly increasing in the metropolitan networks. In this context, 100GFLEX studies the relevance of a new transmission scheme: the multiband optical OFDM at very-high rates (up to 100 Gbits/s). In this project we will study efficient algorithms (e.g. synchronization) and high-speed architectures for the digital signal processing of the optical transceivers. Due to the high rate of analog signals (sampling at more than 10Gsample/s), synchronizing and processing is real challenge. 100Gflex involves Mitsubishi-Electric R&D Center Europe, Institut Télécom, Ekinops, France Télécom, Yenista Optics, Foton and CAIRN.

7.3. International Initiatives

7.3.1. Inria Associate Team LRS

Title: Loop unRolling Stones: compiling in the polyhedral model

Inria principal investigator: Steven Derrien

International Partner (Institution - Laboratory - Researcher):

Colorado State University (United States) - Mélange Group

Duration: 2010 - 2012

See also: http://www.irisa.fr/cosi/HOMEPAGE/Derrien/EA-2010/LRS.htm

The goal of the team is twofold: i) Propose new methodologies and algorithms to tackle some of the open problems in automatic parallelization and high level hardware synthesis from nested loop specifications. In particular, we would like to address the problem of parallelization of complex bioinformatics algorithms based of sophisticated dynamic programming algorithms, for which we would like to propose efficient parallelization schemes for both FPGAs (Field Programmable Gate Arrays) and GPUs (Graphical Processing Units). ii) Provide a common open software infrastructure based on (modern/cutting edge) software engineering techniques (Model Driven Software Development) so as to help researchers prototyping new ideas and concept in the domain of optimizing compilers. Our goal being to be able to make our in-house software completely interoperable.

7.3.2. Inria International Partners

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

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

University of Adelaide (Australia), Arithmetic operators

VLSI CAD lab, Electrical and Computer Engineering Department, University of Massachusetts at Amherst (USA), CAD tools for arithmetic datapath synthesis and optimization

7.3.3. 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.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Prof. Gabriel Caffarena (University CEU-San Pablo, Madrid) for one month in August-September.

Prof. Maciej Ciesielski (University of Massachusetts, VLSI CAD Laboratory, USA) for one month in June-July.

Dr Muhammad Adeel Ahmed Pasha, Assistant Professor at LUMS for a two-month stay in July-August.

PhD Student Nabil Ghanmy (University of Sfax, Tunisia) for one month in November-December.

PhD Student Tomofumi Yuki (Colorado State University, USA) for two months in November and December.

Prof. Sanjay Rajopadhye (Colorado State University, USA) for one week in December.

7.4.2. Internships

Simara Pérez Zurita (from Oct 2012 until Aug 2013)

Subject: Optimizing Computational Precision in High-level Synthesis of Signal Processing Systems: Theory and Implementation using TDS and GECOS

Institution: *Technical University of Kaiserslautern* (Kaiserslautern, Germany)

<div style="text-align:center; color:red;">**CAMUS Team**</div>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *Action d'Envergure Nationale*

Philippe Clauss, Alain Ketterlin and Vincent Loechner are involved in the proposition of an Inria Large Scale Initiative (*Action d'Envergure Nationale*) entitled "Large scale multicore virtualization for performance scaling and portability" and regrouping several french researchers in compilers, parallel computing and program optimization. Philippe Clauss shares the head of the project with Gilles Muller of the Inria REGAL team. The project should start officially early 2013. Philippe Clauss and Erven Rohou (ALF team) will co-advise a PhD thesis on dynamic binary code analysis, parallelization and optimization in the frame of this project.

7.2. International Initiatives

7.2.1. *Inria Associate Teams*

7.2.1.1. ANCOME

    Title: Memory and applications memory behavior

    Inria principal investigator: Philippe Clauss

    International Partner (Institution - Laboratory - Researcher):

        University of Buenos Aires (Argentina) - Departamento de Computación, Facultad de Ciencias Exactas y Naturales - Sergio Yovine

    Duration: 2011 - 2013

    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.

7.2.2. *Participation In International Programs*

The collaboration between the LaFhis team of the University of Buenos Aires and the CAMUS team has also been supported by the CNRS-MINCyt project QUATRIX since 2011.

The CAMUS team is associated to the CNRS-CONICET Associated International Laboratory France-Argentina INFINIS (INformatique Fondamentale, logIque, laNgages, vérIfication et Systèmes) inaugurated in December 2011.

7.3. International Research Visitors

7.3.1. *Visits of International Scientists*

Rachid Seghir, assistant professor at University of Batna (Algeria), was invited in our team from May 10 to 26, 2012. We worked on improving `ZPolyTrans`, our library for computing integer affine images of $\mathbb{Z}$-polyhedra. More precisely, we have implemented non-regression tests and we improved the performance of the library by reducing the complexity of some algorithms. Our major publication on this topic was published in 2012 in ACM TACO [15].

Diego Garbervetsky, University of Buenos Aires, Argentina, has spent two weeks of October 2012 in the CAMUS team.

7.3.1.1. Internships

Juan Manuel Martinez Caamaño, who is Master student at the University of Buenos Aires, is doing his Master thesis internship in the CAMUS team from August 2012 to January 2013.

Gervasio Perez, PhD student at the University of Buenos Aires, Argentina, has spent one month in the CAMUS team in November 2012.

7.3.2. Visits to International Teams

Philippe Clauss visited the parallel computing research team of the University of Tunis, Tunisia, from November the 26th to the 30th. The main goal of the visit was to meet the student Imèn Fassi and her co-advisor Yosr Slama to work for the starting co-advised PhD thesis.

Alain Ketterlin has spent three weeks in the LAFHIS team in January 2012.

Philippe Clauss has spent one week in the LAFHIS team in December 2012.

<p style="text-align:center;color:red;">**CARAMEL Project-Team**</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Function field sieve: implementation and hardware acceleration*

Participants: Jérémie Detrey [contact], Pierrick Gaudry, Hamza Jeljeli, Vlad-Cristian Miclea, Emmanuel Thomé.

The team has obtained for the years 2012 and 2013 a financial support from the Région Lorraine and Inria for a project focusing on the hardware implementation and acceleration of the function field sieve (FFS).

The FFS algorithm is currently the best known method to compute discrete logarithms in small-characteristic finite fields, such as may occur in pairing-based cryptosystems. Its study is therefore crucial to accurately assess the key-lengths which such cryptosystems should use. More precisely, this project aims at quantifying how much this algorithm can benefit from recent hardware technologies such as GPUs or CPU-embedded FPGAs, and how this might impact current key length recommendations.

The funding obtained was used to buy an FPGA ML-605 development board, on which Vlad-Cristian Miclea implemented operators for polynomial arithmetic in characteristic two and three during his internship; along with a GeForce GTX 580 graphics card, on which Hamza Jeljeli developed a GPU-based implementation of sparse linear algebra routines for solving discrete-logarithm problems [16].

8.2. National Initiatives

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

8.2.1. *ANR CATREL (Cribles: Améliorations Théoriques et Résolution Effective du Logarithme discret*

Participants: Răzvan Bărbulescu, Cyril Bouvier, Jérémie Detrey, Pierrick Gaudry, 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 the 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 is scheduled to start in January 2013, but the kick-off meeting has already taken place in Nancy on Dec. 14th, 2012.

8.2.2. *ANR CHIC (Courbes Hyperelliptiques, Isogénies, Comptage)*

Participants: Pierrick Gaudry, Sorina Ionica, Emmanuel Thomé [contact].

The team has obtained a financial support from the ANR ("programme blanc") for a project, common with colleagues from IRMAR (Rennes) and IML (Marseille). The ANR CHIC grant covers the period 09/2009 to 08/2012, and has thus ended in 2012. The purpose of this ANR project is the study of several aspects of curves in genus 2, with a very strong focus on the computation of explicit isogenies between Jacobians.

In 2012, within the context of ANR CHIC, Ionica and Thomé worked on isogeny graphs in genus 2.

8.2.3. *ANR DEMOTIS (Collaborative Analysis, Evaluation and Modelling of Health Information Technology)*

Participant: Marion Videau.

The project from "programme ARPEGE" involved three Inria project-teams as a single partner (SMIS, SECRET and CARAMEL) together with colleagues from CECOJI (CNRS) and the company Sopinspace. It has been running from January 2009 and ended in March 2012.

The project experimented new methods for the multidisciplinary design of large information systems that have to take into account legal, social and technical constraints. Its main field of application is personal health information systems.

8.3. European Initiatives

8.3.1. PHC application with EPFL

The team obtained a PHC Germaine de Staël grant in collaboration with the LACAL team from EPFL (Lausanne, Switzerland), in 2011. The grant has been renewed for a second (and final) year 2012. This collaboration focuses on integer factorization and discrete logarithms.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Vlad-Cristian MICLEA (from Jun 2012 until Sep 2012)

Subject: Efficient FPGA implementation of finite-field multiplication algorithms

Institution: The Technical University of Cluj-Napoca (Romania)

CARTE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- Emmanuel Jeandel is a member of ANR Blanche ANR-09-BLAN-0164 (EMC: *Emerging Phenomena in Computation Models*).
- We obtained an ANR project called Binsec which will start in 2013. The aim of the BINSEC project is to fill part of the gap between formal methods over executable code on one side, and binary-level security analyses currently used in the security industry. We target two main applicative domains: vulnerability analysis and virus detection. Two other closely related applications will also be investigated: crash analysis and program deobfuscation.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. FI-WARE

Title: Morphus

Type: COOPERATION (ICT)

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

Instrument: Integrated Project (IP)

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Others partners:Thales, SAP, Inria

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 for building a true foundation for the Future Internet.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. CRISTAL

Title: Resource Control by Semantic Interpretations and Linear Proof Theory

Inria principal investigator: Romain Péchoux

International Partner (Institution - Laboratory - Researcher):

Universita degli Studi di Torino (Italy) - Dipartimento di informatica

Duration: 2010 - 2012

See also: http://carte.loria.fr/index.php?option=com_content&view=article&id=61&Itemid=75

Topic: resource control using semantics interpretations and linear proof theory.

8.3.2. Participation In International Programs

Mathieu Hoyrup is the principal investigator of a Partenariat Hubert Curien Imhotep 2011-2012 together with Walid Gooma, University of Alexandria, Egypt.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Daniel Leivant: October 25th to November 5th, 2012, Indiana University, USA.

Walid Gooma: December, 2012, University of Alexandria, Egypt.

8.4.2. Visits to International Teams

Guillaume Bonfante: July 7th to 15th, 2012, invited by Stanislas Leibler from the 'Institute of Advanced Studies', Princeton, USA. He gave a course on computer virology at the summer school "PiTP", Prospects in Theoretical Physics http://www.sns.ias.edu/pitp2/index.html

Jean-Yves Marion: October 25th to November 5th, 2012, Indiana University, USA, work with Daniel Leivant.

Romain Péchoux: February and August 2012, University of Pennsylvania, USA, invited talk to the PLclub seminar.

CASCADE Project-Team

6. Partnerships and Cooperations

6.1. ANR Projects with Industrials

- **SAPHIR-II** *(Sécurité et Analyse des Primitives de Hachage Innovantes et Récentes)*
  Security and analysis of innovating and recent hashing primitives.
  Participants: Patrick Derbez, Jérémy Jean.

  From April 2009 to March 2013.
  Partners: France Telecom R&D, Gemalto, EADS, SAGEM, DCSSI, Cryptolog, Inria/Secret, UVSQ, XLIM, CryptoExperts.

- **PACE: Pairings and Advances in Cryptology for E-cash.**
  Participants: Olivier Blazy, David Pointcheval, Damien Vergnaud.

  From December 2007 to February 2012.
  Partners: France Telecom R&D, NXP, Gemalto, CNRS/LIX (Inria/TANC), Univ. Caen, Cryptolog.
  This project aims at studying new properties of groups (similar to pairings, or variants), and then to exploit them in order to achieve more practical e-cash systems.

- **BEST: Broadcast Encryption for Secure Telecommunications.**
  Participants: Duong Hieu Phan, David Pointcheval, Elizabeth Quaglia, Mario Strefler.

  From December 2009 to November 2013.
  Partners: Thales, Nagra, CryptoExperts, Univ. Paris 8.
  This project aims at studying broadcast encryption and traitor tracing, with applications to the Pay-TV and geolocalisation services.

- **PRINCE: Proven Resilience against Information leakage in Cryptographic Engineering.**
  Participants: Fabrice Ben Hamouda, Michel Ferreira Abdalla, David Pointcheval.

  From December 2010 to November 2014.
  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.

6.2. ANR Projects within Academics

- **ProSe: Security protocols : formal model, computational model, and implementations.**
  Participant: David Pointcheval.

  From December 2010 to November 2014.
  Partners: ENS Cachan-Inria/Secsi, LORIA-Inria/Cassis, Inria/Prosecco, Verimag.
  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.

- **ROMAnTIC: Randomness in Mathematical Cryptography.**
  Participant: 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).

6.3. European Initiatives

- **ECRYPT-II: Network of Excellence in Cryptology.**
  From August 2008 to January 2013.
  There are three virtual labs that focus on the following core research areas: symmetric key algorithms (STVL), public key algorithms and protocols (MAYA), and secure and efficient implementations (VAMPIRE).
  ENS/Inria/CASCADE leads the MAYA virtual lab.
- **ERC Starting Grant: LATTICE.**
  From September 2010 to August 2012
- **SecFuNet: Security for Future Networks.**
  From July 2011 to December 2013

6.4. International Research Visitors

- Angelo De Caro (PhD student) – Univ. Salerno, Italy
- Karina M. Magalhães (PhD student) – University of Campinas, Brazil
- Daniel Masny (PhD student) – University of Bochum, Germany
- Nuttapong Attrapadung – The National Institute of Advanced Industrial Science and Technology, Japan
- Manuel Bernardo Barbosa – University of Minho, Portugal
- Yu Long – Shanghai Jiao Tong University, China
- Igor Shparlinski – Macquarie U., Australia
- Hoeteck Wee – George Washington University, USA
- Christian Schaffner – CWI, Amsterdam

CASSIS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- 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 the micro-systems, in particular for distributed micro airduct. The project associates several team of FEMTO-ST institute.

8.2. National Initiatives

8.2.1. ANR

- ANR DECERT — *Deduction and Certification*, coordinated by Thomas Jensen (IRISA). This project focuses on the design of decision procedures, in particular for fragments of arithmetic, and their integration into larger verification systems, including skeptical proof assistants. Partners are: IRISA Rennes, LRI Orsay, Inria Sophia, Systerel and CEA. From Inria Nancy, the teams Veridis and Cassis are involved. This project started in January 2009 for three years.

- ANR TASCCC *Test Automatique basé sur des Scenarios et Critères Communs – Automated Testing based on Scenarios and Common Criteria*, duration: 3 years, starting in December 2009. The project aims at completing the model-based testing process initiated in the POSE project, using scenarios to specify the test cases that have to be generated by model animation. The goal is here to provide an automated means for generating the scenarios from a given set of properties. The overall objective is to ease the Common Criteria evaluation of secure softwares. Partners: Trusted Labs (leader), Gemalto, LIG, LIFC, Supelec, Smartesting, and Serma Technologies. The local coordinator is Frédéric Dadeau.

- ANR PROSE *Protocoles de sécurité : modèle formel, modèle calculatoire, and implémentations — 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 Cascade Paris (leader), LSV Cachan, Cassis and Verimag Grenoble.

- ANR STREAMS *Solution for Peer-to-peer Real-Time Social Web*, duration: 3 years, starting in October 2010. This 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. 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. This project aims at providing theoretical solutions to these challenges as well as practical experimentations. Partners are: LORIA Score team (leader), Inria project-teams Regal, Asap, Cassis, and XWiki.

- 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 OSEP *Online and offline model-based testing of SEcurity Properties*, duration: 2 years, starting in December 2011. The goal of this project is to test the security with online and offline model-based testing approach. The main element of project is to capitalize or to reuse a test model with different testing method. So, we develop new algorithms to allow online testing. This approach must be compatible with our previous offline approach to increase the number of artefacts that can be shared. This approach can be applied to the components of security and the Software Radio. Partners are DGA and Smartesting.

8.2.2. Competitivity Clusters

- FUI SQUASH *Software QUality ASsurance enHancement*, duration: 2 years, starting in April 2011. This project aims to industrialize and to structure software testing activities. The project will provide a methodology and tools based on open source components.

- Project "Investissement d'Avenir - Développement de l'Econimie 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. Partners are 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 will focus on developping tools for service security verification and testing tasks.

- ProSecure (2011-2016) [4]— 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.

- SecureChange[5] is funded under the 7th FP (Seventh Framework Program) Research area: ICT-2007.8.6: ICT forever yours. The project will develop processes and tools that support design techniques for evolution, testing, verification, re-configuration and local analysis of evolving software. Our focus is on mobile devices and homes, which offer both great research challenges and long-term business opportunities. The project is lead by Fabio Massacci (University of Trento, Italy) and it has started in February 2009 for a period of 36 months. Cassis is leader of the 7th workpackage (Testing). The local coordinator is Fabrice Bouquet.

8.4. International Initiatives

8.4.1. Inria Associate Teams

BANANAS[6]*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,

---

[4] http://www.loria.fr/~cortier/ProSecure.html
[5] http://www.securechange.eu
[6] http://www.loria.fr/~ringeiss/CHILI/bananas

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 soundness of symbolic models w.r.t. cryptographic ones.
- Collaboration with Mark Ryan's group (University of Birmingham) on the formal analysis of e-voting protocols.
- Collaboration with Paliath Narendran's group (SUNY Albany) on automated deduction.

8.4.3. Participation In International Programs

French-Tunisian project on *Security Policies and Configurations of Firewalls: Compilation and Automated Verification*. We collaborate with SupCom Tunis and the Inria project-team Dahu in the context of STIC-Tunisia.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Jan Otop (Wroclaw University), one month in March 2012
- Markulf Kohlweiss (Microsoft Cambridge), one week in April 2012
- Bogdan Warinshi (Bristol University), one week in May 2012
- Myrto Arapinis (University of Birmingham), three weeks in July 2012
- Mark Ryan (University of Birmingham), one week in July 2012
- Serdar Erbatur (SUNY Albany), two months in October–November 2012
- John Mullins (Ecole Polytechnique de Montréal), one week, February 2012.
- Hanifa Boucheneb, (Ecole Polytechnique de Montréal), one month in March 2012

8.5.1.1. Internships

- Aurel Josias Randolph (from Apr 2012 until May 2012)
  - Subject: Specifying and verifying access control policies for collaborative editors
  - Institution: Polytechnic School of Montreal (Canada)
- Ghazi Maatoug (from Mar 2012 until Jul 2012)
  - Subject: Verification of protocols, analysis of symbolic trace and simulated execution
  - Institution: Ecole Supérieure des Communications de Tunis (Tunisia)
- Apoorva Desphande (from Jul 2012 until Nov 2012)
  - Subject: Verification of equivalence properties in security protocols
  - Institution: BITS Pilani University (India)
- Anshul Malhotra (from Dec 2012 until Jan 2013)

      –   Subject: Efficient implementation of a procedure for the verification of equivalence properties

      –   Institution: IIT Delhi (India)

8.5.2. Visits to International Teams

- Véronique Cortier, February 2012 (one week), Bristol University (collaboration with Bogdan Warinschi)

- Christophe Ringeissen and Laurent Vigneron, December 2012 (two weeks), UTFSM Valparaíso (Inria Associate Team BANANAS)

CELTIQUE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *The PiCoq ANR project*

Participant: Alan Schmitt.

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 November 2010 to October 2014.

7.1.2. *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 founded 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.

7.1.3. *ANR DECERT project*

Participants: Frédéric Besson, Thomas Jensen, David Pichardie, Pierre-Emmanuel Cornilleau.

The DECERT project (2009–2012) is funded by the call Domaines Emergents 2008, a program of the Agence Nationale de la Recherche.

The objective of the DECERT project has been to design an architecture for cooperating decision procedures, with a particular emphasis on fragments of arithmetic, including bounded and unbounded arithmetic over the integers and the reals, and on their combination with other theories for data structures such as lists, arrays or sets. To ensure trust in the architecture, the decision procedures will either be proved correct inside a proof assistant or produce proof witnesses allowing external checkers to verify the validity of their answers.

This is a joint project with Systerel, CEA List and Inria teams Mosel, Cassis, Marelle, Proval and Celtique (coordinator).

7.1.4. Labex COMIN Labs Seccloud project

Participants: Frédéric Besson, Thomas Jensen, Alan Schmitt, 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.

7.2. European Initiatives

7.2.1. Collaborations with Major European Organizations

Imperial College (UK)

The JScert project (http://jscert.org) aims to really understand JavaScript by building models of ECMAScript semantics in the Coq proof assistant, and automated logical reasoning tools built on those semantics.

7.3. International Initiatives

7.3.1. Inria International Partners

Delphine Demange and David Pichardie have been working with Gilles Barthe from IMDEA Software, Madrid, Spain about the new verified SSA middle-end.

7.4. International Research Visitors

7.4.1. Visits to International Teams

David Pichardie has spent one year at Purdue University, Indiana, US (from September 2011 to August 2012) working with Jan Vitek and Suresh Jagannathan. This was a one year Inria sabbatical leave. The collaboration deals with the formal verification of a Java compiler, taking into account concurrency. As a first result, a paper will appear at POPL 2013 where we provide a new intermediate memory model for the Java language.

COMETE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR projects

7.1.1.1. ANR-09-BLAN-0169-01

Project acronym: PANDA

Project title: Analysis of Parallelism and Distribution

Duration: October 2009 - March 2013

URL: http://lipn.univ-paris13.fr/~mazza/Panda/

Coordinator: Catuscia Palamidessi, Inria Saclay

Other PI's and partner institutions: Dale Miller, EPIs Parsifal at Inria Saclay. Emmanuel Haucourt, CEA Saclay. Damiano Mazza, Pôle Parisien (ENS Cachan, Paris VII and Paris XIII). Emmanuel Godard, Pôle Méditerranéen (ENS Lyon and the University of Marseille). Jean Souyris, Airbus.

Abstract: The aim of PANDA is to bring together different mathematical models of parallel and concurrent computation (geometric models, rewriting theory, higher category theory, stochastic processes), along with theoretical frameworks for static analysis (spatial logics, proof construction), in order to guide the development of software tools that meet industrial needs of program specification and verification (in particular, fault detection of parallel programs involved in avionics).

7.1.1.2. ANR-09-BLAN-0345-02

Project acronym: CCP

Project title: Confidence, Proof and Probabilities

Duration: October 2009 - March 2013

URL: http://www.lix.polytechnique.fr/~bouissou/cpp/

Coordinator: Jean Goubault-Larrecq, ENS Cachan

Other PI's and partner institutions: Catuscia Palamidessi, Inria. Olivier Bouissou, CEA LIST. Gilles Fleury, Supelec SSE. Michel Kieffer, Supelec L2S.

Abstract: In the context of proofs of safety properties for critical software, The CPP project proposes to study the joint use of probabilistic and formal (deterministic) semantics and analysis methods, in a way to improve the applicability and precision of static analysis methods on numerical programs.

7.1.2. 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

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 Projects

Program: FP7-PEOPLE-2011-IRSES

Project acronym: MEALS

Project title: Mobility between Europe and Argentina applying Logic to Systems

Duration: October 2011 - September 2005

URL: http://www.meals-project.eu/

Coordinator: Holger Hermans, Saarland University, Germany

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. International Partners

Geoffrey Smith.   School of Computing and Information Sciences, Florida International University, USA.

Vladimiro Sassone.   School of Electronics and Computer Science, University of Southampton, UK.

Camilo Rueda.   Department of Computer Science, Pontificia Universidad Javeriana, Colombia.

7.3.2. Participation in International Programs

Program: ANR Blanc International

Project acronym: LOCALI

Project title: Logical Approach to Novel Computational Paradigms

Duration: October 2011 - September 2015

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.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Carlos Olarte.   Associate professor at the Pontificia Universidad Javeriana, Colombia. He visited for one month in July 2012, funded by the Ecole Polytechnique.

Moreno Falaschi.　Full professor at the Università di Siena, Italy. He visited for one month in June 2012, funded by the Ecole Polytechnique.

Elaine Pimentel.　Associate professor at the Universidade Federal de Minas Gerais, Belo Horizonte, Brazil. She visited for one month in July 2012, funded by the Ecole Polytechnique/Digiteo.

Linda Brodo.　Assistant professor at the Università di Sassari, Italy. She visited for one month in June 2012, funded by the Ecole Polytechnique/Digiteo.

Vladimiro Sassone.　Full professor at the University of Southampton, UK. He visited for two months in October and November 2012, funded by the Ecole Polytechnique/Digiteo.

Camilo Rueda.　Full professor at the Pontificia Universidad Javeriana,Colombia. He visited for two months in October and November 2012, funded by the Ecole Polytechnique.

7.4.2. Internships

Name:　Lili Xu

Duration:　From October 2011 until October 2012)

Subject:　Compositionality of privacy on a probabilistic process calculus

Institution:　Chinese Academy of Sciences of Beijin (China)

Support:　ANR project PANDA, Inria, and Chinese Academy of Sciences

Name:　Marco Stronati

Duration:　From October 2011 until March 2013

Subject:　Compositional analysis of queries' sensitivity

Institution:　University of Pisa, Italy

Support:　Ecole Polytechnique and University of Pisa

Name:　Fernán Martinelli

Duration:　From September 2012 until March 2013

Subject:　Computation of bounds on the information flow

Institution:　University of Rio Cuarto, Argentina

Support:　FP7 project MEALS

Name:　Michela Paolini

Duration:　From September 2012 until December 2012

Subject:　Compositionality of privacy on a probabilistic process calculus.

Institution:　IMT Institute for Advanced Studies, Lucca, Italy

Support:　Grant from IMT

COMPSYS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. CNRS PEPS

Christophe Alias and Laure Gonnord initiated with the DART/Emeraude team at LIFL Laboratory (University of Lille) a CNRS PEPS ("Projets Exploratoire Premier Soutien") called "HLS and real time" (8kEuros/year, during two years). The goal of this project is to investigate how to introduce real-time constraints in the high-level synthesis workflow.

8.1.2. Inria AEN

Compsys is part of an Inria Large Scale Initiative (AEN: action d'envergure nationale) that regroups eight teams: Camus, Regal, Alf, Runtime, Algorille, Parkas, Dali on "Large scale multicore virtualization for performance scaling and portability".

8.1.3. French compiler community

The french compiler community is now well identified and is visible through its web-page http://compilation. gforge.inria.fr/. The "journées françaises de la compilation" were initiated in 2010 and are still animated by Fabrice Rastello and Laure Gonnord as a biannual event. Their local organization is handled alternately by the different research teams (Lyon in Summer 2010, Aussois in Winter 2010, Dinard in Spring 2011, St Hippolyte in Autumn 2011, Rennes in Summer 2012, Lyon/Annecy in Spring 2013).

8.2. International Research Visitors

8.2.1. Visits to International Teams (at least one month)

Paul Feautrier has been invited to spend the month of June 2012 at Colorado State University (CSU), Fort Collins, CO, USA, in prof. Sanjay Rajopadhye's team. The work reported in Section 6.2 and accepted at PPoPP'13 [13] was initiated during this stay. Sanjay Rajopadhye and Tomofumi Yuki, both from CSU, have spent a few days in Paris and Lyon in December 2012. During this visit, we have initiated a sequel to this work, which will handle other parallel features of X10.

8.2.2. Informal Collaborations and Short-Term Visitors

Shorter visits (but at least a week) include exchanges (in both directions) with the groups of S. Rajopadhye (Colorado State University), of P. Sadayappan (Ohio State University), of J. Ramanujam (Louisiana State University), of L.-N. Pouchet (UCLA), all related directly or indirectly to polyhedral code optimizations.

Compsys has also regular contacts with Sebastian Hack (Saarland University, Saarbrücken, Germany), Benoît Dupont de Dinechin (Kalray, Grenoble), Christophe Guillon (STMicroelectronics), Fernando M. Q. Pereira (Federal University of Mina Gerais, Brazil) on back-end code optimizations.

Among french academic researchers, Compsys is particularly linked with people such as Albert Cohen (Inria Parkas team), Steven Derrien (Inria Cairn team), Alain Ketterlin (Inria Camus team), François Irigoin (Ecole des Mines de Paris).

Finally, taking the opportunity of the HdR defense of Fabrice Rastello [2] and the PhD defense of Quentin Colombet [1] on December 7, 2012, a "compilation day" was organized in Lyon on December 6, including talks by K. Pingali (University of Texas, Austin), E. Altman (IBM Yorktown), and V. Sarkar (Rice University).

CONTRAINTES Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

- 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), Cedric Lhoussaine (LIFL/CNRS), and Jean Krivine (PPS lab, Paris Diderot Univ./CNRS).

- 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.

- ANR Cosinus Syne2arti project (2010-2013) coordinated by Grégory Batt, with Oded Maler, CNRS Verimag, Dirk Drasdo, EPI Bang, and Ron Weiss, MIT.

- ANR Blanc BioTempo project (2010-2013) coordinated by Anne Siegel, CNRS IRISA Rennes, with Ovidiu Radulescu, U. Montpellier, Irina Rusu, U. Nantes.

- AE REGATE (2008-2012) on the "REgulation of the GonAdoTropE axis", coordinated by Frédérique Clément, SISYPHE, with E. Reiter, INRA Tours, J.P. Françoise, Univ. Paris 6, B. Laroche Orsay, P. Michel Centrale Lyon, N. Ayache ASCLEPIOS, A. Goldbeter, ULB Bruxelles.

- AE COLAGE (2008-) on the "control of growth and aging in *E. coli* using synthetic biology approaches", coordinated by H. Berry, COMBINING, with F. Taddei, A. Lindner, INSERM Necker, H. de Jong, D. Ropers, IBIS, J.-L. Gouzé, and M. Chaves, COMORE.

- GENCI (2009-) attribution of 300000 computation hours per year on the Jade cluster of 10000 processors of GENCI at CINES, Montpellier.

8.2. European Initiatives

8.2.1. *Collaborations in European Programs, except FP7*

Program: EraNet SysBio

Project acronym: C5Sys

Project title: Circadian and cell cycle clock systems in cancer

Duration: mars 2010 - mars 2013

Coordinator: Francis Lévi, INSERM Hopital Paul Brousse, Villejuif, France and David Rand, Warwick Systems Biology, UK,

Other partners: EPI BANG, Erasmus University Medical Center, Rotterdam, University College London, UK, CNRS Nice, and L2S, Orsay.

Abstract: Mammalian cells are endowed with biological oscillators which time their activities. The circadian clock (circa, about; dies, day) generates a 24-hour rhythm which controls both cellular metabolism and cell division. The cell division cycle is an oscillator which times DNA synthesis, mitosis, and related apoptosis and DNA repair. Our understanding of the molecular mechanisms at work in both oscillators has greatly improved. In sharp contrast, little is known about how these two crucial oscillators interact, and how these interactions affect cellular proliferation in normal or cancer cells. On the one hand, the disruption of circadian clocks impairs cell physiology and quality of life. On the other hand, disruption of cell cycle, DNA repair or apoptosis impacts on cell and organism survival. Experimental and clinical data show that circadian disruption accelerates

malignant proliferation, and that DNA damage can reset the circadian clock. The central question addressed is how interactions between the circadian clock and cell cycle affect cellular proliferation and genotoxic sensitivity in normal and cancer cells, and how this knowledge translates into new prevention or therapeutic applications. Seven teams in France, Netherlands and United Kingdom integrate experimental, mathematical and bioinformatic approaches, so as to develop novel cell lines, biomarker monitoring methods and mathematical tools. C5Sys triggers innovative chronotherapeutic research for human cancers and advances systems medicine for improving patient care.

8.3. International Initiatives

8.3.1. *Inria Associate Teams*

Title: Artificial tissue homeostasis: combining synthetic and computational biology approaches (TISHOM)

Inria principal investigator: Gregory Batt

International Partner (Institution - Laboratory - Researcher):

Massachusetts Institute of Technology (United States) - Weiss Lab - Ron Weiss

Duration: 2012 - 2014

See also: TISHOM

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. Propelled forward by the development of stem cell biology, this research domain has recently attracted significant interest. 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.

Using a synthetic biology approach, we propose to reprogram mammalian cells so as to enforce tissue homeostasis. The proposed design relies on growth control and cell-cell communication mechanisms. The design and tuning of such engineered tissues are particularly challenging. Indeed, the correct functioning of the system depends on its specific molecular implementation. To relate cell population behavior with molecular details, extensive modelling work and in-depth in silico analysis are needed. Therefore, a tight integration between dry lab and wet lab efforts will be essential for the success of the project.

8.3.2. *Inria International Partners*

We also have a collaboration with the Center for Systems and Control at the Delft University of Technology (The Netherlands) on developing formal probabilistic approaches for robust control of gene expression. This collaborative project is funded by the Frans/Nederlandse Academie as part of the van Gogh Programm (Coordination Alessandro Abate/Grégory Batt).

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

8.4.1.1. *Visits of International Scientists*

Prof. Fernando Buarque (from February 2012 until April 2012)

Subject: Fish School Optimization

Institution: University of Pernambuco, Brazil

8.4.1.2. *Internships*

Hui-Ju Katherine CHIANG (from Jul 2012 until Oct 2012)

Subject: Theory of temporal logic constraint solving

Institution: National Taiwan University (Taiwan)

Anthony LINS (from Mar 2012 until Jun 2012)

Subject: Particle swarm optimization for systems biology

Institution: Federal University of Pernambuco (Brazil)

8.4.1.3. Short visits

Andreas Weber, University of Bonn, Germany

Chris Banks, University of Edinburgh, UK

Francesco Santini, CWI, Amsterdam, Netherlands

Ron Weiss, MIT, USA

Alessandro Abate and Ilya Tkachev, TU Delft, Netherlands

Liu Bing, National University of Singapore, Singapore

8.4.2. Visits to International Teams

Xavier Duportet: 6 months with the Weiss lab at MIT

Szymon Stoma: two times two weeks with the Weiss lab at MIT

François Bertaux: two times two weeks with the Weiss lab at MIT

CONVECS 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 (see http://www.opencloudware.org) 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 are the formal specification of the models, architectures, and protocols (self-deployment, self-management, 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 (*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 (see http://www.cluster-connexion.fr), 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, 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. CONVECS will participate, in cooperation with the IIHM team of LIG, to study the application of CADP to specify and validate human-machine interfaces formally.

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*) Mootwin 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.

Bluesky started in September 2012 for three years. The main contributions of CONVECS to Bluesky are the definition of the formal pivot language for describing the asynchronous behaviour of logic controller networks and the automated verification of the behaviour using compositional model checking and equivalence checking techniques.

8.1.3. *Other National Collaborations*

Additionally, we collaborated in 2012 with the following Inria project-teams:

- CONTRAINTES (Inria Paris-Rocquencourt): Grégory Batt,
- OASIS (Inria Sophia-Antipolis – Méditerranée): Eric Madelaine and Ludovic Henrio.

Beyond Inria, we had sustained scientific relations with the following researchers:

- Gaëlle Calvary and Sophie Dupuy-Chessa (LIG, Grenoble),
- Pascal Poizat (LIP6, Paris),
- Meriem Ouederni (IRIT, Toulouse),
- Dimitris Vekris (LACL, Paris-Est Créteil).

8.2. European Initiatives

8.2.1. *FP7 Projects*

8.2.1.1. Sensation
Participants: Hubert Garavel, Radu Mateescu, Wendelin Serwe.

Sensation (*Self ENergy-Supporting Autonomous computaTION*) is the European project no. 318490 funded by the FP7-ICT-11-8 programme. The project (see http://people.cs.aau.dk/~rrh/SENSATION) gathers 9 participants: Inria (Triskell and Convecs teams), Aalborg University (Denmark), RWTH Aachen and Saarland University (Germany), University of Twente and Embedded System Institute (The Netherlands), STMicroelectronics (France), 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, studying common semantic models for quantitative analysis, and applying formal modeling and analysis to the case studies provided by the industrial partners.

8.2.2. *Collaborations with Major European Organizations*

The CONVECS team is member of the FMICS (*Formal Methods for Industrial Critical Systems*) working group of ERCIM (see http://fmics.inria.fr). R. Mateescu is currently the chairman of the FMICS working group and H. Garavel is member of the FMICS board, in charge of dissemination actions.

Hubert 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, in 2012 we had scientific relations with several European universities and research centers, including:

- Saarland University (Alexander Graf-Brill, Ernst-Moritz Hahn, Arnd Hartmanns, Holger Hermanns, and Andrea Turrini),
- Oxford University (Ernst-Moritz Hahn, Marta Kwiatkowska, and Dave Parker),
- RWTH Aachen (Joost-Pieter Katoen and Viet Yen Nguyen),
- University of Twente (Freark van der Berg and Marielle Stoelinga),
- Technical University of Eindhoven (Anton Wijs).

H. Garavel participates in the DFG (*Deutsche Forschungsgemeinshaft*) transregional project AVACS (*Automatic Verification and Analysis of Complex Systems*, see http://www.avacs.org) and he attended two meetings held at Freiburg (Germany) in February 2012 and at Mannheim (Germany) in November 2012.

8.3. International Initiatives

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.

8.3.1. Other International Collaborations

We had sustained scientific relations with Tevfik Bultan (University of California at Santa Barbara, USA).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Pascal Poizat (LIP6, University Pierre et Marie Curie, Paris) visited us on March 26–27, 2012.
- Dimitris Vekris (LACL, University Paris-Est Créteil) visited us from April 23 to May 11, 2012.
- Meriem Ouederni (IRIT, Toulouse) visited us on June 4–15, 2012.
- The annual CONVECS seminar was held in Pont-en-Royans (France) on November 5–7, 2012. The following invited scientists attended the seminar:
  - Jérémy Buisson (University of Bretagne-Sud / VALORIA and Ecoles de St-Cyr Coëtquidan) gave on November 5, 2012 a talk entitled "*Vers un futur pi-ADL reconfigurable*".
  - Sophie Dupuy-Chessa (LIG, Grenoble) gave on November 6, 2012 a talk entitled "*Qualité des interfaces homme-machine plastiques*".
  - Massimo Zendri (STMicroelectronics) gave on November 6, 2012 a talk entitled "*Circuit Level Formal Verification in Industrial Environment*".

DART Project-Team

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. Collaboration with Romania

We collaborate with the University of Laşi (Romania) on formal techniques for general and domain specific languages.

8.1.2. Collaboration with the Netherlands

We collaborate with the Eindhoven University of Technology (The Netherlands) on formal techniques for general and domain specific languages.

8.2. International Research Visitors

8.2.1. Visits of International Scientists

Tim Willemse

Subject: visit to explore future collaborations.

Institution: Eindhoven University of Technology, NL

Duration: 1 week

Frank Stappers

Subject: formal verification for reconfigurable languages

Institution: Eindhoven University of Technology, NL

Duration: 6 weeks

8.2.1.1. Internships

Bram Gerron

Subject: formal verification of compilation

Institution: Eindhoven University of Technology, NL

Duration: 3 months

DEDUCTEAM Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR Locali

We are coordinators of the ANR-NFSC contract Locali with the Chinese Academy of Sciences. This year we mostly developed in proof in a finite structure project of this contract.

6.1.2. ANR BWare

We are members of the ANR Beware which started on last September (David Delahaye is the national leader). The objective is to provide a proof platform for B proof obligations. We are in particular involved in the introduction of Deduction modulo in the automated proved tableaux-based Zenon and also in the combination of Deduction modulo and superposition.

6.1.3. ANR Tarmac

We are members of the ANR Tarmac, coordinated by Pierre Valarcher, on models of computation.

6.2. International Research Visitors

6.2.1. Visits of International Scientists

Nachum Dershowitz (Tel Aviv) has been visiting our group for three months.

Cecilia Englander (Puc-Rio) has been visiting our group for four months.

6.2.2. Visits to International Teams

Pierre Néron has been visiting César Muñoz group in Nasa-Langley for three months.

ESPRESSO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. 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.

7.1.2. Competitivity Clusters

Program: FUI

Project acronym: P

Project title: Project P

Duration: March 2011 - Feb. 2014

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 OPEES and 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 ESPRESSO 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.

The current activities in the project consist in gathering and writing detailed documentation about the project context, requirements and constraints. We are now familiar with the technologies involved in the project and started refining high-level requirements so as to to express technical objectives and solutions. The P formalism is still in the process of being defined and some aspects of the language are unknown (namely the sofwtare architecture formalism). For the subset of P that is sufficiently known and stable, we are investigating the semantical mapping between P and Signal with respect to controller synthesis.

7.1.3. CORAC

Program: CORAC

Project acronym: CORAIL

Project title: Composants pour l'Avionique Modulaire Étendue

Duration: Sep. 2011 - Dec. 2016

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 ESPRESSO is to define a specification method and to provide a generator of multi-task applications.

7.2. European Initiatives

7.2.1. Collaborations in European Programs, except FP7

Program: ARTEMIS

Project acronym: CESAR

Project title: Cost-efficient methods and processes for safety relevant embedded systems

Duration: March 2009 - June 2012

Coordinator: AVL List GmbH

Other partners: 59 project partners (main partners for us: AIRBUS, IRIT (CNRS)...)

URL: http://www.cesarproject.eu/

Abstract:

In the context of CESAR, we have participated to the sub-project 3 demonstrator in order to demonstrate the usability of Polychrony as a co-simulation tool within the reference technology platform of the project, to which its open-source release has been integrated. The case-study, implemented in collaborateion with Airbus and IRIT, consists of co-modeling the doors management system of an Airbus A350 by merging its architecture description, specified with AADL, with its behavioral description, specified with Simulink.

In this case-study, we demonstrate that the Polychrony toolset can effectively serve as a modeling infrastructure to compositionally assemble, compile and verify heterogeneous specifications (AADL and Simulink). Our case study covers code generation for real-time simulation and test as well as

formal verification both at system-level and in a GALS framework. Based on that case study, we are developing further modular code-generation services, real-time simulation, test and performance evaluation, formal verification as well as the validation of the generated concurrent and distributed code.

Program: ITEA2

Project acronym: OPEES

Project title: Open Platform for the Engineering of Embedded Systems

Duration: Feb. 2009 - Dec. 2012

Coordinator: Obeo

Other partners: 30 partners (main partners for us: Airbus, CS Communication & Systèmes, INDRA (Spain), INPT/IRIT...)

URL: http://www.opees.org/

Abstract: The ITEA2 project OPEES is the continuation of the ANR project OPENEMBEDD to provide an open-source platform for embedded software design. Its outcome will outlive the duration of the project as it has given rise to an Industrial Working Group of the Eclipse consortium, Polarsys, whose goal is to host and maintain the proposed open-source platform and guarantee its long-term availability.

The mission of OPEES is to build a community able to ensure durability of innovative engineering technologies in the domain of critical software-intensive embedded systems. Its main objectives are to secure the industrial strategy, improve their competitiveness and develop the European software industry.

Our goal in the OPEES project was to deliver the Polychrony toolset on the Polarsys platform as an infrastructure for the co-simulation and co-verification of embedded architectures. To this end, Polychrony has been under a quality assessment process performed in collaboration with CS.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. POLYCORE

Title: Polychronous models

Inria principal investigator: Jean-Pierre Talpin

International Partner (Institution - Laboratory - Researcher):

Virginia Tech (United States) - Fermat Laboratory - Sandeep Shukla

Duration: 2011 - 2013

See also: http://www.irisa.fr/espresso/Polycore

Inria Associate Project POLYCORE starts from an observation that can be shared with anyone how experienced with multi-threaded programming, to acknowledge the difficulty of designing and implementing such software. Resolving concurrency, synchronization, and coordination issues, and tackling the non-determinism germane in multi-threaded software is extremely difficult. Ensuring correctness with respect to the specification and deterministic behavior is however necessary for safe execution of such code on embedded architectures. It is therefore desirable to synthesize multi-threaded code from formal specifications using a provably 'correct-by-construction' approach.

While time-triggered programming model simplifies code generation, our shared intuition is that multi-rate event driven execution models are much more efficiently adapted to tackle embedded software design challenges posed by forthcoming heterogeneous multi-core embedded architectures. To this aim, we develop formal models, methods, algorithms and techniques for generating provably correct multi-threaded reactive real-time embedded software for mission-critical applications. For

scalable modeling of larger embedded software systems, the specification formalism has to be compositional and hierarchical.

Our proposed formalism entails a model of computation (MoC) based on a multi-rate synchronous data-flow paradigm: Polychrony. It aims at combining the capabilities of Esterel/Quartz (ESG/TUKL) for correctly programming synchronous modules, with the capabilities of Polychrony (Inria), to give high-level abstractions of complex multi-clocked networks and yet provide powerful communication and scheduling code synthesis, all combined in an application-specific modeling and programming environment, design in collaboration with Virginia Tech and the AFRL [12], [11]. This year, we laid novel semantical foundations to designing our envisioned environment by defining a constructive semantic encompassing the polychronous data-flow model of Signal and the reactive synchronous imperative model of Quartz, and allowing to formulate the very first executable, small-step, structured operational semantics of Signal [17].

7.4. International Research Visitors

7.4.1. *Visits of International Scientists*

Pr. John Koo (SIAT, Shenzhen) visited ESPRESSO in summer 2012 with the support of the University of Rennes 1. During his stay, we elaborated a collaboration plan and project proposal on integrated discrete/continuous/hardware simulation with LIAMA.

In the context of the associate project Polycore, Jens Brandt (TU Kaiserslautern) visited ESPRESSO in June to share code generation techniques in Quartz and Signal. Loïc Besnard visited Virginia Tech in June to present the open-source release of Polychrony and explore possibles uses of Polychrony in the MRCDIF environment developed at the FLVT. Jean-Pierre Talpin visited Virginia Tech in May and October to prepare our work on Quartz and Signal and jointly draft a project proposal for the USAFRL.

7.4.2. *Visits to International Teams*

Jean-Pierre Talpin received a grant as invited scientist by the Chinese Academy of Science to visit the Shenzhen Institute for Advanced Technology in December 2012 and further ongoing collaborations with Pr. Koo and LIAMA.

FORMES Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Tsinghua Grant

contract: Tsinghua National Laboratory for Information Science and Technology, Cross-discipline Foundation grant 2011-9

title: An Intensional Logical Framework and Its Implementation

PIs: Jean-Pierre Jouannaud, Jianqi Li

duration: 2011 - 2012

Amount: 100,000 RMB

8.1.2. NSFC Grant

contract: National Science Foundation of China grant 61272002

title: The meta-theories of higher-order rewriting and their proof automation: toward the next generation theorem prover

PIs: Jean-Pierre Jouannaud, Jianqi Li

duration : 2013-2016

Amount: 600,000 RMB

8.2. International Initiatives

8.2.1. Inria International Partners

FORMES is an international project from LIAMA in China, located on two sites, Tsinghua University in Beijing, and CAS Shenzhen Institute of Advanced Technologies in Shenzhen. In addition this project has had collaborations with CAS Institute of Software and Harbin Engineering University in 2012.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

FORMES received visiting Pr Nachum Dershowitz from Israel at Tsinghua for a short stay.

8.3.1.1. Internships

Rémi Nollet (L3, ENS Lyon) did an internship at Inria Rocquencourt co-supervised by Frédéric Blanqui and Pierre Weis on the certification of construction functions generated by Moca.

8.3.2. Visits to International Teams

Jean-Pierre Jouannaud, invited in Barcelone, UTC, LSI-Lab, September 2012.

Frédéric Blanqui visited the Institute of Applied Mechanics and Informatics (IAMI) of the Vietnamese Acadamy of Sciences at Ho Chi Minh City.

GALAAD Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. 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.

7.1.2. ANEMOS

ANEMOS - Advanced Numeric for ELMs : 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 .

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. 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.

7.2.1.2. EXCITING

Title: Exact geometry simulation for optimized design of vehicles and vessels

Type: FP7-CP-SST-2007-RTD-1-218536, COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2008 - April 2012

Coordinator: Jozef Kepler universitet, Linz (Austria)

Others partners:

SINTEF, Oslo (Norway); Siemens AG (Germany); National Technical University of Athens (Greece); Hellenic Register of Shipping (Greece); University of Technology, Munich (Germany); Inria Méditerranée (France); VA Tech Hydro (Austria); Det Norske Veritas AS (Norway).

See also: http://exciting-project.eu/

Abstract: This project focuses on computational tools for the optimized design of functional free-form surfaces. Specific applications are ship hulls and propellers in naval engineering and car components, frames, and turbochargers in the automotive and railway transportation industries. The objective is to base the corresponding computational tools on the same exact representation of the geometry. This should lead to huge benefits for the entire chain of design, simulation, optimization, and life cycle management, including a new class of computational tools for fluid dynamics and solid mechanics, simulations for vehicles and vessels based. This seamless integration of CAD and FEM will have direct applications in product design, simulation and optimization of core components of vehicles and vessels.

7.2.1.3. SAGA

Title: ShApe, Geometry and Algebra, 2008-2012

Type: FP7-PEOPLE-2007-1-1-ITN.

Instrument: Initial Training Network (ITN)

Duration: November 2008 - October 2012

Coordinator: SINTEF (Norway)

Others partners: University of Oslo (Norway); Johannes Kepler Universitaet Linz (Austria); Universidad de Cantabria, Santander (Spain); Vilniaus Universitetas (Lithuany); National and Kapodistrian University of Athens (Greece); Inria Méditerranée (France); GraphiTech (Italy); Kongsberg SIM GmbH (Austria); Missler Software (France);

See also: http://saga-network.eu/

Abstract: The project aims at promoting the interaction between Geometric Modeling and Real Algebraic Geometry and, in general, at strengthening interdisciplinary and inter-sectorial research and development concerning CAD/CAM. Its objective is also to train a new generation of researchers familiar with both academic and industry viewpoints, while supporting the cooperation among the partners and with other interested collaborators in Europe.

7.2.1.4. DECONSTRUCT

> Title:Decomposition of Structured Tensors, Algorithms and Characterization.
>
> Type: PEOPLE (FP7-PEOPLE-2009-IEF)
>
> Instrument: Marie Curie Intra-European Fellowships for Career Development (IEF)
>
> Duration: November 2010 - November 2012
>
> Coordinator: Inria (France)
>
> Others partners: No.
>
> See also: http://www-sop.inria.fr/teams/galaad/joomla/index.php/international-collaborations-147/172-deconstruct.html
>
> Abstract: Tensors play a wide role in numerous application areas as Signal Processing for Telecommunications, Arithmetic Complexity or Data Analysis. In some applications tensors may be completely symmetric, or symmetric only in some modes, or may not be symmetric. In most of these applications, the decomposition of a tensor into a sum of rank-1 terms is relevant, since tensors of interest have a reduced rank. Most of them are structured, i.e., they are either symmetric or enjoy some index-invariance. Lastly, they are often real, which raises open problems concerning the existence and calculation of the decompositions. These issues build the basic bricks of the research program we propose. The classes of tensors described above have a geometric translation in terms of classical algebraic varieties: Segre, Veronese, Segre-Veronese varieties and Grassmannians and their secant varieties. A complete description of equations for those secant varieties and their dimensions is still not known (only dimensions of secant varieties to Veronsean are classified), although they have been studied by algebraic and differential geometers and algebraists for a long period up to now. The aim of this research project is:
>
> - To attack both the description of the ideal of those secant varieties and their dimensions, starting from low dimensions and low degrees.
> - To propose algorithms able to compute the rank of structured tensors.

7.2.2. Collaborations in European Programs, except FP7

7.2.2.1. PHC TOURNESOL FL

> Program: Tournesol
>
> Project acronym: PHC TOURNESOL FL 2012 - 26409SH
>
> Project title: Extracting multidimensional shapes
>
> Duration: January 2012 - December 2013
>
> Coordinator: E. Hubert (Inria), A. Cuyt (Universiteit Antwerpen)
>
> Other partners: Inria Sophia-Antipolis (France); Universiteit Antwerpen (Belgium)
>
> Abstract: We are working on the shape-from-moments problem : from measurement-like data, reconstructing a desired object. Since many years, this problem has been solved and optimized in the 2D-case thanks to use of complex numbers. Thanks to a new formula, we want to stay in the real domain in order to generalize this problem to multidimensional shapes - in particular 3D-shapes. For more details about our project Tournesol : http://www-sop.inria.fr/teams/galaad/joomla/index.php/international-collaborations-147/173-tournesol.html. For more details about the program Tournesol : http://www.campusfrance.org/fr/tournesol-communaute-francaise.

7.3. International Initiatives

7.3.1. Participation In International Programs

7.3.1.1. CNRS-NSFC collaboration with Hangzhou Dianzi University

> Contact in China: Xu Gang, College of computer - Hangzhou Dianzi University.

Participants in France: André Galligo, Bernard Mourrain, R. Duvigneau, B. Nkonga.

Abstract: CAD/CAE technology plays an important role in advanced manufacture, and the seamless integration of CAD/CAE is a difficult and important problem. The current CAD/CAE workflow can be classified into three steps: Computer-aided design, finite element analysis (FEA) and shape optimization. From the above workflow in CAD/CAE, the main gap of the geometric data is from the analysis step. Isogeometric analysis (IGA) can be employed to overcome the gap between CAD and finite element analysis by using the same geometric representation based on NURBS for the design and analysis tasks. In this collaboration, we studied the following problems: (1) Parameterization of computational domain for IGA methods, in particular generation of volume parameterization from CAD surface models. (2) IGA on complicated geometry and topology.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Wen-Shin Lee and Annie Cuyt (University of Antwerp, Belgium) visited on April 23-27 and December 10-22 in the context of the TOURNESOL project .

Nelly Villamizar (University of Oslo, Norway) visited us from March 28 to May 15, to collaborate with B. Mourrain on splines spaces, in the context of the ITN Marie-Curie SAGA.

Ibrahim Adamou (University of Cantabria, Spain) visited us from September 30 to October 8 to collaborate with B. Mourrain on Voronoï diagrams of half-lines and robust geometric computation, for his secondement in the context of the ITN Marie-Curie SAGA.

Gang Xu visited Inria and the university of Nice from November 1 to November 8 in the context of the CNRS-NSFC collaboration program.

Xiao-Shan Gao and Jingsan Chen (Chinese Academy of Science, Beijing) visited from July 18 to July 20.

George Labahn (University of Waterloo, Canada) visited from July 16 to July 22 to explore new collaboration topics with Evelyne Hubert.

<p align="center" style="color:red">GALLIUM Project-Team</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ADN4SE (FSN)

Participant: Damien Doligez.

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. BWare (ANR)

Participant: Damien Doligez.

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.

8.1.3. CEEC (FSN)

Participants: Thomas Braibant, 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.

8.1.4. LaFoSec

Participant: Damien Doligez.

The LaFoSec study, commissioned by ANSSI, aims at studying the security properties of functional languages, and especially of OCaml. The study is done by a consortium led by the SafeRiver company. Last year, it produced more than 600 pages of documents, including recommendations for security-aware development in OCaml.

The study continued this year with the production of a prototype of a secure XML/XSD validator following these recommendations, and a security evaluation of the prototype by an independent company.

Most of these documents will be made available in 2013 on the ANSSI Web site (http://ssi.gouv.fr/).

8.1.5. Paral-ITP (ANR)

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.

8.1.6. U3CAT (ANR)

Participant: Xavier Leroy.

The "U3CAT" project (2009-2012) ended in August 2012. It was coordinated by Virgile Prevosto at CEA LIST and funded by the *Arpège* programme of *Agence Nationale de la Recherche*. This action focused on program verification tools for critical embedded C codes. We were involved in this project on issues related to memory models [35] and formal semantics for the C language, at the interface between compilers and verification tools.

8.1.7. Verasco (ANR)

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.

8.2. International Research Visitors

8.2.1. Visits of International Scientists

Gabriel Dos Reis, assistant professor at Texas A&M University, visited the Gallium team in July 2012, to work on the formal semantics of the C and C++ languages.

8.2.1.1. Internships

Joseph Tassarotti, undergraduate student at Harvard University, did an internship at Gallium from June to August 2012. He worked on register allocation and instruction scheduling for the CompCert verified compiler.

GEOMETRICA Project-Team (section vide)

GRACE Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. 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). The aim of this project is to make effective "attacks" on reduced-size discrete logarithm problem (DLP) instances. It 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.

7.1.2. DGA

- DIFMAT: this two-year project aims to find matrices with good diffusion, over small finite fields. These matrices are used in block ciphers and hash functions; coding theory helps to build and analyse them. G. Quintin has been hired as postdoctoral researcher using this funding.
- D. Augot is co-advising Gwezheneg Robert, with Pierre Loidreau (DGA, Rennes University).

7.2. European Initiatives

7.2.1. Collaborations in European Programs, except FP7

Program: PHC Hubert Curien PROCOPE

Project acronym: PowerList

Project title: PowerList

Duration: 01/01/2011 to 31/12/2012.

Coordinator: Daniel Augot

Other partners: Ulm Universität, TAIT group, Germany.

Abstract: Building a less powerful but faster probabilistic list decoding algorithm. This funded Alexander Zeh's visits.

7.3. International Initiatives

7.3.1. Inria International Partners

- DTU Lyngby.
- Ulm Universität.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Internships

- Johan Sebastian Nielsen, DTU Lyngby PhD student, visited us from September 1st to December 20th.

7.4.2. Visits to International Teams

- D. Augot, A. Couvreur, and B. Smith visited the University of Illinois at Urbana–Champaign. This visit included two talks given in the Number Theory seminar, and discussions with I. Duursma to prepare the second year of the DGA DIFMAT contract.
- A. Zeh visited the Institute of Information Transmission Problems (IITP), Moscow in December 2012. He gave a talk on low-rate small-minimum distance binary cyclic codes.

LFANT Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Projet Idex CPU

The LFANT team takes part in Work package 6 of the Idex project CPU (Numerical certification and reliability). The work package concerns "Codes, Cryptology and Arithmetic Algorithms" and involves researchers from the Institut de Mathématiques de Bordeaux (Codes and Lattices team, LFANT) and Laboratoire Bordelais de Recherche en Informatique (Combinatorics and Algorithmic team).

8.2. National Initiatives

8.2.1. ANR AlgoL: Algorithmics of L-functions

Participants: Bill Allombert, Karim Belabas, Henri Cohen, Jean-Marc Couveignes, Andreas Enge.

http://www.math.u-bordeaux1.fr/~belabas/algol/index.html

The ALGOL project comprises research teams in Bordeaux, Montpellier, Lyon, Toulouse and Besançon.

It studies the so-called L-functions in number theory from an algorithmic and experimental point of view. L-functions encode delicate arithmetic information, and crucial arithmetic conjectures revolve around them: Riemann Hypotheses, Birch and Swinnerton-Dyer conjecture, Stark conjectures, Bloch-Kato conjectures, etc.

Most of current number theory conjectures originate from (usually mechanised) computations, and have been thoroughly checked numerically. L-functions and their special values are no exception, but available tools and actual computations become increasingly scarce as one goes further away from Dirichlet L-functions. We develop theoretical algorithms and practical tools to study and experiment with (suitable classes of) complex or p-adic L-functions, their coefficients, special or general values, and zeroes. For instance, it is not known whether K-theoretic invariants conjecturally attached to special values are computable in any reasonable complexity model. On the other hand, special values are often readily computed and sometimes provide, albeit conjecturally, the only concrete handle on said invariants.

New theoretical results are translated into new or more efficient functions in the PARI/GP system.

The project lasted from 15/11/2007 to 15/02/2012, for 51 months it received an ANR funding of 200k€ for a global cost of 1M€.

8.2.2. ANR Peace – Parameter spaces for Efficient Arithmetic and Curve security Evaluation

Participants: Bill Allombert, Karim Belabas, Jean-Marc Couveignes, Andreas Enge, 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 to constitute 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 theorical side, this includes an effective description of moduli spaces of curves, 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.

8.2.3. ANR Simpatic – SIM and PAiring Theory for Information and Communications security

Participant: 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, University of Paris 8.

The aim of the SIMPATIC project is to provide the most possible 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 efficient 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.

As a member, Damien Robert will aim to bridge the gap between the theoretical results described in the pairing module and the practical realisation of pairing-based SIM cards in an industrial setting.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. ANTICS

Title: Algorithmic Number Theory in Cryptology

Type: IDEAS

Instrument: ERC Starting Grant

Duration: January 2012 - December 2016

Coordinator: Inria (France)

Abstract: Data security and privacy protection are major challenges in the digital world. Cryptology contributes to solutions, and one of the goals of ANTICS 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.

8.3.2. Collaborations in European Programs, except FP7

Program: Erasmus Mundus

Project acronym: ALGANT

Project title: ALgebra, Geometry and Number Theory

Duration: 09/2004–

Coordinator: University Bordeaux 1

Other partners: University Leiden (Netherlands), University Milano (Italy), University Padova (Italy), University Paris-Sud (France), Chennai Mathematical Institute (India), Concordia University (Canada), Stellenbosch University (South Africa)

Abstract: Joint master and doctoral programme; the PhD theses of Athanasios Angelakis and Julio Brau are co-supervised by P. Stevenhagen (Leiden) and K. Belabas

8.4. Research Visitors

- Atelier PARI/GP (23–27/01)

- – Charles Boyd (Amherst)
- – Pierre Castel (Caen)
- – Jeroen Demeyer (Ghent)
- – Tony Ezome (Franceville)
- – Vincent Fleckinger (Besançon)
- – Jean-Pierre Flori (Télécom Paristech)
- – Eduardo Friedman (Santiago de Chile)
- – Loic Grenié (Bergamo)
- – Bernadette Perrin-Riou (Orsay)
- – Firmin Varescon (Besançon)
- Damien Stehlé, Lyon (06–09/03)
- Bernadette Perrin-Riou, Orsay (24–27/01, 09–23/03)
- Vasily Golyshev, Bonn and Moscow (12/03)
- Marco Streng, Warwick (27–30/03)
- Gaëtan Bisson, Sydney (10–13/04)
- David Lubicz, Rennes (10–13/04, 03–07/09, 17–21/12)
- Bruno Salvy, Inria Paris (14/06)
- Workshop MPFR/MPC (25–27/06)
  - – Benjamin Dadoun (Nancy)
  - – Mickaël Gastineau (Paris)
  - – Vincent Lefèvre (Lyon)
  - – Patrick Pélissier (Toulouse)
  - – Philippe Théveny (Lyon)
  - – Paul Zimmermann (Nancy)
- Bernhard Schmidt, Singapore (02/07)
- Fernando Mario, Berlin (09/10)
- Luca De Feo, Versailles (30/10)

8.4.1. *Visits to International Teams*

J.-M. Couveignes: Tsinghua University, Beijing, 02/04–08/05

A. Enge: Tsinghua University, Beijing, 20/04–02/06

<p align="center">**MARELLE Project-Team**</p>

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

- We participated in the ANR project DeCert, which started on January 2009. Other participants are CEA List (Paris), LORIA-Inria (Nancy), Celtique (IRISA Rennes), Proval (LRI Orsay), Typical (Inria Saclay), Systerel (Aix-en-provence). The objective of the DeCert project was to design an architecture for cooperating decision procedures. To ensure trust in the architecture, the decision procedures will either be proved correct inside a proof assistant or produce proof witnesses allowing external checkers to verify the validity of their answers.

- We participate in the ANR project TAMADI, which started in October 2010. Other participants are ARENAIRE-Inria Rhone-Alpes and the PEQUAN team from University of Paris VI Pierre and Marie Curie. The objective of the TAMADI project is to study the question of precision in floating-point arithmetic and to provide formal proofs on this topic.

6.2. European Initiatives

6.2.1. FP7 Projects

6.2.1.1. FORMATH

Title: Formath

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: March 2010 - July 2013

Coordinator: Univ Götegorg (Sweden)

Others partners: Radboud University Nijmegen, (the Netherlands), University of La Rioja, (Spain).

See also: http://wiki.portal.chalmers.se/cse/pmwiki.php/ForMath/ForMath

Abstract: The objective of this project is to develop libraries of formalised mathematics concerning algebra, linear algebra, real number computation, and algebraic topology. The libraries that we plan to develop in this proposal are especially chosen to have long-term applications in areas where software interacts with the physical world. The main originality of the work is to structure these libraries as a software development, relying on a basis that has already shown its power in the formal proof of the four-colour theorem, and to address topics that were mostly left untouched by previous research in formal proof or formal methods.

6.3. International Initiatives

6.3.1. Inria International Partners

We are in close contact with the University of Chalmers in Göteborg, Sweden and with the IMDEA Software Institute in Madrid, Spain.

6.4. International Research Visitors

6.4.1. Visits to International Teams

- Benjamin Grégoire visited IMDEA in Madrid, spain in April (23-27), October (1-5), and November (26-30).

MEXICO Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

The research involving the PhD thesis of Aiswarya Cyriac on temporal logics for concurrent recursive programs is supported by the DIGITEO project LOCOREP, 2010-2013. Hernán Ponce de León's research on conformance testing for concurrent systems through event structures is supported by the DIGITEO project TECSTES, 2011-2014.

7.2. National Initiatives

7.2.1. ANR

Participants: Sandie Balaguer, 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.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. Hycon2

Title: Highly Complex and Networked Control Systems

Type: COOPERATION (ICT)

Defi: Engineering of Networked Monitoring and Control Systems

Instrument: Network of Excellence (NoE)

Duration: September 2010 - August 2014

Coordinator: CNRS (France)

Others partners: Inria (France), ETH Zurich (Switzerland), TU Berlin (Germany), TU Delft (Netherlands) and many others.

See also: http://www.hycon2.eu

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.

7.3.1.2. Univerself

Title: Univerself

Type: COOPERATION (ICT)

Defi: The Network of the Future

Instrument: Integrated Project (IP)

Duration: September 2010 - August 2013

Coordinator: Alcatel Lucent (France)

Others partners: Universiteit Twente, Alcatel Lucent Ireland, Alcatel Lucent Deutschland, Valtion Teknillinen Tutkimuskeskus (Finland), University of Piraeus, France Telecom, Telecom Italia, National University of Athens, Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung, Interdisciplinary Institute for Broadband Technology, Telefonica Investigacion y Desarrollo,Thales Communications, Inria,Nec Europe, University of Surrey, University College London, IBBT (Belgium).

See also: http://www.univerself-project.eu/

Abstract: UniverSelf unites 17 partners with the aim of overcoming the growing management complexity of future networking systems, and to reduce the barriers that complexity and ossification pose to further growth. Univerself has been launched in October 2010 and is scheduled for four years.

7.4. International Initiatives

7.4.1. *Inria International Partners*

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 new International Associated Laboratory (LIA) INFORMEL (INdo-French FORmal Methods Lab). This LIA was created in January 2012 by an agreement between CNRS, ENS Cachan, University Bordeaux 1 on the french side and the Chennai Mathematical Institute, the Institute of Mathematical Sciences of Chennai, and the Indian Institute of Science of Bangalore on the Indian side.

7.4.2. *Participation In International Programs*

Benedikt Bollig, Aiswarya Cyriac, and Benjamin Monmege are participating in LeMon, a joint Procope project with LIAFA, (Paris) and the University of Lübeck, supported by EGIDE/DAAD. The aim of the project is to develop techniques for the inference of systems that deal with infinite data domains.

7.5. International Research Visitors

7.5.1. *Visits of International Scientists*

Supported by the LIA INFORMEL,

- K. Narayan Kumar from CMI visited our team from May 2nd to 27th, and
- Madhavan Mukund from CMI visited our team from May 8th to June 3rd.

From April 10 to April 13, Victor Khomenko from Newcastle University (UK) visited the team.

Estibaliz Fraca, PhD student from Zaragossa, is visiting from november 2012 trough February 2013.

7.5.1.1. Internships

Umang Mathur (IIT Bombay, India) effected a two-month internship from May to July at ENS Cachan, co-financed by the Inria Internship program, which was jointly supervised by Rohit Chadha (of the Secsi team) and Stefan Schwoon. The co-operation is being continued remotely, with Rohit Chadha now at the University of Missouri.

Subject: Estimating the Information Leakage of a Recursive Probabilistic Program.

Institution: IIT Bombay, India

Gaurav MAHAJAN (from May 2012 until Jul 2012)

Subject: Probabilistic Unfolder for Petri Nets

Institution: IIT Delhi (India)

7.5.2. Visits to International Teams

The team members made several *short* visits:

- Supported by the LIA INFORMEL, Paul Gastin visited the Chennai Mathematical Institute (CMI) in India from January 9 to 21.
- Benedikt Bollig and Aiswarya Cyriac were visiting Thomas Schwentick's group at TU Dortmund University (March 13 – 16).
- Benjamin Monmege was visiting Martin Leucker's group at the University of Lübeck (July 9 – 14 and October 28 – November 2).
- Stefan Schwoon visited Javier Esparza's group at TU Müchen and gave a talk in April 2012.
- Serge Haddad visited Rolf Hennicker's group at LMU Munich in November 2012.

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

The team participated to the CLASYCO network on DSL for simulation, supported by the RNSC (réseau national des systèmes complexes).

Jean-Louis Giavitto participates to the SynBioTIC ANR Blanc project (with IBISC, University of Evry, LAC University of Paris-Est, ISC - Ecole Polytechnique).

7.2. International Research Visitors

7.2.1. Visits of International Scientists

Miller S. Puckette is a professor of computer music in University of California San Diego (UCSD) and author of *Max* and *PureData* real-time programming environments for interactive arts. He participated in May 2012 in the MuTant Real-time Multimedia Computing Seminars (available on the web) and contributed to the team's knowledge of multimedia real-time scheduling challenges and paradigms.

James McCartney is a senior researcher in Apple Core Audio project and author of the audio synthesis and algorithmic composition programming environment *SuperCollider*. He visited *MUTANT* in November 2012 and participated in the MuTant Real-time Multimedia Computing Seminars (available on the web). He is interested in robust scheduling of heterogeneous computing for real-time multimedia applications.

David Rizo is lecturer at the University of Alicante, Spain. He is interested in music information retrieval and classification of musical genres by combining audio and symbolic descriptors. He visited *MuTant* in March 2012 and participated in a session of the MaMux seminar dedicated to trees and hierarchical structures in computer music.

Masahiko Sakai is a professor at the University of Nagoya and director of the Sakabe/Sakai computer science laboratory of the department of computer science and mathematical informatics of Nagoya University. He visited *MuTant* in April 2012.

Yoshiharu Kojima is an research fellow of the Japan society for the promotion of science. He has made a two months post-doctoral visit in *MuTant* in October and November 2012 on the application of term rewriting techniques to the formalization of musical processes, under the institutional program for young researchers overseas visits of the graduate school of information science at Nagoya University.

<p style="text-align:center">**PAREO Project-Team**</p>

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).

7.1.1. *FRAE QUARTEFT (2009-2012)*

Participants: Jean-Christophe Bach, Horatiu Cirstea, Pierre-Etienne Moreau.

"QUARTEFT: QUALifiable Real TimE Fiacre Transformations" is a research project funded by the FRAE (Fondation de Recherche pour l'Aéronautique et l'Espace). A first goal is to develop an extension of the Fiacre intermediate language to support real-time constructs. A second goal is to develop new model transformation techniques to translate this extended language, Fiacre-RT, into core Fiacre. One of the main difficulties consists in proposing transformation techniques that could be verified in a formal way. A more detailed presentation is available at http://quarteft.loria.fr/dokuwiki/.

7.2. International Research Visitors

7.2.1. *Visits of International Scientists*

Cooperation with Prof. Mark van den Brand from Technical University of Eindhoven.

PARKAS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. 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 Partout (program "defis"), 2009-2012.

ANR CAFEIN, 2013-2015.

Action d'envergure Synchronics, 2008-2012. The action was driven by Alain Girault (Inria, PopArt, Grenoble) and Marc Pouzet (Inria, Parkas, Paris-Rocquencourt), to focus on "langages for embedded systems". This has been instrumental in driving our new research on hybrid system modelers.

8.1.2. Competitivity Clusters

FUI project OpenGPU, 2008–2012.

8.2. International Research Visitors

8.2.1. Visits of International Scientists

September, 27 - October, 3, Peter Sewell (U. Cambridge) visited the Parkas team for collaboration with F. Zappa Nardelli and R. Morisset.

October, 6-13, Mike Hicks (U. Maryland) visited the Département d'informatique of the ENS.

January, 18-20, P. Sadayappan (Ohio State U.) visited the team to work with Tobias Grosser and Sven Verdoolaege. Similar visits took place in July and December.

June-July 2013. Stephen Edwards (Columbia U.) was invited by ENS to spend a month in the team.

8.2.1.1. Internships

January-July, Pankaj Pawan (IIT Kanpur) was intern student (M2) under the supervision of F. Zappa Nardelli.

May-September, Robin Morisset (ENS Ulm) was intern student (M2) under the supervision of F. Zappa Nardelli.

May-September, Fran cois Gindraud (ENS Ulm) was intern student (M2) under the supervision of A. Cohen.

December 2011-November 2012, Mehdi Dogguy was post-doc funded by the ANR Partout grant. Mehdi Dogguy worked on the static analysis of ReactiveML programs and was supervised by L. Mandel.

April-July 2012, Cyprien Lecourt (École Polytechnique) was intern student (M1) under the supervision of M. Pouzet.

April-September 2012, Guillaume Baudart (École normale supérieure de Cachan) was intern student (M2) under the supervision of M. Pouzet. Guillaume was a student from IRCAM and the supervision was joint with Florent Jacquemart (Inria Paris-Rocquencourt and IRCAM).

8.2.2. Visits to International Teams

Louis Mandel spent 7 weeks in the team of Vijay Saraswat at IBM T.J. Watson. He worked on the type system of the X10 language.

Albert Cohen and Tobias Grosser visited Prof. Uday Bondhugula at the Indian Institute of Science (IISc), CSA department, for 4 days and 2 weeks, respectively. Tobias Grosser gave a lecture/tutorial on optimizing compilation in LLVM to IISc students and AMD engineers.

<h1 style="text-align:center; color:red">PARSIFAL Project-Team</h1>

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 Projects

7.1.1.1. Proofcert

> Title: ProofCert: Broad Spectrum Proof Certificates
>
> Type: IDEAS
>
> Instrument: ERC Advanced Grant (Advanced)
>
> Duration: January 2012 - December 2016
>
> Coordinator: Inria (France)
>
> See also: https://team.inria.fr/parsifal/proofcert/
>
> Abstract: 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 times 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.

7.1.2. Collaborations in European Programs, except FP7

7.1.2.1. STRUCTURAL: ANR blanc International

Participants: Kaustuv Chaudhuri, Nicolas Guenot, Willem Heijltjes, François Lamarche, Dale Miller, Lutz Straßburger.

> Title: Structural and computational proof theory
>
> Duration: 01/01/2011 – 31/12/2013
>
> Partners:
>
> > University Paris VII, PPS (PI: Michel Parigot)
> >
> > Inria Saclay–IdF, EPI Parsifal (PI: Lutz Straßburger)
> >
> > University of Innsbruck, Computational Logic Group (PI: Georg Moser)
> >
> > Vienna University of Technology, Theory and Logic Group (PI: Matthias Baaz)
>
> Total funding by the ANR: 242 390,00 EUR (including 12 000 EUR pôle de compétivité: SYSTEMTIC Paris région)

This project is a consortium of four partners, two French and two Austrian, who are all internationally recognized for their work on structural proof theory, but each coming from a different tradition. One of the objective of the project is build a bridge between these traditions and develop new proof-theoretic tools and techniques of structural proof theory having a strong potential of applications in computer science, in particular at the level of the models of computation and the extraction of programs and effective bounds from proofs.

On one side, there is the tradition coming from mathematics, which is mainly concerned with first-order logic, and studies, e.g., Herbrand's theorem, Hilbert's epsilon-calculus, and Goedel's Dialectica interpretation. On the other side, there is the tradition coming from computer science, which is mainly concerned with propositional systems, and studies, e.g., Curry-Howard isomorphism, algebraic semantics, linear logic, proof nets, and deep inference. A common ground of both traditions is the paramount role played by analytic proofs and the notion of cut elimination. We will study the inter-connections of these different traditions, in particular we focus on different aspects and developments in deep inference, the Curry-Howard correspondence, term-rewriting, and Hilbert's epsilon calculus. As a byproduct this project will yield a mutual exchange between the two communities starting from this common ground, and investigate, for example, the relationship between Herbrand expansions and the computational interpretations of proofs, or the impact of the epsilon calculus on proof complexity.

Besides the old, but not fully exploited, tools of proof theory, like the epsilon-calculus or Dialectica interpretation, the main tool for our research will be deep inference. Deep inference means that inference rules are allowed to modify formulas deep inside an arbitrary context. This change in the application of inference rules has drastic effects on the most basic proof theoretical properties of the systems, like cut elimination. Thus, much of the early research on deep inference went into reestablishing these fundamental results of logical systems. Now, deep inference is a mature paradigm, and enough theoretical tools are available to think to applications. Deep inference provides new properties, not available in shallow deduction systems, namely full symmetry and atomicity, which open new possibilities at the computing level that we intend to investigate in this project. We intend to investigate the precise relation between deep inference and term rewriting, and hope to develop a general theory of analytic calculi in deep inference. In this way, this project is a natural continuation of the ANR project INFER which ended in May 2010.

7.1.2.2. PHC Procope: From Proofs to Counterexamples for Programming
Participants: Kaustuv Chaudhuri, Nicolas Guenot, Willem Heijltjes, Lutz Straßburger.

> Title: From Proofs to Counterexamples for Programming
>
> Duration: 01/01/2012 – 31/12/2013
>
> German Partner: University of Bonn, Institute for Computer Science (Department III)

Finding counterexamples is an endeavor which is as important as proving theorems. But while the latter has seen a huge amount of research effort—we have nowadays a large quantity of tools for automated and interactive theorem proving—the former has mainly been neglegted by proof theorists. One of the reasons is that finding counterexamples or countermodels has been considered a model theoretical activity, rather than a proof theoretical one. Only recently, researchers have begun to explore the well-known duality between "proof search" and "search for countermodels" in a purely proof theoretical way. The main objective of this collaboration is to develop the necessary proof theory for automatically generating such counterexamples in a more general setting.

7.1.2.3. PHC Germaine de Staël: Extending the Realm of the Curry-Howard-Correspondence
Participants: Nicolas Guenot, Willem Heijltjes, Lutz Straßburger.

> Title: Extending the Realm of the Curry-Howard-Correspondence
>
> Duration: 01/01/2011 – 31/12/2012
>
> Swiss Partner: University of Bern, Institut für Informatik und angewandte Mathematik (IAM)

The Curry-Howard correspondence between proofs and programs is probably the most interesting and surprising connection between mathematics and computer science. It was discovered in the 1960s, but its main development started in the 1980s. The basis of the correspondence is a correspondence between intuitionistic proofs and typed functional programs (written as terms of lambda-calculus).

Our goal is to develop such a correspondence for new formalisms, like hypersequents, nested sequents and deep inference, in order to better understand their proofs and, we hope, either to discover new programming constructs or to give a new logical interpretation to existing ones.

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. RAPT
Participants: Beniamino Accattoli, Kaustuv Chaudhuri, Quentin Heath, Dale Miller, Yuting Wang.

Title: Applying Recent Advances in Proof Theory for Specification and Reasoning

Inria principal investigator: Kaustuv Chaudhuri

International Partner:

Institution: McGill University (Canada)

Laboratory: School of Computer Science

Researcher: Prof. Brigitte Pientka

International Partner:

Institution: Carnegie Mellon University (United States)

Laboratory: Department of Computer Science

Researcher: Prof. Frank Pfenning

International Partner:

Institution: University of Minnesota (United States)

Laboratory: Department of Computer Science and Engineering

Researcher: Prof. Gopalan Nadathur

Duration: 2011 - 2013

See also: http://www.lix.polytechnique.fr/~kaustuv/rapt/

Many aspects of computation systems, ranging from operational semantics, interaction, and various forms of static analysis, are commonly specified using inference rules, which themselves are formalized as theories in a logical framework. While such a use of logic can yield sophisticated, compact, and elegant specifications, formal reasoning about these logic specifications presents a number of difficulties. The RAPT project will address the problem of reasoning about logic specifications by bringing together three different research teams, combining their backgrounds in type theory, proof theory, and the building of computational logic systems. We plan to develop new methods for specifying computation that allow for a range of specification logics (eg, intuitionistic, linear, ordered) as well as new means to reason inductively and co-inductively with such specifications. New implementations of reasoning systems are planned that use interactive techniques for deep meta-theoretic reasoning and fully automated procedures for a range of useful theorems.

7.2.2. Inria International Partners

7.2.2.1. Eternal: Inria ARC
Participants: Kaustuv Chaudhuri, Dale Miller, Lutz Straßburger.

Title: Interactive Resource Analysis

webpage: http://eternal.cs.unibo.it/

Inria principal investigator: Dale Miller

Inria Partner:

Institution: Inria

Team: FOCUS

Researcher: Ugo Dal Lago

Inria Partner:

Institution: Inria

Team: pi.r2

Researcher: Pierre-Louis Curien

Duration: 2011 - 2013

This project aims at putting together ideas from Implicit Computational Complexity and Interactive Theorem Proving, in order to develop new methodologies for handling quantitative properties related to program resource consumption, like execution time and space. The task of verifying and certifying quantitative properties is undecidable as soon as the considered programming language gets close to a general purpose language. So, full-automatic techniques in general cannot help in classifying programs in a precise way with respect to the amount of resources used and moreover in several cases the programmer will not gain any relevant information on his programs. In particular, this is the case for all the techniques based on the study of structural constraints on the shape of programs, like many of those actually proposed in the field of implicit computational complexity. To overcome these limitations, we aim at combining the ideas developed in the linear logic approach to implicit computational complexity with the ones of interactive theorem proving, getting rid of the intrinsic limitations of the automatic techniques. In the obtained framework, undecidability will be handled through the system's user, who is asked not only to write the code, but also to drive the semi-automatic system in finding a proof for the quantitative properties of interest. In order to reduce the user effort and allow him to focus only on the critical points of the analysis, our framework will integrate implicit computational complexity techniques as automatic decision procedures for particular scenarios. Moreover, in order to be widely applicable, the modularity of the framework will permit to deal with programs written in different languages and to consider different computational resources. The kind of study proposed by this project has been almost neglected so far. Here, we aim at providing such a framework for both theoretic investigations and for testing in practice the effectiveness of the approach.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Brigitte Pientka, Associate Professor, McGill University
February 21 – 24

Gopalan Nadathur, Professor, University of Minnesota
July 10 – 12

Elaine Pimentel, Associate Professor, Universidade Federal de Minas Gerais
June 6 – July 17

Chuck Liang, Professor, Hofstra University
March 6 – May 6 and December 17 – 24

7.3.2. Internships

Yuting WANG (May – August)
  Subject: Development of the Abella theorem prover.
  Institution: University of Minnesota (United States)

Florence Clerc (March – July)
  Subject: Relating double-negation translations and focused proof systems
  Institution: Master Parisien de Recherche en Informatique

Zakaria Chihani (April – September)
  Subject: Proof certificates for some basic proof systems in classical logic
  Institution: Master Parisien de Recherche en Informatique

7.3.3. Visits to International Teams

Stefan Hetzl has visited the Vienna University of Technology four times, for a total of 36 days, within the framework of the FWF/ANR Structural project.

<p style="text-align:center">**PI.R2 Project-Team**</p>

7. Partnerships and Cooperations

7.1. National Initiatives

Matthieu Sozeau, Hugo Herbelin, Lourdes del Carmen Gonzalez Huesca and Yann Régis-Gianas are members of the ANR Paral-ITP started 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 project (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 on January 8th, 2012 and is a joint project with LRI, PPS and Inria Grenoble.

7.2. European Initiatives

7.2.1. FP7 Projects

Yann Régis-Gianas is a participant of the EU-FP7 Certified Complexity project (CerCo). This European project started in February 2010 as a collaboration between Bologna university (Asperti, Sacerdoti Coen), Edinburgh university (Stark) and Paris 7 university (Amadio, Régis-Gianas). The CerCo project aims at the construction of a formally verified complexity preserving compiler from a large subset of the C programming language to some typical micro-controller assembly language, of the kind traditionally used in embedded systems. François Bobot's postdoc is funded by this project.

7.2.2. Collaborations in European Programs, except FP7

Hugo Herbelin is participating to a PHC Pavle Savić with the university of Novi Sad in Serbia, the mathematical institute of Belgrade, ENS Lyon and the university of Turin. This project, called TLIT and headed by Silvia Ghilezan on the Serbian side, is about the properties of resource λGtz calculus; subject reduction for the $\overline{\lambda}\mu\widetilde{\mu}$-calculus; explicit substitutions and confluence; the diagrams and termination for $^*X$ calculus; introducing imperative features in classical logic; the $\lambda\mu$ calculus and its properties; the symmetries in classical logics.

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.

7.3. International Initiatives

7.3.1. Inria Associate Teams

> Title: Proof theory and functional programming languages (SEMACODE)
>
> Inria principal investigator: Alexis SAURIN
>
> International Partner:
>
>> Institution: University of Oregon (United States)
>>
>> Laboratory: Computer and Information Science Department
>>
>> Researcher: Zena ARIOLA
>
> International Partner:
>
>> Institution: University of Novi Sad

Laboratory: Faculty of Engineering

Researcher: Silvia GHILEZAN

Duration: 2011 - 2013

See also: http://www.pps.univ-paris-diderot.fr/~saurin/EA-SEMACODE

Activity report: http://www.pps.univ-paris-diderot.fr/~saurin/EA-SEMACODE/en/activite.html

Cross-fertilisation between logic and programming languages theory is at the root of many striking developments in programming concepts as well as tools for formal analysis of programs. Our associated team project aims at gathering senior and young researchers from both sites in order to put a joint research effort on the following research themes: formalising particular evaluation strategies of functional languages based on logical techniques coming from sequent calculi. More specifically, we shall be interested in incorporating control operators directly in call-by-need and in developing a uniform framework for call-by-value and call-by-name calculi with delimited control, in particular to unveil the logical interpretation of delimited control (that is its logical counterpart with respect to Curry-Howard correspondence), and developing connections between delimited control and stream calculi; developing the logical content of realistic abstract machines and associated formal analysis tools for realistic abstract machines building on Curien-Herbelin $\overline{\lambda}$ calculi. The project will gather πr^2 expertise in proof theory and in the logical foundations of functional programming languages, the expertise of the Oregonian group on call-by-need evaluation and delimited control as well as respective crucial inputs of Gaboardi and Ghilezan on stream calculi, delimited control, semantics and type theory. The project will in particular allow to have the Inria and American students and post-docs involved in the project (7 out of 13 people involved) to travel between both sites and to organise joint workshops (one such workshop is planned in June 2011).

7.3.2. PHC

Hugo Herbelin started a PHC STAR with Gyesik Lee and Sungwoo Park in Korea on reverse mathematics and Coq, and on the role that polarisation can play in this respect.

7.3.3. *Inria International Partners*

πr^2 has strong relations with the following universities: Cambridge (Tim Griffin), Nottingham (Thorsten Altenkirch), Münich (Andreas Abel, Martin Hofmann), Strathclyde (Conor McBride), Chalmers in Göteborg (Thierry Coquand, Peter Dybjer), Technical University in Tallinn (Tarmo Uustalu, Keiko Nakata), Yale University (Zhong Shao), Harvard University (Greg Morrisett).

7.4. International Research Visitors

7.4.1. *Visits of International Scientists*

Thorsten Altenkirch (University of Nottingham) visited πr^2 for one month April 2012.

Conor McBride (University of Strathclyde) visited πr^2 for three weeks April-May 2012.

Keiko Nakata (University of Tallin) visited πr^2 for 4 days in September and worked with Zena Ariola and Hugo Herbelin on typing the continuation-passing-style semantics of call-by-need λ-calculus.

Tim Griffin visited πr^2 from January to June 2012 (and was funded 3 months by the Inria Paris-Rocquencourt invitation programme). He worked on the formalisation of routing protocols in Coq, and had many exchanges with Coq and ssreflect implementors.

Zena Ariola is visiting πr^2 during the whole academic year 2012-2013. She works on call-by-need, continuation-passing translations and related subjects.

Beta Ziliani (MPI Saarbrücken) visited πr^2 for one week in January 2012 and one week in July 2012 to work with Matthieu Sozeau on formalising the unification algorithm of Coq.

Jael Kriener (University of Kent) visited πr^2 for one week in January 2012 to work with Matthieu Sozeau on proof-search for Type Classes.

7.4.2. Internships

We host Paul Downen (PhD student of Zena Ariola, University of Oregon), during the entire academic year 2012/2013.

7.4.3. Visits to International Teams

Hugo Herbelin and Matthieu Sozeau have spent three months at the IAS as part of the special year on Univalent Foundations (October-December 2012).

7.4.4. Shorter International Visits Abroad

Pierre-Louis Curien visited Zena Ariola (Univ. of Oregon) for 2 weeks in May-June, and Tarmo Uustalu (Institute of Cybernetics of Technical University, Tallinn) for 2 weeks in December.

Hugo Herbelin visited Silvia Ghilezan at the University of Novi Sad in Serbia for one week in January 2012. He visited Predrag Janičić at the University of Belgrade for 2 days. He visited Danko Ilik in Skopje for one week.

Hugo Herbelin visited 4 days Gyesik Lee in Seoul and 3 days Sungwoo Park in Pohang in May as part of their joint project on Reverse Mathematics in Coq.

Guillaume Munch-Maccagnoni also visited Seoul (as part of the PHC STAR programme) 10 days in December.

Matthieu Sozeau was invited by the French Ministry of Foreign Affairs to visit Keiko Nakata and Tarmo Uustalu (IoC, Tallinn) for 4 days in June 2012. He gave a seminar on Equations there.

POLSYS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- **ANR Jeunes Chercheurs CAC Computer Algebra and Cryptography (2009-2013).** The contract CAC "Computer Algebra and Cryptography" started in October 2009 for a period of 4 years. This project investigates the areas of cryptography and computer algebra, and their influence on the security and integrity of digital data. In CAC, we plan to use basic tools of computer algebra to evaluate the security of cryptographic schemes. CAC will focus on three new challenging applications of algebraic techniques in cryptography; namely block ciphers, hash functions, and factorization with known bits. To this hand, we will use Gröbner bases techniques but also lattice tools. In this proposal, we will explore non-conventional approaches in the algebraic cryptanalysis of these problems (Participants: L. Perret [contact], J.-C. Faugère, G. Renault).

- **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).** he 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]).

8.2. European Initiatives

8.2.1. FP7 Projects

ECRYPT II - European Network of Excellence for Cryptology II is a 4 1/2 year network of excellence funded within the Information & Communication Technologies (ICT) Programme of the European Commission's Seventh Framework Programme (FP7) under contract number ICT-2007-216676. It falls under the action line Secure, dependable and trusted infrastructures. ECRYPT II started on 1 August 2008. Its objective is to continue intensifying the collaboration of European researchers in information security. The ECRYPT II research roadmap is motivated by the changing environment and threat models in which cryptology is deployed, by the gradual erosion of the computational difficulty of the mathematical problems on which cryptology is based, and by the requirements of new applications and cryptographic implementations. Its main objective is to ensure a durable integration of European research in both academia and industry and to maintain and strengthen the European excellence in these areas. In order to reach this goal, 11 leading players have integrated their research capabilities within three virtual labs focusing on symmetric key algorithms (SymLab), public key algorithms and protocols (MAYA), and hardware and software implementations associate (VAMPIRE). They are joined by more than 20 adjoint members to the network who will closely collaborate with the core partners. The team joins the European Network of Excellence for Cryptology ECRYPT II this academic year as associate member (J.C. Faugère [contact], L. Perret, and G. Renault).

8.3. International Initiatives

8.3.1. Inria Associate Teams

The POLSYS Team and ARIC at ENS Lyon are part of the QOLAPS (Quantifier Elimination, Optimization, Linear Algebra and Polynomial Systems) Associate Team with the Symbolic Computation Group at North Carolina State University.

8.3.2. Participation In International Programs

The POLSYS Team is part of the ECCA (Exact/Certified Computations with Algebraic systems) project at LIAMA in Beijing; our Chinese collaborators are from Beihang University, Peking University, the Chinese Academy of Sciences (Key Laboratory of Mathematics Mechnanization and State Key Laboratory of Information Security).

We are also part of an International Royal Society Joint Project with the Crypto team Royal Holloway, University of London, UK (2010-2012). The Royal Society Joint Project Grant Programme is designed to enable international collaboration. The main goal of the project is to investigate the viability of a wide range of new algebraic techniques in the cryptanalysis of block ciphers, and potentially other symmetric cryptographic algorithms (such as hash functions).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

As part of its collaboration with Guénaël Renault, the Professor Kazuhiro Yokoyama from Rikkyo University (Japan) visited the team during December 2012.

Erich Kaltofen (Professor at North Carolina State University) visited the group in June-July 2012 in the frame of the QOLAPS Associate Team.

Xiao-Shan Gao, Lihong Zhi, Jinsan Cheng (Chinese Academy of Sciences, KLMM) visited the group in July 2012 in the frame of the ECCA project and the ANR EXACTA project.

8.4.1.1. Internships

- T. Verron (Internship M2 and ENS Paris): Computation of Gröbner bases for quasi-homogeneous systems.
- F. Martani (Internship M2): Dedicated Linear Algebra for Gröbner Bases.

POP ART Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Inria Large Scale Actions

8.1.1.1. Inria Large Scale Action Synchronics: Language Platform for Embedded System Design

Participants: Gwenaël Delaval, Alain Girault [contact person, co-coordinator], Bertrand Jeannet, Xavier Nicollin, Peter Schrammel.

The SYNCHRONICS (Language Platform for Embedded System Design) project [mid-2008 to mid-2012] gathers 9 permanent researchers on the topic of embedded systems design: B. Caillaud (INRIA Rennes – Bretagne Atlantique), A. Cohen, L. Mandel, and M. Pouzet (Inria-Saclay and ENS Paris), G. Delaval, A. Girault, and B. Jeannet (INRIA Grenoble – Rhône-Alpes), E. Jahier and P. Raymond (VERIMAG).

SYNCHRONICS capitalizes on recent extensions of data-flow synchronous languages, as well as relaxed forms of synchronous composition or compilation techniques for various platform, to address two main challenges with a language-centered approach: (i) the co-simulation of mixed discrete-continuous specifications, and more generally the co-simulation of programs and properties (either discrete or continuous); (ii) the ability, inside the programming model, to account for the architecture constraints (execution time, memory footprint, energy, power, reliability, etc.).

8.1.2. ANR

8.1.2.1. ANR Asopt: Analyse Statique et OPTimisation

Participants: Bertrand Jeannet [contact person, coordinator], Peter Schrammel.

The ASOPT (Analyse Statique et OPTimisation) project [january 2009-july 2012] [35] brings together static analysis (Inria-POP ART, VERIMAG, CEA LMeASI), optimisation, and control/game theory experts (CEA LMeASI, Inria-MAXPLUS) around some program verification problems. POP ART is the project coordinator.

Many abstract interpretations attempt to find "good" geometric shapes verifying certain constraints; this not only applies to purely numerical abstractions (for numerical program variables), but also to abstractions of data structures (arrays and more complex shapes). This problem can often be addressed by optimisation techniques, opening the possibility of exploiting advanced techniques from mathematical programming.

The purpose of ASOPT is to develop new abstract domains and new resolution techniques for embedded control programs, and in the longer run, for numerical simulation programs.

The main results are 1. improved *numerical abstract domains* (in particular the MaxPLus polyhedra and zonotopes-based abstract domains), and their combination with finite-types domains (using BDDs); 2. new *symbolic domains*, in particular for the accurate analysis of aliased expressions in data-structures and for precise interprocedural analysis in the presence of pointers to the call-stack; 3. improved *equation solving techniques*, with the generalization of the *policy iteration* approach and the widening of its applicability; 4. precise abstractions of full blocks of code, based either on quantifier elimination or on abstract acceleration.

Most of these contributions have been integrated into either the FIXPOINT library or the APRON/BDDAPRON libraries and they can be experimented on-line or off-line with the INTERPROC analyzer (see Section 5.5.5), which was the common experimental platform of the project.

8.1.2.2. ANR Vedecy: Verification and Design of Cyber-physical Systems

Participants: Gregor Goessler [contact person], Bertrand Jeannet, Sebti Mouelhi.

---

[35]http://asopt.inrialpes.fr/index.php

The VEDECY project brings together hybrid systems and formal methods experts. Three partners are involved: Laboratoire Jean Kuntzmann (LJK), Inria POP ART, and VERIMAG.

VEDECY aims at pursuing fundamental research towards the development of algorithmic approaches to the verification and design of cyber-physical systems. Cyber-physical systems result from the integration of computations with physical processes: embedded computers control physical processes which in return affect computations through feedback loops. They are ubiquitous in current technology and their impact on lives of citizens is meant to grow in the future (autonomous vehicles, robotic surgery, energy efficient buildings, ...).

Cyber-physical systems applications are often safety critical and therefore reliability is a major requirement. To provide assurance of reliability, model based approaches and formal methods are appealing. Models of cyber-physical systems are heterogeneous by nature: discrete dynamic systems for computations and continuous differential equations for physical processes. The theory of hybrid systems offers a sound modeling framework for cyber-physical systems. The purpose of VEDECY is to develop hybrid systems techniques for the verification and the design of cyber-physical systems.

8.2. International Initiatives

8.2.1. Inria Associate Teams

8.2.1.1. AFMES

Title: Advanced Formal Methods for Embedded Systems

Inria principal investigator: Alain Girault

International Partner (Institution - Laboratory - Researcher):

University of Auckland (New Zealand) - Department of Electrical and Computer Engineering

Duration: 2010 - 2012

See also: http://pop-art.inrialpes.fr/~girault/Projets/Afmes/

Embedded systems are characterized by several constraints, such as determinism and bounded reaction time. Accordingly, design methods for embedded systems should, when possible, guarantee these properties by construction. This allows the shifting of the burden of checking these constraints from the programmer to the design method and the associated compilers and code generation tools. In order to achieve this, our goal is to improve the existing design methods in several key directions: (1) Incremental converter synthesis. (2) Programming language for adaptive computing (SystemJ and beyond) [15]. (3) Time predictable programming language and execution architectures [10], [12]. Together, these advanced methods will provide a higher level of safety in the design of embedded systems.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Aditya Zutshi, PhD student at the University of Colorado Boulder (USA), visited POP ART from July to August 2012 and worked on the abstract acceleration of general linear loops with inputs.
- Partha Roop, Senior Lecturer at the University of Auckland (New Zealand) visited POP ART in March 2012 to work on the AFMES associated team.
- Eugene Yip, PhD student at the University of Auckland (New Zealand) visited POP ART from October to December 2012 to work on the AFMES associated team.

8.3.2. Visits to International Teams

- Bertrand Jeannet and Peter Schrammel visited the University of Colorado Boulder (USA) in February 2012 from the 3th to the 21th.
- Alain Girault visited the University of Auckland (New Zealand) to work on the AFMES Associated Team.
- Alain Girault visited the University of California Berkeley (USA) in August 2012 to work on time predictable programming languages and on parametric dataflow models of computation.

PROSECCO Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. ProSe

Title: ProSe: Security protocols : formal model, computational model, and implementations (ANR VERSO 2010.)

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.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. CRYSP

Title: CRYSP: A Novel Framework for Collaboratively Building Cryptographically Secure Programs and their Proofs

Type: IDEAS ()

Instrument: ERC Starting Grant (Starting)

Duration: November 2010 - October 2015

Coordinator: Karthikeyan Bhargavan, Inria (France)

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.

8.3. International Initiatives

8.3.1. Inria International Partners

- We work closely with Microsoft Research in Cambridge, Redmond, and Bangalore (C. Fournet, N. Swamy, P. Naldurg)
- We work closely with University of Venice, Italy (R. Foccardi).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Michael May (Faculty Lecturer, Kinneret College on the Sea of Galilee, Israel) visited us for three months as professeur invité.

- Sergio Maffeis (Imperial College, London) visited us as part of an ongoing collaboration.

8.4.1.1. Internships

- Jean Karim Zinzindohoue did his M1 stage with Karthikeyan Bhargavan. He won the "Prix du stage de recherche dit prix d'option" for his work on "Tracking Cryptographically Masked Flows in Android Applications"

- Antoine Delignat-Lavaud did his M2 stage with Karthikeyan Bhargavan on "Security Types for Web Applications"

- Chetan Bansal did a Master's stage with Karthikeyan Bhargavan on "Analysis and Verification of Security for Web Applications"

- Avinash Thummala did a Master's stage with Karthikeyan Bhargavan on "Verifying JavaCard Applets"

- Sneha Popley did a PhD summer internship with Karthikeyan Bhargavan on "Verifying Cryptographic Applications in Java"

8.4.2. Visits to International Teams

- Visits to Imperial College, London: Karthikeyan Bhargavan, Antoine Delignat-Lavaud, Chetan Bansal

- Visits to Microsoft Research, Cambridge: Karthikeyan Bhargavan, Alfredo Pironti

- Visits to University of Birmingham: Ben Smyth, Miriam Paiola

<p style="text-align:center; color:red">**S4 Project-Team**</p>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *Synchronics: Language Platform for Embedded System Design*

Participants: Albert Benveniste, Benoît Caillaud.

Large scale initiative funded by INRIA. *http://synchronics.inria.fr/*

This project, started Jan 1st 2008, is supported by INRIA. It capitalizes on recent extensions of data-flow synchronous languages (mode automata, Lucid Synchrone, Signal, Lustre, ReactiveML, relaxed forms of synchronous composition or compilation techniques for various platforms). We aim to address the main challenges of embedded system design, starting from a single, semantically well founded programming language.

Our contributions to Synchronics in 2012 are:
- A journal paper [10] presenting the non-standard semantics for hybrid systems and its applications to the semantics and compilation of hybrid modeling languages. Details can be found in Section 6.2 .
- Inputs to the latest evolution of the Modelica language, related to state machines and a clock calculus.
- A study of modular code generation techniques for reactive synchronous programming languages, based on an interface theoretic approach [15], [26]. See 6.3 for further details.

7.2. European Initiatives

7.2.1. *Collaborations in European Programs, except FP7*

Program: ITEA 2

Project acronym: MODRIO

Project title: Model driven Physical Systems Operation

Duration: Sep 2012 - Aug 2015

Coordinator: EDF (France)

Other partners:ABB (Sweden and Germany), AIT (Austria), Ampère - INSA Lyon and CNRS (France), Bielefeld university (Germany), Dassault Aviation (France), DLR (Germany), DPS (France), Dassault Systèmes (France), EADS (France), Enicon (Austria), Equa Simulation (Sweden), IFPEN (France), Ilmenau university (Germany), ITI (Germany), KUL (Belgium), Knorr-Bremse (Germany), Linköping university (Sweden), LMS Imagine (France and Belgium), MathCore Engineering (Sweden), Modelon AB (Sweden), Pöyry Finland Oy (Finland), QTronic (Germany), Scania (Sweden), Semantum Oy (Finland), Sherpa Engineering (France), Siemens AG (Germany), Siemens Industrial Turbomachinery AB (Sweden), Simpack AG (Germany), Supméca (France), Triphase (Belgium), University of Calabria (Italy), Vattenfall (Sweden), VTT (Finland), Wapice Ltd. (Finland).

Abstract: MODRIO seeks solutions to support adoption of model-based systems engineering in the design of mechatronic systems. The project covers all phases of the development cycle - from early concept design, over detailed system design, to verification and validation - and operational use including diagnostics during the entire system's life cycle.

7.3. International Initiatives

7.3.1. *Participation In International Programs*

Eric Badouel is contributing to the ALOCO research project of the LIRIMA, on component-based software architectures (http://www.lirima.uninet.cm/index.php/component/content/article?id=2).

7.4. International Research Visitors

7.4.1. Internships

Hela GOMRI (from Mar 2012 until Sep 2012)

Subject: Systèmes collaboratifs à l'aide de documents actifs.

Institution: Ecole Nationale d'Ingénieurs de Tunis (Tunisia)

SECRET Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- **ANR DEMOTIS** (02/09 → 02/12)
  Collaborative Analysis, Evaluation and Modelling of Health Information Technology
  http://www.demotis.org/
  ANR program: ARPEGE (Systèmes Embarques et Grandes Infrastructures)
  Partners: Sopinspace, Inria (project-teams SECRET and SMIS), CNRS/CECOJI
  55 kEuros.
  DEMOTIS brings together computer scientists and legal scholars. The project experiments new methods for the multidisciplinary design of large information systems that have to take in account legal, social and technical constraints. Its main field of application is personal health information systems. Most notably, work is conducted in priority on the infrastructure for the French personal medical file system (DMP) and secondarily on the data infrastructure for the research and public health networks associated with specific diseases (AIDS, cancer). The aim is to understand how the intrication between the legal and technical domains affects the design of such data infrastructures.

- **ANR SAPHIR-2** (03/09 → 03/13)
  Security and Analysis of Primitives of Hashing Innovatory and Recent 2
  http://www.saphir2.fr/
  ANR program: VERSO (Reseaux du Futur et Services)
  Partners: France Telecom, Gemalto, Cryptolog international, EADS SN, Sagem Securite, ENS/LIENS, UVSQ/PRISM, Inria (project-team SECRET), ANSSI
  153 kEuros
  This industrial research project aims at participating to the NIST competition (cryptanalysis, implementations, optimizations, etc.), and in supporting the SHA-3 candidates proposed by its partners.

- **ANR COCQ** (01/09 → 07/12)
  Codes correcteurs quantiques
  http://www-roc.inria.fr/secret/Jean-Pierre.Tillich/COCQ.html
  ANR program: Domaines emergents
  Partners: ENSEA, Inria (project-team SECRET), Université de Bordeaux, Telecom ParisTech
  117 kEuros
  This project deals with the development of fundamental research on error correcting codes for quantum channels. In particular, we aim to suggest suitable generalizations to the quantum setting of the best known families of quantum codes (such as LDPC or turbo-codes) and to analyze their performance.

- **ANR BLOC** (10/11 → 09/15)
  Conception et analyse de chiffrements par blocs efficaces pour les environnements contraints
  ANR program: Ingénierie numérique et sécurité
  Partners: INSA Lyon, Inria (project-team SECRET), University of Limoges (XLIM), CryptoExperts
  446 kEuros
  The BLOC project aims at providing strong theoretical and practical results in the domain of cryptanalyses 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, UVSQ (Prism), 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.

7.1.2. Others

- **French Ministry of Defense** (01/11 → 12/13)
  Funding for the supervision of Marion Bellard's PhD.
  30 kEuros.

- **French Ministry of Defense** (10/12 → 09/15)
  Funding for the supervision of Audrey Tixier's PhD.
  30 kEuros.

- **DGA-MI** (12/11 → 02/13)
  Analysis of binary streams.
  20 kEuros.

7.2. European Initiatives

Associate member of the ECRYPT II European network of excellence (08/08 → 07/12) http://www.ecrypt.eu.org/

7.2.1. Collaborations with Major European Organizations

Otto-von-Guericke Universität Magdeburg, Institut für Algebra und Geometrie (Germany)
Study of Boolean functions for cryptographic applications
DTU - Danmarks Tekniske Universitet, Department of Mathematics
Symmetric crytography and code-based cryptography

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- Gohar Kyureghyan, Otto-von-Guericke Universität Magdeburg, Germany, from October 2011 to June 2012
- Davide Schipani, Universität Zurich, Switzerland, February 13-17
- Sergey Abrahamyan, Institute for Informatics and Automation Problems, Yerevan, Armenia, May 20-26
- Yves Edel, Gent University, Belgium, June 3-9
- Christiane Peters, DTU, Denmark, November 19-23
- Stefan Heyse, Ingo von Maurich and Ralf Zimmermann, Ruhr-Universität Bochum, Germany, November 19-23
- Grigory Kabatyanskiy, IPIT, Moscow, Russia, December 17-21 .

7.3.2. Visits to International Teams

- DTU-Mathematics, Denmark Technical University, Denmark, January-August, 8-month sabbatical stay funded by the DGA (A. Canteaut).
- School of Informatics, University of Edinburgh, Scotland, December 3-6, invitation to the *Quantum Security Meeting*, and visit of Elham Kashefi's group (A. Leverrier).

<p style="text-align:center;color:red;font-weight:bold;">SECSI Project-Team</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

- DIM Digiteo project RedPill: Malware Detection on Virtualized Architectures, Oct. 2009-Sept. 2012. Sole partner: LSV. Funds Hedi Benzina's PhD Thesis.

- DIM Digiteo project API: Automated Proofs of Indistinguishability, 2010-2013. Partners: EPI SECSI, EPI CASCADE. Oct. 2010-Sept. 2013. Funds Vincent Cheval's PhD Thesis.

7.2. National Initiatives

7.2.1. ANR

- ANR programme blanc CPP ("Confidence, Probability, and Proofs"), 2009-2012. Partners: LSV (scientific leader), CEA LIST (co-leader), Inria (Comète, Parsifal), Ecole Supérieure d'Electricité (L2S, SSE). External partners: Safran, Dassault Systèmes.

    In the context of proofs of safety properties for critical software, The CPP project proposes to study the joint use of probabilistic and formal (deterministic) semantics and analysis methods, in a way to improve the applicability and precision of static analysis methods on numerical programs. See http://www.lix.polytechnique.fr/~bouissou/cpp/index.php.

- ANR SeSur ("Sécurité et Sûreté Informatique") project AVOTÉ, 2008-2012. Partners: Inria (Cassis, leader), LSV, Verimag and, until September 2009 France Télécom R&D.

    Electronic voting promises the possibility of a convenient, efficient and secure facility for recording and tallying votes. However, the convenience of electronic elections comes with a risk of large-scale fraud and their security has seriously been questioned. The AVOTÉ project aims at proposing formal methods to analyze electronic voting protocols. See http://www.lsv.ens-cachan.fr/anr-avote/.

- ANR VERSO program ProSe ("Proofs of Security"), 2010-2014. Partners: Inria (Cascade, leader; Cassis), LSV, Verimag.

    The goal of the ProSe 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; and the *implementation* level: the program itself. This project is a continuation of the FormaCrypt project. See https://crypto.di.ens.fr/projects:prose:main.

- ANR JCJC project VIP, 2012-2015. Awarded to Stéphanie Delaune.

    The aim of this project is to formally analyze modern applications in which privacy plays an important role. Many applications having an important societal impact are concerned by privacy, e.g. electronic voting, electronic auction protocols, RFID tags, safety critical application in vehicular ad hoc networks, routing protocols in mobile ad hoc networks, etc. Moreover, each application comes with its own specificities. E.g. e-voting protocols often rely on complex cryptographic primitives, some routing protocols rely on recursive tests, and so on. In mobile ad hoc networks, taking into account mobility issues is also an important challenge.

    Because security protocols are notoriously difficult to design and analyse, formal verification techniques are extremely important. However, nearly all studies focus on trace-based security properties, and thus to not allow one to analyse privacy-type properties that play an important role in many modern applications. Moreover, the envisioned applications have some specificities that prevent them to be modelled in an accurate way with existing verification tools.

The goal of this project is to design verification algorithms to analyse privacy-type properties on several applications having an important societal impact. The project is accompanied by an effort in case studies and application domains which will allow at the end of the project an assessment of the pragmatic potential both in terms of modelling and effective analysis. More details are available on the web page of the project: http://www.lsv.ens-cachan.fr/Projects/anr-vip/.

7.3. International Initiatives

7.3.1. Participation In International Programs

- Inria Project Lab CAPPRIS (Collaborative Action on the Protection of Privacy Rights in the Information Society). Member: Stéphanie Delaune.

The goal of CAPPRIS is to provide solutions to enhance the privacy protection in the Information Society. The tageted applications are Online Social Networks, Location Based Services, and Electronic Health Record Systems.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Myrto Arapinis, April 2012 (1 week) and in December 2012 (1 week).
- Alwen Tiu, December 2012 (1 week).

7.4.1.1. Internships

Umang MATHUR (from May 2012 until Jul 2012)

　　　　Subject: Estimating the information leakage of a recursive probabilistic program

　　　　Institution: IIT Bombay (India)

TASC Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

1. The goal of Ligéro is to create an internationally visible regional research group putting together the key actors in the domain of Operations Research in the Pays de la Loire region.
2. A regional grant from the Région Pays de la Loire for inviting in Nantes a senior researcher was obtained end of 2012 (6 months in 2013 and 2014 for Helmut Simonis) on *learning generic constraint models*.

8.2. National Initiatives

1. Cooperation with J.-C. Régin from Univ. Nice on efficient graph filtering algorithms.
2. Cooperation with A. Miné from ENS Paris on abstract domains by M. Pelleau and C. Truchet.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

SICS, Computer Systems Laboratory (Sweden)
Global Contraint Catalog, scalable global constraints.
4C, (Ireland)
Learning constraint models.
Uppsala University, (Sweden)
Automata and constraints.

8.4. International Initiatives

8.4.1. Inria International Partners

- SICS, Sweden: Work on the *global constraint catalog* and on *scalable constraints* with Mats Carlsson.
- Uppsala University, Sweden: Work on automata and dedicated filtering algorithms for some constraint patterns with the ASTRA group of Pierre Flener.
- École Polytechnique de Montreal, Canada: Work on graph constraints with Louis Martin Rousseau.
- JFLI, Japan: Work with Philippe Codognet.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Helmut Simonis (4C): work on model learning and work on learning constraints in the context of EDF, one month.

8.5.1.1. Internships

- Naina Razakarison (internship of ENS Cachan in summer 2012 on learning generic models).
- Mohamed Kebe (internship of Clermont University in summer 2012 on reformulations of the *cumulative* constraint).

8.5.2. Visits to International Teams

- N. Beldiceanu, 4C Cork Ireland: work on *learning generic models* and work on *learning constraints in the context of EDF* with H. Simonis.
- N. Beldiceanu, Uppsala University and SICS: work on *automata and constraints* with P. Flener and J. Pearson and on *learning generic models* with M. Carlsson.

TOCCATA Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Hisseo*

Participants: Sylvie Boldo [contact], Claude Marché, Guillaume Melquiond, Thi-Minh-Tuyen Nguyen.

Hisseo is a 3 and half year Digiteo project that started in September 2008 and ended in June 2012. http://hisseo.saclay.inria.fr

The Hisseo project focuses on the problems related to the treatment of floating-point computations in the compilation process, especially in the case of the compilation of critical C code [12], [46].

Partners: CEA List (Saclay), Inria Paris-Rocquencourt (Team Gallium).

8.1.2. *Coquelicot*

Participants: Sylvie Boldo [contact], Catherine Lelay, Guillaume Melquiond.

Coquelicot is a 3 years 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 [30], [22]. This is sorely needed to ease the verification of numerical applications, especially those involving advanced mathematics.

Partners: LIX (Palaiseau), University Paris 13

8.1.3. *Pactole*

Participants: Évelyne Contejean [contact], Jean-Christophe Filliâtre.

Pactole is a 3 year Digiteo project which started in October 2009.

The Pactole project focuses on automation and formal verification for ubiquitous, large scale environments. Tasks include proof automation techniques for distributed systems, verification conditions for fault tolerant distributed systems, specification and design of fundamental services for mobile sensor networks. The principal investigator of Pactole is Xavier Urbain.

Partners: CÉDRIC (CNAM/ENSIIE), LIP6 (UPMC).

8.2. National Initiatives

8.2.1. *ANR BWare*

Participants: Sylvain Conchon, Évelyne Contejean, Jean-Christophe Filliâtre, Andrei Paskevich, Claude Marché.

This is a research project funded by the programme "Ingénierie Numérique & Sécurité" of the ANR. It is funded for a period of 4 years and started on September 1, 2012. http://bware.lri.fr.

It 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. 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 [29]. 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) ; Inria teams Gallium, Deducteam and Asap ; Mitsubishi Electric R&D Centre Europe, the ClearSy company that mdevelop and maintains *Atelier B* and the OCamlPro start-up.

8.2.2. *ANR DECERT*

Participants: Sylvain Conchon, Évelyne Contejean.

DECERT (DEduction and CERTification) is an ANR "Domaines Emergents" project. It started on January 2009 for 3 years; the coordinator is Thomas Jensen from the Lande team of IRISA/Inria Rennes.

The goal of the project DECERT is to design and implement new efficient cooperating decision procedures (in particular for fragments of arithmetics), to standardize output interfaces based on certificates proof objects and to integrate SMT provers with skeptical proof assistants and larger verification contexts such as the Rodin tool for B and the Frama-C/Jessie tool chain for verifying C programs.

The partners are: CEA List, LORIA/Inria Nancy - Grand Est, IRISA/Inria Rennes - Bretagne Atlantique, Inria Sophia Antipolis - Méditerranée, Systerel

8.2.3. *ANR FOST*

Participants: Sylvie Boldo [contact], Jean-Christophe Filliâtre, Guillaume Melquiond.

FOST (Formal prOofs of Scientific compuTation programs) is a 3 years ANR "Blanc" project started in January 2009 and ended in April 2012. S. Boldo is the principal investigator of this project. http://fost.saclay. inria.fr

The FOST project follows CerPAN's footprints as it aims at developing new methods to bound the global error of a numerical program. These methods will be very generic in order to prove a large range of numerical analysis programs. Moreover, FOST aims at providing reusable methods that are understandable by non-specialists of formal methods.

Partners: University Paris 13, Inria Paris - Rocquencourt (Estime).

8.2.4. *ANR U3CAT*

Participants: Jean-Christophe Filliâtre, Claude Marché [contact], Guillaume Melquiond, Asma Tafat, Paolo Herms.

U3CAT (Unification of Critical C Code Analysis Techniques) is a project funded by ANR within its programme "Systèmes Embarqués et Grandes Infrastructures - ARPEGE". It aims at verification techniques of C programs, and is partly a follow-up of the former CAT project. It started in January 2009 and ended in August 2012.

The main goal of the project is to integrate various analysis techniques in a single framework, and make them cooperate in a sound way. We address the following general issues:

- Verification techniques for floating-point programs;
- Specification and verification of dynamic or temporal properties;
- Combination of static analysis techniques;
- Management of verification sessions and activities;
- Certification of the tools chains for compilation and for verification.

Partners: CEA-List (Saclay, project leader), Lande team (Inria Rennes), Gallium team (Inria Rocquencourt), Dassault Aviation (Saint-Cloud), Airbus France (Toulouse), ATOS Origin (Toulouse), CNAM Cedric laboratory (Evry), CS Communication & Systems (Toulouse), Hispano-Suiza/Safran (Moissy-Cramayel).

8.2.5. *ANR Verasco*

Participants: Guillaume Melquiond [contact], Sylvie Boldo, Arthur Charguéraud, Claude Marché.

This is a research project funded by the programme "Ingénierie Numérique & Sécurité" of the ANR. It is funded for a period of 4 years and started on January 1st, 2012. 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).

8.2.6. *Systematic: Hi-Lite*

Participants: Claude Marché [contact], Jean-Christophe Filliâtre, Sylvain Conchon, Évelyne Contejean, Andrei Paskevich, Alain Mebsout, Mohamed Iguernelala, Denis Cousineau.

The Hi-Lite project (http://www.open-do.org/projects/hi-lite/) is a project in the SYSTEMATIC Paris Region French cluster in complex systems design and management http://www.systematic-paris-region.org.

Hi-Lite is a project aiming at popularizing formal methods for the development of high-integrity software. It targets ease of adoption through a loose integration of formal proofs with testing and static analysis, that allows combining techniques around a common expression of specifications. Its technical focus is on modularity, that allows a divide-and-conquer approach to large software systems, as well as an early adoption by all programmers in the software life cycle.

Our involvements in that project include the use of the Alt-Ergo prover as back-end to already existing tools for SPARK/ADA, and the design of a verification chain for an extended SPARK/ADA language to verification conditions, via the *Why* VC generator.

This project is funded by the french ministry of industry (FUI), the Île-de-France region and the Essonne general council for 36 months from September 2010.

8.3. European Initiatives

8.3.1. *Collaborations in European Programs, except FP7*

8.3.1.1. *FoVeOOS*

Participants: Claude Marché [contact], François Bobot, Asma Tafat.

Program: COST (European Cooperation in the field of Scientific and Technical Research, http://www.cost.esf.org/)

Project acronym: FoVeOOS (IC-0701, http://www.cost-ic0701.org/)

Project title: Formal Verification of Object-Oriented Software

Duration: May 2008 - April 2012

Coordinator: B. Beckert, University Karlsruhe, Germany

Other partners: 40 academic groups among 18 countries in Belgium, Denmark, Estonia, France, Germany, Ireland, Israel, Italy, The Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and United Kingdom.

Abstract: The aim of this action is to develop verification technology with the reach and power to assure dependability of object-oriented programs on industrial scale.

8.4. International Initiatives

8.4.1. Participation In International Programs

- C. Paulin is the representative of Univ. Paris-Sud for the education part of the EIT KIC ICT Labs. She contributed to the proposition of two master programs as well as the action on weaving Innovation and Entrepreneurship in Doctoral programs and the preparation of the Summer School "Imagine the future in ICT".

8.4.2. Other International Partners

- S. Conchon has continued his collaboration with S. Krstic and A. Goel (Intel Strategic Cad Labs in Hillsboro, OR, USA) on the development of the Cubicle SMT-based model checker [24].
- J.-C. Filliâtre has collaboration with University do Minho (Braga, Portugal) on the use of *Why* as intermediate for verification of cryptographic programs [13].
- J.-C. Filliâtre has collaboration with Universidade da Beira Interior (Covilhã, Portugal) on the use of *Why* as intermediate for verification of ARM programs [34].
- Our on-going development of a verified JavaScript interpreter, described above, is an active collaboration with people from Imperial College, London, UK.

8.5. International Research Visitors

8.5.1. Visits to International Teams

- S. Conchon visited Intel Strategic Cad Labs during summer 2012.
- J.C. Filliâtre visited SRI (Menlo Park, California, USA) during summer 2012.

<h1 style="text-align:center;color:red;">TRIO Project-Team</h1>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Open-PEOPLE - Open Power and Energy Optimization PLatform and Estimator

Participants: Fabrice Vergnaud, Jérôme Vatrinet, Kévin Roussel, Olivier Zendra.

Open-PEOPLE initially gathers 5 partners from academia and 2 from industry. This project aims at providing a federative and open platform for the estimation and optimization of power and energy consumption in computer systems. The platform users will be able to evaluate application consumption on a hardware architecture chosen among a set of provided typical, parametric architectures. In the considered system, the components will be picked from a library of hardware and software components, be they parametric or not. It will be possible to perform the estimation at various stages of the specification refinement, thanks to a methodology based on multi-level, interoperable and exchangeable consumption models allowing an easy exploration of the design space. Thus, estimations results may be used to check the energy behaviour of a system developed with simulation platforms. Feedback about the application functional properties will allow further refining of the estimation results in Open-PEOPLE. A standardisation of consumption models will be proposed in order to allow interoperability and have easier exchanges with other platforms. The Open-PEOPLE library of consumption models will be extensible: new component models will be added as the user applicative requirements evolve and as implementation techniques progress. To do so, the software estimation platform that will be accessible via an Internet portal shall be linked to a hardware platform made of an automated measurement testbench, which will be controllable from the software platform. A standalone version will also be provided to meet the confidentiality requirements of industry. A library of applications benchmarks will be proposed to characterize new components and new architectures. In addition to the research work required to build methods for multi-level estimation in heterogeneous complex systems, research work shall be carried on in order to offer new methods and techniques making it possible to optimize consumption thanks to the results provided by Open-PEOPLE. Open-PEOPLE is hence geared towards academia to support research work pertaining to consumption estimation and optimization methods, as well as towards industry to estimate or optimize the consumption of future products.

This project ended in late 2012, and we hope to continue work in this direction through other subsequent projects.

8.1.2. BGLE DEPARTS

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

The project DEPARTS started on October 1st for five next years. This project is funded by the national funding program BGLE. TRIO team will propose solutions for probabilistic component-based models.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. PROARTIS

        Title: ___PROARTIS___
        Type: COOPERATION (ICT)
        Defi: Embedded Systems Design
        Instrument: Specific Targeted Research Project (STREP)
        Duration: February 2010 - July 2013
        Coordinator: Barcelona Supercomputong Center (Spain)
        See also: ___http://www.proartis-project.eu/___

Participants: Liliana Cucu-Grosjean, Adriana Gogonel, Luca Santinelli, Codé Lo, Dorin Maxim.

TRIO team participates to PROARTIS which is a STREP project within the FP7 call and it started on February 2010. It has six partners: Barcelona Supercomputing, University of York, University of Padova, Inria and Airbus. The overarching objective of the PROARTIS project is to facilitate a probabilistic approach to timing analysis. The proposed approach will concentrate on proving that pathological timing cases can only arise with negligible probability, instead of struggling to eradicate them, which is arguably not possible and could severely degrade performance. This will be a major turn from previous approaches that seek analyzability by trying to predict with cycle accuracy the state of hardware and software through analysis.

The PROARTIS project will facilitate the production of analysable CRTE systems on advanced hardware platforms with features such as memory hierarchies and multi core processors.

8.2.1.2. TIMMO-2-USE

Participants: Liliana Cucu-Grosjean, Aurélien Monot, Nicolas Navet, Françoise Simonot-Lion, Ammar Oulamara, Luca Santinelli, Dominique Bertrand, Cristian Maxim.

TRIO team participated to TIMMO-2-USE (http://timmo-2-use.org/) is an ITEA 2 European project. It started in November 2010 and ended in September 2012. TIMMO-2-USE addresses the specification, transition and exchange of different types of timing information throughout different steps of the development process. The general goal is to evaluate and enhance standards for different applications in the development by different technical use cases covering multiple abstraction levels and tools. For this, TIMMO-2-USE will bring the AUTOSAR standard, TADL and EAST-ADL2 into different applications like WCET analysis and in-the-loop scenarios. This will bring new algorithms and tools for the transition and conversion of timing information between different tools and abstraction level based on a new advanced methodology which, in turn, will be based on a combination of the TIMMO and the ATESST2 methodologies.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. European Network of Excellence (NOE) High Performance Embedded Architectures and Compilation (HiPEAC)
Participant: Olivier Zendra.

The TRIO team is involved in the HiPEAC (High Performance Embedded Architecture and Compilation) European Network of Excellence (NoE). Olivier Zendra was initiator and leader in this context of a cluster of European Researchers "Architecture-aware compiler solutions for energy issues in embedded systems" from mid-2007 to mid-2009. A STREP proposal tentatively titled "RuSH2LEAP: Runtime Software-Hardware interactions to Lower Energy And Power"is currently being written, mostly in the context of this network of excellence, for submission in Call ICT 2013.10, challenge 3.4 Advanced computing, embedded and control systems.

8.2.3. Collaborations with Major European Organizations

Partner 1: University of York (U.K.)

Sujet 1: probabilistic and statistical analysis of real-time systems

Partner 2: Malardelan University (Sweden)

Sujet 2: statistical analysis of real-time systems

Partner 3: University of Edinburgh (U.K.)

Sujet 3: energy modeling and optimisation of computing systems

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Rob Davis, University of York
- Marko Bertogna, University of Modena

8.3.2. Visits to International Teams

Luca Santinelli visited University of York and Rapita, York for one month in April 2012.

<p style="text-align:center">TYPICAL Project-Team</p>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. 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. Participants: A. Mahboubi, E. Tassi.
Website: http://paral-itp.lri.fr/.

7.1.1.2. Psi (ANR-09-JCJC-0006)

Goal: Investigate the theory and the implementation of proof-search methods in the context of specific theories. This project aims at understanding how to combine state-of-the-art proof-theoretic generic methods (DPLL, focusing, ...) with efficient automated-reasoning methods for well-identified theories (linear arithmetic, ...).
Leader: S. Lengrand (CNRS, LiX). Participant: A. Mahboubi.
Website: http://www.lix.polytechnique.fr/~lengrand/PSI/.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. FORMATH

Title: Formath

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: March 2010 - February 2013

Coordinator: Univ Götegorg (Sweden)

Others partners: Radboud University Nijmegen, (the Netherlands), University of La Rioja, (Spain).

See also: http://wiki.portal.chalmers.se/cse/pmwiki.php/ForMath/ForMath

Abstract: The objective of this project is to develop libraries of formalised mathematics concerning algebra, linear algebra, real number computation, and algebraic topology. The libraries that we plan to develop in this proposal are especially chosen to have long-term applications in areas where software interacts with the physical world. The main originality of the work is to structure these libraries as a software development, relying on a basis that has already shown its power in the formal proof of the four-colour theorem, and to address topics that were mostly left untouched by previous research in formal proof or formal methods.

<div align="center">**VEGAS Project-Team**</div>

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

The ANR blanc 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 (VEGAS).

6.2. International Research Visitors

6.2.1. *Visits of International Scientists*

William J. Lenhart, Williams College (USA), one year sabbatical until July 2012.

Boris Aronov, from NYU-Poly, visited the VEGAS project for 2 weeks in October.

Martin Tancer, Pavel Paták and Zuzana Safernová, from Charles Univ. in Prague, visited the VEGAS project for 1 week in August.

Hyo-Sil Kim (postdoc at POSTECH, South Korea) and Jae-Soon Ha (PhD student at KAIST, South Korea) visited the VEGAS project for 2 weeks in February.

<p style="text-align:center; color:red; font-weight:bold;">VERIDIS Project-Team</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

Participants: Pascal Fontaine, Stephan Merz.

The DeCert (Deduction and Certification) project has been funded by ANR from 2009 to 2012 within its "Domaines émergents" program. It was coordinated by the Celtique project team of Inria Rennes, the other partners are academic teams from Inria Saclay (Proval) and Inria Sophia Antipolis (Marelle) as well as the CEA and the Systerel company. In Nancy, the project also involves members of the Cassis team, in particular Alain Giorgetti and Christophe Ringeissen.

The objective of the project has been to study certified decision procedures, including the design of appropriate certificates, the development of new certifying decision procedures, their combination, their integration with skeptical proof assistants such as Coq or Isabelle, and their use in application domains such as software verification or static analysis. The main lines of research concern questions of expressiveness vs. efficiency, certificates vs. proof objects, and the integration of certificates into verification environments. Our work within the project is related to veriT (see section 5.1), its proof production, and its integration with verification environments such as Isabelle or the TLA$^+$ proof environments (see section 5.2).

8.1.2. Inria Development Action VeriT

Participants: Pablo Federico Dobal, Pascal Fontaine.

Inria funds this project (started in 2011) for the future 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). Federico Dobal has been 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.

8.2. European Initiatives

8.2.1. Cooperation with TU Wien, Austria

Participants: Pascal Fontaine, Stephan Merz.

This project started in 2012 and fosters bilateral cooperation with the team headed by Prof. Alexander Leitsch at TU Vienna. It focuses on aspects of proof production and proof compression in automated reasoning. It is headed by Bruno Woltzenlogel Paleo of TU Wien, who was formerly a post-doctoral researcher in VeriDis until March 2011, and Pascal Fontaine. The project is funded by the Amadeus Programme of the Partenariat Hubert Curien and the Österreichischer Austausch Dienst.

A first workshop of one week took place in Vienna in spring, and gathered around 15 people, including Pascal Fontaine and Stephan Merz as well as a student from TU Graz. A second one-week workshop was organized in Nancy in the fall, with 12 participants including 5 researchers from Vienna, and one student from Univ. Paul Sabatier, Toulouse. The web page gives more information on this project.

8.3. International Initiatives

8.3.1. Participation In International Programs

8.3.1.1. Cooperation with Córdoba, Argentina
Participants: Pascal Fontaine, Stephan Merz.

This cooperation with the team of Carlos Areces (formerly a researcher at Inria Nancy) at the University of Córdoba is along two axes. First, we study symmetries for automated reasoning (and SMT) as a means to reduce the search space and improve efficiency. Second, we investigate automated reasoning techniques (and more specifically SMT) for modal logics and similar fragments of first-order logic. The cooperation is funded within the context of the IRSES project MEALS coordinated for Inria by Catuscia Palamidessi (Saclay).

Two PhD students from Córdoba visited Inria Nancy in Summer 2012: Ezequiel Orbe for two weeks, and Raul Fervari for one month. Carlos Areces also came to Nancy for two weeks. Pascal Fontaine and Stephan Merz visited Argentina in November where they spent two weeks in Córdoba working on the above subjects, and one week visiting our contacts at the universities of Rosario and Buenos Aires.

The team has a long term relationship with the Universities of Córdoba, Rosario and Buenos Aires, with frequent exchanges of students. One Internship student in 2012 was from Buenos Aires, and the newly recruited engineer is from Rosario.

8.3.1.2. Cooperation with Universidade Federal do Rio Grande de Norte, Brazil
Participants: David Déharbe, Pablo Federico Dobal, Pascal Fontaine, Stephan Merz.

VeriDis has a close working relationship with a team at Universidade Federal do Rio Grande de Norte (UFRN), Brazil, and more particularly with Prof. David Déharbe. David Déharbe visited VeriDis in July and October. Pascal Fontaine is scheduled to visit Natal in early 2013. The project is centered around the development and applications of the veriT solver (section 5.1), of which David Déharbe and Pascal Fontaine are the main developers. Our cooperation is also supported by the Inria-CNPq project SMT-SAVeS from 2010 throughout early 2013.

8.3.1.3. Cooperation with Tiaret University
Participants: Dominique Méry, Stephan Merz.

Mostapha Belardi (Université Ibn Khaldoun de Tiaret), Camel Tanougast (LICM, Université de Lorraine), Dominique Méry and Stephan Merz have started a joint project entitled *CIPRONoC : Conception Incrémentale Prouvée pour pROtotypage rapide de NoC Tolérant aux Fautes à base de technologie FPGA*. The project is sponsored by the STIC Algérie program, which funded a visit of Mostapha Belardi and an internship of Hayat Daoud in 2012. The work led to the design of a model for a network on chip proposed by our partners from LICM. A short presentation has been published in a local workshop.

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

David Déharbe from Universidade Federal do Rio Grande de Norte, Brazil, visited VeriDis from July 9 to July 27 and from October 15 to October 26 in the context of the Inria-CNPq project SMT-SAVeS. The work resulted in several improvements of the veriT solver.

Thomas Sturm, from MPI für Informatik, and Ulrich Loup and Florian Corzilius, from RWTH Aachen, visited VeriDis from October 22nd to 26th, in the context of the ADT veriT for discussing techniques for non-linear arithmetic in SMT solving.

8.4.2. *International Internships*

- Rodrigo Castaño (from Sep 2012 until Dec 2012)
    - Subject: Methods for efficient SMT solving
    - Institution: University of Buenos Aires (Argentina)

VERTECS Project-Team

7. Partnerships and Cooperations

7.1. National initiatives

7.1.1. *ANR VACSIM: Validation of critical control-command systems by coupling simulation and formal analysis*

Participants: Nathalie Bertrand, Thierry Jéron, Hervé Marchand.

The Vacsim project (2011-2014) is a 3-year project with EDF R&D, Dassault Systèmes, LURPA Cachan, I3S Nice and Labri Bordeaux. The project aims at developping both methodological and formal contributions for the simulation and validation of control-command systems. The role of the Vertecs team will be to contribute to the advance of validation techniques for timed systems, including quantitative analysis and its application to testing, monitoring of timed systems, and verification of communicating timed automata. The VACSIM project funds the PhD thesis of Srinivas Pinisetty.

7.1.2. *ANR Ctrl-Green (Autonomic management of green data centers)*

Participant: Hervé Marchand.

The project Ctrl-Green (2011-2014) is a 3-year project with UJF/LIG, INPT/IRIT, Inria, 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. The role of the Vertecs team will be to contribute to the development of new controller synthesis methodology for symbolic synchronous systems handling variables and to its application to the autonomic management of data centers.

7.2. European Initiatives

7.2.1. *Artist design network of excellence*

Participants: Nathalie Bertrand, Thierry Jéron, Hervé Marchand.

Program: FP7

Project acronym: Artist Design

Project title: Artist - European Network of Excellence on Embedded System Design

Duration: 01/08 - 03/12

Coordinator: VERIMAG

Abstract: The central objective for ArtistDesign is to build on existing structures and links forged in Artist2, to become a virtual Center of Excellence in Embedded Systems Design. This will be mainly achieved through tight integration between the central players of the European research community. Also, the consortium is smaller, and integrates several new partners. These teams have already established a long-term vision for embedded systems in Europe, which advances the emergence of Embedded Systems as a mature discipline.

The research effort aims at integrating topics, teams, and competencies, grouped into 4 Thematic Clusters: "Modelling and Validation", "Software Synthesis, Code Generation, and Timing Analysis", "Operating Systems and Networks", "Platforms and MPSoC". "Transversal Integration" covering both industrial applications and design issues aims for integration between clusters.

The Vertecs EPI is a partner of the "Validation" activity of the "Modeling and Validation" cluster. This year, the Vertecs EPI has contributed to quantitative verification of timed automata [20], test generation from nondeterministic timed automata [7], and control sysnthesis using abstract interpretation for infinite state systems [12].

7.2.2. Major European Organizations with which the Team has followed Collaborations

Université Libre Bruxelles (Belgium), Prof. Thierry Massart, Testing and control of symbolic transitions systems.

University of Kaiserslautern (Germany), Roland Meyer, Petri nets.

University of Dresden (Germany), Prof. Christel Baier, Probabilistic automata over infinite words.

University of Mons (Belgium), Prof. Thomas Brihaye, Stochastic timed automata.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Laurie Ricker, associate professor at the Mathematics & Computer Science department of Mount Allison University (Canada) has visited Vertecs for 6 months, from January 2012 to June 2012. We collaborate on control of discrete event systems for distributed and decentralized systems.

7.3.2. Visits to International Teams

Nathalie Bertrand spent 9 months at University of Liverpool, from November 1st 2011 to July 31st 2012. Her visit was supported by the Leverhulme Trust and the Sabbatical program of Inria, which also permitted Paulin Fournier to spend 5 months at University of Liverpool for his Master thesis.

ALEA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The project PSI (Psychology and sounds interactions), headed by P. Legrand received a grant by the region Aquitaine for a PhD thesis on "Dimension reduction in supervised learning. Application to the study of brain activity".

8.2. National Initiatives

8.2.1. ANR Propagation (2010-2012)

To combat dramatic event such as happened in Bombay last year (coming from the sea, a terrorist commando killed more than 200 peoples in Bombay city), authorities are decided to deploy efficient sea surveillance system to protect coastal zone including sensitive infrastructures often in vicinity of important cities.

Regulation on frequencies allocation and on coastal constructions is strong constraint to be taken into account to install technical capabilities to permanently survey vulnerable littoral zones. For example, new active sensor shall be frequencies compatible within numerous existing ones in inhabited region. In this context to perform coastal surveillance, attractive solution is to deploy passive sensors networks because:

- Not necessarily compatible within existing active sensors network.
- Provide large possibilities to install the passive sensors, because, it is not needed to be on the shoreline, but can be deployed inside the territory. Such as facility offers more potential sites and then, to optimise the deployment for optimal coverage of the sensitive zone.
- Is totally undetectable by external technical means in hand of structured criminal organisations.

For these objectives, the PROPAGATION project study, develop and experiment a demonstrator to carry out maritime traffic picture from a set of passive sensors: passive radar, AIS and optronic cameras deployed over a coastal site. This is a joint ANR project with DCNS, Thalés and Exavision.

8.2.2. Project PEPII

This is an interdisciplinary exploratory research project, between Institut de Mathématiques de Bordeaux and Laboratory Ecologie & Evolution, UMR 7625 CNRS-UMPC-ENS (responsible: B. Cazelles). The objective of this project on the dynamics of epidemic diseases characterized by multiple strains of pathogens, is to use the competencies of the ALEA team to get efficient Bayesian optimization techniques. An opening workshop on stochastic models and bayesian inference in epidemiology has been organized in Bordeaux in November 2011.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

Partner 1: Oxford University, Department of Statistics (UK)
Interacting particle systems
Bayesian Nonparametrics
Partner 2: Imperial College (UK)
Interacting Particle Systems

8.4. International Research Visitors

8.4.1. Visits of International Scientists

The following researchers visited the Team ALEA during 2012: A. Doucet (Univ. Oxford), C. Holmes (Oxford), N. Whiteley (Univ. Bristol), R. Xu (Univ. of Tech. Sydney), G. Peters (University College London), Pavel V. Shevchenko (CSIRO).

APICS Project-Team

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. Collaborations with Major European Organizations

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

Subject: System identification concerns the construction, estimation and validation of mathematical models of dynamical physical or engineering phenomena from experimental data.

8.2. International Initiatives

8.2.1. Inria International Partners

LMS grant, support of collaborative research with Leeds Univ., U.K., School of Mathematics (no. 41130, 2012).

PHC Utique CMCU, cooperation France-Tunisia (no. 10G 1503, led by Univ. Orléans, MAPMO).

NSF CMG collaborative research grant DMS/0934630, "Imaging magnetization distributions in geological samples", with Vanderbilt University and the MIT (USA).

Cyprus NF grant "Orthogonal polynomials in the complex plane: distribution of zeros, strong asymptotics and shape reconstruction."

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Smain Amari (RMC Ontario).
- Bernard Hanzon (Univ. Cork, External Collaborator).
- Tahar Moumni (Univ. Bizerte, Tunisia).
- Jonathan R. Partington (Univ. Leeds, U.K., External Collaborator).
- Vladimir Peller (Michigan state Univ. at East Lansing)
- Yves Rolain (Vrije Universiteit Brussels).
- Nikos Stylianopoulos (Univ. of Cyprus).

8.3.2. Internships

Shubham KUMAR (from May 2012 until Sep 2012)

     Subject: Mathematical methods for multiplexers study

     Institution: IIT Delhi (India)

Dmitry Ponomarev (from Jun 2012 until Aug 2012)

     Subject: Constrained optimization with prescribed values on the disk

     Pre-doctoral trainee

Rahul PRAKASH (from May 2012 until Sep 2012)

     Subject: Mathematical methods for multiplexers study

     Institution: IIT Delhi (India)

Xuan Zhang (from May 2012 until Sep 2012)

Subject: Groebner basis methods for multiplexers study

Institution: Polytech'Nice

Jie Zhou (from May 2012 until Aug 2012)

Subject: A Hardy-Hodge Decomposition on the 2D Sphere

Institution: Ecole des Mines de Nancy

8.4. External collaborators of the team

The following people are external collaborators of the team:

- Smain Amari [RMC (Royal Military College), Kingston, Canada, since October].
- Ben Hanzon [Univ. Cork, Ireland, since October].
- Mohamed Jaoua [French Univ. of Egypt].
- Jean-Paul Marmorat [Centre de mathématiques appliquées (CMA), École des Mines de Paris].
- Jonathan Partington [Univ. Leeds, UK].
- Edward Saff [Vanderbilt University, Nashville, USA].

ASPI Project-Team

6. Partnerships and Cooperations

6.1. National initiatives

6.1.1. *Ensemble methods for prediction and data assimilation (PREVASSEMBLE) — ANR Conception et Simulation*

Participants: François Le Gland, Valérie Monbet.

See 5.14 .

Inria contract ALLOC 3767 — January 2009 to December 2012.

This ANR project is coordinated by École Normale Supérieure, Paris. The other partner is Météo–France. This is a collaboration with Étienne Mémin and Anne Cuzol (Inria Rennes Bretagne Atlantique, project–team FLUMINANCE).

The contribution of ASPI to this project is to continue the comparison of sequential data assimilation methods initiated in [73], [62], such as the ensemble Kalman filter (EnKF) and the weighted ensemble Kalman filter (WEnKF), with particle filters. This comparison has been made on the basis of asymptotic variances, as the ensemble or sample size goes to infinity, and also on the impact of dimension on small sample behavior.

The consortium has organized the international conference on *Ensemble Methods in Geophysical Sciences*, held in Toulouse in November 2012.

<p align="center" style="color:red">**BACCHUS Team**</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

Title: PETALH: Preconditioning scientific applications on pETascALe Heterogeneuous machines

Type: ANR

Grant: Cosinus 2010

Duration: September 2011 - May 2013

Coordinator: GRIGORI Laura (Inria Saclay-Île de France)

Other partners: Inria Saclay-Île de France (leader of the project), Paris 6, IFP (Rueil-Malmaison), CEA Saclay.

See also: http://petal.saclay.inria.fr/

Abstract: In this collaborative effort, we propose to develop parallel preconditioning techniques for the emergent hierarchical models of clusters of multi-core processors, as used for example in future petascale machines. The preconditioning techniques are based on recent progress obtained in combining the well known incomplete LU (ILU) factorization with tangential filtering.

The track we are following in order to contribute to this goal is to investigate improved graph ordering techniques that would privilege the diagonal dominance of the matrices corresponding to the subdomains of the Schur complement. It amounts to integrating numerical values into the adjacency graph of the matrices, so that the importance of off-diagonal terms is taken into account when computing graph separators. The core of this work is planned to take place at the beginning of next year.

This project is a continuation of `PETAL` project that was funded by ANR Cosinus 2008 call.

8.1.2. 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.

8.1.2.1. CEMRACS 2012

Participants: Dragan Amenga-Mbengoué, Damien Genet, Emeric Martin [ONERA], Maxime Mogé [Cagire], Vincent Perrier [Cagire], Floren Renac [ONERA], Francois Rué, Mario Ricchiuto.

Jointly with the team Bacchus and with ONERA, we participated in project *Colargol*, which aimed at comparing implementations and performances of high order finite elements methods implemented in our library `Aerosol`, and in the high order discontinuous Galerkin library AGHORA developed at ONERA. For making fair comparisons with this library, we had to extend our library to three dimensions, and to finish the first parallel version of the code. Our first conclusions is the necessity of storing all geometrical terms of the finite elements methods (Jacobian, Jacobian matrices, etc...) for obtaining good performance. We are still running the comparison tests on the *Mésocentre de Calcul Intensif Aquitain*.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. IDIHOM

Title: Industrialisation of High-Order Methods

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - September 2013

Coordinator: Deutsches Zentrum fur Luft und Raumfahrt (Germany)

Others partners: DLR (Germany), Dassault Aviation (France), EADS-Cassidian (Germany), Cenaero (Belgium), Numeca (Belgium), ARA (UK), FOI (Sweden), Inria (france), NLR (the Nederlands), ONERA (France), TSAGI (Russia), ENSAM (France), Imperial College (UK), Universities of Bergamo (Italy), Varsaw (Poland), Poznan (Poland), Linköping (Sweden), UniversitĆatholique de Louvain (Belgium).

See also: http://www.dlr.de/as/en/desktopdefault.aspx/tabid-7027/11654_read-27492/

Abstract:The proposed IDIHOM project is motivated by the increasing demand of the European aerospace industries to advance their CFD-aided design procedure and analysis by using accurate and fast numerical methods, so-called high-order methods. They will be assessed and improved in a top-down approach by utilising industrially relevant complex test cases, so-called application challenges in the general area of turbulent steady and unsteady aerodynamic flows, covering external and internal aerodynamics as well as aeroelastic and aeroacoustic applications. Thus, the major aim is to support the European aeronautics industry with proven-track method(s) delivering an increased predictive accuracy for complex flows and (by same accuracy) an alleviation of computational costs which will secure their global leadership. An enhancement of the complete "high-order methods suite" is envisaged, including the most relevant methods, Discontinuous Galerkin and Continuous Residual-Based methods, in combination with underlying technologies as high-order grid generation and adaptation, visualisation, and parallelisation. The IDIHOM project is a key-enabler for meeting the ACARE goals, as higher-order methods offer the potential of more accurate prediction and at the same time faster simulations. Inria is involved in the design of Continuous Residual-Based methods for the simulation of steady trubulent flows.

8.2.1.2. ADDECCO

Title: ADaptive schemes for DEterministic and stoChastiC Flow PrOblems (ADDECCO)

Type: IDEAS (AdG # 226316)

Instrument: ERC Advanced Grant (Advanced)

Duration: December 2008 - November 2013

Coordinator: Inria (France)

Others partners: none

See also: http://www.math.u-bordeaux.fr/~rabgrall

Abstract: The numerical simulation of complex compressible flow problem is still a challenge nowadays, even for the simplest physical model such as the Euler and Navier Stokes equations for perfect gases. Researchers in scientific computing need to understand how to obtain efficient, stable, very accurate schemes on complex 3D geometries that are easy to code and to maintain, with good scalability on massively parallel machines. Many people work on these topics, but our opinion is that new challenges have to be tackled in order to combine the outcomes of several branches of scientific computing to get simpler algorithms of better quality without sacrificing their efficiency properties. In this proposal, we will tackle several hard points to overcome for the success of this program. We first consider the problem of how to design methods that can handle easily mesh refinement, in particular near the boundary, the locations where the most interesting engineering quantities have to be evaluated. CAD tools enable to describe the geometry, then a mesh is generated which itself is used by a numerical scheme. Hence, any mesh refinement process is not directly connected with the CAD. This situation prevents the spread of mesh adaptation techniques in industry and we propose a method to overcome this even for steep problems. Second, we consider the problem of handling the extremely complex patterns that occur in a flow because of boundary layers: it is not always sufficient to only increase the number of degrees of freedom or the formal accuracy of the scheme. We propose to overcome this with class of very high order numerical schemes that can utilise solution dependant basis functions. Our third item is about handling unsteady uncertainties in the model, for example in the geometry or the boundary conditions. This need to be done efficiently: the amount of computation increases a priori linearly with the number of uncertain parameters. We propose a non–intrusive method that is able to deal with general probability density functions (pdf), and also able to handle pdfs that may evolve during the simulation via a stochastic optimisation algorithm, for example. This will be combined with the first two items of this proposal. Many random variables may be needed, the curse of dimensionality will be dealt thanks to multiresolution method combined with sparse grid methods. The aim of this proposal is to design, develop and evaluate solutions to each of these challenges. Currently, and up to our knowledge, none of these problems have been dealt with for compressible flows with steep patterns as in many moderns aerodynamics industrial problems. We propose a work program that will lead to significant breakthroughs for flow simulations with a clear impact on numerical schemes and industrial applications. Our solutions, though developed and evaluated on flow problems, have a wider potential and could be considered for any physical problem that are essentially hyperbolic.

8.3. International Initiatives

8.3.1. *Inria Associate Teams*

AQUARIUS associated team is a research project dealing 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.

8.3.2. *Inria International Partners*

Politechnico de Milano, Aerospace Department (Pr. A. Guardone)

We have a collaboration on ALE for compressible flows and ORC fluids.

von Karman Institute: T. Magin

We work together on Uncertainty Quantification problems for the identification of inflow condition of hypersonic nozzle flows.

8.3.3. *Participation In International Programs*

8.3.3.1. *JLPC*

In the context of the JLPC (Joint Laboratory for Petascale Computing), people involved in the development of graph partitioning algorithms in `Scotch` collaborate with several US partners (UIUC, Argonne) so as to improve partitioning run time and quality for large scale simulations. Sébastien Fourestier has been attending the Inria-UIUC meeting of last September and has delivered two talks, one regarding `Scotch` and the other regarding `PaMPA`.

8.3.3.2. *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.

8.3.3.3. *Inria@SILICONVALLEY*

People involved in the development of graph partitioning algorithms in `Scotch` have a loose collaboration with Sherry Li and her team at Berkeley, regarding sparse matrix reordering techniques.

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

8.4.1.1. *Internships*

Jan KLOSA (from Apr 2012 until Oct 2012)

Subject: Arbitrary Lagrangian Euler (ALE) for very high order schemes in compressible fluid dynamics

Institution: Technische Universität Braunschweig (Germany)

Paul Constantine (Post doc, January 2102)

Subject: Uncertainty quantification

Institution: Aquarius team, Stanford University (Germany)

Luca Arpaia (From Apr 2012 until Oct 2012)

Subject: Arbitrary Lagrangian Euler (ALE) for very high order schemes in compressible fluid dynamics

Institution: Politechnico de Milano (Italy)

Andrea Filipni (From october 2012 until April 2013)

Subject:

Institution: Politechnico de Milano (Italy)

8.4.2. *Visits to International Teams*

Visits of Pietro Marco Congedo and Gianluca Geraci during a month (June-July 2012) at the NASA Center for Turbulence Research, Stanford University.

BIPOP Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Participants: Guillaume James, Vincent Acary, Franck Pérignon, Bernard Brogliato.

An IXXI project (institute for complex systems) has been accepted in November 2012. It concerns the study of nonsmooth mechanical systems with a particular focus on nonlinear waves, and nonlinear modes. Title: Ondes non linéaires dans les réseaux granulaires et systèmes mécaniques spatialement discrets.

8.1.1. ANR

- Project ChaSlim (01 October 2011–30 September 2015). Coordinated by Bernard Brogliato. Partcipants from BIPOP: V. Acary, O. Huber, B. Wang. Other partners: IRCCYN nantes and EPI NON-A from Inria Lille. Topic: reduction of chattering in sliding mode control (http://chaslim.gforge.inria.fr/)

- NSFC/ANR project Multiple Impact (01 january 2009 – 31 March 2012). Coordinated by B. Brogliato for the French side, and by C. Liu for the Chinese side. Participants from BIPOP: N.S. Nguyen.

- Project Saladyn (01 January 2009 –31 December 2012). Coordinated by V. Acary. Participants from BIPOP: F. Pérignon, M. Brémond, B. Brogliato (http://saladyn.gforge.inria.fr/)

- Project Geolmi (January 2011– December 2014). Geometry and Algebra of LMI with Systems Control Applications. Participants from BIPOP: J. Malick (http://homepages.laas.fr/henrion/geolmi/

8.1.2. Competitivity Clusters

- PSPC Project Romeo 2 (01 December 2012–01 December 2016). Topic: Development of a humanoid robot assistant and companion for everyday life. Participants from Bipop: P.-B. Wieber and D. Dimitrov.

8.2. International Initiatives

8.2.1. Participation In International Programs

- PHC Procope collaboration with DLR in Munich (Jan. 2012–Dec. 2013). Topic: Real-Time Optimization based Control of Bipedal Humanoid Robots. Participants from Inria: P.-B. Wieber, A. Herdt, J. Lafaye, D. Dimitrov.

<p style="text-align:center; color:red;">**CAD Team**</p>

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Inria Associate Teams

CAD is an Inria/Tsinghua University team related to LIAMA (China).

8.1.2. Participation In International Programs

We attend an international program of National Natural Science Foundation of China from 2010 to 2013.

Floating Point continuity clearly is a pioneer effort to solving a well-known unsolved problem. Up to now, almost all geometric modeling tool kits are based on traditional mathematics. They ignore the fact that computers can only represent a finite set of real numbers and simply use the formula $(a - \varepsilon < b)$ and $(b < a + \varepsilon)$ to compare whether two real numbers a and b are equal to each other or not. In the way, it becomes a very hard problem how to choose the proper value i.e., the precision is often out of control in geometric modeling tool kits although few documents report such the fact. This problem is very difficult. We also explore some formal methods and applied them to geometric algorithms. It seems to be an interesting research avenue. Finally, we also plan to study tolerances problem more carefully with CAD/CAM experts, because many of tolerances are not only directly related to the actual manufacturing process.

The central challenge with spline surfaces is to control their continuity when multiple patches join and to enable different types of sharpness. We are especially excited by a new result that addresses a central problem with spline modeling that has been open for five decades: the variation of continuity across a patch. This is needed, for example, when a crease forms in a smooth area. Because spline surfaces are modeled using a (mostly separable) tonsorial product of polynomial bases, it is hard to have a different level of continuity on two opposite edges of a patch. We proposed a particularly elegant solution to this challenge by smoothly varying the parametric location of the spline knots. This allows the curve to transition from a configuration where knots overlap (sharp C^1 discontinuity) to a configuration where they are distinct (fully continuous surface). We think that this work will have a large impact on CAD-CAM. Moreover, we speculate that our new geometric representation could be good candidates for better solving numerical simulation (PDEs) problems.

CAGIRE Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Boundary conditions for DNS (6 months of post-doct funded by Conseil régional d'Aquitaine)

Although DNS is mostly used in simplified geometries, issues remain for properly imposing boundary conditions. Indeed, considering for example an inflow boundary condition (BC), a number of variables depending on the subsonic or supersonic nature of the flow must be suitably imposed. As far as the velocity is concerned, it is highly desirable to prescribe boundary conditions with statistics which will match as much as possible those encountered in practice while controlling the reflective nature of the boundary. This can be highly beneficial to drastically reduce the computational domain, thus reducing the computational time. It has to be checked though that the best identified methodology suitable for the continuous problem is still compatible with the methods of resolution adopted to solve the related discrete problem.The long-term objective is to develop, implement and test an efficient method to prescribe boundary conditions for the DNS simulation of a jet in cross-flow. The focus here will be made on the constraints brought about by the compressible and low Mach nature of the flow. Accordingly, the successful low Mach number compressible laminar flow simulation will be considered as the criterion of success of the post-doc. Project: The activity will begin by properly identifying the different sets of physical inlet/outlet physical boundary conditions that are relevant for the low Mach compressible nature of the flow to be simulated; In that framework, a specific analysis of the popular Navier-Stokes characteristic boundary condition (NSCBC) will be carried out in the context of a low Mach number viscous flow. Second, the compatibility of these NSCBC's with the finite element DG formulation retained in the Aerosol library will be investigated in depth in order to identify any potential incompatibility and the way to overcome it, if necessary. Then, the methodology for combining these BC's with the various flux schemes and methods of solution of Aerosol will be developed. The programming of the proposed methodology in Aerosol will be carried out in a parallel environment. Then, a set of unitary tests will be defined and progressively addressed. Last, the simulation of a laminar low-Mach jet in cross-flow configuration will be carried out.Yann Moguen has been recruited on November 2012 to take up that post-doct position. The Conseil régional d'Aquitaine 6-month funding is supplemented by funding from the European programme IMPACT-AE so that the total duration of the post-doct will be 12 months.

7.1.2. Low Mach number aspects for DG schemes (18 months of thesis funded by Conseil général des Pyrénées Atlantiques)

In the litterature, the targeted direct numerical simulation (DNS) of a jet in a subsonic crossflow at low Mach number has been carried out by solving the zero Mach number Navier Stokes equations i.e. without acoustics. The reader is referred to the work by Muppidi and Mahesh (2007) or by Bagheri et al. (2009). Such an approach is acceptable since in a real combustion chamber, the Mach number is rarely above 0.3 and as long as thermo-acoustic instabilities are not to be dealt with. However, in the present project, it has been decided to adopt a compressible framework in order to be able to study in the future the interaction of a jet with a crossflow where a standing acoustic wave is present which corresponds to the configuration presently studied in the framework of the EU funded KIAI programme Workpackage 3.1). To the best of our knowledge, no DNS of an inclined turbulent JICF with a DG based compressible flow solver has been carried out so far. So a thesis work breakdown on that topic has been established as follows:

- Year 1: Understanding the industrial and contractual context. Asymptotic analysis for small Mach numbers of the continuous problem. Study of the various alternatives for discretization schemes at low Mach number. Establishing the link with schemes adapted for zero Mach number flows. Writing of the corresponding thesis chapter; Writing a communication for an international symposium. Participating in a summer school on numerical simulation.

- Year 2: Implementation of the schemes which exhibit a satisfactory asymptotic behavior at low mach number. Carrying out a DNS of an isothermal single jet in cross flow configuration with and without yaw angle in the framework of the IMPACT-AE programme. Analysis of the results, comparison with existing experimental data available in the team. Writing of the corresponding thesis chapter. Writing and submission of a journal paper.

- Year 3: Improvement of the schemes if necessary. Carrying out the DNS of a cold jet in a hot crossflow configuration with and without yaw angle in the framework of the IMPACT-AE programme. Analysis of the results. Writing of the corresponding thesis chapter. Thesis defense.

Thus a thesis proposal has been established and submitted to the Conseil Général des Pyrénées Atlantiques who agreed to fund 18 months of this thesis. The remaining 18 months will be funded through the European programme IMPACT-AE. The recruitment procedure was launched in June 2012 for a provisional starting date in January 2013.

7.2. National Initiatives

7.2.1. GIS Success

Participants: Vincent Perrier, Pascal Bruel.

We are presently participating in the CNRS GIS (Groupement d'Intérêt Scientifique) which is provisionally called "Super-calcul en Combustion et en Mécanique des Fluides dans les Géométries Complexes" and is led by CORIA. A license agreement has been signed with CORIA to permit the installation of the code Yales 2. This installation has been completed on the LMA cluster by the end of december 2012 and the first test will begin in january 2013 in the framework of our benchmarking activity.

7.2.2. CEMRACS 2012

Participants: Dragan Amenga-Mbengoué [Bacchus], Damien Genet [Bacchus], Emeric Martin [ONERA], Maxime Mogé, Vincent Perrier, Floren Renac [ONERA], Francois Rué [Bacchus], Mario Ricchiuto [Bacchus].

Jointly with the team Bacchus and with ONERA, we participated to the project *Colargol*, which aimed at comparing implementations and performances of high order finite elements methods implemented in our library Aerosol, and in the high order discontinuous Galerkin library Aghora developed at ONERA. For making fair comparisons with this library, we had to extend our library to three dimensions, and to finish the first parallel version of the code. Our first conclusions is the necessity of stocking all geometrical terms of the finite elements methods (Jacobian, Jacobian matrices, etc...) for having good performances. We are still running the comparison tests on the Mésocentre de Calcul Intensif Aquitain.

7.3. European Initiatives

7.3.1. FP7 Projects

Participants: Vincent Perrier [responsible], Pascal Bruel [substitute].

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 advanced representation of low emission combustors and the capability to investigate combustor scaling effects allow an efficient optimisation of future combustors targeting a cut of combustor development time by 50work packages: WP1'Development of smart design methodologies for clean combustion' as central WP to deliver the new methodology for combustor design, WP2'Modelling and design of advanced combustor wall cooling concepts' for combustor liner design definition as key technology area, WP3'Technology validation by detailed flame diagnostics' to substantiate fuel injector design rules implemented into the design methodology and WP4'Methodology demonstration for efficient low NOx combustors' will validate the combustor design. The consortium consists of all major aero-engine manufactures in Europe, 7 universities and 3 research establishments with recognised experience in low emission combustion research and 10 SMEs. The contribution of our team is to create 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.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Dr. A. Naïmanova, Institute of Mathematics, Almaty, Kazakhstan came for a one-month stay in September 2012.

CALVI Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- Takashi Hattori, Simon Labrunie and Jean-Rodolphe Roche participate in the ANR project "CHROME" (Heating, Reflectometry and Waves for Magnetized Plasma), grouping researchers from Université Paris 6 (B. Després, M. Campos Pinto and others), the Inria project-team POEMS (E. Bécache, C. Hazard and P. Joly) and Université de Lorraine (S. Heuraux). Simon Labrunie is the head of the Lorraine team.

  The CHROME project seeks to develop advanced mathematical and numerical tools for the simulation of electromagnetic waves in strongly magnetized plasmas (e.g., tokamak plasmas) in the context of reflectometry (a technique for probing the plasma by analysing the propagation of electromagnetic waves) and heating.

- GYPSI project (2010–2014), https://sites.google.com/site/anrgypsi/: coordinator Philippe Ghendrih (CEA Cadarache), other participants, University of Marseille, Universities of Strasbourg and Nancy (CALVI project-team). The aim is to understand the physics of turbulence in magnetically confined plasma using numerical simulation

- accepted ANR project "PEPPSI" in Programme Blanc SIMI 9 – Sciences de l'ingénierie (Edition 2012). Participants : Giovanni Manfredi (coordinator), Sever Hirstoaga.

- Stéphanie Salmon is a major member of ANR Project "VIVABRAIN" (Modèles Numériques, 2012) from 2013 to 2016.

8.1.2. Euratom-CEA projects

- Michel Mehrenberger is the coordinator 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.

- Jean Roche is the coordinator of the FR FCM project with Euratom-CEA association, Title: "Full wave modeling of lower hybrid current drive in tokamaks". The goal of this project is to develop a full wave method to describe the dynamics of lower hybrid current drive problem in tokamaks.

8.2. European Initiatives

8.2.1. Collaborations with Major European Organizations

E. Sonnendrücker: Max Planck Institut, Munich (Germany)

We will continue to collaborate with Eric Sonnendrücker on numerical and mathematical studies for plasma physics. We also collaborate on the SeLaLib project.

CASTOR Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

- ANR ECINADS

  Castor is associated to the ANR ECINADS project started in end of 2009, devoted to the design of new solution algorithms for unsteady compressible flows, adapted to scalable parallelism and to reverse (adjoint) Automatic Differentiation. See in the activity report of Tropics.

- ANR ESPOIR

  The ANR ESPOIR (Edge Simulation of the Physics Of Iter Relevant turbulent transport) associates the CASTOR team with the M2P2, LPIIM and LATP laboratories in Marseille and IRFM in Cadarache to investigate edge plasma turbulence. The numerical simulation of the plasma wall interactions requires efficient codes and thus the development of advanced numerical methods and solvers. The aim of this project is to study different numerical strategies for edge plasma models in the real geometrical and magnetical configurations corresponding to the future Iter machine.

- 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 qualifies 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 IODISEE : 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).

6.1.2. Inria initiatives

Large scale Initiative FUSION (2009–2012), http://www-math.u-strasbg.fr/ae_fusion: Modeling and numerical simulation of magnetic fusion plasmas in view of the ITER project.

6.1.3. Federation on Magnetic Confinement Fusion Projects

- FR FCM (Federation on Magnetic Confinement Fusion) project within Euratom-CEA association, "Reconstruction, simulation and control of plasma equilibrium"

- FR FCM (Federation on Magnetic Confinement Fusion) project within Euratom-CEA association, "Two-fluid numerical modelling of edge plasma in tokamak; Application to ITER".

6.2. International Initiatives

6.2.1. Euromediterranée 3+3 Medlagoon program

Participants: Hervé Guillard, Marco Bilanceri.

The goal of the Medlagoon project (https://project.inria.fr/medlagoon/en) is to contribute to the design of simulations tools aimed to the integrated mathematical modeling of Mediterranean lagoons ranging from hydrodynamics and sediment transport modeling to biological models for phyto and zoo-plankton. This program associates CASTOR with the Mohamedia Engineering school and the university of Oujda in Morocco, the University of Pisa (Italy), the Polytechnic school of Tunisia, the university of Paris 13, Ain Sham University in Egypt and the Department of Applied Mathematics, University of Crete in Greece.

6.3. International Research Visitors

6.3.1. Visits of International Scientists

6.3.1.1. University of Pilzen : Algebraic Multigrid Solvers

In the framework of a collaboration on algebraic multigrid solvers, Petr Vanek and Roman Kuzel of the University of Pilzen, Cezch Republic have visited CASTOR in November.

6.3.1.2. Institute of Mathematical Modeling and university of Moscow : Acoustics

The long-term scientific collaboration with IMM on acoustics focussed this year on new reconstruction schemes for noise propagation with linear and nonlinear hyperbolic models. Ludwig W. Dorodnicyn has visited us in april 2012.

6.3.1.3. University of Oujda: Environmental flows

In the framework of the Medlagoon project, Imad El Mahi has visited us in November 2012

6.3.1.4. National Taiwan University : Granular and Multiphase flows

In the wake created by the Hubert Curien project (ORCHID 08-09), Keh-Ming Shyue (Department of Mathematics, National Taiwan University) has visited us in July 2012.

CLASSIC Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

- ANR project in the conception and simulation track: EXPLO/RA (involves Emilien Joly, Pierre Gaillard, Sébastien Gerchinovitz, Gilles Stoltz; see http://sites.google.com/site/anrexplora/);

- ANR project in the blank program: Parcimonie (involves Sébastien Gerchinovitz, Vincent Rivoirard, Gilles Stoltz; see http://www.proba.jussieu.fr/ANR/Parcimonie/);

- ANR project in the blank program: Calibration (involves Vincent Rivoirard, who is the coordinator; see https://sites.google.com/site/anrcalibration/home);

7.2. European Initiatives

Thanks to the PASCAL European network of Excellence (http://www.pascal-network.org/), we have strong links with Gábor Lugosi, Universitat Pompeu Fabra, Spain and Nicolò Cesa-Bianchi, Università degli Studi di Milano.

7.3. International Initiatives

We have some internal collaborations, with

- Karine Bertin, University of Valparaiso, Chile;

- Luc Devroye, McGill University, Canada;

- Shie Mannor, Technion, Israel.

In particular, Pierre Gaillard spent 5 months working with Shie Mannor from January to May 2012.

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 In particular, in 2012, R. Masson has been involved in the organization of two MoMaS workshop "Multiphasic flows", Oct. 8-9 2012, with Danielle Hilhorst, University of Orsay.

- S. Junca is involved in the GdR-e "Wave Propagation in Complex Media for Quantitative and non Destructive Evaluation"; in particular he organized the Worshop "Nonlinearities in Acoustics" Nice, March 22-23/2012.

- GdR EGRIN is a newly created CNRS-network, devoted to gravitational flows and naturals risks; Coffee is among the members of this network.

- R. Masson, with Pierre Samier (Total) has been organizer of ECMOR XIII European Conference on the Mathematics of Oil Recovery, 10-13 september 2012, Biarritz, France, a scientific event of the European Association of Geoscientists and Engineers.

<p style="text-align:center; color:red">COMMANDS Project-Team</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. DGA

Participants: Olivier Bokanowski, Anna Désilles, Hasnaa Zidani.

Our team has a financial support from the DGA, within the programme "etudes Laboratoires". The research programme concerns the Hamilton-Jacobi approach for optimal control problems with state constraints. Our main interest in this class of control problems comes from the fact that the field has an important potential role in future technological developments to take account of environmental, physical or economical constraints.

A part of our findings in this topic have been used to develop a software for collision avoidance of a Uav.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. SADCO

Title: Sensitivity Analysis for Deterministic Controller Design

Instrument: Initial Training Network (ITN)

Duration: January 2011 - December 2014

Coordinator: Inria (France)

Others partners: Univ. of Louvain, Univ. Bayreuth, Univ. Porto, Univ. Rome - La Sapienza, ICL, Astrium-Eads, Astos solutions, Volkswagen, Univ. Padova, Univ. Pierre et Marie Curie

See also: http://itn-sadco.inria.fr

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.

8.2.2. Collaborations with Major European Organizations

Univ. Rome 1 - La Sapienza: Department of Mathematics

Collaboration with Antonio Siconolfi on "Hamilton-Jacobi equations in multi-domains".

Univ. Rome 2: Department of Mathematics

Numerical schemes for Hamilton-Jacobi coupled systems, controller design for hybrid systems.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. OCONET

Title: Optimization and control in network economics

Inria principal investigator: J.F. Bonnans

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - Center for Mathematical Modeling - Alejandro Jofre

Duration: 2012 - 2014

Web page: 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.

8.3.2. Inria International Partners

Univ. Buenos Aires: Department of Mathematics

Collaboration with Constanza de la Vega on the optimal control of systems with delay.

Moscow State Univ.: Department of Mathematics

Collaboration with Andrei Dmitruk on optimal control with singular arcs.

ENIT, Tunis: Department of Mathematics

Collaboration with Mohamed Mnif on the numerical methods for swing options.

Louisiane State University, USA

Collaboration with Peter Wolenski on stratified controlled systems.

8.3.3. Participation In International Programs

The team is involved in the "Energy Optimization" group of the Inria research center in Chile (CIRIC). Several visits to Chile were conducted in relation with this project.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Claudia Sagastizabal from IMPA in Rio (2 weeks, November 2012)
- Fabio Ancona, from Univ. of Padova (1 week, October 2012)
- Roberto Ferretti, from Univ. of Rome II (2 weeks, October 2012)
- Antonio Siconolfi, from Univ. of Rome I (2 weeks, June 2012)
- Lars Grüne, from Univ. of Bayreuth (1 week, June 2012)
- Adam Oberman, from Univ. of Vancouver (2 weeks, May 2012)
- Peter Wolenski, from Univ. of Louisiane (3 days, March 2012)
- Mohamed Mnif, from ENIT (2 weeks, February 2012)

8.4.1.1. Internships

Imene BEN LATIFA (from Feb 2012 until May 2012)

Subject: Numerical computation of swing options

Institution: Ecole Nationale d'Ingénieurs de Tunis (Tunisia)

Lucas Corrales (from May 2012 until Jul 2012)

Subject: Optimal control for some drug models

Institution: National University of the Center of the Buenos Aires Province (Argentina)

8.4.2. Visits to International Teams

- Olivier Bokanowski visited the Mathematics Department at Brown Univ., for 1 week.
- Hasnaa Zidani visited the Mathematics Department at Univ. of Rome 1- La sapienza, for 1 week.
- Olivier Bokanowski visited the Mathematical institute (Oxford), for 1 week.

CONCHA Project-Team (section vide)

CORIDA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

Alexandre Munnier, Jean-François Scheid (co-leader), Takéo Takahashi and Marius Tucsnak are members of the project CPER AOC-MISN "Autopropulsion dans un Fluide à bas Reynolds" (AFR). Collaborative project with the CRAN laboratory (Centre de Recherche en Automatique de Nancy).

8.1.1. ANR

Most of the members of our team are involved at least one ANR program.

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.

CQFD Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

In collaboration with UMR SAVE of INRA de Bordeaux, Anne Gégout-Petit and Marie Chavent supervise a PhD until september 2012 founded by a regional grant on the subject "Détermination des facteurs environnementaux et culturaux liés à l'esca de la vigne par une approche de modélisation spatio temporelle".

Marie Chavent participates to a project financed by the Région Aquitaine for three years (2010-2013), named *PSI : Etude des interactions états psychophysiologiques et musique* including the PHD-grant of Laurent Vezard. The subject of this PHD, co-directed by M. Chavent, F. Faita and P. Legrand from Project-Team ALEA, is *Dimension reduction in the context of supervised learning. Applications to the electrical brain activity study.*

7.2. National Initiatives

7.2.1. *ANR FAUTOCOES*

The goal of the project "FAUTOCOES" (number ANR-09-SEGI-004) of the ARPEGE program of the French National Agency of Research (ANR) can be described as follows. Today, complex technological processes must maintain an acceptable behavior in the event of random structural perturbations, such as failures or component degradation. Aerospace engineering provides numerous examples of such situations: an aircraft has to pursue its mission even if some gyroscopes are out of order, a space shuttle has to succeed in its re-entry trip with a failed on-board computer. Failed or degraded operating modes are parts of an embedded system history and should therefore be accounted for during the control synthesis.

These few basic examples show that complex systems like embedded systems are inherently vulnerable to failure of components and their reliability has to be improved through fault-tolerant control. Embedded systems require mathematical representations which are in essence dynamic, multi-model and stochastic. This increasing complexity poses a genuine scientific challenge:

- to model explicitly and realistically the dynamical interactions existing between the physical state variables defining the system: pressure, temperature, flow rate, intensity, etc, and the functional and dysfunctional behavior of its components;
- to estimate the performance of the system through the evaluation of reliability indexes such as availability, quality, and safety;
- to optimize the control to prevent system failures, as well as to maintain the system function when a failure has occurred.

Our aim is to meet the previously mentioned challenge by using the framework of piecewise deterministic Markov processes (PDMP's in short) with an emphasis on probabilistic and deterministic numerical methods. More precisely, our objectives are

- to use the framework of piecewise deterministic Markov processes to model complex physical systems and phenomena;
- to compute expectations of functionals of the process in order to evaluate the performance of the system;
- to develop theoretical and numerical control tools for PDMP's to optimize the performance and/or to maintain system function when a failure has occurred.

More details are available at http://fautocoes.bordeaux.inria.fr/.

7.2.2. 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 will work on tasks 1 and 3.

7.3. International Initiatives

7.3.1. Collaborations with Major European Organizations

Numerical methods for Markov decision processes 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 (LP) 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).

This project is supported by the *Gobierno de Espana, Derccion Genral de Investigacion Cinetifica y Tecnica* (reference number: MTM2012-31393) for three years (25 000 euros) to support the scientific collaboration between Tomas Prieto-Rumeau and François Dufour.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Tomas Prieto-Rumeau (Department of Statistics and Operations Research, UNED, Madrid, Spain) visited the team during one month in 2012. 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 Markov Decision Processes. He visited the team during two weeks in 2012.

Alexey Piunovskiy (University of Liverpool) visited the team during one month in 2012. The main subject of the collaboration is the linear programming approach for Markov Decision Processes.

7.4.2. Visits to International Teams

François Dufour has visited A. Piunovskiy at Liverpool University for a week in March.

Jérôme Sracco was invited to MCR Biostatistics Units at Cambridge University for one week in november 2012. He gave a seminar untitled "Dimension reduction based on sliced inverse regression (SIR): a look at the special case when $n < p$.

DEFI Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Olivier Pantz is in charge of the Gaspard Monge Program for Optimization and operations research (PGMO) *Optimization of a Fast Sodium Reactor*

8.2. National Initiatives

8.2.1. ANR

- J.R. Li is the coordinator of the project Simulation du signal d'IRM diffusion dans des tissus biologiques (SIMUDMRI), funded 2010-2013 by the ANR Program COSINUS. Participants : Jing-Rebecca Li, Houssem Haddar, Dang Van Nguyen. Joint proposal between Inria-Saclay and CEA Neurospin. http://www.cmap.polytechnique.fr/~jingrebeccali/grants/simudmri.html
- 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

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

Partner 1: University of Goettingen, Department of Math. (Germany)

Development of conformal mapping method to electrostatic inverse problems. Correspondant: Rainer Kress.

Partner 2: University of Genova, Department of Math. (Italy)

Development of qualitative methods in inverse scattering problems. Correspondant: Michele Piana.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. ISIP

Title: Inverse Scattering and Identification Problems

Inria principal investigator: Houssem HADDAR

International Partner (Institution - Laboratory - Researcher):

University of Delaware (United States) - Mathematical Department - Fioralba Cakoni

Duration: 2008 - 2013

See also: http://www.cmap.polytechnique.fr/~defi/ISIP/isip.html

The associated team concentrates on the use of qualitative methods in electromagnetic inverse scattering theory with applications to the imaging of urban infrastructure, the nondestructive evaluation of coated materials and medical imaging. Most of the effort is focused in the solution of the inverse problems using time harmonic waves, in particular for frequencies in the resonance regime.

8.4.2. Inria International Partners

- Close collaboration with the former member of our EPI, A. Lechleiter, who is now professor at University of Bremen. Joint PhD advising of T. Rienmuller, partly funded by French-German university.

8.4.3. Participation In International Programs

- H. Haddar is member of the EPIC, an Inria team in the framework of LIRIMA.
- 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).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

Mohamed MAHJOUB (from Feb 2012 until Aug 2012)

Subject: Level set method applied to structural optimization with contact

Institution: Ecole Polytechnique de Tunisie (Tunisia)

Jackie FAN YAN (from June 2012 until Aug 2012)

Subject: Direct and inverse simulation of hyper lenses

Institution: University of Delaware (Tunisia)

DISCO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

+ DIGITEO Project (DIM LSC) ALMA
  Project title: Mathematical Analysis of Acute Myeloid Leukemia
  Decembrer 2010 - December 2013
  Coordinator: Catherine Bonnet
  Other partners: Inria Paris-Rocquencourt, France, L2S, France, INSERM, Cordeliers Research Center, France.
  Abstract: this project studies a model of leukaemia based on previous works by M. Adimy and F. Crauste (Lyon), with theoretical model design adjustments and analysis in J. L. Avila Alonso's Ph D thesis and experimental parameter identification initiated by F. Merhi, postdoc of Bang (Dec. 2010-Nov. 2011), working at St. Antoine Hospital (Paris) on biological experiments on leukaemic cells.

+ DIGITEO Project (DIM Cancéropôle) ALMA2
  Project title: Mathematical Analysis of Acute Myeloid Leukemia - 2
  October 2011 - March 2013
  Coordinator: Jean Clairambault (Inria Paris-Rocquencourt)
  Other partners: Inria Saclay-Île-de-France, France, L2S, France, INSERM, Cordeliers Research Center, France.
  Abstract: This project has taken over the experimental identification part in St. Antoine Hospital, together with further model design with the postdoc of A. Ballesta (BANG). With this postdoc project have also been developed the theoretical and experimental - in leukaemic cell cultures - study of combined therapies by classical cytotoxics (anthracyclins, aracytin) and recently available targeted therapies (anti-Flt-3).

+ DIGITEO Project (DIM LSC) MOISYR
  Project title: Monotonie, observateurs par intervalles, et systèmes à retard
  Decembre 2011 - Decembre 2014
  Coordinator: Frédéric Mazenc
  Other partners: organisme, labo (pays) L2S, France, Mines-ParisTech, France.
  Abstract: MOISYR is concerned with the creation of 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 setp, we shall extend our result to discrete time systems and to a specific class of continuous/discrete systems called Networked Control Systems.

8.2. National Initiatives

8.2.1. *Competitivity Clusters*

C. Bonnet and S. Olaru are members of the Multimodal Transportation section of the IRT SystemX

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

Partner 1: Patras University, Greece

Constrained control systems (analysis and design)

Partner 2: Leeds University, United Kingdom

Analysis of delay systems

Partner 3: Bilkent University, Turkey

Modelling of cell dynamics

Partner 4: RWTH Aachen University, Germany

Mathematical systems theory, control theory, symbolic computation.

Alban

8.4. International Initiatives

8.4.1. Inria International Partners

- UNICAMP, Sao Paulo, Brazil

- Kyushu Institute of Technology, Iizuka, Fukuoka, Japan

- Louisiana State University, Baton Rouge, USA

- University of California, San Diego, CA, USA

8.4.2. Participation In International Programs

A. Quadrat has developed a strong collaboration with the members of the Lehrstuhl B für Mathematik and particularly with Daniel Robertz and Mohamed Barakat. He is a member of a PHC Procope developed in collaboration with the University of Limoges (XLIM) and the Lehrstuhl B für Mathematik, RWTH Aachen University (2011-2012) which aims at developing computer algebra aspects to mathematical systems theory and control theory.

A. Quadrat is developing a new collaboration with the team of Ülle Kotta, Control Systems Department, Tallinn University, Estonia, on symbolic computation and control theory. A PHC Parrot has just been accepted (2013-2015).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Mohamed Barakat (University of Kaiserslautern), Daniel Robertz (University of Aachen), and Thomas Cluzeau (University of Limoges) visited A. Quadrat within a PHC Procope.

George Bitsoris (University Patras, Greece), 1 Octobre - 30 Novembre 2012.

Hiroshi Ito, Kyushu Institute of Technology, Japan, 26 September - 8 October 2012.

Hitay Ozbay, Bilkent University, Turkey, 19 November - 23 November 2012.

<h1 style="text-align:center; color:red;">DOLPHIN Project-Team</h1>

8. Partnerships and Cooperations

8.1. Regional Initiatives

+ PPF Bioinformatics: This program within the University of Lille 1 deals with solving bioinformatics and computational biology problems using combinatorial optimization techniques, 2010-2013.

+ PPF High Performance Computing, This program deals with parallel optimization, 2010-2013.

+ CIA (Campus Intelligence Ambiante) project from CPER (Contrat Plan Etat Région): Transversal research action: "High performance computing", 2010-2013.

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 Black-box 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).

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.2. Collaborations in European Programs, except FP7

Program: COST

Project acronym: IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: Jan 2009 - May 2013

Coordinator: J. M. Pierson

Other partners: More than 20 European countries.

Abstract: The COST Action IC0804 proposes realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and Storage resources, their energy consumption is exponentially increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, network and applications. The Action characterizes the energy consumption and energy efficiencies of distributed applications.

8.3.3. Collaborations with Major European Organizations

University of Luxembourg: CSC, ILIAS (Luxembourg), "Design of parallel and hybrid metaheuristics to solve complex optimization problems"

University of Malaga: ETSI Informatica (Spain), "Parallel metaheuristics for dynamic optimization"

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. STEM

Title: deciSion Tools for Energy Management (STEM)

Inria principal investigator: L. Brotcorne

International Partners (Institution - Laboratory - Researcher):

Université de Montréal (Canada) - Département d'informatique et recherche opérationnelle - Francois Gilbert

Polytechnic School of Montreal (Canada) - Département de mathématique et génie industriel - Michel Gendreau

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 between costs (production, security) and revenues when determining the daily hydro-electricity generation and storage within an environment where demand is 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

- University of Sydney, Australia
- University of Montreal and Ecole Polytechnique of Montreal, Canada
- University of Dortmund, Germany
- ETH Zurich, Switzerland
- SINTEF, Norway

8.4.3. Participation In International Programs

- Inria STIC-Tunisie,2011-2013.
- Inria STIC-Algérie, 2011-2013.
- CNRS PICS Luxembourg, 2011-1014.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

The project had visitors during the year 2010:

- Prof. Michel Gendreau, University of Montreal
- Prof. Pascal Bouvry, University of Luxembourg
- Dr. Gleb Belov, Univ. Essen, Germany
- Dr. Manuel Lopez-Ibanez, IRIDIA, Université Libre de Bruxelles, Belgium,
- Dr. Boris Naujoks, Cologne University of Applied Sciences, Gummersbach, Germany
- Prof. Gunter Rudolph, TU Dortmund University, Germany

8.5.2. *Visits to International Teams*

- D. Brockhoff, June 2012, TU Dortmund University, Germany
- D. Brockhoff, March 2012, ETH Zurich, Switzerland
- E-G. Talbi, Dec 2012, Univ. Luxembourg, Luxembourg
- A. Liefooghe, jan 2012, University of Malaga, Spain

GAMMA3 Project-Team

5. Partnerships and Cooperations

5.1. Regional Initiatives

- Maîtrise des propriétés des fibres de chanvre (fibre / chènevotte), dans le cadre de valorisation s en agro-composites base polymère, MAPROFI CONTRAT DE PROJETS ETAT-REGION 2007-2013, INRA, UTT, USTL, AFT plasturgie, ITC
- Valorisation par recyclage de composites bio-sourcés à base de fibres de chanvre au travers de leur comportement mécanique sous sollicitations statiques et dynamiques, Projet BioComposites Incitatif Amont DRRT 2012 de la région Champagne Ardenne

5.2. European Initiatives

5.2.1. FP7 Projects

- Projet Européen : FP7 Health-F5-2009-241818 : NANOANTENNA
  Participants: Dominique Barchiesi [correspondant], Thomas Grosges, Sameh Kensentini
  Développement d'un biocapteur in vitro, ultra sensible et sélectif destiné à la détection de protéines impliquées dans les premières phases du développement de maladies. Modélisation et optimisation numériques du dispositif (taille, forme, couplage électromagnétique-matériaux).

5.3. International Research Visitors

5.3.1. Internships

- ZHANG Jie, 3D advanced remeshing procedure for numerical simulation of forming processes
- SLIMANI Faouzi, Modélisation mécanique des aptitudes de formage à chaud des tôles et des tubes minces avec remaillage adaptatif en grandes déformations

5.3.2. Visits to International Teams

- Frederic Alauzet, Septembre 2011-Septembre 2012, Mississippi State University, CAVS lab.

<p align="center" style="color:red">GECO Team</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

- **Digitéo project CONGEO.** CONGEO (2009–2013) is financed by Digitéo in the framework of the DIM *Logiciels et systèmes complexes*. It focuses on the neurophysiology applications. U. Boscain, Y. Chitour (leader), F. Jean and P. Mason are part of the project.

7.2. National Initiatives

- **ANR project GCM.** The project ANR GCM (*programme blanc*, 2009–13) involves the great majority of GECO's members (permanent and external). It focuses on various theoretical aspects of geometric control and on quantum control. It is coordinated by J.-P. Gauthier.
- **ANR ArHyCo.** The project ANR ArHyCo (*programme ARPEGE*, 2009–12) is about switched systems. It is coordinated by J. Daafouz. The first theme of the ANR, on stability of switched systems, is lead by M. Sigalotti.

7.3. European Initiatives

7.3.1. 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.

7.4. International Initiatives

7.4.1. Inria 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.

7.4.2. Participation In 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/

7.5. International Research Visitors

7.5.1. Visits of International Scientists

Gianluca Panati visited GECO from 18/6 to 18/7 (thanks to an invitation by École Polytechinque). He worked on the control of spin-boson systems in collaboration with U. Boscain, P. Mason and M. Sigalotti.

7.5.1.1. Internships

Guilherme MAZANTI (from Jul 2012 until Nov 2012)

> Subject: Persistent excitation with bounded variation & arbitrary rate of stabilization

> Institution: University of São Paulo (Brazil)

GEOSTAT Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- OPTAD project. Title: *Méthodes multiéchelles pour l'optique adaptative et les données d'astronomie"*, with Conseil Régional Région Aquitaine. Duration: 2010-2013.
- Convention CRA 20111602015 on speech processing, with Conseil Régional Région Aquitaine (2011-2014) (funding, equipement and Speech databases).
- DIAFIL project, cofunded by Conseil Régional Région Aquitaine and IHU LYRIC. Title: *Méthodes non-linéaires pour le diagnostic et la prévention de la fibrillation ventriculaire*.

7.2. National Initiatives

- HIRESUBCOLOR, OSTST-CNES-NASA program. Partners: DYNBIO (LEGOS UMR CNRS 5565), LOCEAN, ICM-CSIC. Title: *Multiscale methods for the evaluation of high resolution ocean surface velocities and subsurface dynamics from ocean color, SST and altimetry*. We obtained a 1 year prolongation in 2012 from CNES. Coordinator: H. Yahia. Abstract: nonlinear signal processing methods for high resolution mapping of ocean dynamics. Duration: 2008-2012.
- FIBAUR ARC: *Fibrillation auriculaire: approches nouvelles pour l'analyse des signaux complexes du rythme cardiaque*. Inria ARC, duration: 2011-2012. Partners: GEOSTAT, INSERM EA3668, SIGMA team (ESPCI).

7.3. International Initiatives

- CRSNG Canadian program. Title: *Profilage à partir des données hétérogènes du Web pour la cybercriminalité*. Partners: Concordia University, University of Sherbrooke, E-Profile Compagny, S. d. Quebec, GEOSTAT (Inria). Coordinator: Concordia University. Duration: 2011-2014. Abstract: use of various complex signals for cybersecurity.

7.4. European Initiatives

- OCEANFLUX project, ESA (European Space Agency), Program: Support to Sicence Element ESRIN/AO/1-6668/11/I-AM, fund: E/0029-01-L. Partners: IWR (University of Heidelberg, Germany), GEOSTAT (Inria, France) , KIT (Karlsruher Institu fur Technologie, Germany), LEGOS (CNRS DR14, France), IRD (France), University Paul Sabatier (France). Duration: 2011-2013. Abstract: Mapping at high spatial resolution of GHGs exchange flux between ocean and atmosphere using model outputs and nonlinear techniques in signal processing. Coordinator: C. Garbe, Interdiscplinary Center for Scientific Computing (IWR), University of Heidelberg.
- PHC Volubilis. Title: *Study of upwelling in the Moroccan coast by satellite imaging*. Partners: GEOSTAT, Rabat University, CRTS. French coordinator: K. Daoudi. Abstract: multiscale methods for the characterization of coastal upwelling from remote sensing data. Duration: 2010-2012.

7.5. International Research Visitors

7.5.1. *Visits of International Scientists*

Max Little (MIT Media Lab Human Dynamics Group, Visiting Senior Research Associate, Oxford Complex Systems) has made one month visit at GEOSTAT. He made a presentation to Inria BSO: *A global functional minimization approach to nonlinear signal processing* on Thursday, April 5th.

7.5.1.1. Internships

Hicham Badri (from Mar 2012 until Aug 2012)

Subject: Computer graphics effects from the framework of reconstructible systems

Institution: Université Mohamed V Agdal - Faculté des Sciences de Rabat (Morocco)

Nicolas Vinuesa (from October 1st 2012 until April 31 2013)

Subject: Biologically realistic coding efficiency in auditory cortex vs wavelet analysis

Institution: Universidad Nacional de Rosario, Facultad de Ciencias Exactas, Agrimensura Y Ingineria, Rosaria, Argentina.

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Pôle de Compétitivité ASTECH MODIPRO

Participants: Laurent Mevel, Meriem Zghal.

Contract Inria 4162

I4S is implied in a national project for aircraft SHM starting Fall 2009. This project will improve on monitoring procedures developed in previous projects to provide some algorithms for use in Dassault Aviation aircraft monitoring procedures. I4S works together with Qinghua Zhang of Inria Rocquencourt, project team SISYPHE, on this topic. The project ended in October 2012.

8.1.2. Collaboration with IFSTTAR

Participant: Laurent Mevel.

I4S is related to the project FUI SIPRIS (Systèmes d'Instrumentation pour la prévention des risques), lead by Advitam. Work has just started with IFSTTAR.

8.1.3. Collaboration with ALEA, EPI Team at Inria Bordeaux Center

Participants: Laurent Mevel, Meriem Zghal.

I4S has a 2 year collaboration with EPI ALEA on using particular filtering in vibration analysis. The output has been submitted for publication.

8.1.4. Collaboration with ISAE

Participants: Laurent Mevel, Ahmed Jhinaoui.

Ahmed Jhinaoui is finishing his thesis on helicopter instability. This thesis is codirected by professor Morlier from ISAE, France. This thesis is funded by FP7-NMP Large Scale Integrated Project IRIS. See also [25].

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. FP7 ISMS

Type: PEOPLE

Instrument: Industry-Academia Partnerships and Pathway (IAPP)

Duration: September 2010 - August 2013

Coordinator: SVS (Structural Vibrations Solutions) (Denmark)

Others partners: University of British Columbia, Canada

In 2009, a proposal has been submitted with SVS, University of British Columbia and I4S to develop a framework for handling structural health monitoring methods. This proposal implies some long stay of the concerned people, Laurent Mevel and Michael Döhler for I4S abroad. Palle Andersen and one of its engineer from SVS are assumed to stay 9 months at Inria, for tighten integration of COSMAD and ARTEMIS software. The proposal has been rated 88/100 and ranked A in the final selection procedure. The project has been signed on August 1st 2010 and has been running from September 1st. Michael Döhler has been spending 5 months in 2010-2011 in Danemark. Laurent Mevel spent 2 months in 2012 in Danemark. The mid term project has been well reviewed by the EC.

8.2.1.2. FP7-NMP CP-IP 213968-2 IRIS

Type: Cooperation

Instrument: Collaborative project -Large Scale Integrating project

Duration: October 2008 - March 2012

Coordinator: VCE, Austria (Denmark)

Others partners: 40 partners

IIRIS (*Integrated European Industrial Risk Reduction System*), which helds its kick off meeting in October 2008. This project has been elaborated within the framework of the SAMCO association. I4S is involved in the online monitoring sub-project.

I4S is involved in the core consortium of this FP7-NMP Large Scale Integrated Project.

Inria is involved in Group 3 about Structural Health Monitoring. I4S works with Sheffield University and BAM (Germany) for development of tools for structural damage detection for bridges and wind farms. Laurent Mevel is also member of the core IRIS Vision group, and is responsible of the scientific coherency of the project.

The project ended in Spring 2012.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. SIMS, Canada

Participants: Michael Döhler, Laurent Mevel.

A new project called SIMS is currently ongoing on vibration analysis and monitoring in Canada. This project is funded by Ministry of Transport, British Columbia, Canada. It implies deep collaboration with University of British Columbia, Canada.

SVS and I4S are investigating how to link the modal analysis software ARTeMIS of SVS and COSMAD. Through an annual agreement, I4S gets a license of ARTeMIS in exchange to offer support for integrating our damage detection software into SVS software and offerings. A contract has been signed, where I4S provides algorithms and expertise for integration within a damage detection structural health monitoring system and SVIBS does the implementation. This technology transfer has been funded by the ministry of transportation of British Columbia, Canada. The work is supervised by UBC, CA. The end product will be a web based structural health monitoring system for in operation bridges.

8.3.1.2. Collaboration on damage localization and monitoring with Boston University

This work is related to the thesis of Luciano Marin. The objective is the draft of an associated Inria team. Currently exchange of postdocs and joint PhD supervision have been done.

8.3.2. Participation In International Programs

8.3.2.1. Northeastern University

Participants: Laurent Mevel, Luciano Marin.

Program: International joint supervision of PhD agreement

Title: Design of fast statistical algorithms for monitoring of damage and uncertainties in civil and aeronautic structures

Inria principal investigator: Laurent MEVEL

  Northeastern University (United States)

Duration: May 2011 - Apr 2014

This collaboration involves a new PhD student, Luciano Marin, and is involving Professor Bernal from University of Boston, USA.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Michael Döhler of Northeastern University has visited twice in June and September 2012 for a total of 4 weeks.

<div align="center">

IPSO Project-Team

</div>

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR Programme blanc (BLAN) MEGAS: 2009-2012

Participants: François Castella, Philippe Chartier, Arnaud Debussche, Erwan Faou.

Geometric methods and sampling: application to molecular simulation. The project was financed for 3 years, coordinated by Tony Lelièvre and has gathered the following teams and persons:

- Team of Eric Cancès at CERMICS
- Team IPSO
- Mathias Rousset from Inria Lille
- Christophe Chipot, from the CNRS in Nancy.

P. Chartier was the coordinator for IPSO.

6.1.2. ANR Programme blanc GYPSI: 2010-2014

Participant: Nicolas Crouseilles.

Leader: Ph. Gendrih.

The full description is available at https://sites.google.com/site/anrgypsi/

6.1.3. ANR Programme blanc E2T2: 2010-2014

Participant: Nicolas Crouseilles.

Leader: P. Beyer

6.1.4. ANR Programme blanc STOSYMAP

Participant: Arnaud Debussche.

Leader: A. Shirikyan, The full description is available at http://shirikyan.u-cergy.fr/stosymap.html

6.1.5. Inria Large scale initiative FUSION

Participant: Nicolas Crouseilles.

Leader: E. Sonnendrücker. The full description is available at http://www-math.u-strasbg.fr/ae_fusion

6.2. European Initiatives

6.2.1. FP7 Projects

6.2.1.1. http://www.irisa.fr/ipso/perso/faou/geopardi.html Geopardi

Title: Geometric Partial Differential Equations
Type: IDEAS ()
Instrument: ERC Starting Grant (Starting)
Duration: September 2011 - August 2016
Coordinator: Inria (France)
See also: http://www.irisa.fr/ipso/perso/faou/geopardi.html
Abstract: The goal is to develop new numerical methods for the approximation of evolution equations possessing strong geometric properties such as Hamiltonian systems or stochastic differential equations. Use intensive numerical simulations to discover and analyze new nonlinear phenomena.

6.3. International Initiatives

6.3.1. Participation In International Programs

6.3.1.1. ANR Programme blanc international (BLAN) LODIQUAS 2012-2015

Participants: François Castella, Philippe Chartier, Florian Méhats, Mohammed Lemou.

Leaders: N. Mauser (Univ. Vienna) and F. Castella (IPSO).

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 rechearchers :

Norbert Mauser (Vienna), Erich Gornik (Vienna), Mechthild Thalhammer (Innsbruck), Christoph Naegerl (Innsbruck), Joerg Schmiedmayer (Vienna), Hans-Peter Stimming (Vienna).

Francois Castella (IPSO), Florian Mehats (IPSO), Francis Nier (Rennes), Raymond El Hajj (Rennes), Mohammed Lemou (IPSO), Claudia Negulsecu (Toulouse), Fanny Delebecque (Toulouse), Stephane Descombes (Nice), Philippe Chartier (IPSO), Christophe Besse (Lille),

The expected scientific and technological progress brought by the present project are as follows. "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. On the side of fermions quantum electronic structures like resonant tunnelling diodes show well studied "non classical effects" like a negative differential resistance that are exploited for novel devices. On the side of bosons the creation and manipulation of Bose Einstein Condensates (the first creation of BECs by Ketterle et al merited a Nobel prize) has become a standard technique that allows to study fundamental quantum concepts like matter-wave duality with increasingly large objects and advanced quantum effects like decoherence, thermalization, quantum chaos. In state-of-the?art experiments e.g. with ultracold atoms in optical lattices the bosonic or fermionic nature of quantum objects can change and it makes a lot of sense to treat the models in parallel in the development of mathematical methods. The experimental progress in these fields is spectacular, but the mathematical modelling and analysis as well as the numerical simulation are lagging behind. Low dimensional models are mostly introduced in a heuristic way and there is also a need for systematic derivations and comparison with the 3-d models. To close the gap is a main goal of this project that aims to deliver reliable tools and programme packages for the numerical simulation of different classes of quantum systems modelled by partial differential equation of NLS type. Virtually all participants have a strong track record of international collaboration, they grew up with the concept of the "European Research Area" where science knows no boundaries and scientists used to work in different countries, as it was the case in a pronounced way in mathematics and in quantum physics in the thirties of the last century. The Pre- and Post-Docs to be funded by this project will be trained in this spirit of mobility between scientific fields and between places.

6.4. International Research Visitors

6.4.1. *Visits of International Scientists*

- Mechthild Thalhammer, University of Innsbrück, one week
- Yong Zhang, University of Vienna, three weeks

6.4.2. *Visits to International Teams*

- G. Vilmart: EPF Lausanne (Switzerland), invitation by Assyr Abdulle in the chair of numerical analysis and computational mathematics, several 1-2 weeks visits (totalizing 3 months).

<p style="text-align:center;color:red;">**MATHRISK Team**</p>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

ANR ANR-08-BLAN, Program: Big'MC (Issues in large scale Monte Carlo). (2009-2012).

Partners ENST, ENPC, University Paris-Dauphine.

7.1.2. Competitivity Clusters

Pôle Finance Innovation.

Project "Credinext" on credit risk derivatives (2009-2012).

Partners: Thomson Reuters, Lunalogic, Pricing Partners, Ecole Polytechnique, Inria, ENPC, Université Paris-Est Marne la Vallée.

(Several PhD and Postdoc grants)

7.2. European Initiatives

Eurostars Program "Transparency in Financial Markets" (OSEO grant) (Postdoc grants).

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Emmanuella Rosazza Gianin, Bococca Milano University , January 2012

Peter Forsyth, Waterloo university Canada, July 2012

7.3.2. Internships

- Roxana Dumitrescu, Master 2 , University Paris-Dauphine
- Jiang Pu , Ecole Polytechnique, 3rd year

MAXPLUS Project-Team

8. Partnerships and Cooperations

8.1. Actions nationales/National Initiatives

8.1.1. ANR

- Projet ANR Arpège ASOPT (Analyse statique et Optimisation), responsable B. Jeannet. Partenaires: équipe-projet Popart (Inria Grenoble), équipe MeASI, EADS, et Maxplus. Ce projet a été labellisé par le pôle de compétitivité System@tic. Ce projet a financé notamment le postdoc de S. Sergeev dans l'équipe.
- Participation au projet ANR CPP (Confidence, Proof and Probabilities), responsable J. Goubault Larecq. Partenaires: LSV, CEA List, Inria Saclay (Comète [responsable], Parsifal, Maxplus), Supelec L2S, Supelec SSE.
- Participation de Cormac Walsh au projet ANR FINSLER (Géométrie de Finsler et applications), démarrage 1 Dec 2012.

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.

8.2. Actions internationales/International Initiatives

8.2.1. Participation In 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-Darmstadt).
- La thèse de Zheng Qu est co-encadrée par Shanjian Tang de l'université Fudan (Shanghai), dans l'équipe duquel la doctorante effectue une partie de son travail de recherche.
- Les membres de l'équipe sont partenaires du Grant RFBR–CNRF 11-01-93106 "Tropical Mathematics and Mathematical Physics", porté par l'équipe de Grigori Litvinov (Moscou independent University), qui a financé le séjour de M. Akian et C. Walsh auWorkshop "Tropical and idempotent Mathematics", Moscou, 26-31 août 2012.

8.3. Accueils de chercheurs étrangers/International Research Visitors

8.3.1. Chercheurs étrangers/Visits of International Scientists

- Srinivas Sridharan (University of California San Diego), 1 semaine en mai.
- Ngoc Tran (Berkeley University), 3 jours en Juin.
- Visites d'un ou deux jours de Paul Van Dooren, Roberto Tempo, Konstantin Avrachenkov (autour de la thèse d'Olivier Fercoq, avec séminaire).
- Visites d'un jour de Maurizio Falcone, Xavier vasseur, Yvan Notay (autour de la thèse de Sylvie Detournay).
- Ricardo Katz (Conicet, Rosario, Argentine), 1 mois en octobre-novembre, financé par DIGITEO.
- Alexander Guterman (Université d'état de Moscou), 5 jours en décembre.

8.3.1.1. Stagiaires/Internships

- Soren Ravn, stage de M2 du 15 mars au 9 mai.

8.3.2. Séjours à l'étranger/Visits to International Teams

- P. Benchimol, visite à TU Darmstadt, 19 au 24 mars 2012.
- Z. Qu: séjour à l'Université Fudan, août - sep 2012.

MC2 Project-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 MANIPHYC

Participants: Charles-Henri Bruneau, Thierry Colin.

Simulations of complex fluids.

Collaboration with Rhodia-Lof and University of Lyon 1, 2008–2012.

8.2.2. ANR CARPEiNTER

Participants: Héloïse Beaugendre, Michel Bergmann, Charles-Henri Bruneau, Angelo Iollo [Leader Project], Lisl Weynans.

Cartesian grid, penalization method, complex flow. The P.I. is Angelo Iollo. See http://www.math.u-bordeaux1.fr/CARPEINTER/

8.2.3. ANR CYCLOBULLE

Participants: Charles-Henri Bruneau, Yong Liang Xiang.

The formation and dynamics of long lived coherent structures in atmospheric flows can be mimicked by soap film experiments on an hemisphere heated at the equator. The aim of this work is to simulate such flows and to compare both to the experiments and to the known data of various tornados.

8.2.4. ANR INTCELL

Participants: Thierry Colin, Olivier Saut, Clair Poignard.

The members T.Colin, C.Poignard and O.Saut are involved in the consortium INTCELL directed by P.LEVEQUE (XLIM), and which begun in December 2010. This mutlidisciplinary project, composed of four partners (XLIM laboratory, Vectorology and Anticancer therapies team at the IGR, EDAM and MC2) aims at studying the electropermeabilization by nanopulses at the subcellular level. The goal is to develop new electrical devices and accurate models to understand the electropermeabilization of the cytoplasm constituents such as the nuclear envelop or the mitochondrial membrane, based on the experiments and on the simulations of molecular dynamics.

8.2.5. ANR MEMOVE

Participants: Mathieu Colin, 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) are involved in the consortium MEMOVE coordinanted by MC2 (coordinator C. Poignard), and which begins at the begining 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.

8.2.6. PEPS CaRaMel3d

- Program: PEPS Idex-CNRS
- Project acronym: CaRaMel3d
- Project title: Calibration et Recalage sur l'Imagerie Médicale
- Duration: 07/2012-07/2013
- Coordinator: Olivier Saut
- Other partners: Institut Bergonié, CHU Pellegrin (Bordeaux),
- Abstract: Les médecins de l'Institut Bergonié (centre régional de lutte contre le cancer) s'intéressent à l'évaluation de l'agressivité de métastases dans le poumon. Les modèles mathématiques spatiaux développés par des mathématiciens de l'IMB permettent de décrire la croissance d'une tumeur solide plus ou moins fidèlement. Pour adapter ces modèles à un patient, il faut développer des méthodes pour trouver des valeurs raisonnables de leurs paramètres. Ces modèles calibrés peuvent alors fournir une prédiction numérique de l'évolution des nodules. Une collaboration entre ces deux équipes a déjà permis de développer un modèle et une technique de calibration qui permet d'évaluer cette agressivité en utilisant des coupes 2D. Même si ces résultats sont encourageants, l'aspect 3D de la croissance n'est pas pris en compte. L'objectif de ce projet est de prendre en compte cette 3ème dimension en développant pour cela de nouveaux algorithmes de recalage et de calibration en vue d'une application pratique.

8.3. European Initiatives

8.3.1. FP7 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

8.4. International Initiatives

- Collaboration with Hassan Fathallah, Neuro-oncoly and mathematics, University of Alabama at Birmingham. We work on numerical modeling of brain tumor.
- Collaborations with Luca Zannetti, Politecnico di Torino; Simone Camarri, Universita di Pisa; Eyal Arian, Boeing Commercial Airplanes.
- 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.

7. Partnerships and Cooperations

7.1. Regional Initiatives

The "région *Provence Alpes Côte d'Azur*" partially supports Helen Heninger's PhD. The other part comse from Thales Alenia space, see section 6.1 .

7.2. National Initiatives

7.2.1. 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 in leave from Université de Bourgogne; Jean-Baptiste Caillau collaborates actively with us; there is also an active common seminar http://nolot.perso.math.cnrs.fr/JourneesControleTransport2.html .

7.2.2. GCM (ANR project)

This is a four year project ending in 2013, on Geometric Control Methods, Sub-Riemannian Geometry and Applications. It is organized in four "poles" and gathers people from Université du Sud Toulon-Var, Université de Bourgogne (Dijon), École Polytechnique (Paris), Nancy-Université, Université Joseph Fourier (Grenoble 1), Université Paris Sud, ParisTech ENSTA and Université Nice Sophia-Antipolis. Bernard Bonnard and Ludovic Rifford (leader of one pole) are members of this project. More details on the site; http://www-fourier.ujf-grenoble.fr/~charlot/GCM.html.

7.2.3. MOA (GDR)

Bernard Bonnard and Ludovic Rifford participate in this CNRS network on Mathematics of Optimization and Applications. http://gdrmoa.univ-perp.fr/.

7.3. European Initiatives

Collaborations with Major European Organizations

Technische Universität München, Department of Chemistry (Germany).

The applications of optimal control to MNR (see sections 4.2 and 5.1.2) are conducted with the group of Prof. Steffen Glaser in Munich.

7.4. International Initiatives

Inria International Partners

University of Hawaii, Department of Mathematics (U. S. A.)

There is a lon term collaboration on optimal control and control of quantum systems, see mostly section 5.1.1 . Besides, Gautier Picot, a former Phd student from Dijon has a temporary position at the Math Department and collaborates with M. Chyba and G. Patterson (second Phd student from M. Chyba) in relation with the Laboratoire d'Astronomie de Paris, to apply the Hampath code to make rendez-vous with quasi-asteroids entering in the solar system near the L1-Lagrange point, in the continuation of the work developed by G. Picot and B. Daoud. This collaboration is very active and has to be emphasized.

University of Toronto, Department of Mathematics (Canada)

Optimal Transport. Alice Erlinger's PhD is co-supervised by Ludovic Rifford and John Mc Cann from University of Toronto. See section 5.4 .

7.5. International Research Visitors

7.5.1. *Visits of International Scientists*

Alessio Figalli, from University of Texas at Austin, visited twice, for a total of slightly more than a month.

7.5.2. *Visits to International Teams*

There is a strong collaboration with the control group in the University of Hawaii around M. Chyba. B. Bonnard visited the group twice in 2012-2013 (a total of 3 months). The purpose of the collaboration is to study the aspects of the contrast problem in Nuclear Magnetic Resonance, see section 5.1.1 .

<p align="center" style="color:red">MICMAC Project-Team</p>

7. Partnerships and Cooperations

7.1. Regional activities

The project-team is shared between Inria and Ecole des Ponts ParisTech.

7.2. National Initiatives

The project-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 Micmac team. It is coordinated by E. Cancès.

- I. Dabo is members of the ANR PANELS (Photovoltaics from Ab-initio Novel Electronic-structure Simulations).The PANELS initiative gathers three groups (CNRS, Institut Neel, France; Université de Lyon, LPMCN, France; Ecole des Ponts, Université Paris-Est, CERMICS, France) expert in methodology developments around many-body perturbation theory and a novel orbital-dependent density functional formalism, in order to study the electronic, optical and transport properties of second/third generation photovoltaic devices.

- 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 (CMLS, Ecole polytechnique).

- F. Legoll participates to the ANR Megas.

- T. Lelièvre is in charge of the ANR project "MEGAS".

- T. Lelièvre is member of the ANR-project "BIGMC" (PI: Gersende Fort, Telecom ParisTech) and of the ANR-project "STAB" (PI: I. Gentil, Université de Lyon).

- F. Nier is a member of ANR-NOSEVOL led by F. Hérau (Nantes) T. Ramond (Orsay) and S. Vu-Ngoc (Rennes), started in jan. 2012 for 4 years.

- F. Nier is a member of ANR-LODIQUAS led by F. Castella (Rennes) and N. Mauser (Wien), started in april 2012 for 4 years.

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 CoDFT,

- the GdR Maths et entreprise,

- the GdR correl (correlated methods in electronic structure computations),

- the GDR-CNRS 3274 Dynamique Quantique 2009-2012,

- the GDR-CNRS 2434 Analyse des Equations aux Dérivées Partielles.

The MICMAC team project is involved in two Labex, namely the Labex Bezout (started in 2011) and the Labex MMCD (started in 2012).

We have invited the following National researchers to visit our team:

- A. Lozinski (University of Toulouse and now at the University of Besançon): repeated visits during the year 2012.

7.3. International Initiatives

7.3.1. *Visits of International Scientists*

We have invited the following researchers to visit our team:

- U. Hetmaniuk (University of Washington in Seattle), March 5-16, 2012,
- B. Khoromskij and V. Khoromskaia, (Max-Planck-Institute for Mathematics in the Sciences Leipzig), December 17-20, 2012.
- G. Nguetseng (University of Yaoundé 1, Cameroon), March 19-30, 2012,

7.3.2. *Bilateral international relations*

E. Cancès is involved in a France-Berkeley project on the modelling of solvated molecules.

T. Lelièvre, G. Stoltz and F. Legoll participates 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 Nancy, Université de Lyon and Inria Rennes.

MISTIS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

MISTIS participates in the weekly statistical seminar of Grenoble. F. Forbes is one of the organizers 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.

7.2. National Initiatives

7.2.1. *Competitivity Clusters*

MISTIS is a partner in a three-year (2010-12) MINALOGIC project (I-VP for Intuitive Vision Programming) supported by the French Government. The project is led by VI Technology (http://www.vitechnology.com), a world leader in Automated Optical Inspection (AOI) of a broad range of electronic components. The other partners involved are the CMM (Centre de Morphologie Mathematiques) in Fontainebleau, and Pige Electronique in Bourg-Les-Valence. The overall goal is to exploit statistical and image processing techniques more intensively to improve defect detection capability and programming time based on existing AOI principles so as to eventually reach a reliable defect detection with virtually zero programming skills and efforts.

7.2.2. *ARC Inria*

Florence Forbes is coordinating the 2-year Inria ARC project AINSI (http://thalie.ujf-grenoble.fr/ainsi). AINSI stands for "Modeles statistiques pour l'Assimilation d'Informations de Neuroimagerie fonctionnelle et de perfuSIon cerebrale". The goal is to propose an innovative statistically well-based solution to the joint determination of neural activity and brain vascularization by combining BOLD constrast images obtained in functional MRI and quantitative parametric images (Arterial Spin Labelling: ASL). The partners involved are Visages team from Inria in Rennes and Parietal in Saclay, the INSERM Unit U594 (Grenoble Institute of Neuroscience) and the LNAO laboratory from CEA NeuroSpin.

7.3. European Initiatives

7.3.1. *FP7 Projects*

7.3.1.1. HUMAVIPS

Title: Humanoids with audiovisual skills in populated spaces

Type: COOPERATION (ICT)

Defi: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project (STREP)

Duration: February 2010 - January 2013

Coordinator: Inria (France)

Others partners: CTU Prague (Czech Republic), University of Bielefeld (Germany), IDIAP (Switzerland), Aldebaran Robotics (France)

See also: http://humavips.inrialpes.fr

Abstract: Humanoids expected to collaborate with people should be able to interact with them in the most natural way. This involves significant perceptual, communication, and motor processes, operating in a coordinated fashion. Consider a social gathering scenario where a humanoid is expected to possess certain social skills. It should be able to explore a populated space, to localize people and to determine their status, to decide to join one or two persons, to synthetize appropriate behavior, and to engage in dialog with them. Humans appear to solve these tasks routinely by integrating the often complementary information provided by multi sensory data processing, from low-level 3D object positioning to high-level gesture recognition and dialog handling. Understanding the world from unrestricted s

7.4. International Research Visitors

7.4.1. Internships

MINWOO JAKE LEE (from Jun 2012 until Aug 2012)

Subject: Clustering or classification of high dimensional data in the presence of outliers

Institution: Colorado State University (United States)

El Hadji DEME (from Mar 2012 until May 2012)

Subject: Bias reduction in extreme-value statistics

Institution: Université Gaston Berger (Senegal)

Seydou-Nourou Sylla (from October 2012 to December 2012)

Subject: Classification for medical data

Institution: Université Gaston Berger (Senegal)

<p align="center" style="color:red">MODAL Project-Team</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Institut de Biologie de Lille, Génomique et Maladies Métaboliques lab*

Participants: Christophe Biernacki, Julien Jacques, Loic Yengo.

8.1.2. *Industrial Studies Center, Arcelor-Mittal*

Participants: Clément Thery, Christophe Biernacki.

8.1.3. *Gene Diffusion*

Participants: Julien Jacques, Julie Hamon.

8.1.4. *Institut Pasteur Lille and Institut de Biologie de Lille*

Participant: Guillemette Marot.

- Team "Etudes Transcriptomiques et Génomiques Appliquées"n (D. Hot).
- Team "Peste et Yersinia pestis", (F. Sebbane).
- team "Unité d'approches fonctionnelle et structurale des cancers", O. Pluquet.

8.1.5. *Université de Lille 2*

Participant: Guillemette Marot.

Plate-forme de génomique fonctionnelle et Structurale, (M. Figeac)

8.1.6. *CHRU Lille*

Participant: Guillemette Marot.

Centre de Biologie Pathologie, Laboratoire d'Hématologie, (C. Preudhomme)

8.1.7. *ASEL and CRESGE*

Participant: Cristian Preda.

ASEL (Association Septentrionale pour l'Etude de Lymphomes) and CRESGE (Centre de Recherches Economiques Sociologiques et de Gestion) from Lille

8.2. National Initiatives

8.2.1. *StatLearn'12*

Christophe Biernacki, Alain Ceélisse, Serge Iovleff and Julien Jacques co-organized with Charles Bouveyron (University Paris 1, SAMM) a workshop on "Challenging problems in Statistical Learning", StatLearn'12, in April 2012 in Lille (http://www.inria.fr/en/centre/lille/calendar/workshop-statlearn-12). There were about 80 applicants, 12 one-hour invited talk organized in four sessions: Statistical learning and vizualization, Statistical learning in high dimension, Statistical learning and structured data, New and future problems in statistical learning.

8.2.2. *StatOmique*

Guillemette Marot belongs to the StatOmique working group http://vim-iip.jouy.inra.fr:8080/ statomique/

8.3. European Initiatives

8.3.1. *University of Granada, Department of Statistics and Operational Research*
Participant: Cristian Preda.

Collaboration with Professor Ana Aguilera : teaching at Master and Doctoral level, joint research, ERASMUS mobility and conference organization.

8.4. International Research Visitors

8.4.1. *Nanyang Technology University of Singapore*
Participant: Cristian Preda.

Collaboration with Professor Lian Heng on functional regression models : joint research.

Cristian Preda was invited at NTU from December 3th to December 15th 2012.

NACHOS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. Analysis of children exposure to electromagnetic waves (KidPocket)
   Participants: Stéphane Lanteri, Joe Wiart [WHIST Laboratory, Orange Labs, Issy-les-Moulineaux].

The project-team is a partner of the KidPocket project (Analysis of RF children exposure linked to the use of new networks or usages) which is funded by ANR in the framework of the *Réseaux du Futur et Services* program and has started in October 2009 for a duration of 3 years.
See also the ewb page http://whist.institut-telecom.fr/kidpocket

8.1.2. Competitivity Clusters

8.1.2.1. Volumic, automatic, industrial and generic mesh generation (MIEL3D-MESHER)
   Participants: Clément Durochat, Paul-Louis Georges [GAMMA project-team, Inria Paris - Rocquencourt], Stéphane Lanteri, Mark Loriot [Distene, Pôle Teratec, Bruyères-le-Chatel], Philippe Barabinot [LMS Samtech France].

MIEL3D-MESHER is a national project of the SYSTEM@TIC Paris-Région cluster which aims at the development of automatic hexahedral mesh generation tools and their application to the finite element analysis of some physical problems. One task of this project deals with the definition of a toolbox for the construction of non-conforming, hybrid hexahedral/tetrahedral meshes. In this context, the contribution of the team to this project aims at the development of a DGTD-$\mathbb{P}_p\mathbb{Q}_k$ method formulated on such hybrid meshes. Here, $\mathbb{P}_p$ stands for the polynomial interpolation method on tetrahedral elements while $\mathbb{Q}_k$ denotes the polyomial interpolation method on hexahedral elements.

8.1.3. Large-Scale Initiative

8.1.3.1. 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 [CALVI project-team, Inria Nancy - Grand-Est], Franck Cappello [GRAND-LARGE 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], 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 2012, the team is coordinating the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria large-scale initiative. 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 the C2S@Exa Inria large-scale initiative 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. *Collaborations with Major European Organizations*

Prof. Martin Gander: University of Geneva, Mathematics section (Switzerland)

Domain decomposition methods (optimized Schwarz algorithms) for the solution of the frequency domain Maxwell equations

Dr. Maciej Klemm: University of Bristol, Communication Systems & Networks Laboratory, Centre for Communications Research (United Kingdom)

Numerical modeling of the propagation of electromagnetic waves in biological tissues with biomedical applications

8.3. International Initiatives

8.3.1. *Participation In International Programs*

8.3.1.1. *CNPq-Inria HOSCAR project*
Participant: Stéphane Lanteri [Coordinator of the project].

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 Computação Científica), COPPE/UFRJ (Instituto Alberto Luiz Coimbra de Pós-Graduação 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 Computação Departamento de Computação, Universidade Federal do Ceará). The French partners are research teams from several Inria research centers.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Prof. Martin Gander, University of Geneva, Switzerland, July 2-12

Prof. Jay Gopalakrishnan, Portland University, USA, July 2-6

Dr. Maciej Klemm, University of Bristol, UK, June 18-22

Dr. Sascha Schnepp, ETH Zurich, Switzerland, September 25-27

<div align="center">

NANO-D Team

</div>

7. Partnerships and Cooperations

7.1. Regional Initiatives

We have obtained a regional grant for a PhD student (ARC 2012). The PhD student will be co-advised by Jean-François Mehaut (LIG, Grenoble) and Benjamin Bouvier (IBCP, Lyon), and will develop algorithms for parallel adaptive molecular dynamics simulations.

7.2. National Initiatives

7.2.1. ANR

In 2012, NANO-D received funding from four ANR programs:

- **ANR 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 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).

- **ANR PIRIBio**: 25,000 Euros over four years (2010-2013). We are participating in this project coordinated by Michel Vivaudou at IBS, with Serge Crouzy at CEA/LCBM and Frank Fieschi at IBS.

- **ANR COSINUS**: 85,000 Euros over four years (2009-2012). This project, coordinated by NANO-D (S. Redon), gathers physicists, biologists and computer scientists from five research groups: Xavier Bouju and Christian Joachim at CEMES, Martin J. Field at IBS, Serge Crouzy at CEA/LCBM, Thierry Deutsch and Frederic Lancon at CEA/SP2M (total grant: 380,000 Euros).

7.2.2. 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.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. ADAPT

> Title: Theory and algorithms for adaptive particle simulation
>
> Type: IDEAS
>
> Instrument: ERC Starting Grant
>
> Duration: September 2012 - August 2017
>
> Principal Investigator: Stephane Redon
>
> Coordinator: Inria (France)

7.4. International Research Visitors

7.4.1. Internships

> Georgy CHEREMOVSKIY (from Jul 2012 until Oct 2012)
>
>> Subject: Development of Orientation-Dependent Potential Function for Computational Drug Design
>>
>> Institution: Moscow Institute for Physics and Technology (Russian Federation)

NECS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The 12-months post-doctoral stay of Alireza Esna Ashari has been funded by Inria-Schneider Endowed Chair on Foundations of Component-based Design for Embedded Systems. A. Esna Ashari has been working on distributed estimation and fault detection using wireless sensor networks, under the supervision of F. Garin and A. Kibangou.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ANR VOLHAND

VOLHAND (**VOL**ant pour personne âgée et/ou **HAND**icapée) is a project funded by the ANR (National Research agency). This project, started in October 2009, is a result of collaboration between C. Canudas de Wit and Franck Quaine/Violaine Cahouët (from the biomechanical team of GIPSA-Lab). The project aims at developing a new generation of Electrical power-assisted steering specifically designed for disabled and aged people. Our contribution is to work out new assisted laws that accomodate to the specific mechanical characteristics of this particular driver population. The consortium is composed by: LAMIH, CHRU, Fondation Hopale, GIPSA-Lab, INRETS and JTEKT. More information can be found on-line: http://www.univ-valenciennes.fr/volhand/.

8.2.2. PREDIT

8.2.2.1. MoCoPo

The MOCoPo project (Measuring and mOdelling traffic COngestion and POllution) is funded by the French Ministry in charge of Transport (MEDDTL), through the PREDIT (Research and Innovation in Land Transport Program). The project began in January 2011 and will end up in December 2013. Various research institutes and universities, some teams of the MEDDTL and pollution measurements associations are involved in the project: LICIT (Transport and Traffic Engineering Laboratory, joint unit of IFSTTAR and ENTPE), LTE (Transports and Environment Laboratory, IFSTTAR), LEPSIS (Laboratory for Road Operations, Perception, Simulators and Simulations, IFSTTAR), IM (Infrastructures and Mobility Department, IFSTTAR), MACS (Monitoring, Assessment, Computational Sciences, IFSTTAR), Inria-NECS, Atmo Rhône Alpes, DIR-CE (Center-East Direction of Roads), LRPC Angers (Regional Laboratory of Angers), CERTU (Center for Cities and Urban Transportation), and CEREA (Center of Teaching and Research in Atmospheric Environment, laboratory Ecole des Ponts ParisTech / EDF Research and Development). NeCS is particularly involved in tasks devoted to travel time estimation and prediction. For this purpose one post-doc (Fabio Morbidi) has been recently hired. More information can be found on-line:http://mocopo.ifsttar.fr/.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. FeedNetBack

> Title: FeedNetBack
>
> Type: COOPERATION (ICT)
>
> Defi: Networked embedded and control systems
>
> Instrument: Specific Targeted Research Project (STREP)

Duration: September 2008 - January 2012

Coordinator: Inria (France)

Others partners: ETH Zurich (CH), Universidad de Sevilla (ES), KTH Stockholm (SE), Universita di Padova (IT), Ifremer (FR), Videotec (IT), OMG (GB), Vitamib (FR).

See also: http://feednetback.eu

Abstract: The main objective of the FeedNetBack project is to generate a rigorous co-design framework that integrates architectural constraints and performance trade-offs from control, communication, computation, complexity and energy management. The goal is to master complexity, temporal and spatial uncertainties such as delays and bandwidth in communications and node availability. This approach enabled the development of more efficient, robust and affordable networked control systems that scale and adapt with changing application demands. The project extend the current scientific state-of-the-art in networked control and develop a set of software tools to support the co-design framework.

8.3.1.2. Hycon2

Title: Highly Complex and Networked Control Systems

Type: COOPERATION (ICT)

Defi: Engineering of Networked Monitoring and Control Systems

Instrument: Network of Excellence (NoE)

Duration: September 2010 - August 2014

Coordinator: CNRS (France)

Others partners: Inria (France), ETH Zurich (Switzerland), TU Berlin (Germany), TU Delft (Netherlands) and many others

See also: http://www.hycon2.eu

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.

8.4. International Initiatives

8.4.1. Inria International Partners

- H. Fourati has started a new collaboration with the Kazakhstan National Technical University (KazNTU). He curretly co-advises with Pr. Olga Shiryayeva in KazNTU, Zarina Samigulina PhD student in KazNTU. He also submitted an European project "LA STRADA" with two teams and an SME: Istituto per le Applicazioni del Calcolo "M. Picone" (Università di Roma), the Mathematical Modeling and Scientific Computing Research Group (University of Mannheim) and Karrus (SME).
- F. Garin has collaborations with University of Padova, Italy (S. Zampieri), University of Newcastle, Australia (D. Quevedo), with Lund University, Sweden (G. Como and E. Lovisari), and with KTH Stockholm, Sweden (D. Varagnolo)

8.4.2. Participation In International Programs

8.4.2.1. TeMP

TeMP (Tensor-based Information modelling and Processing) is a project funded in the framework of the French-Brazilian bilateral collaboration program (FUNCAP-Inria). It started from August 2011 for a duration of two years and is coordinated for the French part by A. Kibangou. This project aims to study, analyze, propose and evaluate new models and techniques for digital communication systems using tensors and multilinear algebra tools, through in-depth theoretical analysis of mathematical models, optimization algorithms, and computational simulations. Indeed, new models should be developed for generalizing existing tensor models in order to allow the modeling of a wider class of communication systems for more realistic propagation channels including the cooperation among multiple nodes of a communication network (users or sensors). Due to dynamic change of parameters, tensor-based filtering algorithms need to be developed for information retrieval systems in cooperative communication. These algorithms should be distributed for avoiding network vulnerability and for a better management of computation and storage resources.

8.5. International Research Visitors

8.5.1. *Visits of International Scientists*

- Maria Guinaldo Losada, PhD Student, UNED, Madrid, Spain, 2 months visit (Oct. and Nov. 2012).
- André L.F. de Almeida, Associate Professor, UFC, Brazil, visit within the framework of the TeMP project (January 2012).
- Joao Cesar M. Mota, Professor, UFC, Brazil, visit within the framework of the TeMP project (January 2012).
- Zarina Samigulina, PhD student, Kazakhstan National Technical University (KazNTU), two weeks visit (November 2012).

8.5.2. *Visits to International Teams*

- H. Fourati spent two weeks in Kazakhstan National Technical University (KazNTU), Dec. 2012.
- F. Garin spent three weeks in Lund University during the LCCC focus period on Information and Control in Networks, Oct. 2012.
- A. Kibangou spent three weeks in UFC, Brazil, in two stays (May and Oct. 2012).
- C. Canudas de Wit visited universities of Berkeley (USA), Lund (Sweden), Madrid, Sevilla, and Valencia (Spain).

<p style="text-align:center;color:red;font-weight:bold;">NON-A Project-Team</p>

7. Partnerships and Cooperations

7.1. National Initiatives

- We are 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" and "Control in Electrical Engineering".
- Model-free control: collaborations with Professor Brigitte D'Andréa-Novel at Mines ParisTech and Professor Emmanuel Delaleau at ENIB (Brest).
- Atomic Force Microscope (AFM): application of new algebraic methods in tapping mode for AFM, collaboration with the National Laboratory of Metrology (LNE) located at Trappes.

7.2. European Initiatives

- Collaboration with Sarah Spurgeon of University of Kent on Sliding mode control;
- Collaboration with Emmanuel Brousseau of Cardiff University for the project: "on nano mechanical machining of 3D nano structures by AFM".

7.3. International Initiatives

- Collaboration with Professors Tulay Adali (University of Baltimore, USA) and Daniel Alpay (University of Ben Gurion, Israel) on signal processing.
- Collaboration with Professors Emilia Fridman (Tel Aviv University) and Joao Manoel Gomes da Silva (UFRGS, Porto Allegre, Brasil) on time-delay systems.
- Collaborations with Professor Guiseppe Fedele from University of Calabria, Italy, on "Model-free control".
- Programme Hubert Curien GALILEE for scientific exchange between LAGIS and University of Cagliari, Italy;
- Programme Hubert Curien VOLUBILIS (Maroc, Integrated Action MA/09/211) between LAGIS (Université Lille1), Non-A/Inria and Laboratory of Electronic, Information and Biotechnology of Department of Science at University Moulay Ismail of Meknès;
- Programme Hubert Curien COGITO for scientific exchange between University of Reims Champagne Ardenne, Non-A and University of Zagreb.
- Collaboration and scientific exchanges with Saint-Petersburg National Research University ITMO, Russia, on interval estimation of linear-parameter-varying systems and on spark ignition engine control.
- Collaboration and scientific exchanges with Universidad Nacional Autónoma de México (UNAM) (Prof. L. Fridman) and Autonomous University of Nuevo Leon (Prof. M. Basin), Mexico, on estimation of linear-parameter-varying systems and sliding-mode control.

7.4. International Research Visitors

7.4.1. *Visits of international scientists*

- Emilia Fridman, Professor of Tel Aviv University, Israel, June 2012, supported by École Centrale de Lille;

- Marc Bodson, Professor of University of Utah, USA, June 2012, supported by École Centrale de Lille;
- Michael Basin, Professor of Autonomous University of Nuevo Leon, Mexico, June 2012, supported by a bilateral CNRS project.
- Hebertt Sira Ramírez, Professor of CINVESTAV IPN, Mexico, November 2012, supported by École Centrale de Lille.

7.4.2. Internships

- Stanislav Chebotarev, PhD student of National Research University ITMO, Russia, June 2012, "Interval estimation of LPV systems", supported by ITMO;
- Hector Rios, PhD student of UNAM, Mexico, September–November 2012, "Discrete state estimation for switched LPV systems", supported by UNAM.

OPALE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. Project "OMD2", Optimisation Multi-Disciplinaire Distribuèe (Distributed Multidisciplinary Optimization)

This project funded by ANR deals with the development of a software platform devoted to Multidisciplinary Design Optimization (MDO) in the context of distributed computing.

The notion of optimization platform based on distributed and parallel codes is undertaken with a distributed workflow management system running on a grid infrastructure using the GRID5000 middleware from Inria.

Renault is the coordinator of this project, which involves also EMSE, ENS Cachan, EC Nantes, Université de Technologie de Compiègne, CD-Adapco, Sirehna, Activeon, and Inria project TAO, OASIS and OPALE. This contract provides the grant supporting two PhD theses (A. Zerbinati and L. Trifan)

8.1.2. 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).

8.1.3. Project "Bulbe"

This project is funded by the Ministry of Fishing and gathers OPALE Project-Team, K-Epsilon company (specialized in CFD for naval hydrodynamics) and PROFIL compagnie (naval architect). The objective is to design and optimize bow shapes for trawler ships, in order to reduce the fuel consumption during fishing campaigns. Our role is to construct an automated optimization loop to improve bow efficiency, on the basis of CFD tools provided by K-Epsilon company and naval architect recommendations.

8.1.4. Project "Memoria"

This project is funded by the National Foundation for Aeronautics and Space (FNRAE). The partners are the University of Toulouse Paul-Sabatier and the CERFACS. The objective is to study optimization methods under uncertainty in the context of aerodynamic problems.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. EXCITING

        Title: Exact Geometry Simulation for Optimized Design of Vehicles and Vessels

        Type: COOPERATION (TRANSPORTS)

        Instrument: Specific Targeted Research Project (STREP)

        Duration: October 2008 - Mars 2012

        Coordinator: Jozef Kepler universitet (Austria)

Others partners: SINTEF (SW), SIEMENS (GER), NTUA (GR), HRS (GR), TUM (GER), HYDRO (AUS), DNV (NOR)

See also: http://exciting-project.eu/

Abstract: The objective is to develop simulation and design methods and software based on the isogeometric concepts, that unify Computer-Aided Design (CAD) and Finite-Elements (FE) representation bases. Applications concern hull shape, turbine and car structure design.

8.2.1.2. GRAIN

Title: GReener Aeronautics International Networking

Type: CAPACITIES (TRANSPORTS)

Instrument: Coordination and Support Action (CSA)

Duration: October 2010 - December 2012

Coordinator: CENTRE INTERNACIONAL DE METODES NUMERICS EN ENGINYERIA (Spain)

Others partners: AIRBUS (SP), ALENIA (I), EADS-IW (F), Rolls-Royce (UK), INGENIA (SP), NUMECA (B), U. SHEFFIELD (UK), U. BIRMINGHAM (UK), CIRA (I), VKI (B), AIRBORNE (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), ZJU (CN).

See also: http://www.cimne.com/grain

Abstract: The GReener Aeronautics International Networking (GRAIN) is a 24 month project co-funded by the 7th Framework Programme of the European Community (EC) and by the Chinese Ministry of Industry and Information Technology (MIIT). It is managed by the European Commission as a Coordination and Support Action. The main objectives of GRAIN are to identify and assess the future development of large scale simulation methods and tools needed for greener technologies reaching the Vision 2020 environmental goals. GRAIN will prepare the R&T development and exploitation with new large scale simulation tools used on distributed parallel environments to deeper understand and minimize the effects of aircraft/engine design on climate and noise impact. This objective can be met by supporting joint Europe-China networking actions for defining the necessary technologies to improve green aircraft performance.

8.2.1.3. MARS

Title: Manipulation of Reynolds Stress

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - September 2013

Coordinator: CENTRE INTERNACIONAL DE METODES NUMERICS EN ENGINYERIA (Spain)

Others partners: USFD (UK), AIRBUS (SP), FOI (SW), ALENIA (IT), DLR (GER), CNRS (FR), DASSAULT (FR), NUMECA (BEL), UNIMAN (UK), EADS (UK)

See also: http://www.cimne.com/mars/

Abstract: The objective is to study flow control devices for aeronautical applications. This project gathers twelve European partners and twelve Chinese partners for a common work that includes both experimental and numerical studies. Opale Project-Team is in charge of developing numerical algorithms to optimize flow control devices (vortex generators, synthetic jets).

8.2.1.4. TraM3

Title: TRaffic Management by Macroscopic Models

Type: IDEAS

Instrument: ERC Starting Grant (Starting)

Duration: October 2010 - September 2015

Coordinator: Inria (France)

See also: http://www-sop.inria.fr/members/Paola.Goatin/tram3.html

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.

8.2.2. Collaborations in European Programs, except FP7

Program: PHC Polonium

Project acronym: CROM3

Project title: Crowd Motion Modeling and Management

Duration: jan. 2011 - dec. 2012

Coordinator: P. Goatin (France), M.D. Rosini (Poland)

Other partners: ICM, Warsaw University (Poland)

Abstract: The aim of this collaboration is to provide new analytical and numerical tools for solving control and optimization problems arising in pedestrian traffic management. Our scope is to develop a rigorous analytical framework and fast and efficient numerical tools for solving optimization and control problems, such as buildings exits design. This will allow to elaborate reliable predictions and to optimize traffic fluxes. To achieve this goal, we will study in details the structure of the solutions of the partial differential equations modeling traffic dynamics, in order to construct ad hoc methods to tackle the analytical and numerical difficulties arising in this study.

8.2.3. Collaborations with Major European Organizations

Partner 1: organisme 1, labo 1 (pays 1)

Sujet 1 (max. 2 lignes)

Partner 2: organisme 2, labo 2 (pays 2)

Sujet 2 (max. 2 lignes)

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. ORESTE

Title: Optimal REroute Strategies for Traffic managEment

Inria principal investigator: PaolaGoatin

International Partner (Institution - Laboratory - Researcher):

> University of California Berkeley (United States) - Electrical Engineering and Computer Science (EECS) - Alexandre M. Bayen

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.

8.3.2. Participation In 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.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Senior Researchers

Pr. Ellaia Rachid

  Subject: Theory and algorithms for global and multiobjective optimization.

  Institution: Ecole Mohammadia d'Ingénieurs (EMI) , Rabat (Morocco)

8.4.1.2. Internship

Bouthaina Yahyaoui, Asma Ghdami and Marwa Mokni

  Subject: Multiobjective optimization of laminated composite Mindlin-Reissner plates

  Institution: Institut Supérieur des Mathématiques Appliquées et d'Informatique, Kairouan, (Tunisia)

<p style="text-align:center;color:red;font-weight:bold;">POEMS Project-Team</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- ANR project *AEROSON: Simulation numérique du rayonnement sonore dans des géométries complexes en présence d'écoulements réalistes*
  Partners: EADS-IW, CERFACS, Laboratoire d'Acoutique de l'Université du Maine.
  Start : 10/01/2009, End : 02/28/2013. Administrator : CNRS. Coordinator : Jean-François Mercier.

- 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, DMIA-ISAE.
  Start : 12/01/2011, End : 11/30/2015. 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

8.1.2. Competitivity Clusters

- GDR Ultrasons: this GDR, which regroups more than regroup 15 academic and industrial research laboratories in Acoustics and Applied Mathematics working on nondestructive testing. It has been renoveled this year with the participation of Great Britain.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. SIMPOSIUM

Title: Simulation Platform for Non Destructive Evaluation of Structures and Materials

Type: COOPERATION (ICT)

Defi: PPP FoF: Digital factories: Manufactoring design and product lifecycle manage

Instrument: Integrated Project (IP)

Duration: September 2011 - August 2014

Coordinator: CEA (Pierre Calmont) (France)

Others partners:SERCO LIMITED (UNITED KINGDOM), SIMULAYT LTD (UNITED KING-DOM), SKF SVERIGE AB (SWEDEN), UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II (ITALY), UNIVERSITA DEGLI STUDI DI CASSINO (ITALY), VOLKSWAGEN AG (GERMANY), ARCELORMITTAL MAIZIÈRES RESEARCH SA (FRANCE), EXTENDE (FRANCE), EUROPEAN AERONAUTIC DEFENCE AND SPACE COMPANY EADS FRANCE SAS (FRANCE), IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE (UNITED KINGDOM), SAARSCHMIEDE GMBH FREIFORMSCHMIEDE* (GERMANY), KATHOLIEKE UNIVERSITEIT LEUVEN (BELGIUM), FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V (GERMANY).

See also: http://cordis.europa.eu/projects/rcn/99653_en.html

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- *Sergei Nazarov*, Professor at the University of Saint-Petersbourg.

<p align="center" style="color:red">REALOPT Project-Team</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

Region Aquitaine is supporting a post-doc in our team. Jinil Han has been recruited to contribute to our team effort to develop efficient decomposition based approaches to real-life combinatorial optimization problems. Jinil's research aims at enhancing performance of such approach and prepare the way to high performance computing through parallelization. Jinil's mission extends to problem solving that serves both as a motivation and an proof-of-concept. Jinil has contributed to warm-starting the methods and to convergence acceleration through stabilization techniques [23].

8.2. National Initiatives

8.2.1. CNRS

Pierre Pesneau has got a grant from the OR research group from CNRS to finance mission between Bordeaux and Paris within the context of a collaboration with University Paris 6 (P. Fouilhoux) and University Paris 13 (S. Borne, R. Grappe, M. Lacroix). This collaboration aims to study polyhedral properties and algorithmic aspects to the problem of connected graph partitioning.

8.3. International Initiatives

8.3.1. ANR Gratel

André Raspaud launched in 2005 a fruitful cooperation with the Department of Applied Mathematics of the Sun Yat-Sen University of Kaohsiung, Taiwan. This gave rise to an international ANR project funded for three years (January 2010 - December 2013), that is managed by Arnaud Pêcher and André Raspaud. The scientific priority theme is "Telecommunications", a well-known key application area of graph theory. The aim is to tackle especially wireless communications problems, with the help of graph colorings and polyhedral graph theory. Currently, Sagnik Sen (PhD student of E. Sopena, A. Pêcher, A. Raspaud) benefits from a scholarship on this ANR.

8.3.2. Inria Associate Teams

8.3.2.1. SAMBA

         Title: Combinatorial optimization problems

         Inria principal investigator: François Vanderbeck

         International Partner (Institution - Laboratory - Researcher):

             Pontificia Universidade Catolica do Rio de Janeiro (Brazil) - ATD-Lab - Marcus Poggi

         Duration: 2011 - 2013

         See also: https://wiki.bordeaux.inria.fr/realopt/pmwiki.php/Project/Samba

         The so-called Dantzig-Wolfe decomposition approach has not yet made its way into general purpose solvers for Mixed Integer Programming (MIP). Despite its proved efficiency, the use of the method is currently restricted to specific applications and requires ad-hoc algorithms developed by experts. Our project is to develop general purpose algorithms to make this method generic. We shall focus in particular on (i) preprocessing procedures, (ii) warm-starting, (iii) stabilization (to improve convergence), (iv) strategies for combining cut and column generation, and (v) primal heuristics. The project builds on the accumulated experience of both the Brazilian and the French teams that have done pioneering work in tackling complex applications and deriving generic solution strategies

using this decomposition approach. The new algorithms are implemented and tested in the software platform BaPCod. Hence, the collaborative research on methodological developments should lead to, as a bi-product, a Version 2 of BaPCod as a state-of-the-art Branch-and-Price-and-Cut Solver. This prototype should (i) serve as proof-of-concept code for the research planned in this project and beyond, (ii) enable us to achieve new benchmark results on key problems,(iii) provide incentive for the use of the method by non experts, (iv) leverage technology transfer to industry.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Short term Visitors

- Artur Pessoa, LOGIS, the Universidade Federal Fluminense (UFF), Brazil.
- Oriol Serra, Universitat Politècnica de Catalunya, Spain
- Eduardo Uchoa, LOGIS, the Universidade Federal Fluminense, Brazil.

8.4.1.2. Internships

Diego PECIN, from Pontificade Universitat Catholica (PUC-Rio) from Feb 2012 until Mar 2012

Subject: Comparative study of column generation stabilization techniques

Institution: Federal University of Rio de Janeiro (Brazil)

Alexey KARPYCHEV (from Sep 2012 until Dec 2012)

Subject: Multi-commodity transportation problem with application to the freight service design

Institution: Moscow Institute of Physics and Technology (Russia)

8.4.2. Visits to International Teams

Pierre Pesneau was invited one week (Mars 5th-9th, 2012) by Luis Gouveia (Universidade de Lisboa) to work on time-dependent formulations for the capacitated vehicle routing problem.

Ruslan Sadykov and Francois Vanderbeck have both spend a two-week visit in our associated team at PUC-Rio and UFF in Brazil in March 2012.

<p align="center">**REGULARITY Project-Team**</p>

8. Partnerships and Cooperations

8.1. National Initiatives

Erick Herbin is member of the CNRS Research Groups:

- GDR Mascot Num, devoted to stochastic analysis methods for codes and numerical treatment;
- GDR Math-Entreprise, devoted to mathematical modeling of industrial issues.

8.2. International Initiatives

8.2.1. *Inria International Partners*

- Regularity collaborates with Bar Ilan university on theoretical developments around set-indexed fractional Brownian motion and set-indexed Lévy processes (invitations of Erick Herbin in Israël during five months in 2006, 2007, 2008, 2009 and 2011 and invitation of Prof. Ely Merzbach at Ecole Centrale Paris in 2008, 2009, 2010 and 2011). The PhD thesis of Alexandre Richard is co-supervised by Erick Herbin and Ely Merzbach.

  Erick Herbin was invited to the Mathematics Colloquium (Bar Ilan University, Israel) in July, 2012. Talk: "Haudorff dimension of the graph of Gaussian processes".

- Regularity collaborates with Michigan State University (Prof. Yimin Xiao) on the study of fine regularity of multiparameter fractional Brownian motion (invitation of Erick Herbin at East Lansing in 2010).

- 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.

- Regularity collaborates with Milan University (Prof. Davide La Torre) on the study of certain economic growth models. A joint project has just been selected in the frame of the Galilée program.

8.3. International Research Visitors

8.3.1. *Visits of International Scientists*

Professors Ely Merzbach from Bar Ilan University and Franklin Mendivil from Acadia University have visited the team this year.

8.3.1.1. *Internships*

Ankush GOYAL (from May 2012 until Jul 2012)

Subject: Stochastic calculus with multistable Lévy motion and applications in finance

Institution: IIT Delhi (India)

<div align="center">**SCIPORT Team**</div>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. ECINADS

Sciport is coordinator of the ANR project ECINADS, with CASTOR team, university Montpellier 2, Institut de Mécanique des Fluides de Toulouse and the Lemma company in Sophia-Antipolis. ECINADS concentrates on scalable parallel solution algorithms for state and adjoint systems in CFD, and on the use of this adjoint for mesh adaptation applied to unsteady turbulent flows.

7.2. European Initiatives

7.2.1. FP7 Projects

Program: FP7-PEOPLE-2012-ITN

Project acronym: About Flow

Project title: Adjoint-based optimisation of industrial and unsteady flows

Duration: Nov 2012 - Oct 2016

Coordinator: J.-D. Mueller, Queen Mary University of London

Other partners: Engys (UK), ESI-Group (F), Inria (F), National Technical University of Athens (GR), Rolls Royce (D), RWTH Aachen University (D), Volkswagen AG (D), Warsaw University of Technology (PL).

Abstract: Adjoint-based methods have become the most interesting approach in CFD optimisation due to their low computational cost compared to other approaches. The development of adjoint solvers has seen significant research interest, and a number of EC projects have been funded on adjoint-based optimisation. In particular, partners of this proposal are members of the EC FP7 project FlowHead which develops complete adjoint-based design methods for steady-state flows in automotive design. Integration of the currently available shape and topology modification approaches with the gradient-based optimisation approach will be addressed, in particular development of interfaces to return the optimised shape into CAD for further design and analysis, an aspect that currently requires manual interpretation by an expert user. In industrial practice most industrial flows have small levels of instability, which leads to a lack of robustness and instability of the adjoint, such as trailing edge vortex shedding in turbo-machinery. Many industrial applications are also partly unsteady such as bluff body separation in cars or fully unsteady such as vertical-axis wind turbines. In unsteady adjoints 'checkpoints' of the flow solution at previous timesteps need to be recorded and algorithms for an effective balance between storage and recomputation need to be implemented. The recomputation involves significant memory and runtime overheads for which efficient methods are developed and implemented. The results of the project will be applied to realistic mid-size and large-scale industrial optimisation problems supplied by the industrial project partners ranging from turbo-machinery, to automotive to wind-turbines. Training will be provided by academic, industrial and SME partners in methods development, industrial application and software management. A large programme of complementary training in professional skills will be provided with support from all partners.

7.3. International Initiatives

7.3.1. Inria International Partners

The team's collaboration with the Mathematics and Computer Science (MCS) division of Argonne National Laboratory is recognised by Inria as an "Inria International Partnership". This partnership is named "SARDINE" for "Sophia-Antipolis ARgonne DIfferentiation INitiativE".

7.3.2. Participation In International Programs

The team participates in the Joint Laboratory for Petascale Computing (Inria, University of Illinois at Urbana Champaign, Argonne National Laboratory). Laurent Hascoët gave talks at this year's meetings in Rennes and Argonne.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Trond Steihaug, professor at the University of Bergen, has spent a sabbatical period with the team, from september 2011 to may 2012. He worked on AD of Factorable and of Separable functions [15].

<p align="center">**SELECT Project-Team**</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

SELECT is animating a working group on model selection and statistical analysis of genomics data with the Biometrics group of Institut Agronomique Nationale Paris-Grignon (INAPG).

Pascal Massart is co-organizing a working group at ENS (Ulm) on Statistical Learning. This year the group focused interest on regularization methods in regression. Most of SELECT members are involved in this working group.

SELECT is animating a working group on Classification, Statistics and fMRI imaging with Neurospin.

SELECT is animating a working group on Unsupervised Classification with the CMAP (École Polytechnique)

8.2. European Initiatives

Gilles Celeux and Pascal Massart are members of the PASCAL (Pattern Analysis, Statistical Learning and Computational Learning) network.

8.3. International Initiatives

Gilles Celeux is one of the co-organizers of the Working Group on Model-Based Clustering. This year this workshop took place in Guelph (Canada).

SEQUEL Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Connectome, and large graph mining
Participant: Philippe Preux.

- *Title*: Connectome and epilepsy
- *Type*: No funding yet (self-funded project)
- *Coordinator*: Louise Tyvaert, Department of clinical neurophysiology, CHRU Lille, Université de Lille 2, France
- *Others partners*: Mostrare, Inria Lille
- *Duration*: Began in spring 2012
- *Abstract*: The long term goal of this collaboration is to investigate the use of machine learning tools to analyse connectomes, and possibly related EEG signals, to determine, for a given patient, the region of the brain from which originate epilepsy strokes. As a first step, we concentrate on connectome, that is a graph representation of the connectivity in the brain. We study the properties of these graphs from a formal point of view, and try to match these properties with brain activity, and brain disorders.
- *Activity Report*: being a multi-disciplinary project, the first thing was to understanding each others. Connectomes having been acquired at the hospital via MRI and image processing, the resulting graphs have been processed using a spatially regularized spectral clustering approach; we were able to recover well-known brain areas automatically. Indeed, one of the first issues to clarify is the relevance of the graph representation of these MRI data (connectomes), an issue unclear in the medicine community. These first results have been submitted for publication at the IEEE 2013 symposium on Bio-Imaging (ISBI'2013).

8.2. National Initiatives

8.2.1. DGA/Thales
Participants: Emmanuel Duflos, Philippe Vanheeghe, Emmanuel Delande.

- *Title*: Multi-sensor PHD filtering with application to sensor management (http://www.theses.fr/2012ECLI0001)
- *Type*: PhD grant
- *Coordinator*: LAGIS - Inria Lille - Nord Europe (SequeL)
- *Others partners*: DGA and Thales Communications
- *Web site*: http://www.theses.fr/2012ECLI0001
- *Duration*: *EDIT THIS: 3 years*
- *Abstract*: The defense of this PhD thesis was held in January 2012.
- *Activity Report*:

8.2.2. ANR-Lampada

Participants: Mohammad Ghavamzadeh, Hachem Kadri, Jérémie Mary, Olivier Nicol, Philippe Preux, Daniil Ryabko, Christophe Salperwyck.

- *Title*: Learning Algorithms, Models an sPArse representations for structured DAta
- *Type*: National Research Agency (ANR-09-EMER-007)
- *Coordinator*: Inria Lille - Nord Europe (Mostrare)
- *Others partners*: Laboratoire d'Informatique Fondamentale de Marseille, Laboratoire Hubert Curien ; Saint Etienne, Laboratoire d'Informatique de Paris 6.
- *Web site*: http://lampada.gforge.inria.fr/
- *Duration*: ends mid-2014
- *Abstract*: Lampada is a fundamental research project on machine learning and structured data. It focuses on scaling learning algorithms to handle large sets of complex data. The main challenges are 1) high dimension learning problems, 2) large sets of data and 3) dynamics of data. Complex data we consider are evolving and composed of parts in some relations. Representations of these data embed both structure and content information and are typically large sequences, trees and graphs. The main application domains are web2, social networks and biological data.

  The project proposes to study formal representations of such data together with incremental or sequential machine learning methods and similarity learning methods.

  The representation research topic includes condensed data representation, sampling, prototype selection and representation of streams of data. Machine learning methods include edit distance learning, reinforcement learning and incremental methods, density estimation of structured data and learning on streams.

- *Activity Report*: Philippe Preux has collaborated with Ludovic Denoyer and Gabriel Dulac-Arnold from LIP'6 to investigate further the idea of datum-wise representation, introduced in 2011, and originally published at ECML/PKDD'2011. This eventually led to a deeped presentation in the *Machine Learning Journal*.

  They also studied the reinforcement learning problem in the case of a large but not infinite number of actions (hundreds, or thousands discrete actions). They introduced the use of Error-correcting output codes to deal with this setting, proposed, and studied two RL algorithms that take advantage of an ECOC-based representation of actions. The idea was published at ECML/PKDD'2012 and other conferences (EWRL workshop held as part of the ICML conference, and French ones).

  Hachem Kadri and Philippe Preux have continued their work on machine learning for functional data. They introduced an algorithm for multiple operators learning. Along with Mohammad Ghavamzadeh, they only introduced a operator-based aprroach for structured output.

  Danil Ryabko and colleagues have obtained new results on nonparametric clustering of time-series data. In particular, a fully online clustering algorithm has been developed; we have also shown how to use binary classification methods for clustering time series.

8.2.3. ANR EXPLO-RA

Participants: Alexandra Carpentier, Mohammad Ghavamzadeh, Jean-François Hren, Alessandro Lazaric, Rémi Munos, Daniil Ryabko.

- Title: EXPLOration - EXPLOitation for efficient Resource Allocation with Applications to optimization, control, learning, and games
- Type: National Research Agency
- Coordinator: Inria Lille - Nord Europe (SequeL, Rémi Munos)

- Others partners: Inria Saclay - Ile de France (TAO), HEC Paris (GREGHEC), Ecole Nationale des Ponts et Chaussées (CERTIS), Université Paris 5 (CRIP5), Université Paris Dauphine (LAM-SADE).

- Duration: 2008-2012.

- See also: https://sites.google.com/site/anrexplora/

- Activity Report: We developed bandit algorithm for planning in Markov Decision Processes based on the optimism in the face of uncertainty principle.

8.2.4. ANR CO-ADAPT

Participants: Alexandra Carpentier, Rémi Munos.

- *Title*: Brain computer co-adaptation for better interfaces

- *Type*: National Research Agency

- *Coordinator*: Maureen Clerc

- *Other Partners*: Inria Odyssee project (Maureen Clerc), the INSERM U821 team (Olivier Bertrand), the Laboratory of Neurobiology of Cognition (CNRS) (Boris Burle) and the laboratory of Analysis, topology and probabilities (CNRS and University of Provence) (Bruno Torresani).

- *Web site*: https://twiki-sop.inria.fr/twiki/bin/view/Projets/Athena/CoAdapt/WebHome

- *Duration*: 2009-2013

- *Abstract*: The aim of CoAdapt is to propose new directions for BCI design, by modeling explicitly the co-adaptation taking place between the user and the system. The goal of CoAdapt is to study the co-adaptation between a user and a BCI system in the course of training and operation. The quality of the interface will be judged according to several criteria (reliability, learning curve, error correction, bit rate). BCI will be 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. From the point of view of the system, it is important to devise adaptive learning strategies, because the brain activity is not stable in time. How to adapt the features in the course of BCI operation is a difficult and important topic of research. We will investigate Reinforcement Learning (RL) techniques to address the above questions.

- *Activity Report*: See https://twiki-sop.inria.fr/twiki/bin/view/Projets/Athena/CoAdapt/WebHome

8.2.5. ANR AMATIS

Participant: Pierre Chainais.

- *Title*: Multifractal Analysis and Applications to Signal and Image Processing

- *Type*: National Research Agency

- *Coordinator*: Univ. Paris-Est-Créteil (S. Jaffard)

- *Duration*: 2011-2015

- *Other Partners*: Univ. Paris-Est Créteil, Univ. Sciences et Technologies de Lille and Inria (Lille, ENST (Telechom ParisTech), Univ. Blaise Pascal (Clermont-Ferrand), and Univ. Bretagne Sud (Vannes), Statistical Signal Processing group at the Physics Department at the Ecole Normale Supérieure de Lyon, one researcher from the Math. Department of Institut National des Sciences Appliquees de Lyon and two researchers from the Laboratoire d'Analyse, Topologie et Probabilités (LAPT) of Aix-Marseille University.

- *Abstract*: Multifractal analysis refers to two concepts of different natures : On the theoretical side, it corresponds to pointwise singularity characterization and fractional dimension determination ; on the applied side, it is associated with scale invariance characterization, involving a family of parameters, the scaling function, used in classification or model selection. Following the seminal ideas of Parisi and Frisch in the mid-80s, these two components are usually related by a Legendre transform, stemming from a heuristic argument relying on large deviation and statistical thermodynamics prin-

ciples : The multifractal formalism. This led to new theoretical approaches for the study of singularities of functions and measures, as well as efficient tools for classification and models selection, that allowed to settle longstanding issues (e.g., concerning the modeling of fully developed turbulence). Though this formalism had been shown to hold for large classes of functions of widely different origins, the generality of its level of validity remains an open issue. Despite its popularity in applications, the interactions between theoretical developments and applications are unsatisfactory. Its use in image processing for instance is still in its infancy. This is partly due to discrepancy between the theoretical contributions mostly grounded in functional analysis and geometric measure theory, and applications naturally implying a stochastic or statistical framework. The AMATIS project aims at addressing these issues, by proposing a consistent and documented framework combining different theoretical approaches and bridging the gap towards applications. To that end, it will both address a number of challenging theoretical issues and devote significant efforts to elaborating a WEB platform with softwares and documentation. It will combine the efforts of mathematicians with those of physicists and experts in signal and image processing. Dissemination among and interactions between scientific fields are also intended via the organization of summer schools and workshop.

- *Activity Report*: a collaboration with P. Bas (CR CNRS, LAGIS) has started on the steganalysis of textured images. While steganography aims at hiding a message within some support, e.g. a numerical image, steganalysis aims at detecting the presence or not of any hidden message in the support. Steganalysis involves two main tasks: first identify relevant features which may be sensitive to the presence of a hidden message, then use supervised classification to build a detector. While the steganalysis of usual images has been well studied, the case of textured images, for which multifractal models may be relevant, is much more difficult. Indeed, textured images have a rich and disordered content which favors hiding information in an unperceptible manner. A student internship of 6 months at Master level has finished in November. The purpose was to explore the potential of new multiscale wavelet based discriminant features for steganalysis.

8.2.6. National Partners

- Inria Nancy - Grand Est, Team MAIA, France.
  - Bruno Scherrer *Collaborator*
    We have had collaboration on the topics of *approximate dynamic programming and statistical learning* and *high-dimensional reinforcement learning* this year. On the first topic, we have published a conference paper [47] and a technical report [62], and on the second one we have published a conference paper [36] together.
- Supélec, IMS Research Group, Metz, France.
  - Matthieu Geist *Collaborator*
    We have had collaboration on the topics of *approximate dynamic programming and statistical learning* and *high-dimensional reinforcement learning* this year. On the first topic, we have published a conference paper [47] and a technical report [62], and on the second one we have published a conference paper [36] together.
- LIP'6, UPMC, Paris, France.
  - Ludovic Denoyer *Collaborator*
    We have a collaboration on the topic of *reinforcement learning, sparse representation*. We have worked on the datum-wise representation of data, as well as the handling of large but non infinite sets of actions. See section 8.2.2 for further details.

8.3. European Initiatives

8.3.1. FP7 Projects

PASCAL-2

Participants: the whole SEQUEL team is involved.

- *Title*: Pattern Analysis, Statistical Modeling, and Computational Learning
- *Type*: Cooperation (ICT), Network of Excellence (NoE)
- *Coordinator*: Univ. Southampton
- *Others partners*: Many european organizations, universities, and research centers.
- *Web site*: http://www.pascal-network.org/
- *Duration*: March 2008 - February 2013

PASCAL-2 Pump Priming Programme

Participants: Mohammad Ghavamzadeh, Rémi Munos.

- *Title*: Sparse Reinforcement Learning in High Dimensions
- *Type*: PASCAL-2 Pump Priming Programme
- *Partners*: Inria Lille - Nord Europe, Shie Mannor (Technion, Israel)
- *Web site*: http://sites.google.com/site/sparserl/home
- *Duration*: November 2009 - September 2012
- *Abstract*: With the explosive growth and ever increasing complexity of data, developing theory and algorithms for learning with high-dimensional data has become an important challenge in statistical machine learning. Although significant advances have been made in recent years, most of the research efforts have been focused on supervised learning problems. We propose to design, analyze, and implement reinforcement learning algorithms for high-dimensional domains. We will investigate the possibility of using the recent results in l1-regularization and compressive sensing in reinforcement learning.
- *Activity report*: The project ended early this year. The list of publications obtained within the project is listed at https://sites.google.com/site/sparserl/publications.

CompLACS

Participants: Mohammad Ghavamzadeh, Nathan Korda, Prashanth Lakshmanrao Anantha Padmanabha, Alessandro Lazaric, Rémi Munos, Philippe Preux, Daniil Ryabko, Michal Valko.

- *Title*: Composing Learning for Artificial Cognitive Systems
- *Type*: Cooperation (ICT), Specific Targeted Research Project (STREP)
- *Coordinator*: University College of London
- *Other partners*: University College London, United Kingdom (John Shawe-Taylor, Stephen Hailes, David Silver, Yee Whye Teh), University of Bristol, United Kingdom (Nello Cristianini), Royal Holloway, United Kingdom (Chris Watkins), Radboud Universiteit Nijmegen, The Netherlands (Bert Kappen), Technische Universitat Berlin, Germany (Manfred Opper), Montanuniversitat Leoben, Austria (Peter Auer), Max-Planck Institute of Biological Cybernetics, Germany (Jan Peters).
- *Web site*: http://www.complacs.org/
- *Duration*: March 2011 - February 2015
- *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.

- *Activity report*: We worked on WorkPackage 2 (multi-armed bandits and extensions) and we designed hierarchical bandit-based planning algorithms for MDPs and POMDPs.

8.4. International Initiatives

8.4.1. Inria Associate Teams
SEQRL
- *Title*: Decision-making under Uncertainty with Applications to Reinforcement Learning, Control, and Games
- *Inria principal investigator*: Rémi Munos
- *International Partner*:
    – *Institution*: University of Alberta (Canada)
    – *Laboratory*: Department of Computer Science
    – *Principal investigator*: Csaba Szepesvári
- *Duration*: January 2010 - January 2013
- *Website*: http://sites.google.com/site/associateteamualberta/home
- *Abstract*: This associate team aims at bridging researchers from the SequeL team-project at Inria Lille with the Department of Computing Science of the University of Alberta in Canada. Our common interest lies in machine learning, especially reinforcement learning, bandit algorithms and statistical learning with applications to control and computer games. The department of Computing Science at the University of Alberta is internationally renown as a leading research institute on these topics. The research work spans from theory to applications. Grounded on an already existing scientific collaboration, this associate team will make it easier to collaborate further between the two institutes, and thus strengthen this relationship. We foresee that the associate team will boost our collaboration, create new opportunities for financial support, and open-up a long-term fruitful collaboration between the two institutes. The collaboration will be through organizing workshops and exchanging researchers, postdoctoral fellows, and Ph.D. students between the two institutes.
- *Activity report*: This year we had two Ph.D. students from the university of Alberta, Yasin Abbasi and Bernardo Avila Pires, who visited SequeL for six and four weeks, respectively. We send our Ph.D. student Amir Sani to a workshop organized by the university of Alberta and McGill university in Barbados in April. Mohammad Ghavamzadeh had a one week visit to the university of Alberta to work with Csaba Szepesvári and Bernardo Avila Pires.
- *Joint Publications*: We have one conference paper submitted [53] and one in preparation [61] this year.

8.4.2. Inria International Partners
- University of Alberta, Edmonton, Alberta, Canada.
    – Prof. Csaba Szepesvári *Collaborator*
    – Bernardo Avila Pires *Collaborator*
      With Csaba Szepesvári we managed the associate team with the university of Alberta. We have had several visits to SequeL and UAlberta this year. We also have a conference paper [61] on *risk bounds in cost-sensitive multiclass classification* in preparation with Csaba Szepesvári and Bernardo Avila Pires.

- McGill University, Montreal, Quebec, Canada.
    – Prof. Joelle Pineau *Collaborator*
    – Prof. Doina Precup *Collaborator*
    – Amir massoud Farahmand *Collaborator*
      Mohammad Ghavamzadeh and Rémi Munos wrote a proposal with Joelle Pineau, Doina Precup, and Amir Farahmand to start an associate team with the McGill university. Mohammad Ghavamzadeh also have a conference paper submitted [53] on *classification-based approximate policy iteration* with Amir Farahmand and Doina Precup.

- Technion - Israel Institute of Technology, Haifa, Israel.
    – Prof. Shie Mannor *Collaborator*
      Mohammad Ghavamzadeh continued his collaboration with Shie Mannor. This year, we co-authored a book chapter on *Bayesian reinforcement learning* [57].

- University of Waterloo, Waterloo, Ontario, Canada.
    – Prof. Pascal Poupart *Collaborator*
      Mohammad Ghavamzadeh continued his collaboration with Pascal Poupart. This year, we co-authored a book chapter on *Bayesian reinforcement learning* [57].

- University of Waterloo, Waterloo, Ontario, Canada.
    – Prof. Carl Haas *Collaborator*

- University of Waterloo, Waterloo, Ontario, Canada.
    – Prof. Giovani Cascante *Collaborator*

- Politecnico di Milano, Italy.
    – Prof. Marcello Restelli *Collaborator*
    – Prof. Nicola Gatti *Collaborator*
      We continued our collaboration on transfer in reinforcement learning and we developed a novel collaboration focused on the interplay between bandit theory and mechanism design, notably in the sponsored search auction application domain [35].

- Technicolor Research, Palo Alto.
    – Branislav Kveton *Collaborator*
      We have an ongoing collaboration related to the sequential graph-based learning. This involves both theory and the application to industry, such as sequential face recognition. Currently we investigate the problem of face detection from a single labeled face and the streams of unlabeled data.

8.5. International Research Visitors

- Ronald Ortner, from University of Leoben, Austria.
  Period: spent his sabbatical Jan-Oct 2012 with us. Some papers as a result of this collaboration are [43], [44]; some more are under submission.

- Gusztav Morvai, senior research at Budapest University of Technology and Economics.
  Period: Oct 18-24, 2012

- Tor Lattimore, Ph.D. student at Australian National University.
  Period: Nov. 2-9, 2012

- Bernardo Avila Pires
  Period: May 2012 (one month)
  He worked with Mohammad Ghavamzadeh on *risk bounds in cost-sensitive multiclass classification*. The outcome of this collaboration has been a conference paper in preparation [61] so far.

- Joelle Pineau
  Period: September 2012 (one week)
  Prof. Pineau visited SequeL for one week as a part of her sabbatical. During her stay, in addition to have discussions with SequeL team members and giving two talks on her research, she wrote a proposal with Mohammad Ghavamzadeh and Rémi Munos to start an associate team between SequeL and McGill university.

- Pr. Giovanni Cascante, University of Waterloo, Waterloo, Ontario, Canada.
  Period: June 2012
  He worked with Philippe Vanheeghe and Emmanuel Duflos on parameters estimation in acoustic probing in civil engineering. The outcome of this collaboration has been a project master (from November 2012) and a proposition of research project under evaluation the University of Waterloo so far.

8.5.1. Internships

- Louis Dacquet, student at Ecole Centrale Lille.
  Period: April-June 2012.
  He worked with Pierre Chainais on *blind image deconvolution*.

- Alexandre Kazmierowski, student at Ecole Telecom ParisTech.
  Period: June-July 2012.
  He worked with Pierre Chainais and Antoine Gloria (SIMPAF project) on textured models for heterogeneous media and homogeneization theory in PDEs.

- Phuong Nguyen, Ph.D. student at Australian National University.
  Period: 15 February - 30 April 2012
  He worked with Daniil Ryabko on state representation for reinforcement learning. As a result, one paper is submitted and one is being prepared.

- Florian Gas, Student at the Ecole Centrale de Lille, France.
  Period: May 2012 - July 2012.
  He worked with Emmanuel Duflos on foundations of Sequential Monte Carlo Methods in high dimension

<h1 style="text-align: center; color: red;">SIERRA Project-Team</h1>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. Calibration

Participant: Sylvain Arlot.

S. Arlot, Membre du projet ANR Calibration

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/

8.1.1.2. Detect

Participants: Sylvain Arlot, Francis Bach, Rémi Lajugie.

Title: New statistical approaches to computer vision and bioinformatics

Coordinator: Ecole Normale Supérieure (Paris)

Leader of the project: Sylvain Arlot

Other members: J. Sivic (Willow project-team, ENS), A. Celisse (University Lille 1), T. Mary-Huard (AgroParisTech), E. Roquain and F. Villers (University Paris 6).

Instrument: ANR, Young researchers Program

Duration: Sep 2009 - Aug 2012

Total funding: 70000 Euros

See also: http://www.di.ens.fr/~arlot/ANR-DETECT.htm

Abstract: The Detect project aims at providing new statistical approaches for detection problems in computer vision (in particular, detecting and recognizing human actions in videos) and bioinformatics (e.g., simultaneously segmenting CGH profiles). These problems are mainly of two different statistical nature: multiple change-point detection (i.e., partitioning a sequence of observations into homogeneous contiguous segments) and multiple tests (i.e., controlling a priori the number of false positives among a large number of tests run simultaneously).

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. SIERRA

Participants: Francis Bach [correspondant], Simon Lacoste-Julien, Augustin Lefèvre, Nicolas Le Roux, Mark Schmidt.

Title: SIERRA – Sparse structured methods for machine learning

Type: IDEAS

Instrument: ERC Starting Grant (Starting)

Duration: December 2009 - November 2014

Coordinator: Inria (France)

See also: http://www.di.ens.fr/~fbach/sierra

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: the tenet of this proposal is that to achieve the expected breakthroughs, this two-stage paradigm should be replaced by an integrated process where the

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. STATWEB

Participants: Francis Bach [correspondant], Ronny Luss.

Title: Fast Statistical Analysis of Web Data via Sparse Learning

Inria principal investigator: Francis Bach

International Partner (Institution - Laboratory - Researcher):

> University of California Berkeley (United States) - EECS and IEOR Departments - Laurent El Ghaoui

Duration: 2011 - 2013

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.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Michael Jordan (U.C. Berkeley, http://www.cs.berkeley.edu/~jordan), is spending one year in our team, starting September 2012, financed by the Fondation de Sciences Mathématiques de Paris and Inria.

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Collaborations within Inria

       MICMAC (M. Rousset)

       REO (A. Gloria)

       COFFEE (E. Creusé and C. Calgaro)

       POEMS (C. Besse and I. Lacroix-Violet)

       CORIDA (C. Besse)

       IPSO (C. Besse)

8.1.2. ANR

8.1.2.1. ANR MICROWAVE (2009-2012)

Participants: Christophe Besse, Ingrid Lacroix-Violet.

Ch. Besse and I. Lacroix-Violet are members of the new 4-years ANR "blanche" project MICROWAVE. Ch. Besse is the North node coordinator. The scientific subjects deal with artificial boundary conditions for dispersive equations, electromagnetism and high frequency regimes in acoustic simulations. This ANR project concerns the development of new numerical methods for wave propagation problems using tools from microlocal analysis. It focuses on microlocal analysis and numerical methods for acoustic and electromagnetic wave scattering and microlocal analysis and numerical methods for Schrödinger-type equations.

8.1.2.2. ANR IODISSEE (2009-2012)

Participants: Christophe Besse, Pauline Lafitte.

C. Besse has obtained a 4-years ANR grant, from the Cosinus proposal, for the project IODISSEE. P. Lafitte and C. Yang, also members of the EPI Simpaf, are involved in this project. The project IODISSEE also involves a team of mathematicians from Toulouse, a physicist team from Versailles and the Thales group. It deals with the elaboration of a physical model for helping the industrial partner for the new generation of Galileo satellites. For the last decade, satellite positioning devices became one of the most interesting means of navigation for the displacement of the goods and the people. The only current solution is based on the constellation of satellites Navstar GPS American system. Originally developed for military applications, its use was released under the Clinton administration. However, in order to guarantee its autonomy, Europe decided to launch a competitor program known as Galileo. Galileo system differs from the GPS thanks to its capability to provide real time integrity information to the user. In order to guarantee the stability of this system, it is fundamental to take into account the various problems which can affect the mission and to identify all the potential sources of system unavailability. One of the main source of data unavailability that has been identified is the phenomena of ionospheric scintillations. Indeed scintillation causes radio frequency signal amplitude fades and phase variations as satellite signals pass through the ionosphere. Such effects may induce loss of lock or cycle slips on ranging signals broadcast by Galileo satellites making them totally useless for accurate integrity information determination. Scintillations are clearly identified like a source of disturbances. They appear as the turbulent aspect of a larger disturbance of the ionospheric plasma density which have the shape of a plasma bubble. The difficulty of their modelling is due to the lacks of in situ measurements with regard to them. However, some measurements recently acquired during the mission of satellite DEMETER make possible on the one hand the validation of the models existing but also, using techniques of data-models coupling, to reinforce them. The object of this proposal is therefore to provide a physical model making it possible to anticipate the attenuation of the signals during their propagation within the disturbed Earth ionosphere.

8.1.2.3. ANR MEGAS (2009-2012)
Participant: Mathias Rousset.

M. Rousset is involved in the ANR MEGAS. The main scientific subject is numerical methods in Molecular Dynamics simulation.

8.1.2.4. ANR INTOCS (2009-2012)
Participant: Pauline Lafitte.

The main scientific subject of the project is the interaction of compressible waves, and more precisely the propagation of high frequency oscillations in hyperbolic boundary value problems. One of the physical motivations is the "Mach stems" formation in reacting gas flows. The head of the project is JF Coulombel (Univ. Nantes), former member of SIMPAF.

8.1.2.5. ANR AMAM (2011-2014)
Participant: Antoine Gloria.

A. Gloria is involved in the 4-year ANR project "young researcher" AMAM, led by V. Millot (Paris 7). The aim of the project is to develop mathematical tools for the analysis of multiscale problems in material sciences (PDEs and variational methods). The fields of interest are primarily micromagnetics, dislocations, fatigue in nonlinear elasticity, and homogenization.

8.1.2.6. ANR STAB (2013-2017)
Participant: Pauline Lafitte.

STAB (starting in 2013) : Most of the natural time-evolving systems that one encounters in Physics, Biology, Economics..., can be described by means of evolution equations, or systems of such equations. These equations may include randomness or not. During the last decade, a lot of progress has been made in the understanding of the stabilization of these dynamics, i.e. their convergence to equilibrium. In particular the picture of the qualitative description of the rate of convergence is now almost complete for symmetric models (reversible dynamics). However, the non-reversible setting is still unsufficiently understood. One of the most fascinating features of this research area is the strong intricacy between the analysis of partial differential equations and stochastic methods, each approach enlightening the other one. The main goal of this project is to go further, developing tractable and efficient tools, in particular for numerical schemes and algorithms, based on the computation of explicit theoretical bounds. Hence, even if part of the project is devoted to the theoretical study of non-reversible or highly degenerate situations (we typically have to face kinetic or reaction-diffusion models for example), the heart of the project will include discretization schemes, approximating particle systems and concrete simulation situations (including boundary conditions). This concerns the stability of the discretization or numerical methods. The acronym STAB covers both aspects: stabilization and stability. Indeed, sensitivity to small perturbations (or to boundary conditions) is the first definition of large time stability for numerical schemes. The head of the project is I. Gentil (Univ. Lyon1).

8.1.3. Competitivity Clusters

8.1.3.1. LABEX Centre Européen pour les Mathématiques, la Physique et leurs Interactions – CEMPI (2012-2019)

The "Laboratoire d'Excellence" CEMPI was created by the French government within the framework of its "Projets d'Investissement d'Avenir" program, in February 2012. It is a joint venture of the Laboratoire Paul Painlevé (mathematics) and the Laboratoire Physique des Lasers, Atomes et Molecules (PhLAM). Several members of CEMPI participate actively in the CEMPI research and training project, notably through the focus area "The interaction of mathematics and physics". The corresponding research is described in Sections 3.2.4 and 3.5 .

8.2. European Initiatives

8.2.1. Collaborations with Major European Organizations

Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany (F. Otto)

Quantitative homogenization theory (see Section 3.2.1)

TAO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **JASMIN**– 2010-2012 (205 kEur). DRIRE *programme FEDER.*
  Participants: CADLM, Intercim, TAO (Michèle Sebag) .

- **CSDL**– 2009-2012 (290 kEur). FUI System@tic (Région Ile de France grant). *Complex System Design Lab*
  Participants: Anne Auger, Nikolaus Hansen, Ilya Loshchilov, Raymond Ros, Verena Heidrich-Meisner, Marc Schoenauer.

- **TIMCO**– 2012-2015 (432 kEur). FUI-System@tic (Région Ile de France grant).
  Participants: Cécile Germain, Marc Schoenauer, Lovro Ilijasic.

8.2. National Initiatives

- **OMD2** – 2009-2012 (131 kEur).*Optimisation Multi-Disciplinaire Distribuée*, ANR *programme COSINUS* Coordinator Maryan Sidorkiewicz, RENAULT Technocentre;
  Participants: Anne Auger, Yohei Akimoto, Nikolaus Hansen, Marc Schoenauer, Olivier Teytaud.

- **SyDiNMaLaS** – 2009-2012 (158 kEur).*Integrating Symbolic Discovery with Numerical Machine Learning for Autonomous Swarm Control*, ANR *programme BLANC* Coordinator Michèle Sebag, CNRS;
  Participants: David Meunier, Marc Schoenauer, Michèle Sebag.

- **TRAVESTI** – 2009-2012 (206 kEur).*Estimation du volume de Trafic par Interface Spatio-temporelle*, ANR *programme SYSCOMM 2008* Coordinator Cyril Furtlehner, Inria;
  Participants: Anne Auger, Cyril Furtlehner, Victorin Martin, Maxim Samsonov.

- **ASAP** – 2009-2013 (178 kEur). *Apprentissage Statistique par une Architecture Profonde*, ANR *programme DEFIS 2009* Coordinator Alain Rakotomamonjy, LITIS, Université de Rouen, France;
  Participants: Sylvain Chevallier, Hélène Paugam-Moisy, Sébastien Rebecchi, Michèle Sebag.

- **IOMCA** 2010-2013 (264 kEur). Including Ontologies in Monte-Carlo Tree Search and Applications, ANR international project coordinated by O. Teytaud (Tao, Inria).
  Participants: Adrien Couëtoux, O. Teytaud.

- **EXPLORA** 2010-2012 (289 kEur, to be shared with Inria Lille). EXPLOitation pour l'Allocation efficace de Ressources. Applications l'optimisation. ANR Project coordinated by R. Munos (Inria Lille).
  Participants: David Auger, Olivier Teytaud.

- **DESCARWIN** 2010-2013 (201 kEur). Coordinateur P. Savéant, Thalès.
  Participants: Mostepha-Redouane Khouadjia, Marc Schoenauer.

- **SIMINOLE** 2010-2014 (1180k, 250k 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, Djalel Benbouzid, Nikolaus Hansen, Michèle Sebag, Cécile Germain

- **NUMBBO** 2012-2016 (290k for TAO). Analysis, Improvement and Evaluation of Numerical Black-box Optimizers, ANR project, Coordinator Anne Auger, Inria. Other partners: Dolphin, Inria Lille, Ecole des Mines de Saint-Etienne, TUD Dortmund
  Participants: Anne Auger, Nikolaus Hansen, Marc Schoenauer, Ouassim Ait ElHara

- **LOGIMA** 2012-2016 (136k 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

8.2.1. Other

- **GCO** - 2011-2012) *Green Computing Observatory* PEPS-INS2I. Coordinator Cécile Germain. Participants: Cécile Germain, Julien Nauroy, Michèle Sebag.
- **GO** (2011-2013) *Observatoire de la Grille* Action de Développement technologique Inria. Coordinator Cécile Germain. Participants: Dawei Feng, Cécile Germain, Julien Nauroy, Michèle Sebag. Also funded by the France Grilles national initiative.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. SYMBRION

Title: Symbiotic Evolutionary Robots Organisms

Type: COOPERATION (ICT)

Defi: Embedded systems design

Instrument: Integrated Project (IP)

Duration: February 2008 - January 2013

Coordinator: Universität Stuttgart (Germany)

Others partners: Almende, Netherlands; Universität Graz, Austria; Universität Karlsruhe, Germany; Vlaams Interuniversitair Instituut Voor biotechnologie VZW, Blegium; University of the West of England, Bristol, United Kingdom; Eberhard Karls Universität Tübingen, Germany; University of York, United Kingdom; Université libre de Bruxelles, Belgium; Inria, France.

See also: http://symbrion.eu

8.3.1.2. MASH

Title: Massive Sets of Heuristics For Machine Learning

Type: COOPERATION (ICT)

Defi: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project (STREP)

Duration: January 2010 - December 2012

Coordinator: IDIAP Research Institute (Switzerland)

Others partners: Centre National de la Recherche Scientifique, France; Weierstrass-Institut fur Angewandte Analysis Und Stochastik, Part of Furschungsverbund Berlin E.V, Germany; Inria, France; Ceske Vysoke Uceni Technicke V Praze,Czech Republic.

See also: http://mash-project.eu/

Abstract: The Mash project is about massive crowd-sourcing. It is based on several artificial applications. We however used the codes also for our favorite applications, because the original Mash applications have nearly no user, which make it hard to have massive crowd-sourcing; for our applications, we have a moderate number of users, but at least they are motivated. Our contributions are twofolds:

- Building solvers on top of existing expert solvers; this is quite related to our Metis platform (Section 5.1) and our work on Minesweeper and on the mixing of direct policy search and Monte-Carlo Tree Search;

- Adapting solvers for cases in which we can not "undo" on the problem, i.e. if we apply a decision, we can not come back to the previous time step; this makes planning much harder and slower. This is developped in [63].

8.3.1.3. CitInES

Title: City and Industry Energy Strategy

Type: COOPERATION (ICT)

Defi: Design of a decision support tool for sustainable, reliable and cost-effective e

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2011 - March 2014

Coordinator: Artelys (France)

Others partners: Artelys (http://www.artelys.com), Inescp (http://www2.inescporto.pt/, Portugal), Ait (http://www.ait.ac.at/, Austria), Armines (Ecole des Mines, Paris http://www.ensmp.fr), Tupras (http://www.tupras.com.tr, Turkey), Ervet (http://www.ervet.it/, Italy), Schneider (http://www.schneider-electric.com), Cesena (Italy), Bologna (Italy)

See also: http://www.citines.com

Abstract: According to OECD, 67% of world energy is used by cities and 70% of CO_2 emissions come from cities. Therefore, optimizing urban energy investments is a key challenge for reducing polluting emissions and financial exposition to fuel price uncertainties. However, the definition of a sustainable, reliable and cost-effective energy strategy requires to simulate the whole energy chain (consumption, transport, distribution, storage, production) with different types of energy (electricity, gas, heat, wind, waste, etc.) and to assess the environmental and financial impacts of various long-term scenarios (fuel prices, consumption scenarios, etc.).

Local authorities facing this issue have today only partial answers to these questions (simulation of a given type of energy, of a part of the energy chain only or without any long-term risk assessment) and lack a global analysis.

The goal of the CitInES project is to design and develop decision-support software to help local authorities / industries to :

- Assess and compare energy strategies through detailed energy chain simulations
- Optimize local energy strategy to cost-effectively integrate green energy and reduce CO_2 emissions
- Define robust energy schemes to face fuel price uncertainties.

The CitInES project is financed by the European Commission, under 7th Framework Programme. It gathers:

- 4 high-level research centers (INESCP for electric system modelling, AIT for building and energy infrastructure planning, ARMINES for long-term energy strategies and Inria for optimization algorithms)
- 1 SME specialized in decision-support software in the energy field (Artelys, leader of the consortium)
- 2 well-known industrial groups (Schneider Electric for its expertise in electric systems; TUPRAS, Turkish refineries as end-user) and 1 national company (ERVET for its expertise in energy processes)
- 2 large cities (Cesena and Bologna as end-users).

8.3.1.4. EGI-Inspire

Title: Integrated Sustainable Pan-European Infrastructure for Researchers in Europe

Type: Research Infrastructures (CP-CSA)

Defi: European Grid Infrastructure Ecosystem

Instrument: Integrated Project (IP)

Duration: May 2010 - April 2014

Coordinator: EGI.eu (Netherlands)

Others partners: 50 institutions, coordinator for France: CNRS.

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

Abstract: The EGI-InSPIRE project supports the transition from a project-based system to a sustainable pan-European e-Infrastructure, by supporting 'grids' of high-performance computing (HPC) and high-throughput computing (HTC) resources. EGI-InSPIRE supports the establishment of a sustainable model for a European Grid Infrastructure (EGI) that integrates resources contributed by national and domain-specific resource providers. Key to this process is a new organisation, EGI.eu, coordinator on behalf of the European resource provider community of the EGI-InSPIRE project. The EGI is a federation of independent national and domain specific resource providers, who support specific research communities and international collaborators both within Europe and worldwide.

8.3.2. Collaborations in European Programs, except FP7

Program: COST

Project acronym: Action IC0804

Project title: Energy Efficiency in Large Scale Distributed Systems

Duration: January 2009 - May 2013

Coordinator: IRIT

Other partners: see http://www.cost804.org

Abstract: The main objective of the Action is to foster original research initiatives addressing energy awareness/saving and to increase the overall impact of European research in the field of energy efficiency in distributed systems.

8.3.3. Collaborations with Major European Organizations

Partner 1: organisme 1, labo 1 (pays 1)

Sujet 1 (max. 2 lignes)

Partner 2: organisme 2, labo 2 (pays 2)

Sujet 2 (max. 2 lignes)

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 Electricity Generation

Inria principal investigator: Olivier Teytaud

International Partner (Institution - Laboratory - Researcher):

>   National University of Tainan (Taiwan) - Ontology Application and Software Engineering - Chang-Shing Lee

Duration: 2012 - 2014

See also: http://www.lri.fr/~teytaud/indema.html

The objectives of the project are three-folds:

- Objective 1: Designing consistent iterative realistic algorithms for partially observ- able 1-player or 2-player games. We mean:

    – consistent algorithms, in the sense that they are mathematically, provably, optimal asymptotically in the computation time.

    – iterative algorithms in the sense that when you give more time to the algorithm, it should be better; and with little time, it should do its best for replying something acceptable. This is also termed an anytime algorithm. Most algorithm which survive decades are iterative.

    – realistic algorithms; we mean that one can easily design a consistent iterative algorithm that will never work in practice in a real-world setting; so, additionally, we want an algorithm which looks reasonnable and we refer to the second objective for the assesment of this property

  We consider our work on MineSweeper[31] and combining Mcts and Dps [38] as realizations of this principle; we also apply this principle for real applications in the related Citines project.

- Objective 2: Impressive visible applications, e.g. applications in games or puzzles, because such games are very clear assessment tools. Possibilities include Minesweeper (on which we believe that much progress is still possible), Chinese Dark Chess, Kriegspiel, Phantom-Go, card games. Such nice results are critical for advertising and assessing our research. Since the beginning of the project, we had results on MineSweeper, Urban Rivals.

- Objective 3: Big industrial applications. Having both mathematics and visible real- izations in games and industrial applications might be considered as too much; yet, we have chosen to request the maximum possible funding and to include many people in the travelling; also, the persons in the project are all people working in related subjects, with various terminologies, and we already have concrete applications in mind, just far enough from our past activities for being new (we want to tackle in a principled manner partial observability which was somehow ignored in many past works) and close enough for strongly reducing the "warm up" time. In the fully observable case, we worked successfully for these three objectives and want to do the same in the partially observable case. More precisely, when working on real applications in the field of energy generation, we have seen that many problems are simplified so that they boil down to fully observable problems, but that this is a bad application; and our solvers must include some tricks for the partial observability. This is the main motivation for this project; 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. We believe that requirements above (objective 1) and visible realizations will facilitate the migration to real-world application; also we point out that previous research projects involving us facilitated contacts with industry, in particular in the field of energy generation, which is a key point for this third objective. A roadmap for objective 3 is as follows:

    – Check on simple versions of energy production problems whether the fully observable approximation is ok. We guess that in many cases it is not ok, and we want to clearly state to which extent (by how many percents) we loose in terms of loss function.

    – Experiment our algorithms on real industrial problems. We will work both on Taiwan-centered and on Europe-Centered electricity generation problems in order to widen the scope of the analysis and so that both partners can be helpful in terms of applications in their own countries.

  We have made papers related to energy management, including papers in very applied conferences. We are in the process of creating a company in Taiwan, hopefully during the

2nd semester of 2013. One student (Adrien Couëtoux) has spent 6 months there, another student has spent 5 months; Adrien just starts a second 6 months stay there.

8.4.2. Inria International Partners

8.4.2.1. Microsoft Research Cambridge

Within the *Microsoft-Inria Joint Lab*, the collaboration with Youssef Hamadi (Microsoft Research Cambridge), through the *Adapt* project, has been pursued, in spite of the departure of the 2 PhD students Alvaro Fialho and Alejandrao Arbelaez. Nadjib Lazaar and Manuel Loth have been hired as post-doc, and a new collaboration with Christian Shulte (KTH Stockholm) based on the use of Bandit algorithm within GECODE has recently given its first results [52] (see Section 3.2).

8.4.3. Participation In International Programs

- The UCT-SIGhas started a collaboration with Inria Chile around energy management; for the moment this is only preliminary discussions (a few face-to-face meetings in Paris, a visioconference with Inria Chile).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Christian Shulte (Software and Computer Systems, School of Information and Communication Technology, KTH - Royal Institute of Technology in Stockholm, Sweden), Jan. 24-27, to initiate the generic implementation of Bandit algorithms in Gecode (see Section 3.2).
- Visits from a Taiwanese delegation, see the Franco-Taiwanese week. This included visits to Univ. Paris-Sud, to other universities (Paris-Nord, Limoges), to companies working around energy.
- One month visit from Cheng-Wei Chou, Taiwanese ph.D. student from National Dong-Hwa University.
- Francis Maes, Post-doc, Leuven University, Leuven, Nov. 20 to Dec. 21.
- One week visit from Muneki Yasuda associate professor in the department of Information science, Tohoku University.

Xiangliang ZHANG (25-31 October 2012)

Continued collaboration on large scale clustering.

Institution: KAUST-King Abdullah University of Science and Technology (Saudi Arabia)

8.5.1.1. Internships

Christopher DELGADO (from Apr 2012 until Sep 2012)

Subject: Designing lean classifiers for detectors and triggers

Institution: Massachusetts Institute of Technology (United States)

Gaurav MAHESHWARI (from Apr 2012 until Sep 2012)

Subject: Sampling-based statistical analysis in large-scale physics experiments

Institution: IIT HYDERABAD (India)

Mauro DI MASSO (from Mar 2012 until Sep 2012)

Subject: Evolutionary Adaptation and the Emergence of Speciation in a Population of Autonomous Robots

Institution: National University of Rosario (Argentina)

8.5.2. Visits to International Teams

- Olivier Teytaud has made a one-year visit (August 2011 to July 2012) in National University of Tainan, Taiwan, and to many other universities.

TOSCA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- N. Champagnat and D. Villemonais are members of the ANR MANEGE (Modèles Aléatoires eN Écologie, Génétique et Évolution, started in 2009) 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. In addition, the three working groups that operate in each of the three poles of the MANEGE project (Paris, Palaiseau, Marseille) gather all local probabilistic interests in the issues of this project. http://www.cmap.polytechnique.fr/~anr-manege/index_en.html

- N. Champagnat is member of the ANR MODECOL (Using mathematical MODeling to improve ECOLogical services of prairial ecosystems, which ended in August 2012), whose goal is to develop computational ecological modeling of terrestrial plants communities via the simulation of a prairie in relation with environmental data. This project focuses on developing an original tool-box that takes advantage of complementary mathematical disciplines (partial differential equations, individual-based stochastic modelling...) to assess ecological problems. Simulations will be extensively processed using distributed computing and webcomputing. Our target application concerns the setup of herbal strips around intensive cereal fields for purificating water from extra nitrate and pesticides, imposed by the European Common Agricultural Policy. http://ecobio.univ-rennes1.fr/modecol/gb/description.php

- S. Herrmann, J. Inglis, D. Talay and E. Tanré are member of the ANR MANDy (Mathematical Analysis of Neuronal Dynamics, started in 2009 under the direction of M. Thieullen, Univ. Paris 6). This project, which gathers mathematicians and neuroscientists, aims at developing mathematically rigorous approaches to neuroscience considering single neurons as well as interconnected neuronal populations. Our target is to conduct the mathematical analysis of existing models where there is still much work to be done and to enrich the modelling by proposing new models. See http://www.proba.jussieu.fr/pageperso/thieullen/MANDy/accueil.html for a more complete description of this project.

- A. Lejay is member of the ANR SIMUDMRI (Simulation of diffusion MRI signals in biological tissues) which started in November 2010 (directed by Jing-Rebecca Li, Inria Rocquencourt). http://www.cmap.polytechnique.fr/~jingrebeccali/grants/simudmri.html

- 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, Jacques Morice.

Carbon value and carbon tax in the context of renewable energies deployment Since January 2009, M. Bossy was member of a collaboration funded by the French Environment and Energy Management Agency (ADEME), involving the Center for Applied Mathematics (CMA) at Mines ParisTech, and COPRIN and TOSCA teams at Inria Sophia Antipolis. It focuses on a short term carbon value derived from the so-called financial *carbon market*, the European Union Emission Trading Scheme (EU ETS), which is a framework for GHG emissions reduction in European industry.

The objective of this project is to study the compatibility and complementarity of a carbon tax and a target for renewable energy deployment. As a first step, we are developing a method for assessing the EU ETS value. We consider the constraints related to emission allowances distributed through national plans of allocation (NAP) and the mechanisms of taxes that are taking place. The work will focus on electricity producers, key players in the market in its first phase (NAP-I, 2005-2007). The impact of the *Renewable Energies* park of the electricity producers on their own carbon value will be particularly studied.

We have selected the financial concept of indifference price as a relevant methodology to assess the European Union Emission Trading Scheme (EU ETS) value. In this setting, modelling strategies of production and emission of market quotas rely on stochastic optimal control problems and associated Hamilton-Jacobi-Bellman equations.

This year, we worked on game theoretic approach for the carbon market price, in the framewrok of a cap&trade program. Based on the Nash equilibrium concept, we derive an equilibrium price equation for the allowances. The analysis of this equation and its wellposedness strongly depend on the design of the penalty function.

The final report [30] synthesizes of the results of all the work of this 2009-2012 ADEME Convention

8.1.3. Promotion of Mathematics in the industry

D. Talay is the Vice-President of the Fondation d'Entreprise Natixis which aims to contribute to develop research in quantitative finance. He also serves as a member of the Scientific Committee of the Foundation.

D. Talay is a member of the Scientific Committee of the AMIESNational Agency aimed to promote interactions between Mathematics and Industry.

8.2. European Initiatives

8.2.1. FP7 Projects

- A. Lejay participates to the *Multifractionality* (action Marie Curie *International Research Staff Exchange Scheme* FP7-PEOPLE-IRSES-2008) with Nancy, Kiev, Israël and Cardiff (2009–2012).

8.3. International Initiatives

8.3.1. Inria Associate Team: ANESTOC

Title: Stochastic modelling of renewable energies

Inria principal investigator: Denis Talay

International Partner (Institution - Laboratory - Researcher):

Pontificia Universidad Católica de Chile (Chile) - ANESTOC - Rolando Rebolledo

Duration: 2011 - 2013

See also: http://www.anestoc.cl/es/?page_id=1112

This associate team complements a CIRIC research program in Chile. We refer to the TOSCA-ANESTOC project on stochastic modelling of renewable energies, especially wind farms, and oceanic resources. Our associate team ("équipe associée Inria") will conduct its joint research at two different levels. Firstly, the mathematical work on its own which we have called the "Mathematical Kernel" (MK), motivated by a number of fundamental problems raised by the specific applications in which we are interested. The second level of research concerns two main axes of Applications: (A1) Applications to Engineering (Renewable energies) and (A2) Applications to Neuroscience. The Mathematical Kernel includes a number of fields in the domains of Stochastic Analysis, Statistics and Numerical Analysis. In particular, it is worth mentioning the following: 1. Probabilistic resolution of Boussinesq non-linear partial differential equations; 2. Stochastic approach to Pope's equations on wind dynamics; 3. Open system dynamics as a bridge between Molecular Dynamics and Stochastic

Differential Equations; 4. Inference on Stochastic Processes; 5. Algorithms and simulation. The Applications include the stochastic modelling of renewable energy through ocean resources and wind farms (CIRIC-subproject). This subject will be developed with engineers of the Catholic University of Chile. In addition, applications to ion-channel dynamics through cell membranes will be considered jointly with biophysicists of the CINV (Neuroscience Centre of Valparaíso).

8.3.2. Inria International Partners

- TOSCA participates to the NCCR FINRISK (Financial Risk) forum launched by the Swiss National Science Foundation and managed by the University of Zürich.

8.3.3. Participation In International Programs

- D. Talay was the international coordinator of the MathAmsud program 08MATH05 - Stochastic Analysis and Mathematical Physics Research Network which started in 2009, also involved M. Bossy, A. Lejay and E. Tanré, and ended this year.
- M. Bossy, , A. Lejay, D. Talay and E. Tanré are members of the CIRIC project *Stochastic Analysis of Renewable Energies: Ocean Energy and Wind Farms; dynamics and numerics* with Chile.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- L. Beznea (Simion Stoilow of the Institute of Mathematics of the Romanina Academy) has been visiting TOSCA Nancy for five weeks in April, November and December.
- Patricio Orio (Univ. of Valparaiso) visited TOSCA Sophia-Antipolis one week in October.
- The TOSCA *seminar* organized by J. Charrier and J. Inglis in Sophia Antipolis has received the following speakers: Rolando Rebolledo (Universidad de Chile), François Dufour (Université Bordeaux), Nicole El Karoui (Ecole Polytechnique, Palaiseau), Huyên Pham (Université Paris Diderot), Pierre Patie (Université Libre de Bruxelles), Pierre-Louis Lions (Collège de France), Nicolas Perrin (Inria Sophia Antipolis – Méditerranée), Philip Protter (Columbia University, USA), Mathieu Rosenbaum (CREST), Nicolas Bouleau (ENPC), Jean Jacod (Université Pierre et Marie Curie, Paris), Jonathan Mattingly (Duke University, USA), Patricio Orio (Universidad de Valparaìso, Chile), Carl Graham (Ecole Polytechnique, Palaiseau).

8.4.2. Internships

Souhail BOUKHEROUAA (from Mar 2012 until Aug 2012)
> Subject: Evaluation of Value-at-Risk and applications to portfolio management
> Institution: Université de Lorraine and Alphability

Yi LU (from May 2012 until July 2012)
> Subject: Asymptotic expansions methods for options prices.
> Institution: École Polytechnique

Rajarshi SARKHAR (from March 2012 until August 2012)
> Subject: The First Passage Time Problem
> Institution: University of Nice - Master Erasmus Mundus Mathmodes

Khaled SALHI (from Feb 2012 until Jun 2012)
> Subject: Uncertainties and stochastic volatility models
> Institution: Ecole Polytechnique de Tunisie (Tunisia)

8.4.3. Visits to International Teams

- M. Deaconu was invited one week by Fabio Nobile at the *Ecole Polytechnique Fédérale de Lausanne* in July.
- A. Lejay spend a month at the Bernoulli Center at Ecole Polytechnique Fédérale de Lausanne during the SPDE Semester.
- E. Tanré has visited University of Valparaìso and Pontifical University in Chile in January and March.

ABS Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. *Projets Exploratoires Pluridisciplinaires from CNRS/Inria/INSERM*

Reconstruction by Data Integration (RDI) is an emerging paradigm to reconstruct large protein assemblies, as discussed in section 4.1.3 .

Elaborating on our Toleranced Models framework, a geometric framework aiming at inherently accommodating uncertainties on the shapes and positions of proteins within large assemblies, we ambition within the scope of the two year long PEPS project entitled *Modeling Large Protein Assemblies with Toleranced Models* to (i) design TOM compatible with the flexibility of proteins, (ii) develop graph-based analysis of TOM, and (iii) perform experimental validations on the NPC.

6.2. European Initiatives

6.2.1. *FP7 Projet*

6.2.1.1. CG-Learning

Title: Computational Geometric Learning (CGL)

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: November 2010 - October 2013

Coordinator: Friedrich-Schiller-Universität Jena (Germany)

Others partners: Jena Univ. (coord.), Inria (Geometrica Sophia, Geometrica Saclay, ABS), Tech. Univ. of Dortmund, Tel Aviv Univ., Nat. Univ. of Athens, Univ. of Groningen, ETH Zürich, Freie Univ. Berlin.

See also: http://cglearning.eu/http://cglearning.eu/

Abstract: *The Computational Geometric Learning project aims at extending the success story of geometric algorithms with guarantees to high-dimensions. This is not a straightforward task. For many problems, no efficient algorithms exist that compute the exact solution in high dimensions. This behavior is commonly called the curse of dimensionality. We try to address the curse of dimensionality by focusing on inherent structure in the data like sparsity or low intrinsic dimension, and by resorting to fast approximation algorithms.*

6.3. International Research Visitors

6.3.1. *Internships*

- From May to July 2012, summer internship from Pratik Kumar (Indian Institute of Technology of Bombay). Topic: Modeling density maps in cryo electron microscopy.

<p style="text-align:center">**AMIB Project-Team**</p>

6. Partnerships and Cooperations

6.1. Regional Initiatives

J. M. Steyaertwas the coordinator of RNA-omics Digiteo project, P. Clote (Boston College) being a Digiteo chair until June 2012.

A. Denise is the coordinator of the "Japarin-3D" Digiteo project 2012-2016. This project, in collaboration with PRISM at Versailles, aims to develop new efficient approaches for predicting the 3D structure of large RNA molecules, by applying game theory and graph algorithms.

6.2. National Initiatives

6.2.1. ANR

A. Denise is coordinator of the ANR project AMIS ARN 2009-2012 (ANR-09-BLAN-0160) and is involved in the NSD-NGD ANR project 2010-2014. Y. Ponty is involved in the MAGNUM ANR project (BLAN program, 12/2010–12/2014).

6.3. International Initiatives

6.3.1. Inria Associate Teams

6.3.1.1. ITSNAP

Title: Intelligent Techniques for Structure of Nucleic Acids and Proteins

Inria principal investigator: Julie Bernauer

International Partner (Institution - Laboratory - Researcher):

SLAC National Accelerator Laboratory (United States) - Stanford Synchrotron Radiation Laboratory - Henry van den Bedem

Stanford University (United States) - Computational Structural Biology, School of Medicine, Structural Biology - Michael Levitt

Duration: 2012 - 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. Participation In International Programs

J.Bernauer is coordinator with Pr. X. Huang at the Hong-Kong University of Science and Technology of a Partenariat Hubert Curien (PHC) Procore project (2012-2013). The project is entitled *Computational studies of conformational dynamics of the RNA-induced silencing complex and design of miRNAs to target oncogenes*.

Adrien Rougny, an internship student supervised by C. Froidevaux in AMIB, has successfully applied for the 2nd call of 2012 "NII International Internship Program". In February 2013, he will start an internship at NII for an Internship in Pr. Katsumi Inoue's group on the topic "Inference and Learning for Systems Biology and Network Dynamics".

M. Régnier and D. Sherman (MAGNOME-INRIA) participate to a joint project CARNAGE of France-Russia program.

6.4. International Research Visitors

6.4.1. Visits of International Scientists

R. Giegerich

Institution: Bielefeld University (Germany)

Subject: Efficient algorithms for RNA secondary structure alignment.

Funding: DGAR (Ecole Polytechnique)

R. Giegerich visited the AMIB project-team for a month. He taught dynamic-programming to the students of the BIBS master. He initiated a collaboration on sparsification, an algorithmic technique that speeds up dynamic programming algorithm. A comprehensive review on RNA structure alignment algorithms, to appear in a forthcoming book, was also written during his stay.

J. Waldispühl

Institution: McGill University (Canada)

Subject: RNA design and tertiary structure prediction.

Funding: DIGITEO (LRI)

J. Waldispühl visited AMIB for a month. He finalized a collaboration on RNA design (Y. Ponty, leading to [16]), established a new collaborative research (with A. Denise and Y. Ponty, on tertiary motifs), laid the foundations of a future X-UPSud exchange program, initiated a workshop on molecular interactions (with J. Bernauer), and started a PhD co-supervision (A. Soulé, co-supervised with J.-M. Steyaert and Y. Ponty).

X. Huang

Subject: Millisecond dynamics at atomic resolution by Markov State Models

Institution: Hong Kong University of Science and Technology (Hong-Kong)

A. Sim

Subject: Modeling RNA by hierarchical natural moves

Institution: Stanford University (USA) / A*STAR (Singapore)

L. Pereyaslavets

Subject: Critical assessment of non bonded part of force fields

Institution: Stanford University (USA)

Y. Okamoto

Subject: Protein folding, unfolding, and ligand docking by computer simulations

Institution: Nagoya University (Japan)

6.4.1.1. Internships

A. Martirosyan (March-Jul 2012)

Subject: A Dynamical Model for the Transmembrane Potential Regulation by pH

Institution:Cergy University (Pontoise)

Funding: INRIA

Supervision:L. Paulevé and M. Régnier

B. Brancotte (March-July 2012)

Subject: Designing a framework to compare biological data ranking methods

Institution: Paris-Sud University (France)

Funding: INRIA

Supervision: S. Cohen-Boulakia and A. Denise

Gh.Fievet (March-Sept 2012)

Subject: Improving MPAS software

Institution: Paris-Sud University (France)

Funding: Ecole Polytechnique

Supervision:J.M. Steyaert

J. Weaver (Jun-Aug 2012)

Subject: Efficient Motif Discovery and Evaluation

Institution: Massachusetts Institute of Technology (United States)

Funding: MIT France program

Supervision: Y. Ponty and M. Régnier

A. Menard (Jun-Aug 2012)

Subject: Extending JalView's RNA interconnection with Varna

Institution: Université Paris-Sud

Supervision: Y. Ponty and J. Procter (Univ. Dundee, Scotland)

A. Soulé (Jun-Aug 2012)

Subject: Prediction of RNA-RNA interactions in yeast

Institution: Ecole Polytechnique

Supervision: Y. Ponty and J.-M. Steyaert

V. Arendt (Jun-Aug 2012)

Subject: Integrating RNA web services into JalView using Jabaws

Institution: Duke University (United States)

Funding: Google Summer of Code program

Supervision: Y. Ponty and J. Procter (Univ. Dundee, Scotland)

T. Coulmy & N. Duhamel (Jun-Jul 2012)

Subject: Average-case property analysis of workflows based on hypergraphs

Institution: Université Paris-Sud

Supervision: S. Cohen-Boulakia and Y. Ponty

F.K. Sheong (May-Aug 2012)

Subject: RNA structural design by docking and machine learning

Institution: The Hong Kong University of Science and Technology (Hong Kong, (China))

L. Uroshlev (Oct-Nov 2012)

Subject: Reference state for RNA KB potentials

Institution: IOGEN (Moscou, (Russia))

A. Bari (Oct 2012)

Subject: stress-inducible miRNAs

Institution:El Farabi University (Almaty, (Kazakhstan))

<p style="text-align:center; color:red;">**ASCLEPIOS Project-Team**</p>

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 Projects

7.1.1.1. VPH NOE

Participants: Benoît Bleuzé [correspondant], Olivier Clatz, Maxime Sermesant, Nicholas Ayache.

medinria registration toolbox VPH NOE standards

Title: VPH NoE

Type: COOPERATION (ICT)

Defi: Virtual Physiological Man

Instrument: Network of Excellence (NoE)

Duration: June 2008 - November 2012

Coordinator: University College London, UK

Others partners: Core members include UCL (UK), Oxford (UK), CNRS (FR), ULB (BE), U. of Nottingham (UK), UPF (ES), U. Auckland (NZ), EMBL (DE), U. Sheffield (UK), Karolinka (SE), ERCIM (FR), IOR (IT).

See also: http://www.vph-noe.eu/

Abstract: The Virtual Physiological Human Network of Excellence (VPH NoE) is a EU seventh Framework funded project, working to connect and support researchers in the VPH field within Europe and beyond. Inria is one of the core members, and is more dedicated, through Asclepios, to the data fusion part of the VPH toolkit. More precisely, a registration toolbox has been delivered which aims at including registration algorithms from the team and elsewhere into the new version of MedInria (2.x).

7.1.1.2. EUHEART

Title: euHeart

Type: COOPERATION (ICT)

Defi: Virtual Physiological Man

Instrument: Integrated Project (IP)

Duration: June 2008 - May 2012

Coordinator: Philips Technologie GmbH Forschungslaboratorien (Germany)

Others partners: Philips Technologie GmbH (DE), The University of Oxford (UK), Universitat Pompeu Fabra (SP), The University of Sheffield (UK), Inria, French National Research Institute in Informatics and Mathematics (FR), King's College London (UK), Academisch Medisch Centrum bij de Universiteit van Amsterdam (NL), Universität Karlsruhe (TH) (DE), Institut National de la Santé et de la Recherche Médicale, INSERM (FR), Philips Medical Systems Nederland BV (NL), Berlin Heart GmbH (DE), HemoLab BV (NL), Universitätsklinikum Heidelberg (DE), Volcano Europe SA / NV (BE), Hospital Clínico San Carlos de Madrid (SP), Philips Ibérica S.A. (SP)

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

Abstract: The euHeart project (Ref 224495), is a 4-year integrated European project which aims at developing personalized, and clinically validated multi-physics, multi-level models of the heart and great vessels. Those models need to be tightly integrated with signal and image processing tools in order to assist clinical decision making and to help reducing morbidity and mortality rates associated with cardiovascular diseases. Asclepios is leading a workpackage on radiofrequency ablation for which electromechanical models of the heart are used to improve the planning of radiofrequency ablation lines for patient suffering from atrial fibrillation and ventricular tachycardia. The research performed in this project is partially described in section 5.4.3 and 5.4.4 .

7.1.1.3. MedYMA

Title: Biophysical Modeling & Analysis of Dynamic Medical Images

Type: IDEAS ()

Instrument: ERC Advanced Grant (Advanced)

Duration: April 2012 - March 2017

Coordinator: Inria (France)

See also: http://www.inria.fr/en/centre/sophia/news/medical-imagery-and-i.t.-the-personalised-digital-patient

Abstract: During the past decades, exceptional progress was made with in vivo medical imaging technologies to capture 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 generative 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 on their principled biophysical and statistical foundations, these new models will bring a 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 the 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. Collaborations in European Programs, except FP7

7.1.2.1. Care4Me

Participants: Xavier Pennec [Correspondant], Nicholas Ayache, Hervé Delingette, Kristin McLeod, Erin Stretton, Maxime Sermesant, Marco Lorenzi.

Program: ITEA2

Project acronym: Care4Me

Project title: Cooperative Advanced REsearch for Medical Efficiency

Duration: Sept. 2009 - Sept. 2013

Coordinator: Philips, NL.

Other partners: Alma (ES), Bull (FR), CEA (FR), CIMNE (ES), Compasiss (ES), CVSS (ES), Duodecim (FI), Erasmus MC (NL), ESI (NL), HSP (ES), Helsinki Hosp. (FI), ISI (GGR), LUMC (NL), MediConsult (FI), MEDIS (NL), Nokia (FI), Philips (NL), Pie Medical Imag. (NL), Pohjola (FI), Prowellness (FI), Robotiker (ES), UMC (NL), VTT (FI)

Abstract: This project aims at increasing quality and productivity in the healthcare care cycle by using more advanced medical imaging and decision support methods while combining them with different knowledge sources, from early diagnosis to treatment and monitoring. The final outcome of this project are clinical prototypes of novel medical image analysis and decision support systems for three specific disease areas (cancer, cardio-vascular and neurodegenerative diseases), that connect to the hospital information systems using a new system architecture. In this project, the role of the Asclepios team is to develop atlas of the ageing brain and the beating heart, and to model tumor growth.

7.2. International Initiatives

7.2.1. *Inria Associate Teams*

Title: Analysis of structural MR and DTI in neonates

Inria principal investigator: Pierre Fillard [Parietal]

Asclepios investigator: Xavier Pennec

International Partner (Institution - Laboratory - Researcher):

> University of Pennsylvania (United States) - Penn Image Computing and Science Laboratory - Caroline Brun

International Partner (Institution - Laboratory - Researcher):

> Institution: University of Southern California (United States)
>
> Laboratory: Image Lab at Children Hospital at Los Angeles
>
> Researcher: Natasha Leporé

Duration: 2011 - 2013

See also: http://www.capneonates.org/

While survival is possible at increasingly lower gestational ages at birth, premature babies are at higher risk of developing mental disorders or learning disabilities than babies born at term. A precise identification of the developmental differences between premature and control neonates is consequently of utmost importance. Nowadays, the continuously improving quality and availability of MR systems makes it possible to precisely determine, characterize and compare brain structures such as cortical regions, or white matter fiber bundles. The objective of this project is to understand the developmental differences of premature versus normal neonates, using structural and diffusion MRI. This work consists in identifying, characterizing and meticulously studying the brain structures that are different between the two groups. To do so, we join forces between the Parietal team at Inria and the University of Southern California. Parietal has a recognized expertise in medical image registration and in statistical analyses of groups of individuals. USC has a broad knowledge in MR image processing. In particular, the Children's Hospital at Los Angeles (CHLA), which is part of USC, is in the process of collecting a unique database of several hundreds of premature and normal neonates MR scans. This joint collaboration is consequently a unique chance of addressing key questions pertaining to neonatal and premature development. It will make it possible to elaborate new tools to analyze neonate MR images while tremendously increasing our knowledge of neuroanatomy at such an early stage in life.

7.2.1.1. COMPUTUMOR

Title: Computational Brain Tumor

Inria principal investigator: Olivier Clatz

International Partner:

      Institution: Massachusetts Institute of Technology (United States)

      Laboratory: Computer Science and Artificial Intelligence Laboratory (CSAIL)

International Partner:

      Institution: German Cancer Research Center (United States)

      Laboratory: DKFZ Heidelberg diffusion group

Duration: 2007 - 2012

See also: http://www-sop.inria.fr/asclepios/projects/boston/

The CompuTumor associated team has been funded early 2007 and renewed in 2009. The CompuTumor project is dedicated to the study of brain tumor models and their coupling with medical images to better assist diagnosis and therapy. The project strongly enhance the current collaborations between Inria and a group of world leading teams with complementary technical and clinical expertise on these topics in Boston and Nice. More specifically, the project aims at (a) proposing new medical image processing method that could be used to better analize tumor images, (b) developping new brain tumor models in order to personalise these models with patient data. Microsoft Research has been also recently involved in the collaboration on lesion segmentation. Our most recent activity is described in sections 5.1.1 and 5.4.1 and also on the website of the associated team : http://www-sop.inria.fr/asclepios/projects/boston/.

7.2.2. Inria International Partners

7.2.2.1. Collaboration with international hospitals

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

Maxime Sermesant is a part-time lecturer in the Interdisciplinary Medical Imaging Group, Division of Imaging Sciences, St Thomas' Hospital, King's College London lead by Pr Reza Razavi. The XMR facility within this hospital is a unique possibility to validate and exploit the cardiovascular modelling work.

7.2.2.1.2. Children Hospital, Boston

A collaboration with Dr Simon Warfield, director of the Computational Radiology Laboratory has been active for several years, especially on the issue of atlas-based image segmentation and registration.

7.2.2.1.3. Other International Hospitals

Collaborations with several other European hospitals have been established through the European projects Passport and euHeart.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- **Marc Niethammer** (Assoc. Prof. at the Biomedical Research Imaging Center (BRIC), Univ. North Carolina Chapel Hill). Hosted by the Inria-Microsoft common research lab. *Control methods in diffeomorphic non linear registration for longitudinal image analysis*. September to November.

<p style="text-align:center; color:red;">**ATHENA Project-Team**</p>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.2. ANR ViMAGINE

Participants: Maureen Clerc, Rachid Deriche, Alexandre Gramfort [Parietal project-team, ENST since september 2012], Emmanuel Olivi [Forner member of the Athena Project-Team], Théodore Papadopoulo, Anne-Charlotte Philippe.

Duration: *July 2008 to July 2013*

The partners of this project are Athena, the LENA (CHU Pitié-Salpétrière), and the Parietal project-team at Inria Futurs and Neurospin-Saclay.

This project takes a new challenge on the non invasive exploration of the Human visual system in vivo. Beyond the basic mechanisms of visual perception – which have already been investigated at multiple scales and through a large variety of modalities – we are primarily interested in proposing and exploring innovative solutions to the investigation of dynamic neural activations and interactions at the systems level. Bridging the elements involved in this endeavour requires that we are capable of observing, modelling and predicting the interplay between the anatomical/functional architecture of the brain systems and some identified timing properties of neural processes. The overall framework in which this project will be conducted is a federation of partners who will be bringing complementary expertise to this multidisciplinary research. The collaborators include experts in (1) electromagnetic and magnetic resonance brain imaging methods, (2) computational models of neural systems and (3) the neuroscience of vision. A central asset of our group is the easy access to state-of-the-art imaging platforms (e.g. high-density MEG and EEG arrays; 3T and 7T MR scanners) that will ensure the acquisition of quality experimental data.

7.1.3. ANR CO-ADAPT

Participants: Maureen Clerc, Dieter Devlaminck, Joan Fruitet, Sebastian Hitziger, Théodore Papadopoulo, Eoin Thomas, Romain Trachel.

Duration: *December 2009 to December 2013*

The partners of this projects are the INSERM U821 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 is to study the co-adaptation between a user and a BCI system in the course of training and operation. The quality of the interface will be judged according to several criteria (reliability, learning curve, error correction, bit rate). BCI will be 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. To our knowledge, there is so far no BCI system that integrates such meta-data from the user's brain. From the point of view of the system, it is important to devise adaptive learning strategies, because the brain activity is not stable in time. How to adapt the features in the course of BCI operation is a difficult and important topic of research. A Machine Learning method known as Reinforcement Learning (RL) may prove very relevant to address the above questions. Indeed, it is an adaptive learning method that explicitly incorporates a reward signal, which may be qualitative (hence allowing meta-data integration). The aim of CO-ADAPT is 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).

7.1.4. ANR NucleiPark

Participants: Rachid Deriche, Aurobrata Ghosh, Anne-Charlotte Philippe, Emmanuel Caruyer, Jian Cheng.

Duration: *September 2009 to June 2013*

This project is about High field MR imaging (7T and 3T) of the brainstem, the deep nuclei and their connections in the parkinsonian syndromes with applications to prognosis, pathophysiology and improvement of therapeutic strategies. It involves three partners: The NeuroSpin team including C. Poupon and D. Le Bihan, the Inria with our project as well as the VISAGES project-team and the UPMC (University Pierre and Marie Curie, Paris) including INSERM U678 (H. Benali) and the CENIR (S. Lehericy).

The goal of the project is to find new neuroimaging markers of deep brain nuclei in neurodegenerative diseases that can be used for the diagnosis of Parkinsonian syndromes at the early stage. In addition, the goal is the characterization of lesions of deep brain structures and the detection of biomarkers of neuronal lesions in PD that can be related to clinical signs, such as gait disorders. Biomarkers of Parkinsonian syndromes could be used to create a diagnostic tool of the pathology and to correlate the identified markers with clinical signs. We will perform tractography of small fibre bundles using our HARDI techniques and Diffusion markers (anisotropy, apparent diffusion coefficient, fibre density, curvature, average diameter) will be collected along the reconstructed bundles.

Complementary parts of these objectives directly related to the acquisitions protocols have been accepted within the framework of another proposal submitted by the same partners and accepted for grant for two years (2009 & 2010) by the *France-Parkinson Association*

7.1.5. ANR MULTIMODEL

Participants: Théodore Papadopoulo, Maureen Clerc, Sebastian Hitziger.

Duration: *December 2010 to March 2014*

The general objectives of the MULTIMODEL project are twofold:

- Develop computational models at the level of neuronal systems that will help interpreting neuroimaging data in terms of excitation-, inhibition- and synchronization-related processes.

- 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, during this 3-year project, the following questions will be 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 will operate at the level of population of cell, i.e. at a scale compatible with the resolution of neuroimaging tools (at the level of the mm). A novel model structure will be investigated. It will include astrocytes at this "mesoscopic" level and will operate in networks of connected regions. Moreover, models in physiological and pathological conditions will be compared, which will be a step towards a better understanding of mechanisms underlying epileptic condition.

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).

7.1.6. 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.

7.1.7. 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 th egoal 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, deployement and perenity. The goal of this ADT is to solve these problems, to improve and to extend OpenViBe One main goal is 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 will allow to support the research made in four Inria teams (ATHENA, HYBRID, NEUROSYS and POTIOC) on hot topics such as adaptive or hybrid BCIs.

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. BRAINCONNECTIVITIES

> Title: Fusing anatomical and functional connectivity information using diffusion MRI, MEG and EEG.
>
> Inria principal investigator: Théodore Papadopoulo
>
> International Partners (Institution - Laboratory - Researcher):

University of Québec, School of Higher Technology (Canada) - PhysNum Group, Centre de recherches mathématiques, Montréal - Jean-Marc Lina

University of Sherbrooke (Canada) - Departement d'Informatique - Maxime Descoteaux

Duration: 2012 - 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.

7.2.2. Participation In International Programs

7.2.2.1. STIC-Algérie

Title: Computational Diffusion MRI.

Inria principal investigator: Rachid Deriche

International Partners: Université des Sciences et des Technologies Houari Boumedienne (F. Boumghar, USTHB - Algiers) - Université de Boumerdes (D. Cherifi).

7.3. International Research Visitors

7.3.1. Visits of International Scientists

In the framework of the BrainConnectivities associate team:
- Pr. Linda Boumghar from USTHB (Université des Sciences et Technologies Hourai Boumedienne, Algiers) visited Athena from Jan. 30 to February 4th, 2012.
- Maxime Descoteaux and Michael Paquette (USherbrooke) visited Athena on Sept. 24th for a week.
- Gabriel Girard (USherbrooke) visited Inria from Sept. 24th to Oct. 26th.
- Jean-Christophe Houde and Maxime Chamberland (USherbrooke) visited Athena October 8-9th.
- Jean-Marc Lina and Younes Zerouali (CRM) visited Athena from Nov. 26 to Dec. 2 with the goal of starting integrating cortical patch information developed at Athena into the source localisation method developed at CRM.

In the framework of the STIC-Algérie program:
- Pr. Linda Boumghar from USTHB (Université des Sciences et Technologies Hourai Boumedienne, Algiers) visited Athena from Jan. 30 to February 4th, 2012.
- Thinhinane Megherbi and Sihem Zeggout from USTHB (Université des Sciences et Technologies Houari Boumedienne, Algiers) visited Athena from May 17 to June 21th, 2012.

7.3.2. Internships

Tristan Milne (from May 2012 until Aug 2012)

Subject: Constrained Diffusion Kurtosis Imaging Using Ternary Quartics and MLE
Institution: Queen's University, Kingston, Ontario (Canada)

BAMBOO Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. InférenceGraphesRégulation

- Title: Inférence de graphes de régulations génétiques à partir de données d'expression
- Coordinator: H. Charles
- BAMBOO participant(s): H. Charles, L. Brinza, M.-F. Sagot
- Type: Pré-Projet de Recherche de l'IXXI (2012-2013)
- Web page: Not available

7.2. National Initiatives

7.2.1. 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

7.2.2. Adapthantroph

- Title: Adaptation des insectes aux anthroposystèmes
- Coordinator: M. Harry
- BAMBOO participant(s): C. Vieira
- Type: ANR Génoplante (2009-2012)
- Web page: Not available

7.2.3. 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

7.2.4. ImmunSymbArt

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

7.2.5. 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

7.2.6. MIRI

- Title: Mathematical Investigation of "Relations Intimes"
- Coordinator: M.-F. Sagot
- BAMBOO participant(s): V. Acuña, C. Baudet, C. Gautier, V. Lacroix, P. Milreu, C. Klein, I. Nor, M.-F. Sagot, P. Simões
- Type: ANR Blanc (2009-2012)
- Web page: http://pbil.univ-lyon1.fr/members/sagot/htdocs/team/projects/miri/miri.html

7.2.7. SpeciAphid

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

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. 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

7.3.1.2. 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

7.3.1.3. 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

7.3.1.4. 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

7.3.2. Collaborations with Major European Organizations

Partner 1: Pierluigi Crescenzi, Univ. Florence, Italy

Algorithmic (graphs, trees, sequences), complexity

Partner 2: Ana Teresa Freitas and Susana Vinga, INESC-ID, IST Lisbon, Portugal

NGS, metabolism, small RNAs, motifs

Partner 3: Alberto Marchetti-Spaccamela, Univ. Rome La Sapienza, Italy

Algorithmic (graphs, trees), complexity

Partner 4: Nadia Pisanti and Roberto Grossi, Univ. Pisa, Italy

Algorithmic (graphs, trees, sequences)

Partner 5: Leen Stougie, Free Univ. Amsterdam and CWI, the Netherlands

Algorithmic (graphs, trees), complexity

7.4. International Initiatives

7.4.1. DISCO

- Title: Laboratoire International de Recherche en BIoinformatique
- Coordinators: E. Zucca (Italy)
- BAMBOO participant(s): Pierluigi Crescenzi (external member BAMBOO)
- Type: Ministero dell'Istruzione, dell'Università e della Ricerca
- Web page: http://bart.disi.unige.it/DISCO/

7.4.2. LIA project with Brazil: LIRIO

- Title: Laboratoire International de Recherche en BIoinformatique
- Coordinators: M.-F. Sagot (France), A. T. Vasconcelos (LNCC, Brazil)
- BAMBOO participant(s): BAMBOO Team
- Type: LIA CNRS
- Web page: https://team.inria.fr/bamboo/en/cnrs-lia-laboratoire-international-associe-lirio/

7.4.3. Inria-Faperj (Brazil) project: RAMPA

- Title: Bioinformatics for the Reconstruction and Analysis of the Metabolism of PArasites
- Coordinators: M.-F. Sagot (France), A. T. Vasconcelos (LNCC, Brazil)
- BAMBOO participant(s): Whole BAMBOO Team
- Type: Faperj-Inria
- Web page: Not available

7.4.4. Project within CIRIC

- Title: Omics Integrative Sciences

- Coordinators: Alejandro Maass (Chile), Anne Siegel and M.-F. Sagot (France)
- BAMBOO participant(s): BAMBOO Team
- Type: Communication and Information Research and Innovation Center (CIRIC)
- Web page: Not available

7.4.5. *Inria International Partners*

- Acronym: AMICI
- Title: Algorithms and Mathematics for Investigating Communication and Interactions intra- and inter-organisms
- Coordinators: M.-F. Sagot (France), A. Marchetti-Spaccamela (Univ. Rome, Italy), L. Stougie (Free Univ. Amsterdam and CWI, the Netherlands), P. Crescenzi, Univ. Florence, Italy), N. Pisanti (Univ. Pise, Italy)
- BAMBOO participant(s): Whole BAMBOO Team
- Type: Inria International Partner
- Web page: http://amici.dsi.unifi.it/amici/

7.5. International Research Visitors

7.5.1. *Visits of International Scientists*

Andrea Marino, PhD student (Supervisor: Pierluigi Crescenzi), University of Florence, Italy, visit of 3 months and various visits of 1-2 weeks

Maria Cristina Motta, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, visit of 10 days

Susana Vinga, Professor, INESC-ID, IST Lisbon, Portugal, visit of 1 week

Arnaldo Zaha, Universidade Federal de Rio Grande do Sul, Porto Alegre, Brazil, visit of 10 days

<p style="text-align:center">**BANG Project-Team**</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. CIRB-Collège de France

Jonathan Touboul is leading the team "Mathematical Neuroscience Laboratory" in the Centre for Interdisciplinary Research in Biology of the Collège de France. Several collaborations have been initiated, a postdoc has been recruited, student scholarships have been provided and 3 PhD students have started their research in the laboratory (J. Scher, C. Quininao and L. C. García del Molino).

7.1.2. DIGITEO and Cancéropôle IdF

The DIGITEO IdF LSC *ALMA* and *ALMA2* programs, coordinated by C. Bonnet (DISCO team, Inria Saclay IdF) studies a model of leukaemia based on previous works by M. Adimy and F. Crauste (Lyon), with theoretical model design adjustments and analysis in J. L. Avila Alonso's Ph D thesis (supervised by C. Bonnet, S. Niculescu and J. Clairambault) and experimental parameter identification initiated by F. Merhi, Bang postdoc (Dec. 2010-Nov. 2011), then continued by A. Ballesta (Sep. 2011-Feb. 2013), Bang postdoc detached at INSERM, working at St. Antoine Hospital (Paris), under the supervision of J. Clairambault and C. Bonnet to link experimental and theoretical aspects and of J.-P. Marie and RP. Tang (INSERM-UPMC) to supervise biological experiments on leukaemic cells. ALMA has been granted for 3 years, beginning in December 2010.

A. Ballesta's postdoc at St. Antoine Hospital, granted by Cancéropôle IdF *ALMA2* has led to increased collaboration of the same with the Commands Inria team (F. Bonnans, X. Dupuis, Saclay) with the aim to design optimisation procedures for anti-leukaemic therapies by cytosine arabinoside and by an anti-Flt3 targeted agent (see above "Optimisation of cancer chemotherapy").

7.1.3. INRA

Collaboration with INRA (Isabelle Hue, Juhui Wang, Alain Trubuil) on Trophoblast development. One PhD student position in Bang has been funded within the Doctoral School *Ecole du Vivant*, Paris for Chadha Chettaoui), who has defended her thesis in July 2012.

7.2. National Initiatives

7.2.1. ANR and other national projects

7.2.1.1. ANR program Bimod.

This ANR program, coordinated by V. Volpert (Lyon), involves 3 partners: CNRS (Institut Camille Jordan) in Lyon (V. Volpert), University Bordeaux II (P. Magal) and Inria (Bang project-team and DISCO team, Saclay IdF). It associates PDE models, both spatial and physiologically structured, with individual-based models in *hybrid models* to represent cancer growth (leukaemia and colorectal cancer) and therapy. It has been granted for 4 years, beginning in December 2010.

7.2.1.2. ANR Sine2Arti

Participation in the ANR project Sine2Arti. The project considers tissue homeostasis and cell reprogramming. The project is coordinated by Gregory Batt (coordinator, Contraintes research team, Inria), PIs are Oded Maler (Univ. of Grenoble) and Dirk Drasdo, an external collaborator is Ron Weiss (MIT)

7.2.1.3. ANR TOPPAZ

(url http://www-roc.inria.fr/bang/TOPPAZ/index.html)

TOPPAZ (Theory and Observations of Polymerisation processes in Prion and Alzheimer diseases) is a 3-year (2009-2012) research project financed by ANR grant "programme blanc" and headed by Marie Doumic-Jauffret.

It involves two teams, a mathematical and numerical team (B. Perthame, V. Calvez, P. Gabriel, T. Lepoutre, P. Michel, and a team in Brazil headed by J. Zubelli) and a biophysicist team headed by H. Rezaei. It has allowed to finance the post-doctoral contract of F. Charles and the 1-year grant of L. M. Tine.

The general goal is to develop new mathematical and numerical tools for polymerisation processes, in a strong link with experimentalists and with direct application to experimental data designed by the biologists' team. The achievements of ANR TOPPAZ are described in Sections 6.1.4 and 6.1.5 .

7.2.1.4. GDR DarEvCan

The GDR DarEvCan, for Darwinian Evolution and Cancer, is a interdisciplinary consortium which associates 10 teams in France around the theme of evolution and cancer, in particular evolution of cancer cell populations towards drug resistance [27]. It has held its first national meeting in December 2011 in Paris, and another one in April 2012 in Montpellier. The Bang team takes an active part in its development, which relies mainly on applying methods from evolutionary theory to cancer biology [33]. (url http:///www.darevcan.univ-montp2.fr/)

7.2.1.5. GdR EGRIN

The CNRS supports the creation of a "research group" called EGRIN, starting in january 2013 and devoted to the modelling, analysis and simulation of gravity driven flows. J Sainte-marie is the head of the scientific committee of this research group.

(url http://gdr-egrin.math.cnrs.fr/)

7.2.1.6. Green Stars

Participation in the Green Stars project ("Investissement d'avenir") on the production of biofuel using microalgae in collaboration with the EPI COMORE, LOCEAN, INRAA, LOV.

7.2.1.7. PEPS PTI 'Ondes de concentration en bactéries'

People of the BANG team are involved in this project funded by the CNRS. This is a collaboration with biophysicists of the Institut Curie dedicated to the description of the collective motion of bacteria by chemotaxis.

7.2.1.8. ITMO-Cancer grant PhysCancer

Participation in the ITMO-Cancer (Aviesan) project Physics of Cancer. The project studies the impact of a constraining extracellular material on the growth and division of cells and cellular aggregates. The project is coordinated by Pierre Nassoy (Institut Curie), collaborators are Dirk Drasdo and Christophe Lamaze (INSERM).

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. ERASysbio+ C5Sys European network.

This European program (url http://www.erasysbio.net/index.php?index=272) has begun in April 2010, with the title "Circadian and cell cycle clock systems in cancer". Coordinated by F. Lévi (Villejuif) and D. Rand (Warwick), it studies both from a theoretical and from an experimental viewpoint the relationships between molecular circadian clocks and the cell division cycle, in cancer and in healthy tissues. It has been granted for 3 years. A postdoctoral fellow (F. Billy) has been hired at Inria-Bang until November 2012 on this funding, giving rise to various publications in 2012 [10], [11], [12], [39], [42].

7.3.1.2. NOTOX

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. 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/

7.3.1.3. EU-project PASSPORT

Participation in the European network PASSPORT on modelling liver regeneration after partial hepatectomy (url http://www.vph-noe.eu/vph-projects/74-eu-fp7-vph-projects/50-passport-strep)

7.3.1.4. ERC Starting Grant SKIPPERAD

The ERC Starting Grant allocated to M. Doumic-Jauffret in december 2012 will last for five years. The acronym standing for *Simulation of the Kinetics and Inverse Problem for protein Polymerisation in Amyloid Diseases* (Prion, Alzheimer's), its main goal is to contribute to the design of new methods for protein polymerisation simulation and prediction, a major issue in amyloid diseases.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. QUANTISS, with BMBF

Title: Towards quantitative tissue simulations

Inria principal investigator: Dirk Drasdo

International Partner (Institution - Laboratory - Researcher):

University of Liepzig (Germany) - IZBI

Duration: 2010 - 2012

See also: http://www.msysbio.com/ea

The scientific achievements addressed tissue organisation processes such as tissue regeneration, degeneration and growth. Our main contribution was the development of concepts, a process chain, and software suite to permit quantitative simulations of tissue organisation processes on histological scales. Our main applications were multiple projects on liver, lung cancer and mesenchymal stem cell differentiation. The results of the main projects for 2012 have briefly been summarised the results section (liver regeneration, multiscale liver modelling, blood flow modelling, software generation CellSys, etc. most based on the grant projects LUNGSYS and Virtual Liver network).

7.4.2. ECOS-CONICYT

B. Perthame and K. Vilches take part in the Franco-Chilean project 'Functional analysis, asymptotics and dynamics of fronts' headed by J. Dolbeault (University Paris-Dauphine) funded by ECOS-CONICYT.

7.4.3. EuroMed 3+3

M3CD, *Mathematical Models and Methods in Cell Dynamics*, a transmediterranean EuroMed3+3 program, has begun in January 2012 for 2 [+ 2: renewal] years, under the coordination of J. Clairambault. It associates 2 Inria teams: Bang and Dracula (Mostafa Adimy, Lyon) with the IAC-CNR in Rome (Roberto Natalini), the LMDP team in Marrakech (Hassan Hbid) and the MoMinBi team at Institut Pasteur, Tunis (Slimane BenMiled) to work on the general theme "Mathematical Models and Methods in Cell Dynamics". It has fostered visits of students (in particular to Paris and Lyon, for Y. Bourfia, PhD student at Marrakech and UPMC, who works under the supervision of H. Hbid, M. Adimy and J. Clairambault) and researchers, participation in the international SM2A conference in Marrakech (June 2012, url http://sm2a-2012.ucam.ac.ma/en/), and a M3CD 2-day workshop in Tunis (Institut Pasteur, November 2012, (url http://euromedbiomaths.org/atelier-M3CD-Tunis/)) organised by Amira Kebir (MoMinBi).

7.4.4. Inria International Partners

7.4.4.1. 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 ($http://www.lungsys.de/$)

7.4.4.2. 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. The networks has 69 Principle Investigators organised in about 10 work packages, each of which have a number of sub-projects.

($http://www.virtual-liver.de/about/$)

BEAGLE Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- PAGDEG: Causes and consequences of protein aggregation in cellular degeneration, a three-year project (2009-20012), Call "PIRIBIO". Supervisor: A. Lindner (INSERM, Paris) ; Other participants: Y. Chen (ENS Paris), L. Moisan (Univ. Paris 5). Participants: Hugues Berry, Anne-Sophie Coquel

- Stochagene (2011-2014). Objective: identify the molecular basis of the stochasticity of gene expression in eukaryotic cells. Partners: CGPhyMC (Olivier Gandrillon, Lyon, Leader), Genethon (Andras Paldi, Evry). Participants: G Beslon, H Berry, Gael Kaneko

- Ancestrome: phylogenetic reconstruction of ancestral "-omes", a five-year project (2012-2016), 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

7.1.2. CNRS

- H Berry participates to a PEPII (Projets exploratoires pluridisciplinaires inter-instituts) called NeoBG: towards a biologically realistic theory of reinforcement learning, 2011-2012, Supervisor : B. Delord (Univ. P & M Curie, Paris). With Ph. Faure and L. Venance (College de France, Paris)

- Carole Knibbe coordinated in 2011 and 2012 a PEPII (Projets exploratoires pluridisciplinaires inter-instituts) called "Analyser, simuler et expérimenter l'évolution des génomes bactériens". The aim of the project was to study the dynamics and the evolvability of bacterial genomes by combining "wet" evolution experiments, individual-based simulations, mathematical models and bioinfomatics of real genomes. The total budget was 50 k€. The involved teams were, beside Beagle, Dynamics and evolution of the bacterial genome / Laboratoire Adaptation et Pathogénie des Microorganismes (LAPM, CNRS UMR5163, Grenoble), Modélisation mathématique et calcul scientifique / Institut Camille Jordan (ICJ, CNRS UMR5208, Lyon), Algorithmique et ordonnancement pour plates-formes hétérogènes distribuées / Laboratoire de l'Informatique du Parallélisme (LIP, CNRS UMR5668, Lyon), and Bioinformatique et génomique évolutive / Laboratoire de Biométrie et Biologie Evolutive (LBBE, CNRS UMR5558, Lyon)

- E Tannier participates to a PEPS (Projet exploratoire premier soutien) called C1P: algorithmics of 1D structures, 2012-2013. Supervisor: M. Raffinot (CNRS, LIAFA, Paris), involved teams from Marne-la-Vallée, Nantes, Marseille, Bordeaux, Lyon.

7.2. International Initiatives

7.2.1. Inria International Partners

- "Astrocytic regulation of neuronal network activity" 2012-2103, A Research Networks Program in Computational Neurosciences and Computational Cognitive Sciences of the High Council for Scientific and Technological Cooperation between France-Israel, with E Ben-Jacob and Y Hanein (Tel Aviv Univ, Israel). Supervisors: H. Berry (French side) and Y. Hanein (Israeli side).

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- Nadia El-Mabrouk, professeure à l'université de Montreal, "chercheur invité" of Inria, October 1-12, 2012

- Jacques Rougemont (team leader) and Marion Leleu (researcher) of the Bioinformatics and Bio-statistics Core Facility of EPFL (Ecole Polytechnique Fédérale de Lausanne). November 23, 2012.

- Thomas Höfer (Heidelberg) in May

- Kirsten HWJ ten Tusscher (Theoretical Biology/Bioinformatics, Utrecht University, Netherlands) in September

7.3.2. Visits to International Teams

- H. Soula is visiting professor in the Theunissen Lab of Auditory and Neuroscience during the academic year 2012-2013. Grant: CRCT CNU.

- Visit of C Rigotti to the team Bioinformatics and Biostatistics Core Facility of EPFL (Ecole Polytechnique Fédérale de Lausanne). March 8 and 9, 2012.

<p style="text-align:center;color:red;font-weight:bold;">BIGS Project-Team</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

Co-direction of a PhD thesis by J-M. Monnez:

Partner: Ecole de Hautes Etudes en Santé Publique (Rennes).

Title: Influence of socio-economic and environmental characteristics on infant mortality.

PhD thesis of M. Lalloué.

Regional project leaded by T. Bastogne:

Partners: Contrat de Projets Etat-Région, MISN (Modélisation, Information et Système Numérique), Thème AOC (Analyse, Optimisation et Contrôle).

Title: EMC2 (Experimental design, Modeling and Control in Cancerology).

8.2. National Initiatives

• C. Lacaux is member of the MATAIM (Modèles Anisotropes de Textures. Applications à l'Imagerie Médicale) ANR project, leaded by F. Richard (University of Provence).

• P. Vallois is member of the MASTERIE (Malliavin Stein Random Irregular Equation) ANR project, leaded by F. Russo (ENSTA, Paris).

• T. Bastogne is leader of the MOCOBIO (MOdeling and COntrol of heterogeneous systems in BIOlogy) CNRS-PEPS project.

• T. Bastogne is member of the PDTX (Active Nanoplatforms for Photodynamic Therapy) ANR project, lead by M. Verelst (Université Paul Sabatier, Toulouse)

• T. Bastogne is member of the Nano-VTP (Nanoparticles for Imaging and Vascular Photodynamic Treatment of Brain Tumors) ANR project, lead by M. Barberi-Heyob (Centre de Recherche en Automatique de Nancy, Centre Alexis Vautrin).

• T. Bastogne, C. Lacaux and S. Tindel are members of the OPTIQUE CNRS-PEPS project, lead by M. Thomassin (CRAN) and managed within Inria's framework by BIGS.

8.3. European Initiatives

8.3.1. *Collaborations with Major European Organizations*

Collaboration 1: Smoothness of density for noisy differential systems

Partner 1: Imperial College, London (UK)

Partner 2: Warwick University (UK)

Subject: Smoothness of density for noisy differential systems

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

Visit of D. Nualart (Kansas University) for 1 month, May 2012.

8.4.1.1. Internships

- Raouf Souabni: Simulation of the light propagation in biological tissues. Application to interstitial photodynamic therapy. Advisor: T. Bastogne.
- Yosra Chemli: Applicability of an Exponential-Linear (E-L) model to describe the in vitro cell responses in photodynamic therapy. Advisor: T. Bastogne.
- Kevin Ziegelmeyer: Data Analysis for for liver cirrhosis prediction. Advisor: A. Muller-Gueudin.

<p align="center" style="color:red">BIOCORE Project-Team</p>

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 coordinated by M. Chaves (BIOCORE, Inria)

- **ANR-Symbiose:** The objective of this project is both to improve the energetic balance of biofuel microalgal productions and to recycle nitrogen and phosphorus. The project proposes to study the coupling between a microalgal production system and an anaerobic digester. The objectives of BIOCORE are to propose a model of the coupled system, and to compute the optimal fluxes between the various compartments in order to optimize the energy recovery. See http://anr-symbiose.org/

- **ANR-Facteur 4:** The objective of this project to propose non GMO 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.

- **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)

- **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.

- **Green Stars:** Green Stars was laureate of the French call for projects known as the "French Stimulus Initiative" (Investissements d'Avenir), Institute of Excellence on Carbon-Free Energies. It federates a network of collaborative platforms bringing together all the players in the development of microalgae in France. The Institute includes 45 partners, including academics, large companies and SME. BIOCORE plays a key role in the project set up.

8.1.2. Inria funding

- **ColAge:** The goal of this joint Inria-INSERM consortium is to study bacterial growth and aging by using mathematical modeling and computational predictions to design and implement a *de novo* biological system. This Large-Scale Initiative Action is partly funded by Inria and supervised by H. Berry (Beagle, Inria).

- **Nautilus:** O. Bernard is coordinating the Inria-Nautilus ARC whose objective is to understand and model the coupling between hydrodynamics and microalgae photosynthesis.

8.1.3. INRA funding

- **Eco-tuta:** INRA-SPE is funding the project "Ecologie des communautés dans les agro-écosystèmes et implications pour la lutte biologique contre une espèce invasive: le cas Tuta absoluta sur tomate" in which BIOCORE is a partner with INRA Sophia Antipolis (2010-2012).

- **Propagules:** INRA-SPE is funding the project "Effet de différentes composantes de la pression de propagules sur le succès d'établissement d'un auxiliaire de lutte biologique" in which BIOCORE is a partner with INRA Sophia Antipolis (2011-2013).

- **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).
- **Metacarpe:** This INRA SPE-GAP-EFPA-EA project (call "Gestion durable des résistances des bio-agresseurs") is entitled "Modélisation de l'évolution des traits d'histoire de vie en lien avec l'agressivité des champignons parasites biotrophes : application au pathosystème rouille-peuplier". BIOCORE is taking part with CIRAD, INRA Sophia Antipolis, Nancy and Rennes (2010-2012).

8.1.4. Networks

- **RTP-M3D:** BIOCORE is a participant in the RTP-M3D workgroup (Mathématiques et décision pour le développement durable) that is supported by the "Environment and sustainable growth" department of CNRS. L. Mailleret is one of the co-leaders of M3D.
- **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.
- **COREV:** BIOCORE is an active participant in the research group COREV (Modèles et théories pour le contrôle de ressources vivantes et la gestion de systèmes écologiques).
- **Seminar:** BIOCORE organizes a regular seminar "Modeling and control of ecosystems" at the station zoologique of Villefranche-sur-Mer or at Inria.

8.2. European Initiatives

8.2.1. FP7 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

Univ. Polytechnique Mons: Service d'Automatique (B)

Modeling of photosynthesis

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 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.

8.3.2. Participation In International Programs

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.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

We only list the visitors that stayed more than 2 days in our project-team

- Benoit Chachuat (Imperial College, Department of Chemical Engineering, UK), 1 week;
- Andreas Nikolaou (Imperial college, Department of Chemical Engineering, UK), 2 months;
- Claude Aflalo (Ben Gurion University of the Neguev, Israel), 1 week;
- Jaime Moreno (UNAM, Automation and Environmental Bioprocesses Departments, Institute of Engineering, Mexico), 1 week;
- Andrei Akhmetzhanov (McMaster University, Department of Biology, Canada), 2 weeks;
- Gonzalo Robledo (Universidad de Chile, Facultad de Ciencias, Departamento de Matemáticas, Chile) , 2 weeks;
- Tomas Gedeon (Montana State University, Department of Mathematical Sciences, USA), 2 days.

8.4.1.1. Internships

Luis CASACCIA (from Apr 2012 until Sep 2012)

Subject: Mathematical and computational analysis of genetic regulatory networks

Institution: National University of Rosario (Argentina)

8.5. Project-team seminar

BIOCORE organized a 3-day seminar in October in Peyresq. On this occasion, every member of the project-team presented his/her recent results and brainstorming sessions were organised. Jérôme Harmand of the Inria MODEMIC team was invited to give talks on this occasion.

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

BONSAI Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- At the end of 2010, we started a collaboration with the sequencing platform of Université Lille 2 and IRCL (M. Figeac) and the hematology lab of Lille hospital (N. Grardel, C. Roumier, C. Preudhomme), on the diagnosis of leukemia residual disease. This project has been awarded by a "Projet émergent region" grant for 2012 – 2013.

- Our research on *nonribosomal peptide synthesis* is based on a collaboration with the ProBioGEM laboratory (*Laboratoire des Procédés Biologiques Génie Enzymatique et Microbien*, Université Lille 1). This laboratory develops methods to produce and extract active peptides in agriculture or food. Two PhD thesis has been co-supervised by the two labs.

- We have a long term collaboration with GEPV Lab (Genetics and Evolution in Plants, UMR CNRS 8198, Université Lille 1). Topics includes rearrangements in mitochondrial genomes and evolution of plant miRNAs. One supervised PhD thesis has been defended in 2010, and a new thesis just started in October 2012.

- The team is in charge of the PPF *Bioinformatique*. This is an initiative of Université Lille 1 that coordinates public bioinformatics activities at the local level. It gathers seven labs coming from biology, biochemistry and computer science. Main topics are proteomics, microbiology, population genetics, etc.

7.2. National Initiatives

7.2.1. ANR

- ANR Mappi (2010-2013, call *Conception and Simulation*). This project involves four partners: LIAFA (Université Paris 7), Genscale (Inria Rennes), Genoscope (French NAtional Center for SEquencing) and BONSAI. The topic is *Nouvelles approches algorithmiques et bioinformatiques pour l'analyse des grandes masses de données issues des séquenceurs de nouvelle génération*.

- ANR France Génomique (2011-2014, PIA *Infrastructures Biologie Santé*). This national project involves 13 partners, including sequencing paltforms and bioinformatics platform. We take part to the workpackage on sRNA-seq data analysis.

7.2.2. PEPS

- PEPS Biology-Mathematics-Computer science: "Etude comparative de l'architecture du génome mitochondrial chez les Caryophyllacées et les Poacées". This project involves three partners: IBMP (Institut de Biologie Moléculaire des Plantes), GEPV (UMR CNRS 8198, Université Lille 1) and BONSAI.

7.2.3. ADT

- ADT biomanyocres (2010-2012): see section 5.8 .

- ADT biosciences resources (2011-2013): 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.

7.3. International Initiatives

- S. Blanquart pursues his collaboration with the Sterner Group of the "Institut für Biophysik und Physikalische Biochemie" (Regensburg, Germany) on an ancestral sequences resurrection project. Researchers of the Sterner Groups succeeded in the resurrection and characterization of the LUCA's (Last Universal Common Ancestor) Histidine F enzyme, which have a TIM barrel fold. The paleo-enzyme works fine, just as do modern ones. It is the oldest resurrected yet proteins to our knowledge.

- In genomic rearrangement, we pursued our collaboration with the LaCIM at Université du Québec à Montréal, and DIRO at Université de Montréal. In the context of multiple genome comparison, we proposed a new framework for the multiple comparison of sets of transcripts transcribed from orthologous loci of several species [12].

7.4. International Research Visitors

7.4.1. Visits to International Teams

- A. Thomas, Univ. du Québec à Montréal (Canada), visit to Anne Bergeron (2 weeks),
- J.-S. Varré, Univ. du Québec à Montréal (Canada), visit to Anne Bergeron (1 week),
- A. Ouangraoua, Univ. du Québec à Montréal (Canada), visit to Anne Bergeron (4 months),
- M. Giraud, Univ. of Thessaloniki (Greece), visit to E. Cambouroupoulos (1 month).

<p align="center" style="color:red">CARMEN Team</p>

6. Partnerships and Cooperations

6.1. Regional Initiatives

- Project *Modélisation pour les données multimodales* (2012-2015) funded by the *Conseil Regional Aquitaine*. Coordinator J.-F. Aujol (Pr University Bordeaux 1). The PhD of G. ravon is funded within this project: 3D reconstruction by inverse problem in cardiac optical mapping.

6.2. National Initiatives

6.2.1. IHU Liryc

Our work is partially funded by the Liryc project.

- For 2012-2015: 1/2 PhD thesis associated to the project *Modélisation pour les données multimodales* (see section Regional Initiaves).

6.3. European Initiatives

6.3.1. Collaborations with Major European Organizations

Partner 1: CNR, IMATI (Italie) – G. Manzini.

Finite volume discretization on general, distorted meshes, for second order operators with anisotropy and discontinuities. Applications to the simulation of ECG.

Partner 2: Computational Biology Group, University of Oxford. Department of Computer Science (United Kingdom).

Our work with the computational biology group concerns the development of multi-scale models of the drugs and their effect on the electrical activity of the heart. The main goal is to assess the drug-induced effects on the electrocardiogram, using a computational model describing the physiology from ion channel to body surface potentials.

6.4. International Initiatives

6.4.1. Inria International Partners

- Collaboration with the Pr. Y. Bourgault (http://aix1.uottawa.ca/~ybourg/personal.html) from the department of Mathematics and statistics of the University of Ottawa (Canada).
    - *Subject:* models and numerical methods for cardiac electrophysiology.
    - *Support:* for the last years the collaboration was supported by the ANR project Momme (ANR-JCJC-07-0141), the *Region des Pays de la Loire* and the Natural Sciences and Engineering of Research council of Canada
- Equipe Problèmes Inverses et Contrôle (EPIC), University Tunis Al Manar. 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.

6.5. International Research Visitors

6.5.1. Visits of International Scientists

- Y. Bourgault, Pr. Univeristy of Ottawa, Department of mathematics and statistics. 22/10/2012 to 26/10/2012.

  Comparison between the monodomain and bidomain models for cardiac electrophysiology.

- Moncef Mahjoub, Teaching assistant at University of Tunis Al Manar (ENIT-LAMSIN), Tunisia. 01/10/2012 to 06/10/2012.

  Inverse problems.

- Fadhel Jeday. Teaching assistant at University of Sousse, Tunisia. 03/12/2012 to 07/12/2012.

  Inverse problems.

6.5.1.1. Internships

Nicolas Claude (from July 2012 until September 2012)

> Subject: Real-time simulation of ECGs based on the finite element Sofa library developed at Inria Lille.
>
> Institution: ENSEIRB-MATMECA, Bordeaux (Master 1 student).

Jamila Lassoued (from August 2012 until November 2012)

> Subject: application of model reduction techniques to the inverse problems in cardiac electrophysiology.
>
> Institution: Ecole Nationale d'Ingénieurs de Tunis (Tunisia – Master 2 student)

Sinda Ben Khalfalla (from 04/12/2012 to 21/12/2012)

> Subject: Inverse problems for the quasistatic inverse problem in electrocardiology.
>
> Institution: Ecole Nationale d'Ingénieurs de Tunis (Tunisia – PhD student)

Mohammed Addouche (from 08/12/2012 to 05/01/2013)

> Subject: On using factorisation methods for the quasistatic inverse problems of electrocardiology.
>
> Institution: University of Tlemcen (Algeria – PhD student)

CLIME Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Clime is involved in the project PREQUALIF–IZNOGOUD–BARC, with many partners including the leading partner LSCE ("Laboratoire des Sciences du Climat et l'Environnement"), which aims at designing methods for the evaluation of the measures to be taken in the ZAPA areas ("Priority Areas for Air Quality Measures"). Clime focuses on the assimilation of observations to better evaluate the actual air quality.

8.2. National Initiatives

8.2.1. ANR

- Clime is one partner of the ANR project GeoFluids. It focuses on the specification of tools to analyse geophysical fluid flows from image sequences. Clime objectives concern the definition of reduced models from image data.

- Clime takes part to the ANR project IDEA that addresses the propagation of wildland fires. Clime is in charge of the estimation of the uncertainties, based on sensitivity studies and ensemble simulations.

- The MSDAG project (Multiscale Data Assimilation in Geophysics) is an ANR project. Fours partners are in the project: CEREA (Clime project-team, Marc Bocquet, PI of the whole project), Fluminance (Étienne Mémin), Moise Project-team (Laurent Debreu), LSCE (Frédéric Chevallier). It has ended the 30th of September 2012.

8.2.2. INSU

- Clime is running the project MIDAR "Inverse modeling of deposition measurements in case of a radiological release", under the framework of the LEFE-ASSIM program of INSU. This includes a cooperation with the Institute for Safety Problems of Nuclear Power Plants (National Academy of Sciences of Ukraine). This project has ended in summer 2012.

- Clime is part of the INSU/LEFE project ADOMOCA-2, with about ten French teams working in atmospheric chemistry data assimilation.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

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 (Eu-MetChem) will focus 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. At least, two application areas of the integrated modeling are planned to be 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 will consist 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) will enable the EU to develop world class capabilities in integrated ACT/NWP-Climate modeling systems, including research, forecasting and education.

8.3.2. 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. In 2012, the working group organized sessions during IEMSs conference in Leipzig, Germany.

8.4. International Initiatives

8.4.1. Inria 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.cl/modelos.html).

Partner: Marine Hydrophysical Institute, Ukraine.

The collaboration concerns the study of the Black Sea surface circulation and the issue of image assimilation in forecasting models.

Partner: Institute of Numerical Mathematics, Russia.

The collaboration concerns the estimation of uncertainty of the motion field derived from image data with data assimilation technics.

8.4.2. Participation In International Programs

- Clime is running a two-year project under the PHC-DNIPRO program with Taras Shevchenko University of Kyiv, Ukraine. The subject concerns a posteriori minimax motion estimation from images.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Sergii Demydenko, Taras Shevchenko University of Kyiv, Ukraine,July 2012.
- Andrii Filipenkov, Taras Shevchenko University of Kyiv, December 2012.
- Takemasa Myoshi, University of Maryland, USA, June 2012.
- Oleksandr Nakonechnyi, Taras Shevchenko University of Kyiv, December 2012.
- Sergiy Zhuk, IBM, Dublin Research Lab, Ireland, December 2012.

8.5.2. Visits to International Teams

- Vivien Mallet took part in June to a HARVEST project, funded by Pascal2. He visited the Department of Statistical Science at University College London. The project dealt with uncertainty quantification using statistical emulation of geophysical models, mainly for climate modeling.

CORTEX Project-Team

7. Partnerships and Cooperations

7.1. Regional initiatives

7.1.1. *Action Situated Informatics of the CPER*

Participants: Laurent Bougrain, Octave Boussaton, Thierry Viéville.

In the framework of the Contrat de Projet État Région, we are contributing to the axis IS (Informatique Située) through the project CoBras whose goal is to study reinforcement learning to better control a robotic arm in a Brain-Machine interface. We bought a JACO robotic arm for wheelchair by Kinova.

7.2. National initiatives

7.2.1. *DGE Ministry grant COMAC "Optimized multitechnique control of aeronautic composite structures"*

Participants: Laurent Bougrain, Octave Boussaton, Marie Tonnelier.

The goal of this three-years project is to develop a powerful system of control on site, in production and in exploitation, of aeronautical pieces made of composite. It takes up the challenge of the precise, fast and local inspection on composite pieces of aeronautical structures new or in service by using techniques of non-destructive control more effective and faster to increase the lifespans of the structures of planes. This project requires a decision-making system including fast methods of diagnostic based on several optical technics as non-destructive control.

7.2.2. *ANR project KEOPS*

Participants: Frédéric Alexandre, Laurent Bougrain, Thierry Viéville.

This «ANR Internal White Project» involving NEUROMATHCOMP and CORTEX Inria EPI in France with the U. of Valparaiso, U. Tecnica Frederico Santa-Maria, and U. De Chili is a 3 years, 248 person-months, sensory biology, mathematical modeling, computational neuroscience and computer vision, project addressing the integration of non-standard behaviors from retinal neural sensors, dynamically rich, sparse and robust observed in natural conditions, into neural coding models and their translation into real, highly non-linear, bio-engineering artificial solutions. An interdisciplinary platform for translation from neuroscience into bio-engineering will seek convergence from experimental and analytical models, with a fine articulation between biologically inspired computation and nervous systems neural signal processing (coding / decoding) [23].

7.2.3. *ANR project PHEROTAXIS*

Participants: Dominique Martinez, Thomas Voegtlin.

How can animals so successfully locate odour sources? This apparently innocuous question reveals on analysis unexpectedly deep issues concerning our understanding of the physical and biological world and offers interesting prospects for future applications. Pherotaxis focuses on communication by sex pheromones in moths. The main aim of the project is to integrate the abundant experimental data on the pheromone plumes, neural networks and search behaviour available in the literature, as well as that collected or being collected by us at the molecular, cellular, systemic and behavioural levels into a comprehensive global model of the pheromonal olfactory processes. To reach this objective, the consortium combines several groups of specialists with different and complementary fields, in physics (Institut Pasteur IP), neurobiology (INRA) and bio-robotics (Inria).

7.2.4. Project CNRS PEPII: A large-scale, robotically embodied decision making model

Participants: Frédéric Alexandre, Nicolas Rougier, Thierry Viéville.

This project is a collaboration between the "Institut des Maladies neuro-dégénératives" (UMR 5293, team "Approche systémique de la Boucle Extrapyramidale"), Supélec ("Information, Multimodalité, Signal") and the Cortex team. This project aims at studying the decision making process viewed as a high-level brain function, actioned by a distributed network of cortical and sub-cortical structures, interconnected in positive and negative feedback loops.

7.2.5. Project CNRS PEPII IMAVO

Participants: Nicolas Rougier, Yann Boniface.

This project is a collaboration between the "Institut des Neurosciences Cognitives et Intégratives d'Aquitaine" (UMR 5287), the "Institut des Systèmes Intelligents et de Robotique" (Systèmes Intégrés Mobiles et Autonomes) and the LORIA (Maia and Cortex groups). This project aims at investigating model-free and model-based approaches in the decision process in order to propose a computational model of the decision process in simple tasks.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. MathAna

Title: Mathematical Analysis of Anaesthesia

Type: IDEAS

Instrument: ERC Starting Grant (Starting)

Duration: January 2011 - December 2015

Coordinator: Inria (France)

Abstract: General anaesthesia is an important method in today's hospital practice and especially in surgery. To supervise the depth of anaesthesia during surgery, the anaesthesist applies electroencephalography (EEG) and monitors the brain activity of the subject on the scalp. The applied monitoring machine calculates the change of the power spectrum of the brain signals to indicate the anaesthetic depth. This procedure is based on the finding that the concentration increase of the anaesthetic drug changes the EEG-power spectrum in a significant way. Although this procedure is applied world-wide, the underlying neural mechanism of the spectrum change is still unknown. The project aims to elucidate the underlying neural mechanism by a detailed investigating a mathematical model of neural populations. The investigation is based on analytical calculations in a neural population model of the cortex involving intrinsic neural properties of brain areas and feedback loops to other areas, such as the loop between the cortex and the thalamus. Currently, there are two proposed mechanisms for the charactetisic change of the power spectrum: a highly nonlinear jump in the activation (so-called phase transition) and a linear behaviour.

The project mainly focusses on the nonlinear jump to finally rule it out or support it. A subsequent comparison to previous experimenta results aims to fit the physiological parameters. Since the cortex population is embedded into a network of other cortical areas and the thalamus, the corresponding analytical investigations takes into account external stochastic (from other brain areas) and time-periodic (thalamic) forces. To this end it is necessary to develop several novel nonlinear analysis technique of neural populations to derive the power spectrum close to the phase transition and conditions for physiological parameters.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. Cortina, associate team with Chile

Participants: Frédéric Alexandre, Thierry Viéville, Laurent Bougrain.

The goal of this associate team is to combine our complementary expertise, from experimental biology and mathematical models (U de Valparaiso and U Federico Santa-Maria) to computational neuroscience (CORTEX and NEUROMATHCOMP), in order to develop common tools for the analysis and formalization of neural coding and related sensory-motor loops. Recording and modeling spike trains from the retina neural network, an accessible part of the brain, is a difficult task that our partnership can address, what constitute an excellent and unique opportunity to work together sharing our experience and to focus in developing computational tools for methodological innovations.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

Elaa TEFTEF (from Dec 2011 until Jun 2012)

> Subject: Formalisation de la transformation analogique / événementielle des mécanismes non-standards des cellules ganglionnaires de la rétine.
>
> Institution: Ecole Nationale d'Ingénieurs de Tunis (Tunisia)

TARUN JAIN (from May 2012 until Aug 2012)

> Subject: Optimization of reconstruction of brain signals by neural population models
>
> Institution: IIT Delhi (India)

7.5.1.2. Visiting professors/researchers

Peter BEIM GRABEN (from 01/10/2012 until 22/12/2012)

> Funding: Inria Mathana
>
> Subject: Detection of metastable states in brain signals
>
> Institution: Humboldt University Berlin, Germany

Chahinez Meriem BENTAOUZA (from 17/11/2012 until 08/12/2012)

> Funding: University of Mostaganem
>
> Subject: Etude bibliographique de méthodes d'apprentissage statistique pour l'analyse de signaux médicaux
>
> Institution: University of Mostaganem, Algeria

Samira CHOURAQUI (from 01/04/2012 until 30/04/2012)

> Funding: University of Oran
>
> Subject: Modélisation des systèmes non linéaires par des réseaux de neurones
>
> Institution: University of Oran, Algeria

Fatiha HENDEL (from 12/01/2012 until 28/01/2012)

> Funding: University of Oran
>
> Subject: Apprentissage et classification automatique
>
> Institution: University of Oran, Algeria

Rodrigo SALAS FUENTES (from 20/04/2012 until 19/07/2012)

> Funding: Inria Cortina
>
> Subject: Event-based neural network weight adjustment
>
> Institution: Académico del Departamento de Ingeniería Biomédica, Facultad de Ciencias, Universidad de Valparaíso, Chile

DEMAR Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. SANOFI (Montpellier financial support)

Participants: Christian Geny (CHU Montpellier), Christine Azevedo-Coste, René Zapata (LIRMM), Lionel Lapierre (LIRMM).

Project SANOFI on developing a robot carrying a video camera for gait analysis of patients with neurological disorders.

8.1.2. CGS Merri (Languedoc-Roussillon - Montpellier)

Participants: Christian Geny (CHU Montpellier), Christine Azevedo-Coste, Simone Dalla Bella (UM1 M2H).

Developement and evaluation of controlled assistive device for freezing of gait in Parkinson Disease, 30keuros.

8.2. National Initiatives

8.2.1. 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's national initiative is to favor the scientific collaboration and technological transfer of the innovation between DEMAR and MXM.

The aim of this project is 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.

8.2.2. 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).

8.2.3. ADT SENSAS - SENSBIO

Participants: Christine Azevedo-Coste, David Andreu.

SENSAS is an Inria ADT (Actions de Développement Technologique), implying several Inria project teams on the "SENSor network ApplicationS" 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.

8.2.4. *Programme de recherche en qualité hospitaliere (PREQHOS)*

Participants: Leader: Jean-Christophe LUCET (GH Bichat - Claude Bernard), Christine Azevedo-Coste, Eric Fleury (Inria), Bruno Grandsebastien (CHRU Lille).

Project: Surgery room behaviour and impact on infectious risks (ARIBO : Attitudes et Risque Infectieux au Bloc Operatoire)

8.2.5. *INTENSE project*

Participants: David Guiraud, Pawel Maciejasz, Olivier Rossel, Christine Azevedo-Coste, David Andreu, 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.

8.3. European Initiatives

8.3.1. *FP7 European project TIME*

Participants: David Guiraud, David Andreu, Fabien Soulier, Pawel Maciejasz.

(2008-2012). 375keuros, "*Transverse, Intrafascicular Multichannel Electrode system for induction of sensation and treatment of phantom limb pain in amputees*". Partners : AAU (Aalborg, Denmark), MXM (Vallauris, France), SSSA (Pisa, Italy), IMTEK (Freiburg, Germany), UAB (Barcelona, Spain), UCBM (Roma, Italy), IUPUI (Indianapolis, USA).

8.4. International Initiatives

8.4.1. *Inria Associate Teams*

8.4.1.1. *WALK*

Title: Artificial Walking

Inria principal investigator: Philippe Fraisse

International Partner (Institution - Laboratory - Researcher):

Stanford University (United States) - Artifical Intelligence Lab

Duration: 2010 - 2012

See also: http://www.lirmm.fr/~fraisse/@WALK/

The motivation approach is the complementary research works of these teams. Indeed, a collaborative project should give an additional value to their research results. On one hand, the DEMAR Project Team has experience in Functional Electrical Stimulation to restore or modulate movements on spinal cord injured patients and post stroke patients. In both pathologies researches on assisted gait using FES (for paraplegics with a walker and hemiplegics) are carried out in the team. On the other hand, the Robotics research group (Stanford) carries out manipulation tasks with a humanoid robot under equilibrium constraints. Within the framework of the previous collaboration, the crossed visits and seminars last year led us to work on two different directions: - FES muscle modeling in Opensim framework - Control mechanisms underlying age-related changes in motor control strategies during Sit-To-Stand.

8.4.2. Inria International Partners

- Collaborative Research agreement on Academic Co-operation (contrat sans financement) "Neuro-muscular function analysis and identification for Rehabilitation" Partner: University of Tokyo (Prof. Yoshihiko Nakamura) Duration: 2011 - 2014

8.4.3. Participation In International Programs

8.4.3.1. STIC AmSud

Title: CARAT (Computer Aided Rehabilitation Algorithms and Tools)

Inria principal investigator: Mitsuhiro Hayashibe

International Partner (Institution - Researcher):

Universidade de Brasília (UnB,Brazil) - Antônio P.L. Bó, Geovany Borges

Pontificia Universidad Católica del Perú (PUCP,Brazil) - Dante Elias

Duration: 2012 - 2013

Throughout the world there is an increasing need for better technologies for rehabilitation and assistance. These new solutions must present improved performance in terms of therapy effectiveness, while at the same time minimizing the corresponding costs. In this scenario, computer-aided methods represent a promising alternative for the challenges currently faced by the rehabilitation domain. Within this collaborative research project, we focus on the following research topics: - Algorithms for human motion analysis for both clinical and residential settings based on portable and external sensing technologies - Sensory feedback devices to improve effectiveness on rehabilitation procedures - Robotic platforms for rehabilitation - Software development for telerehabilitation

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Prof. Keisuke Morishima (Professor, Osaka University) visited and presented his work on "Emergent Functionality of Cellular Buildup Wet Robotics" (15th, June 2012).

- Prof. Antônio P.L. Bó (Professor, Universidade de Brasília) visited and presented his work on "Human Centered robotics at UnB" (18th, July 2012).

- Prof. Thomas Stieglitz (Professor, Laboratory for Biomedical Microtechnology, Department of Microsystems Engineering - IMTEK, University of Freiburg) visited and presented his work on "Microtechnologies for Neural Implants" (17th, October 2012).

- Prof. Jessica Rose (Associate Professor, Department of Orthopedic Surgery, Stanford University and Director, Motion and Gait Analysis Lab, Lucile Packard Children's Hospital) visited and presented her work on "Gait Analysis in Cerebral Palsy: Applications for Artificial Walking Technologies" (17th, October 2012).

- Prof. Dejan B. Popović (Professor, University of Belgrade, Serbia and Aalborg University, Denmark) visited and presented his work on "Neuroprosthesis: A tool for neurorehabiliation or functional compensation?" (25th, October 2012).

8.5.2. Visits to International Teams

- Mitsuhiro Hayashibe gave invited talk at the Institute of Perception, Action and Behaviour (IPAB), University of Edinburgh, "Identification and Control of the Human Neuromuscular Dynamics toward Advanced Neuroprosthetics", February 2nd 2012.

- Mitsuhiro Hayashibe was Visiting Researcher at Nakamura lab, University of Tokyo and Tokyo University of Agriculture and Technology for JSPS-Inria Ayame project and worked on "Muscle Strength and Mass Distribution Identification Toward Subject-Specific Musculoskeletal Modeling" (March 2012).

- Mitsuhiro Hayashibe gave invited talk at workshop on EMG Technology and Application, Shanghai Jiao Tong University, May 7th 2012.

- Mitsuhiro Hayashibe visited the Laboratory of Automation and Robotics (LARA), Universidade de Brasília for STIC Amsud - CARAT project and made a seminer on "Modeling and identification for Neuroprosthetic systems and some related works for CARAT program" (20th May 2012 -4th June 2012).

- Mitsuhiro Hayashibe was Visiting Researcher at RIKEN BSI-TOYOYA research institute and worked on "Tacit Motor learning for rehabilitation" (Aug.-Sep. 2012).

DRACULA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Collaboration with the Immune Lab of Jacqueline Marvel in Lyon (Immunité, Infection et Virus), one paper published together in 2012 and one grant obtained from the FINOVI foundation.

8.2. National Initiatives

8.2.1. ANR

Projects coordination by a member of Dracula

+ ANR (jeunes chercheurs) MADCOW "Modelling amyloid dynamics and computation output work: applications to Prion and Alzheimer's disease", 2008-2012.
  Participants: Samuel Bernard, Fabien Crauste, Erwan Hingant, Laurent Pujo-Menjouet [Coordinator], Vitaly Volpert.

+ ANR (jeunes chercheurs) ProCell "Mathematical Methods for Erythropoiesis Modelling: from Proteins to Cell Populations", 2009-2013.
  Participants: Samuel Bernard, Fabien Crauste [Coordinator], Olivier Gandrillon, Laurent Pujo-Menjouet, Emmanuelle Terry, 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

+ Thomas Lepoutre participates in the ANR project (jeunes chercheurs) MODPOL "cell polarization modeling", 2011-2015, Vincent Calvez (ENS Lyon) [Coordinator].

+ Olivier Gandrillon participates in the ANR (Investissement d'Avenir) Iceberg "From population models to model populations: single cell observation, modeling, and control of gene expression", Gregory Batt (Inria) [Coordinator].

8.3. European Initiatives

8.3.1. Collaborations in European Programs

Program: PICS CNRS - RUSSIE

Project title: Mathematical modelling of blood diseases

Duration: 2010-2012

Participants: Samuel Bernard, Fabien Crauste, Laurent Pujo-Menjouet, Alen Tosenberger, Vitaly Volpert [Coordinator].

8.3.2. 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.

8.4. International Initiatives

8.4.1. Participation In International Programs

8.4.1.1. 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.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Michal Komorowski - Institute of Fundamental Technological Research of Polish Academy of Science, Warsaw, Pologne - February 2012.
- Oscar Angulo - University of Valladolid, Spain - March 2012.
- Konstantinos Tzirakis - Institute of Applied and Computational Mathematics, Foundation for Research and Technology, Greece - April 2012.
- Thomas Höfer - German Cancer Research Center, Heidelberg - April 2012.
- John Lygeros - Automatic Control Laboratory, ETH Zurich, Switzerland - June 2012.
- Hassan Hbid - University of Marrakech - June 2012.
- Khalil Ezzinbi (chercheurs invités) - University of Marrakech - September 2012.
- Michael C. Mackey - McGill University, Montréal, Canada - September 2012.
- Marta Tyran-Kaminska - University of Silesia, Pologne - September 2012.
- Sergei Fedotov - School of Mathematics, The University of Manchester, UK - October 2012.
- Amira Kebir - Institut Pasteur de Tunis - December 2012.

<p style="text-align:center">**DYLISS Team**</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Partnership with computer science laboratories in Nantes

Participants: Anne Siegel, Jérémie Bourdon, Damien Eveillard, François Coste, Jacques Nicolas, Oumarou Abdou-Arbi, Vincent Picard, Santiago Videla, Sven Thiele.

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. Two Ph-D thesis are also co-supervised within these collaborations.

7.1.2. Partnership in Marine Biology

Participants: Anne Siegel, Catherine Belleannée, Jérémie Bourdon, François Coste, Damien Eveillard, Jacques Nicolas, Guillaume Collet, Clovis Galiez, Gaëlle Garet, Vincent Picard, Sylvain Prigent.

A strong application domain of the Dyliss project is marine Biology. This application domain is co-developed 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 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 modelling of the initation of sea-urchin translation (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 P.-F. Pluchon) and the dentification of key actors implied in competition for light in the ocean (PELICAN ANR project).

7.1.3. Partnership with Inra and Health

Participants: Jacques Nicolas, Catherine Belleannée, François Coste, Michel Le Borgne, Anne Siegel, Oumarou Abdou-Arbi, Geoffroy Andrieux, Pierre Blavy, Valentin Wucher.

We have a strong and long term collaboration with biologists of INRA in Rennes : IGEEP and SENAH units. This partnership is acted by the co-supervision of one post-doctorant and two PhD students. It is also reinforced by collaboration within ANR contracts (Lepidolf, MirNadapt, FatInteger).

We also have a strong and long term collaboration with the IRSET laboratory at Univ. Rennes 1, acted by a co-supervised Ph-D thesis. This partnership is reinforced with the ANR contract Biotempo and has been also supported in the framework of the previous CPER by a project, BasicLab, on a lab on chip for cell assays.

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, Damien Eveillard, Gaëlle Garet, Jacques Nicolas, Andres Aravena, Sven Thiele, Santiago Videla.

Cooperation with Univ. of Chile (MATHomics, A. Maass) on methods for the identification of biomarkers and softwares 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. Co-funded by Inria and CORFO-chile from 2012 to 2022, the program includes a co-advised ph-D student (A. Aravena) and a post-doc (S. Thiele). 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 2013.

7.2.1.2. ANR Idealg

Participants: Anne Siegel, Catherine Belleannée, Jérémie Bourdon, François Coste, Damien Eveillard, Jacques Nicolas, Guillaume Collet, Clovis Galiez, Gaëlle Garet, 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 sector (CNRS, IFREMER, UEB, UBO, UBS, ENSCR, University of Nantes, INRA, AgroCampus), the industrial sector (C-WEED, Bezhin Rosko, Aleor, France Haliotis, DuPont) as well as a technical centre 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.

7.2.2. Methodology: ANR Biotempo

Participants: Anne Siegel, Jérémie Bourdon, François Coste, Damien Eveillard, Jacques Nicolas, Michel Le Borgne, Geoffroy Andrieux, Sylvain Prigent, Santiago Videla, Andres Aravena.

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 2014. [details]

7.2.3. Proof-of-concept on dedicated applications

7.2.3.1. ANR Fatinteger

Participants: Anne Siegel, Jacques Nicolas, Catherine Belleannée, Pierre Blavy.

This project (ANR Blanc SVE7 "biodiversité, évolution, écologie et agronomie" from 2012 to 2015) is leaded by INRA UMR1348 PEGASE (F. Gondret). It is interested by 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 Lepidolf

Participants: François Coste, Jacques Nicolas.

The LEPIDOLF project aims at better understanding olfactory mechanisms in insects. The goal is to establish the antennal transcriptome of the cotton leafworm Spodoptera littoralis, a noctuid representative of crop pest insects. It is funded by ANR call Blanc and coordinated by E. Jacquin-Joly from UMR PISC (INRA Versailles) from 2009 to 2012. Our contribution is to use grammatical inference to build characteristic signatures of the Olfactory Receptor family, which will be used to scan directly 454-sequencing reads and available partial cDNAs of genes expressed in the antenna of Lepidoptera or deduced proteins.

7.2.3.3. ANR Mirnadapt
Participants: Jacques Nicolas, Catherine Belleannée, Anne Siegel, Valentin Wucher.

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 is strengthened by a co-tutored PhD thesis (V. Wucher). 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.

7.2.3.4. ANR Pelican
Participant: François Coste.

The PELICAN project addresses competition for light in the ocean. It proposes an integrative genomic approach of the ecology, diversity and evolution of cyanobacterial pigment types in the marine environment, which arises from differences in the composition of the light-harvesting complexes (PBS). Our work is to ibuild characteristic signatures of targeted PBS enzymes. This ANR project (génomique et biotechnologies végétales) is coordinated by F. Partensky (CRNS Roscoff) from 2010 to 2013. [details]

7.2.4. Programs funded by research institutions

7.2.4.1. Inria Bioscience Ressource
Participants: Claudia Hériveau, Jacques Nicolas.

This project started in november 2011 and aims at promoting bioinformatics software and resources developed by Inria teams and their partners. A web portal will be deployed to allow users to test the software online. A tool is also developed to enhance the search of a specific resource using different criteria. The project is funded by Inria ADT program from 2011 to 2013, involves 8 research teams and is coordinated by the GenOuest platform and the Dyliss team (J. Nicolas and O. Collin) [details].

7.2.4.2. Aquasyst
Participants: Damien Eveillard, Anne Siegel.

PEPS contract 2011-2012 whose goal is to combine Environmental genomics and Systems biology for the understanding of aquifere denitrification.

7.3. European Initiatives

7.3.1. Collaborations with Major European Organizations

Partner: EBI (Great-Britain)

Modeling the logical response of a signalling network with constraints-programming.

Partner: Potsdam university (Germany)

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: SIEGEL Anne

International Partner (Institution - Laboratory - Researcher):

  University of Chile (Chile) - Center for Mathematical Modeling - MAASS Alejandro

Duration: 2011 - 2013

See also: http://www.irisa.fr/symbiose/people/asiegel/EA/

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 2013. The project aims at developing bioinformatics and mathematical methods for heterogeneous omics data. Within this program, we funded long-stay visitings in France to initiate long-term research lines, in complement to short visit funded by and inria-conycit program.

7.4.2. Participation In International Programs

7.4.2.1. Argentina - MinCYT-Inria 2011-12

  Partner: Universidad Nacional de Cordoba, *Grupo de Procesamiento de Lenguaje Natural (PLN)*, Argentina.

  Title: Modélisation linguistique de séquences génomiques par apprentissage de grammaires

  Financial support: MinCYT-Inria program 2011-12

The projects aims at developing new grammatical inference methods to learn automatically linguistic models of genomic sequences.

7.4.2.2. International joint supervision of PhD agreement

  Title: Introduction des approches combinatoires dans des modèles probabilistes pour la découverte d'évènements de régulation d'un système biologique à partir de données hétérogènes

  Inria principal investigator: Anne Siegel

  International Partners (Institution - Laboratory - Researcher):

    University of Chile (Chile)

  Duration: Jul 2011 - Jul 2014

  Title: Analyse automatisée et générique de réseaux métaboliques en nutrition

  Inria principal investigator: Anne Siegel

  International Partner (Institution - Laboratory - Researcher):

    University of Ouagadougou (Burkina Faso)

  Duration: October 2010 - September 2013

7.4.2.3. Germany. Egide Procope Program 2011-12

  Program: PHC

  Title: Reasoning in systems biology with answer set programming.

  Inria principal investigator: Jacques Nicolas

  International Partner :

    University of Potsdam (Germany)

    Institut fur Informatik Wissensverarbeitung und Informationssysteme

    T. Schaub

  Duration: Jan 2011 - Dec 2012

The cooperation adresses various aspects of the development of the Answer Set Programming approach in bioinformatics.Based on formal methods for the Analysis of big metabolic networks we developed a new approach with Answer Set Programming This approach can be used to check whether a network contains the reaction pathways that explain the bio-synthetic behavior of the organism. Further we developed an approach for the learning of logical models of protein signaling networks.

7.4.2.4. Amadeus (Austria)

Program: PHC

Title: From fractals to numeration

Inria principal investigator: Anne SIEGEL

International Partner (Institution - Laboratory - Researcher):

University of Leoben (Austria)

Duration: Jan 2011 - Dec 2012

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- **Germany**. Department of Computer Science, Potsdam. 5 days [T. Schaub, M. Gebser, M. Ostrowski]
- **Chile**. Centro de Modelimiento Matematico, Santiago. 10 days [A. Maass]

7.5.1.1. Internships

- Internship April to July, 2012. Co-supervised by Anne Siegel and Sylvain Prigent. Student : Floriane Ethys de Corny. Subject: Improvement of metabolic networks. Application to Ectocarpus siliculous.

7.5.2. Visits to International Teams

- **Austria**. Department of Mathematics, Leoben & Vienna. *Dynamical systems*. 5 days [A. Siegel]
- **Burkina-Faso**. Department of Computer Science, Oagadougou. *Multi-objective methods for the static analysis of metabolic network*. 2 months [O. Abdou-Arbi]
- **Chile**. Centro de Modelimiento Matematico, Santiago. *Metabolic modeling of bacteria*. 14 days [D. Eveillard]
- **Chile**. Centro de Modelimiento Matematico, Santiago. *Data integration*. 7 days [A. Siegel]
- **Chile**. Centro de Modelimiento Matematico, Santiago. *Applications of ASP*. 21 days [S. Thiele]
- **Chile**. Centro de Modelimiento Matematico, Santiago. *Applications of ASP*. 10 days [S. Videla]
- **Germany**. Department of Computer Science, Potsdam. *Constraint-based approaches*. 5 days [J. Nicolas]
- **Germany**. Department of Computer Science, Potsdam. *Application of ASP to biology*. 5 days [A. Siegel]
- **Germany**. Department of Computer Science, Potsdam. *Reconstruction of metabolic networks*. 10 days [S. Thiele]
- **Germany**. Department of Computer Science, Potsdam. *Learning logical rules for protein signaling networks*. 2 months [S. Videla]
- **Niger**. University of Maradi. *Multi-objective methods for the static analysis of metabolic network*. 1 month [O. Abdou-Arbi]
- **UK** EMBL-European Bioinformatics Institute. *Learning logical rules for protein signaling networks*. 3 days [S. Videla]

FLUMINANCE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. *Britanny concil ARED IMAGEO:*

Participants: Cédric Herzet, Etienne Mémin, Véronique Souchaud.

duration 36 months. This project of the Britanny concil, which finances the PhD thesis of Véronique Souchaud, aims at studying methods for the estimation of reduced order modeling of fluid flows evolution laws from image sequences. The goal consists here at defining the estimation of a reduced basis describing the flow evolution as a motion estimation problem.

7.2. National Initiatives

7.2.1. *ANR-COSINUS PREVASSEMBLE: Ensemble methods for assimilation of observaions and for prevision in Meteorology and Oceanography*

Participants: Sébastien Béyou, Anne Cuzol, Etienne Mémin.

duration 36 months.

The purpose of this project is to further study ensemble methods -, and to develop their use for both assimilation of observations and prediction. Among the specific questions to be studied are the theory of Particle Filters and Ensemble Kalman Filters, the possibility of taking temporal correlation into account in ensemble assimilation, the precise assessment of what can and cannot be achieved in ensemble prediction, and the objective validation of ensemble methods.

The partners of this project are Laboratoire de Météorologie Dynamique/ENS (leader), Météo-France and three Inria groups (ALEA, ASPI, FLUMINANCE).

7.2.2. *ANR SYSCOMM MSDAG: MultiScale Data Assimilation in Geophysics*

Participants: Pierre Dérian, Patrick Héas, Dominique Heitz, Cédric Herzet, Etienne Mémin.

duration 36 months.

Changing scale is a well-known topic in physics (geophysics, fluid mechanics and turbulence, theoretical and statistical physics, mechanics, porous media, etc.) It has lead to the creation of powerful sophisticated mathematical tools: renormalization, homogenization, etc. These ideas are also used in numerical analysis (the so-called multigrid approach) for solving efficiently partial differential equations. Data assimilation in geophysics is a set of methods that allows to combine optimally numerical models in large spaces with large dataset of observations. At the confluence of these two topics, the goal of this project is to study how to embed the change of scales (a multiscale point of view) issue into the framework of geophysical data assimilation, which is a largely unexplored subject.

The partners of this 3 years project are the CEREA/ CLIME Inria group (leader), the LSCE/CEA, the Inria groups MOISE and FLUMINANCE.

7.2.3. *ANR SYSCOMM GeoFluids:*

Participants: Patrick Héas, Dominique Heitz, Souleymane Kadri Harouna, Etienne Mémin, Véronique Souchaud.

duration 48 months.

The project Geo-FLUIDS focuses on the specification of tools to analyse 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, IPSO, 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.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. HURACAN

Title: Analysis and control of fluid flows from image sequences

Inria principal investigator: Etienne Memin

International Partners (Institution - Laboratory - Researcher):

IRSTEA (France)

University of Buenos Aires (Argentina)

Duration: 2010 - 2012

See also: http://huracan.inria.fr

The HURACAN associated team is centered on the analysis and the control of fluid flows from image sequences. The research objectives of this team are organized into two distinct work axes. The first one aims at defining and studying visual servoing techniques for fluid flows control. In addition to the definition of efficient visual servoing schemes this axis of work gathers research issues related to fluid flows velocity measurement from images and to flows excitation through plasma actuators. The second research axis focuses on the coupling between large scales representations of geo-physical flows and image data. More precisely, it aims at studying means to define directly from the image sequences the small scales terms of the dynamics. This research axis includes the study of coupling models and data defined at different scales, problems of multiscale velocities estimation respecting turbulence phenomenological laws and issues of experimental validation.

7.3.2. Participation In International Programs

STIC AmSud project "Physics-based modeling of voice production" leaded by D. Sciamarella CNRS/LFD-FIUBA.

This project is an interdisciplinary project with researchers spanning from aeroacoustics to physiology, and from computational physics to phonetics. It aims at studying the mechanisms of human voice production system for applications ranging from man-machine communication to medical diagnosis.

GALEN Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- 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 data

    Duration: 1/2012-12/2015

    Coordinator: ECP-FR

- Program: DIGITEO OMTE

    Project acronym: CURATEUR

    Project title: Real-time Multi-sensor (2D/3D) Elastic Image Fusion towards Computer-assisted Tumor Removal Surgery

    Duration: 1/2012-6/2014

    Coordinator: ECP-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: 10/2010-9/2013

    Coordinator: ECP - FR

8.2.2. Competitivity Clusters

- Program: MEDICEN

    Project acronym: ADOC

    Project title: ADOC – Diagnostic peropératoire numérique en chirurgie du cancer

    Duration: 11/2011-10/2014

    Coordinator: LLTECH - FR

8.3. European Initiatives

8.3.1. FP7 Projects

- Project acronym: MOBOT

    Project title: Intelligent Active MObility Assistance RoBOT integrating Multimodal Sensory Processing, Proactive Autonomy and Adaptive Interaction

    Duration: 36 months

    Coordinator: TUM - DE

- Project acronym: RECONFIG

    Project title: Cognitive, Decentralized Coordination of Heterogeneous Multi-Robot Systems

    Duration: 36 months

    Coordinator: KTH - SE

8.3.2. Collaborations in European Programs, except FP7

- Program: European Research Council

    Project acronym: DIOCLES

    Project title: Discrete bIOimaging perCeption for Longitudinal Organ modEling and computEr-aided diagnosiS

    Duration: 9/2011-8/2016

    Coordinator: ECP - FR

8.3.3. Collaborations with Major European Organizations

Technical University of Munich, Chair for Computer Aided Medical Procedures & Augmented Reality - Computer Science Department (DE): Mono and Multi-modal image fusion using discrete optimization and efficient linear programming.

Università della Svizzera Italiana, Institute of Computational Science (CH), Construction of deformation-invariant surface descriptors [39] and meta-descriptors for surfaces [17].

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

Inria principal investigator: Pawan Kumar

International Partner (Institution - Laboratory - Researcher):

Stanford University (United States) - Artificial Intelligence Lab

Duration: 2012 - 2014

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

- **Department of Diagnostic Radiology, University of Pennsylvania:** The GALEN and the Section of Biomedical Image Analysis - SBIA group (Pr. Christos Davatzikos) have an established collaboration during the past three years in the area of deformable image fusion. In this context, PhD candidates of the GALEN group spend time visiting the SBIA group, while Pr. Paragios participates at a Nantional Institute Health grant led by SBIA. Such a collaboration led to a number of outstanding rank journal and conference publications.

- **Department of Computer Science, StonyBrook, State University of New York:** The GALEN and the Image Analysis Lab - CBL (Pr. Dimitris Samaras) have an established collaboration during the past years in the area of graph-based methods in medical imaging and computer vision. Pr. Samaras holds a research professor position (DIGITEO chair) at Ecole Centrale de Paris. Such a collaboration led to a number of outstanding rank conference publications during the last years.

- **Chang Gung Memorial Hospital – Linkou, Taiwan:** In the context of France-Taiwan program sponsored from the French Science Foundation, GALEN (in collaboration with the department of radiology of Henri Mondor University Hospital), a project (ADAMANTIUS) was initiated with the Chang Gung Memorial Hospital – Linkou that is the largest private hospital in Taiwan. The aim of the project is to study the 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.

8.5. International Research Visitors

8.5.1. Internships

- Aseem BEHL (from Nov 2012 to Dec 2012)

  Subject: Optimizing Average Precision using Weakly Supervised Data. The average-precision support vector machine (AP-SVM) optimizes an upper bound on the average-precision (AP) loss, which is often used as a measure of accuracy for binary classification. However, it does not handle partially annotated datasets. To address this shortcoming of AP-SVM, we proposed a novel latent AP-SVM formulation, which allows us to learn an accurate set of classifier parameters by minimizing a carefully designed difference-of-convex upper bound on the AP loss.

  Institution: International Institute of Information Technology (IIIT), Hyderabad (India).

  Enzo FERRANTE (from June 2012 until October 2012)

  Subject: Plane+Deformation 2D-3D multimodal data fusion. The goal of the internship was to study the use of discrete optimization methods in the context of 2D to 3D registration in biomedical image analysis. In particular the aim was to define a metric free graphical model formulation that is able to determine for a given 2D image the corresponding 3D volume plane along with the in plane deformation. The case of computer assisted surgery was considered as a test case between 2D interventional images and 3D pre-operative high resolution annotated data.

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

- Danny GOODMAN (Aug 2012)

  Subject: Discriminative Parameter Estimation for Random Walks Segmentation. While random walks (RW) provide an efficient formulation for segmentation, there use is restricted by the lack of an accurate learning framework that estimates its parameters. The main difficulty is that a user can only provide a hard segmentation of a training sample, instead of the optimal probabilistic segmentation. We overcome this deficiency by treating the optimal probabilistic segmentation as latent variables, which allows us to employ the latent SVM formulation for parameter estimation.

  Institution: Stanford University (USA).

Ishan MISRA (from May 2012 until Aug 2012)

Subject: Shape-from Shading analysis for Object Categories. The goal of the internship was to see whether shape-from-shading techniques can be used to recover the 3D geometry within an object category. Mr. Misra experimented with techniques for shape-from-shading under unknown illumination as well as surface recovery from a single image. Mr. Misra has delivered the source code for his software to our team, and we intend to use it in our on-going research.

Institution: IIIT HYDERABAD (India)

Bharat SINGH (from May 2012 until September 2012)

Subject: Sub-space real-time Deformable Registration. The aim of this internship was to investigate the use of sub-space image representations towards defining an appropriate metric in the context of mono-modal and multi-modal fusion. Furthermore, it was studied their integration in a graph-theoretic framework for deformable fusion that can benefit from its implementation on modern parallel architectures like graphics processing units.

Institution: IIT MADRAS (India)

Eduard TRULLS (from January 2012 until April 2012)

Subject: Segmentation-Aware Image Descriptors. The goal of the internship was to construct appearance descriptors that can exploit segmentation information in order to achieve invariance to background changes. Mr. Trulls implemented a dense descriptor that uses soft segmentation masks, and demonstrated that this results in substantially more invariant descriptors; he evaluated these descriptors on image registration (optical flow) and wide-baseline matching (stereo) where state-of-the-art results were obtained. This work has been submitted for publication and is under evaluation.

Institution: Universidad Polytecnica de Catalunia (UPC) (Spain)

8.5.2. *Visits to International Teams*

Matthew BLASCHKO & Iasonas KOKKINOS (from June 2012 until August 2012)

Subject: Center for Language and Speech Processing: Towards a Detailed Understanding of Objects and Scenes in Natural Images Workshop. The objective of this workshop was to develop novel methods to reliably extract from images a diverse set of attributes, and to use them to improve the accuracy, informativeness, and interpretability of object models. The goal is to combine advances in discrete-continuous optimisation, machine learning, and computer vision, to significantly advance our understanding of visual attributes and produce new state-of-the-art methods for their extraction.

Institution:John Hopkins University (USA)

Pawan KUMAR (from April 2012 until May 2012)

Subject: SPLENDID Associate Team

Institution: Stanford University (United States)

<p style="text-align:center">**GENSCALE Team**</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Program from Région Bretagne : MIRAGE

Participants: Liviu Ciortuz, Claire Lemaitre, Pierre Peterlongo.

The MIRAGE project is funded by Région Bretagne in the framework of the SAD call (Stratégie Attractivité Durable) which aims at attracting international post-doctorant for one year. The MIRAGE project aims at developing new methods to detect complex variation (structural variations) in non-assembled NGS data. It is funded from Sept. 2012 until August 2013 and coordinated by C. Lemaitre.

8.1.2. Partnership with INRA

Participants: Thomas Derrien, Anaïs Gouin, Fabrice Legeai, François Moreews, Raluca Uricaru.

We have a strong and long term collaboration with biologists of INRA in Rennes : IGEPP and SENAH units. This partnership concerns both service and research activities and is acted by the hosting of two ingineers (F. Legeai, F. Moreews) and by the co-supervision of two post-doctorants and one non permanent engineer. In particular, the collaboration with the IGEPP team includes several research projects in which Genscale is formally a partner : an INRA project PEAPOL including an industrial partner, Biogemma, and an ANR project SPECIAPHID. These projects fund the non-permanent INRA members.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. BIOWIC

Participants: Rumen Andonov, Dominique Lavenier, François Moreews.

The BioWIC project aims to speed up both the design and the execution of bioinformatics workflows. It is funded by ANR call ARPEGE and coordinated by D. Lavenier from Jan. 2009 to June 2012. http://biowic.inria.fr/

8.2.1.2. MAPPI

Participants: Rayan Chikhi, Dominique Lavenier, Claire Lemaitre, Nicolas Maillet, Pierre Peterlongo.

The MAPPI project aims to develop new algorithms and Bioinformatics methods for processing high trougthput genomic data. It is funded by ANR call COSINUS and coordinated by M. Raffinot (LIAFA, Paris VII) from Oct 2010 to Dec. 2013.

8.2.1.3. FATINTEGER

Participants: Dominique Lavenier, François Moreews.

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. It is funded by ANR call BLANC and coordinated by F. Gondret from 2012 to 2015.

8.2.1.4. SPECIAPHID

Participants: Thomas Derrien, Anaïs Gouin, Fabrice Legeai, Claire Lemaitre.

The SPECIAPHID project aims to understand the adaptation and speciation of pea aphids by re-sequencing and comparing the genomes of numerous aphid individuals. Genscale's task, as associate partner, is to apply and develop new methods to detect variation between re-sequenced genomes, and in particular complex variants such as structural ones. It is funded by ANR call BLANC and coordinated by J-C Simon (Inra, Rennes) from January 2012 to Dec. 2014.

8.2.1.5. ADA-SPODO

Participants: Rumen Andonov, Dominique Lavenier, Fabrice Legeai, Claire Lemaitre, François Moreews, Pierre Peterlongo.

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 post-genomic and regulatory data. It is funded by ANR call BLANC and coordinated by E. d'Alençon (Inra, Montpellier) from October 2012 to Dec. 2015.

8.2.1.6. RAPSODYN

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo, Erwann Scaon.

RAPSODYN is a long term project funded by the IA French program (Investissement d'Avenir) for 7.5 years (07/2012-12/2019). The objective is the optimisation of the rapeseed oil content and yield under low nitrogen input. GenScale is involved in the bioinformatics workpackage to elaborate advanced tools dedicated to polymorphism.

8.2.1.7. LEPIDOLF

Participants: Dominique Lavenier, Fabrice Legeai.

The LEPIDOLF project aims at better understanding olfactory mechanisms in insects. The goal is to establish the antennal transcriptome of the cotton leafworm Spodoptera littoralis, a noctuid representative of crop pest insects. It is funded by ANR call Blanc and coordinated by E. Jacquin-Joly from UMR PISC (INRA) from 2009 to 2012. As part of this project, a post-doctoral student, Aurore Gallot, visited Genscale for 5 months.

8.2.2. Programs from research institutions

8.2.2.1. Mapsembler

Participants: Alexan Andrieux, Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

The Mapsembler project aims at finalizing and to 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/

8.2.2.2. Mastodons

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

This project, funded by the CNRS Big Data program in 2012, aims do investigate the challenge brought by the processing of high throughput sequencing genomic data. It is coordinated by D. Lavenier from june 2012 to december 2012.

8.2.2.3. BioManyCores

Participants: Guillaume Chapuis, Charles Deltel, Dominique Lavenier.

The BioManyCores project aims to develop a library of bioinformatics softwares implemented on manycore structures such as GPU. It is funded by Inria ADT call and supervised by J.S. Varré in Sequoia Team in Lille. http://www.biomanycores.org/

8.2.2.4. ParaQtlMap

Participants: Guillaume Chapuis, Charles Deltel, Dominique Lavenier.

The ParaQtlMap project is a join initiative from Genscale team and Genetique Animale. to design high performance software for detecting quantitative trait locus. It is funded by Inria/INRA call and coordinated by D. Lavenier (Genscale) and P. Leroy (GA INRA) from oct. 2010 to sept. 2012. https://qgp.jouy.inra.fr/index.php?option=com_content&task=view&id=17&Itemid=28

8.2.2.5. Barcoding de nouvelle génération

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo.

This project is a join initiative between Genscale and LECA (Laboratoire d'Ecologie Alpine in Grenoble). It aims at developping new algorithmic approaches for the species identification from low coverage NGS data. It is funded by a PEPS program at CNRS/Inria and coordinated by C. Lemaitre from sept. 2012 to december. 2013.

8.2.2.6. Poly-BNF

Participants: Dominique Lavenier, Claire Lemaitre, Pierre Peterlongo, Erwann Scaon.

This projects aims to develop bioinformatics strategies for studying polyploid genomes. It is a one year project (09/2012 – 09/2013) funded by the University of Rennes 1. It is a joined project with CNRS/EcoBio lab and INRA/IGEPP lab.

8.2.3. Cooperations

8.2.3.1. Inria Bamboo Team

Participants: Claire Lemaitre, Pierre Peterlongo.

We maintain a long term collaboration with Inria Bamboo Team on the problems of finding biological information, such as variants, in NGS raw data.

8.2.3.2. LIGM, Paris

Participant: Pierre Peterlongo.

P. Peterlongo collaborates with the LIGM lab in Paris (UMR 8049), on problems of large NGS raw data indexation.

8.2.3.3. LIX

Participant: Antonio Mucherino.

A. Mucherino collaborates since 5 years with LIX, Ecole Polytechnique, in Palaiseau on the distance geometry problem. We reformulated the problem as a combinatorial optimization problem and we conceived an ad-hoc algorithm for the solution of this class of problems.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

Partner: CWI, University of Amsterdam, (Netherland)

Subject of cooperation: Optimization algorithms for protein structures alignments.

8.4. International Initiatives

8.4.1. Participation In International Programs

8.4.1.1. CONICYT (Chile)

Program: Coopération bilatérale CNRS

Title: Wine fermentation analysis by biclustering

Inria principal investigator: Antonio MUCHERINO

International Partner (Institution - Laboratory - Researcher):

Technical University Federico Santa Maria (Chile)

Duration: Jan 2012 - Dec 2012

This project aims at using data mining techniques for predicting problematic wine fermentations from the first stages of the fermentation process.

8.4.2. Collaborations

Partner: IMECC, UNICAMP, Campinas-SP (Brazil)

Subject: distance geometry, bioinformatics.

Partner:COPPE, Federal University of Rio de Janeiro (Brazil)

Subject: distance geometry, bioinformatics.

Partner: Los Alamos National Laboratory (lanl), Los Alamos (USA)

Subjects: Combinatorial algorithms (shortest paths, graph partitioning, combinatorial optimization) and algorithm engineering (efficient implementation of combinatorial algorithms)

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Carlile Lavor, from IMECC-UNICAMP, Campinas-SP, Brazil, visited Genscale 3 times (2 times, for 1 week, funded by his own projects and 1 time, for 1 month, funded by "mois ISTIC").

- Alejandra Urtubia, from Universidad Tecnica Federico Santa Maria, Valparaiso, Chile, visited genscale for 2 weeks. This visit was funded by CNRS-CONICYT project on wine fermentation (A. Mucherino).

- Hristo Djidjev from Los Alamos, USA, visited Genscale for a month in the framework of University of Rennes 1 visiting positions "professeur invité".

- Van-Hoa Nguyen from University of Angiang, Viet Nam, visited GenScale for 3 months (nov. 2012 - jan. 2013). The visit was funded by the French Mastodons program from CNRS to research focusing on bioinformatics big data problem.

- Rafael Santos, from UNICAM, Bresil, visited GensCale for 3 months (oct. 2012 - dec. 2012). The visit was funded by CNPq (collaboration with A. Mucherino on protein structure).

- Virginia Silva da Costa, from the Federal University of Rio, Bresil, visited Genscale for 4 months (mar. 2012 - june 2012), funded by CAPES.

- Mariade Cola, from the University of Rome, Italia, visited Genscale for 3 months (apr. 2012 - june 2012), funded by IASI-CNR.

- Sharat Bogaraju, from IIT Delhi, India, visited GenScale for 6 months (dec. 2011 - may 2012). The visit was funded by Rennes Metropole (International exchange of PhD Students). Collaboration with D. Lavenier on parallel bioinformatics algorithms .

8.5.2. Visits to International Teams

- Antonio Mucherino visited IMECC-UNICAMP, Campinas-SP, Brazil, for 2 months, under the program "chaires française à São Paulo"

- Claire Lemaitre and Pierre Peterlongo visited for 1 week the "Laboratory of Bioinformatics and Mathematics of the Genome" hosted at CMM at University of Chile. The visit was funded by CIRIC-omics research line of the Inria center in Chile.

- Nicolas Maillet (PhD) wisited during three months the LNCC (Laboratório Nacional de Computação Científica) in Petropolis (state of Rio de Janeiro, Brazil) from March to June 2012.

- Mathilde Le Boudic-Jamin (PhD) visited the CWI in Amsterdam, Neetherlands (June 2012, one month) and collaborated with Gunnar KLAU and Inken WOHLERS on the family identification problem.

<div align="center">**IBIS Project-Team**</div>

7. Partnerships and Cooperations

7.1. Regional initiatives

Project name	Identification structurelle et paramétrique des réseaux de régulation bactériens
Coordinator IBIS participants Type Web page	E. Cinquemani E. Cinquemani, J. Geiselmann, H. de Jong, D. Stefan Funding PhD grant, Cluster ISLE, Région Rhône-Alpes http://cluster-isle.grenoble-inp.fr/

Project name	Motilité ou adhésion : comment les entérobactéries choisissent entres ces deux états physiologiques déterminants pour la virulence
Coordinator IBIS participants Type	S. Lacour J. Demol, O. Dudin, J. Geiselmann, J. Izard, S. Lacour, C. Pinel Grant, Cluster Infectiologie, Région Rhône-Alpes

Project name	Séminaire grenoblois des systèmes complexes
Coordinators IBIS participants Type Web page	S. Achard, O. François, A. Girard, E. Prados, S. Rafai, D. Ropers D. Ropers Funding by Institut des Systèmes Complexes de Lyon (IXXI) http://www.ixxi.fr/?page_id=114&lang=fr

Project name	Séminaire de modélisation du vivant
Coordinators IBIS participants Type Web page	O. Gandrillon D. Ropers Funding by GdR BIM http://cgphimc.univ-lyon1.fr/CGphiMC/Semovi/Semovi.php

7.2. National initiatives

Project name	ColAge – Lifespan control in bacteria: Natural and engineering solutions
Coordinator IBIS participants Type Web page	H. Berry G. Baptist, E. Cinquemani, J. Geiselmann, H. de Jong, J. Izard, S. Lacour, C. Pinel, D. Ropers Action d'Envergure Inria-INSERM (2008-2012) http://colage.saclay.inria.fr

Project name	GeMCo – Model reduction, experimental validation, and control for the gene expression machinery in *E. coli*
Coordinator	M. Chaves
IBIS participants	G. Baptist, E. Cinquemani, J. Geiselmann, E. Grac, H. de Jong, J. Izard, S. Lacour, C. Pinel, D. Ropers
Type	ANR Blanc (2010-2013)
Web page	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	H. de Jong
IBIS participants	G. Baptist, E. Cinquemani, J. Geiselmann, H. de Jong, J. Izard, S. Lacour, Y. Markowicz, C. Pinel, D. Ropers
Type	Bioinformatics call, Investissements d'Avenir program (2012-2016)

Project name	Fonction du système de régulation post-transcriptionnel CSR dans la dynamique de l'adaptation métabolique chez la bactérie modèle Escherichia coli
Coordinators	M. Cocaign-Bousquet (INRA, LISBP), B. Enjalbert (INSA, LISBP), D. Ropers
IBIS participants	M. Morin, D. Ropers
Type	Contrat Jeune Scientifique INRA-Inria (2012-2016)
Web page	http://www.inra.fr/les_hommes_et_les_femmes/rejoignez_nous/completer_sa_formation/le_recrutement_de_doctorants/cjs__1/inra_inria

7.3. International projects

Project name	French bioinformatics contribution to ICGC
Coordinator	G. Thomas
IBIS participants	F. Rechenmann
Type	International Cancer Genome Consortium (ICGC)
Web page	http://www.icgc.org/

The goal of ICGC (International Cancer Genome Consortium) is to obtain a comprehensive description of genomic, transcriptomic and epigenomic changes in 50 different cancer types. In France, INCa (French National Cancer Institute) contributes to this project and focuses on two types of cancer. The main idea is to sequence the human genome of normal and tumoral cells of a large set of patients and to compare these genomic sequences to identify the mutations which may explain the development of the cancers. Bioinformatics is clearly involved in the management, the analysis and the visualization of the huge sets of data and results. Bioinformatics of the French contribution is carried out at Lyon, in the context of the Synergie Lyon Cancer Foundation. François Rechenmann has joined this bioinformatics team and contributes to the organization of the data management and analysis workflow, under the leadership of prof. Gilles Thomas [12], [10].

7.4. 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.

7.5. International research visitors

Internship	Elif Köksal (Bogazici University, Turkey))
Supervisor	E. Cinquemani
Subject	Modeling, analysis, and identification of metabolic networks

Internship	Nicola Simeone (University of Pavia, Italy))
Supervisor	E. Cinquemani
Subject	Stochastic modeling and identification of bacterial regulatory networks

MACS Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 Projects

7.1.1.1. EUHEART

Title: euHeart

Type: COOPERATION (ICT)

Defi: Virtual Physiological Man

Instrument: Integrated Project (IP)

Duration: June 2008 - May 2012

Coordinator: Philips Technologie GmbH Forschungslaboratorien (Germany)

Others partners: Philips Technologie GmbH (DE), The University of Oxford (UK), Universitat Pompeu Fabra (SP), The University of Sheffield (UK), Inria, French National Research Institute in Informatics and Mathematics (FR), King's College London (UK), Academisch Medisch Centrum bij de Universiteit van Amsterdam (NL), Universität Karlsruhe (TH) (DE), Institut National de la Santé et de la Recherche Médicale, INSERM (FR), Philips Medical Systems Nederland BV (NL), Berlin Heart GmbH (DE), HemoLab BV (NL), Universitätsklinikum Heidelberg (DE), Volcano Europe SA / NV (BE), Hospital Clínico San Carlos de Madrid (SP), Philips Ibérica S.A. (SP)

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

Abstract: The euHeart project (Ref 224495), is a 4-year integrated European project which aims at developing personalized, and clinically validated multi-physics, multi-level models of the heart and great vessels. Those models need to be tightly integrated with signal and image processing tools in order to assist clinical decision making and to help reducing morbidity and mortality rates associated with cardiovascular diseases. Asclepios is leading a workpackage on radiofrequency ablation for which electromechanical models of the heart are used to improve the planning of radiofrequency ablation lines for patient suffering from atrial fibrillation and ventricular tachycardia.

7.1.1.2. VPH-Share

Title: VPH-Share

Type: COOPERATION (ICT)

Defi: Virtual Physiological Human : Sharing for Healthcare

Instrument: Integrated Project (IP)

Duration: March 2011 - February 2015

Coordinator: Univ. Sheffield (UK)

Others 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 integrate 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 Macs team is in charge of developing some high-performance data assimilation software tools.

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. CARDIO

Title: Mathematical modelling and Numerical Simulation for Cardiovascular Applications

Inria principal investigator: Philippe Moireau

International Partner (Institution - Laboratory - Researcher):

University of California San Diego (United States) - Mechanical and Aerospace Engineering - Alison MARSDEN

Duration: 2008 - 2013

See also: https://idal.inria.fr/cardio/

To improve disease understanding, surgical repair or medical device design, mathematical and numerical tools have been the subject of much efforts over the last decades. In this context, we propose a research subject on cardiovascular and air flow modeling. It extends the project of the previous associated team on blood flow modeling to flow of air in the lungs. The goal is to continue to work on bringing together methods developed in the different teams, to compare them if necessary, and to apply them to in-vivo (animal or human) physiologically relevant situations. All the different team members have a strong will to work close to the applications. They all have links to clinicians or biologists, which drive the concrete applications that will be studied: congenital heart disease pathophysiology and repair, artery wall compliance study in normal and pathophysiological cases, heart valve pathophysiology assessment, aerosol deposition in the lungs. Furthermore, the associated team facilitates the breadth of researcher knowledge by exposure to different ways of thinking, methods and/or applications, and by the training of students as they interact with the other institutes.

<div align="center">**MAGIQUE-3D Project-Team**</div>

8. Partnerships and Cooperations

8.1. Regional Initiatives

The PhD fellowship of Elodie Estecahandy is partially (50%) financed by the Conseil Régional d'Aquitaine.

The PhD fellowship of Vanessa Mattesi is partially (50%) financed by the Conseil Régional d'Aquitaine.

The Post-Doctoral fellowship of Juliette Chabassier is partially (50%) financed by the Conseil Général des Pyrénées Atlantiques.

The Post-Doctoral fellowship of Ángel Rodríguez Rozas is partially (50%) financed 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 and with the collaboration of Henri Calandra from Total, Magique-3D coordinates research activities dealing with the development of high-performance numerical methods for solving wave equations in complex media. This project involves French academic researchers in mathematics, computing and in geophysics, and is funded by Total. Currently, two project-teams are involved: Hiepacs and Nachos.

In the framework of DIP, three PhD students are working in Magique 3D and two new PhD students have been hired this year. One of them is shared with the project team Nachos (http://www-sop.inria.fr/nachos/). Moreover, one internship has been realized. Always in the framework of DIP, Magique-3D has a collaboration with Prof. Changsoo Shin who is an expert of Geophysics and works at the Department of Energy resources engineering (College of Engineering, Seoul National University). Jewoo Yoo, who is a first year PhD student advised by Prof.Changsoo Shin, has visited Magique-3D during four months, from November 2011 to February 2012.
The contract ends in 2012 and a second period will start in 2013. We aggreed with Total hat the new contract will be signed for five years and that Magique 3D will strenghten its collaboration with Professor J. Tromp at Princeton on the topic of full wave inversion.

8.3. European Initiatives

8.3.1. *FP7 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, 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: 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.

8.3.2. Collaborations in European Programs, except FP7

Joint project with BCAM (Basque Center of Applied Mathematics) funded by the Conseil Régional d'Aquitaine and the Basque Government in the framework of the Aquitaine-Euskadi Call. Total Amount: 14 000 euros.

Program: Fonds commun de coopération Aquitaine/Euskadi

Project acronym: AKELARRE

Project title: Méthodes numériques innovantes et logiciels performants pour la simulation de la propagation des ondes électromagnétiques en milieux complexes

Duration: février 2011 - février 2013

Coordinator: Hélène Barucq

Other partners: BCAM (Basque Center of Applied Mathematics), Spain

Abstract: This project brings together the complementary skills in the field of wave propagation of two research teams which are respectively located in Pau and Bilbao. The main objective of this collaboration is to develop innovative numerical methods and to implement powerful software for the simulation of electromagnetic waves in complex media. These waves play an important role in many industrial applications and the development of such software is of great interest for many industrial enterprises located in the region. Theoretical and practical issues are considered. In particular, we focus on the mathematical analysis of boundary conditions that play a crucial role for accurate numerical simulations of waves.

Joint project with the Matheon Research Center in Berlin funded by the European Union in the framework of the Procope 2012 Call. Total Amount: 4200 euros.

Program: PHC Procope 2012

Project acronym: Procope Inria - TU Berlin

Project title: Procope Inria - TU Berlin

Duration: January 2012 - December 2014

Coordinator: Sébastien Tordeux

Other partners: Matheon Research Center, TU Berlin, Germany

Abstract: This project aims in funding trips between Pau and Berlin. The young research group of Kersten Schmidt and Magique 3D are both specialist of the modeling and the simulation of the wave propagation phenomena. During this program we focus on the modeling of multiperforate plates which are present in the combustion chambers; on the derivation of absorbing boundary conditions for stratified media and on the development of precise numerical methods in the context of the Hardy problem.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. MAGIC

Title: Advance Modeling in Geophysics

Inria principal investigator: Hélène Barucq

International Partner:

Institution: California State University at Northridge (United States)

Laboratory: Department of Mathematics

Duration: 2006 - 2012

See also: http://uppa-inria.univ-pau.fr/m3d/Equipe-associee/index.html

The main objective of this collaboration is the design of an efficient solution methodology for solving Helmholtz problems in heterogeneous domains, a key step for solving the inversion in complex tectonics. The proposed research program is based upon the following four pillars:

1. The design, implementation, and the performance assessment of a new hybrid mixed type method (HMM) for solving Helmholtz problems. 2. The construction of local nonreflecting boundary conditions to equip HMM when solving exterior high-frequency Helmholtz problems. 3. The design of an efficient numerical procedure for full-aperture reconstruction of the acoustic far-field pattern (FFP) when measured in a limited aperture. 4. The characterization of the Fréchet derivative of the elasto-acoustic scattered field with respect to the shape of a given elastic scatterer.

8.4.2. Participation In International Programs

8.4.2.1. GEO3D

Joint project with the Novosibirsk state University in Russia funded by the Poncelet laboratory in the framework of the Inria Russia Call. Total Amount: 8000 euros for 2012.

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 - Yuri Laevsky

Duration: January 2012 to 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) in the context of geosciences. We are mainly interested to the derivation of numerical methods (discontinuous Galerkin approximation, space-time refinement), to the design of direct and inverse high performance solver, and to the modeling of complex media.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Jewoo Yoo, Ph.D Student at Seoul University spent five months MAGIQUE-3D from December 2011 to April 2012.

- Rabia Djellouli spent one week in MAGIQUE-3D in November 2012.

- Patrick Dular (Université de Liège) is visiting MAGIQUE-3D from December 2012 to February 2013.

<p style="text-align:center">**MAGNOME Project-Team**</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Aquitaine Region "SAGÉSS" comparative genomics for wine starters*

Participants: David James Sherman [correspondant], Elisabeth Bon, Pascal Durrens, Aurélie Goulielmakis, Nicolás Loira, Tiphaine Martin.

This project is a collaboration between the company SARCO, specialized in the selection of industrial yeasts with distinct technological abilities, with the ISVV and MAGNOME. The goal is to use genome analysis to identify molecular markers responsible for different physiological capabilities, as a tool for selecting yeasts and bacteria for wine fermentation through efficient hybridization and selection strategies. This collaboration has obtained the INNOVIN label.

8.2. National Initiatives

8.2.1. *ANR MYKIMUN*

Participants: Pascal Durrens [correspondant], Witold Dyrka, David James Sherman.

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). MAGNOMEdevelops machine learning techniques for classifying and identifying STAND proteins in fungal genomes, as well as statistical analysis of their genomic neighborhoods.

8.2.2. *ANR DIVOENI, 2008-2012*

Participants: Elisabeth Bon [correspondant], Aurélie Goulielmakis.

LaBRI, through Elisabeth Bon, is a partner in DIVOENI, a four-year ANR project concerning intraspecies biodiversity of the oenological bacteria *Oenococcus oeni*. Coordinated by Prof. Aline Lonvaud (Univ. Bordeaux Segalen) from the Institute of Vine and Wine Sciences of Bordeaux – Aquitaine, this scientific programme was developed:

1. To evaluate the genetic diversity of a vast collection of strains, to set up phylogenetic groups, then to investigate relationships between the ecological niches (cider, wine, champagne) and the essential phenotypical traits. Hypotheses on the evolution in the species and on the genetic stability of strains will be drawn.
2. To propose methods based on molecular markers to make a better use of the diversity of the species.
3. To measure the impact of the repeated use of selected strains on the diversity in the ecosystem and to draw the conclusions for its preservation.

Elisabeth is in charge of the computational infrastructure dedicated to genomics and post-genomics data storage, handling and analysis. She coordinates collaboration with the CBiB-Centre de Bioinformatique de Bordeaux (Aurélien Barré).

8.3. European Initiatives

8.3.1. *FP7 Projects*

8.3.1.1. *Affinity Proteomics*

Participants: David James Sherman [correspondant], Natalia Golenetskaya.

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 Associate Teams

8.4.1.1. CARNAGE

Program: Inria-Russia

Title: CARNAGE: Combinatorics of Assembly and RNA in GEnomes

Inria principal investigator: Mireille Régnier

International Partner (Institution - Laboratory - Researcher):

State Research Institute of Genetics and Selection of Industrial Microorganisms (Russia (Russian Federation)) - Bioinformatics laboratory - Vsevolod Makeev

Duration: 2012–13

See also: http://en.inria.fr/domaines-epi/computational-sciences-for-biology-medicine-and-the-environment

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.

8.4.2. Participation In International Programs

8.4.2.1. Génolevures and Dikaryome Consortia
Participants: David James Sherman [correspondant], Pascal Durrens, Florian Lajus, Tiphaine Martin, Anna Zhukova.

Since 2000 our team is a member of the Génolevures Consortium (GDR CNRS), a large-scale comparative genomics project that aims to address fundamental questions of molecular evolution through the sequencing and the comparison of 14 species of hemiascomycetous yeasts. The Consortium is comprised of 16 partners, in France, Belgium, Spain, the Netherlands (see http://genolevures.org/). Within the Consortium, our team is responsible for bioinformatics, for research in new methods of analysis. Pascal Durrens and Tiphaine Martin of the CNRS are responsible for the development of resources for exploiting comparative genomic data. Pascal Durrens is the editorial manager of the Génolevures on-line resource.

The Dikaryome Consortium is a scientific collaboration between several international partners and the National Center for Sequencing (CEA–Génoscope, Évry) on the sequencing, annotation, and comparative analysis of fungal genomes.

These perennial collaborations continue in two ways. First, a number of new projects are underway, concerning several new genomes currently being sequenced, and new questions about the mechanisms of gene formation. Second, through the development and improvement of the Génolevures On Line database, in whose maintenance our team has a longstanding committment and the improvement of tools like the YAGA software.

8.5. International Research Visitors

8.5.1. *Visits of International Scientists*

Rodrigo Assar Cuevas was invited for a month in Fall 2012 to work with David James Sherman on Quantized State Systems applied to BioRica hierarchical models.

8.5.2. *Visits to International Teams*

Anna Zhukova was invited to the Babraham Institute (Babraham, UK) for two week in December, 2012 to work on knowledge engineering for biological networks and visualization.

Pascal Durrens and David James Sherman are invited to the Vavilov Institute for General Genetics in Moscow in December, 2012 to work on regulon identification and analysis in hemisascomycete yeasts.

<p style="text-align:center;color:red;">MASAIE Project-Team</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

MASAIE has obtained a grant from Région Lorraine for a research project : "Dynamique des populations de pathogènes".

7.2. International Initiatives

7.2.1. Inria International Partners

- University Gaston Berger, St Louis, Senegal.
- University of Ouagadougou and Université Polytechnique de Bobo-Dioulaso, Burkina-Faso.
- University Hassan II, Casablanca, Morocco.
- University of Manitoba, Winnipeg, Canada.

7.2.2. Participation In International Programs

7.2.2.1. CAPES-COFECUB

MASAIE is the french correspondent in a cooperation program with Brazil. This project, funded by CAPES-COFECUB, "new methods in epidemiology and early detection of events" for 4 years, has begun in January 2011.

A Brazilian network has been built in 2011, 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 :
- Fondation Oswaldo Cruz (Fiocruz, Rio). Principal investigator : Claudia Codeço
- l'université fédérale de l'état de Pernambuco, Recife (http://www.ufpe.br/ufpenova/); Principal investigator César Castilho;
- IMPA Rio de Janeiro

We investigate in 2012 the biological control of dengue by *Wolbachia*.

7.2.2.2. PAES-UEMOA

A research project on Bilharzia was deposed November 2, 2012, 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 Economique et Monétaire de l'Afrique de l'Ouest). MASAIE is an important component of this network. This project has been accepted July, 1, 2012 and funded with 30 000 000 CFA (XOF) (≈ 45 000 euro).

The Phd thesis of Lena Tendeng (MASAIE) is part of this project.

7.3. International Research Visitors

7.3.1. *Visits of International Scientists*

- Aboudramane GUIRO, Université Polytechnique de Bobo-Dioulaso, Burkina-Faso, March 25 to April 22, 2012.
- Patrick Deleenheer, University of Florida, Gainesville, FL, June 24-28, 2012.
- Diène Ngom, Université de Ziguinchor, Senegal, September 25 to October 18, 2012.
- Blaise Kone (université Ouagadougou) October 26-November 16, 2012.
- Beranrd Bonzi (université Ouagadougou) October 29-November 13,2012.

In the framework of CAPES-COFECUB

- Hyun Mo Yang (UNICAMP) : February 4-February 8, 2012.
- Max Oliveira de Souza (UFF Rio) February 19-March 3, 2012.
- Max Oliveira de Souza (UFF Rio) November 20-December 3, 2012.
- Moacyr Alvim Barbosa da Silva (FGV Rio) November 20-December 3, 2012.

7.3.2. *Visits to International Teams*

In the framework of CAPES-COFECUB, A. Iggidr and G. Sallet visit FGV and UNICAMP from October 28 to November 19, 2012 (see CAPES-COFECUB).

MNEMOSYNE Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. ANR project KEOPS
Participants: Frédéric Alexandre, Thierry Viéville.

We are implicated in this «ANR Internal White Project» involving NEUROMATHCOMP and CORTEX Inria EPI in France with the U. of Valparaiso, U. Tecnica Frederico Santa-Maria, and U. Chile. The project addresses the integration of non-standard behaviors from retinal neural sensors, dynamically rich, sparse and robust observed in natural conditions, into neural coding models and their translation into real, highly non-linear, bio-engineering artificial solutions. An interdisciplinary platform for translation from neuroscience into bioengineering will seek convergence from experimental and analytical models, with a fine articulation between biologically inspired computation and nervous systems neural signal processing (coding / decoding) [9], [10].

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. Cortina, associate team with Chile
Participants: Frédéric Alexandre, Thierry Viéville.

The goal of this associate team initiated within the Cortex team is to combine our complementary expertise, from experimental biology and mathematical models (U de Valparaiso and U Federico Santa-Maria) to computational neuroscience (CORTEX/MNEMOSYNE and NEUROMATHCOMP), in order to develop common tools for the analysis and formalization of neural coding and related sensory-motor loops. Recording and modeling spike trains from the retina neural network, an accessible part of the brain, is a difficult task that our partnership can address, what constitute an excellent and unique opportunity to work together sharing our experience and to focus in developing computational tools for methodological innovations.

<div align="center">

MODEMIC Project-Team

</div>

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Inria Associate Teams

8.1.1.1. Associated team DYMECOS

Participants: Térence Bayen, Fabien Campillo, Jérôme Harmand, Claude Lobry, Alain Rapaport, Alejandro Rojas-Palma, Tewfik Sari, Matthieu Sebbah.

Program: Associate Teams

Title: DYnamical Microbial and Environmental eCOSystems

Inria principal investigator: Alain Rapaport

International Partners (Institution - Laboratory - Researcher):

Universidad de Chile / Departamento de Ingeniería Matemática - Universidad de Chile / CNRS (Chile) / Centro de Modelamiento Matemático (CMM) - Héctor Ramìrez

Universidad Tecnica Federico Santa Maria (Chile) - Departamento de Matematica - Pedro Gajardo

Duration: 01/01/2010 - 31/12/2012

DYMECOS is an associated team with Chile, mainly with CMM (Centro de Modelamiento Matemático), Univ. de Chile, Santiago, DIM (Departamento de Ingeniería Matemática), Universidad de Chile, Santiago and Departamento de Matematica, Universidad Tecnica Federico Santa Maria (UTFSM).

Two kinds of investigations have been conducted:

- minimal time control problems of fedbatch processes with several species, and optimal strategies for the bioremediation of natural water resources,
- stochastic modelling of the chemostat.

The second Franco-Chilean Workshop on Bioprocess Modelling has been co-organized by the team and the Chilean partners in January at Pucón (see https://sites.google.com/site/eadymecos/evenements). The workshop gathers mathematicians, process engineers and micro-biologists.

C. Lobry, A. Rapaport and T. Sari have participated to the 3rd LAWOC (Latin American Workshop on Optimization and Control) held in Valparaiso, Chile [48], [52], [54].

This year, the team has received A. Rojas-Palma as a MSc Internship for 3 months, and M. Sebbah has been hired by Inria-CIRIC for a postdoctoral stay of 3 months in the team (Oct.-Nov. 2012) followed by 13 months in Chile (starting Jan. 2013).

8.1.2. Participation In International Programs

8.1.2.1. CIRIC-Bionature

The team has contributed to the writing proposal of the Bionature line of the CIRIC (Communication and Information Research and Innovation Center) in Chile.

The 16 months postdoctoral grant of M. Sebbah (3 months in France, 13 months in Chile) is supported by Inria-Chile within this research program (see Section 8.1.1.1).

8.1.2.2. TREASURE

Participants: Fabien Campillo, Jérôme Harmand, Claude Lobry, Tewfik Sari.

Program: Euromediterranean 3+3

Title: Treatment and Sustainable Reuse of Effluents in semiarid climates

Inria principal investigator: Jérôme HARMAND

International Partners (Institution - Laboratory - Researcher):

University of santiago de compostella (Spain) - Environmental engineering - Juan GAR-RIDO

National Research Center (Egypt) - Water Pollution Control - Helmy EL-ZANFALY

Université Française d'Egypte (Egypt) - mathematiques - Mohamed JAOUA

Institut National de la Recherche Agronomique (France) - dpts EA, MICA et MIA - Pascal NEVEU

University of Tlemcen (Algeria) - Automatic control - Brahim CHERKI

University of Patras (Greece) - Process Control Laboratory - Costas KRAVARIS

Centre de Biotechnology de Sfax (Tunisia) - Department of environmental engineering - Sami SAYADI

Université Cadi Ayyad de Marrakech -Faculté des Sciences de Semlalia - Dépt. de Mathématiques (Morocco) - Centre National de Recherche sur l'Eau et l'Energie - Laila MANDI

Ecole Nationale des Ingénieurs de Tunis (Tunisia) - Mathématiques - Nabil GMATI

The TREASURE network aims at integrating knowledge on the modelling, the control and the optimization of biological systems for the treatment and reuse of wastewaters 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 parters from South.

8.1.2.3. LIRIMA Stic-Mada

Participants: Fabien Campillo, Angelo Raherinirina.

Program: LIRIMA

Title: Stic-Madagascar

Inria principal investigator: Fabien Campillo

International Partners (Institution - Laboratory - Researcher):

University of Antananarivo (Madagascar) - Lala Andriamampianina

University of Fianarantsoa (Madagascar) - Rivo Rakotozafy

The MODEMIC Project-Team is coordinator of the LIRIMA/Stic-Mada project for the theme: modelling and management of natural resources. In 2012, Angelo Raherinirina (co-advised with F. Campillo and R. Rakotozafy) made a 6 months stay in MODEMIC team-project, he will defend his thesis in January 2013 (see Section 6.2.8).

8.2. International Research Visitors

8.2.1. *Visits of International Scientists*

D. Dochain, from CESAME, Univ. Louvain-la-Neuve (Belgium), has spent one month in the team. D. Dochain is the coordinator of the CAFE project (see Section 7.1).

8.2.1.1. Internships

A. Rojas-Palma, MSc student at Univ. of Chile, has spent 3 months in the team, in the scope of the Inria Internships (see Section 8.1.1.1).

8.2.2. *Visits to International Teams*

B. Haegeman is on secondment to CNRS since September 2012. He is working at the Centre of Biodiversity Theory and Modelling which is part of the Station for Experimental Ecology in Moulis (Ariège).

<p style="text-align:center">**MOISE Project-Team**</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

- E. Blayo is a member of the scientific committee of the regional Institut des Sciences Complexes (IXXI) http://www.ixxi.fr.

- E. Blayo is a member of the scientific committee of the Pôle Alpin Risques Naturels http://www.risknat.org.

- E.Blayo and M. Nodet are responsible for the workpackage "numerical modelling" within the regional project (Région Rhône-Alpes) "**Envirhonalp**" http://www.envirhonalp.fr.

- A. Rousseau leads the working group *Couplage Fluide/Vivant* in Montpellier for the study of coupled systems (fluid dynamics and life sciences) in nearshore regions. This research is funded by the Labex NUMEV in Montpellier.

- M. Nodet is involved in E. Maitre MSTIC project MENTOL about Optimal Transport.

- Nicolas Papadakis is responsible of the ASIOME project (Assimilation de Structures d'Images Océanographiques et Modélisation d'Erreurs) funded by the Pôle Mathématiques Sciences et Technologies de l'Information et de la Communication (MSTIC) of the Joseph Fourier University, Grenoble. and the LEFE/MANU program of INSU (CNRS).6.3.4

8.1.1. Collaborations with Various Regional Research Teams

- LEGI, MEOM team : 6.3.4 ,6.1.2 ,6.2.1 ,6.3.3 .

- LGGE Grenoble, Edge team (C. Ritz, O. Gagliardini, F. Gillet-Chaulet, G. Durand), see paragraphs 6.2.3 , 6.2.4 and 6.2.5 .

- LGGE, Statistical methodology,6.4.1

- LGGE, DatIce tool, 5.3

- LTHE, Anne-Catherine Favre: multivariate extremal risk indicators, project "Soutien à l'Excellence et à l'Innovation Grenoble INP" MEPIERA (MEthodologies innovantes Pour l'Ingénierie de l'Eau et des Risques Associés)

- LTHE, Thierry Lebel, Théo Vischel: tracking of mesoscale convective systems,

- Building energy (G2ELab, Mathilde Grandjacques). : 6.4.1 ,6.4.2

8.2. National Initiatives

8.2.1. Interactions with other Inria Project-Teams or Actions

Participants	Inria Project-Team	Research topic	Link
L.Debreu, E.Blayo	CLIME, FLUMINANCE	Multiscale data assimilation	6.2.1
N. Papadakis	MC2	Image segmentation and assimilation for tumor growth modeling	6.5.1
M. Nodet	SCIPORT	Automatic differentiation	6.2.3
C.Prieur, Laurence Viry	GRAAL	Grid deployment for the study of West African Monsoon	6.4
C. Helbert, C.Prieur	STEEP	Sensitivity analysis for LUTI models	6.4
A. Rousseau	TOSCA	Stochastic Downscaling Method	
A. Rousseau	MODEMIC	Bioremediation of natural resources	6.6
A. Vidard M. Nodet F.X. Le Dimet	CLIME, FLUMINANCE	Image assimilation	6.3.3
A. Vidard, M. Nodet, E.Kazantsev	TROPICS	Ocean Adjoint Modelling	6.2.1 ,6.3.2
C. Prieur, A. Vidard, N. Papadakis	STEEP	Calibration of Land Use and Transport Integrated (LUTI) models.	6.8

8.2.2. Collaborations with other Research Teams in France

Participants	Research Team	Research topic	Link
N. Papadakis	(Labri, IMB, Bordeaux)	image processing problems (histogram equalization and image inpainting)	6.5.1
C. Prieur	IMT Toulouse, IFP Rueil, EDF, CEA Cadarache	Sensitivity analysis	6.4.1
C. Prieur	ISFA Lyon 1, Université de Bourgogne	Multivariate risk indicators	6.4.4
A. Rousseau	Institut de Mathématiques et de Modélisation de Montpellier (I3M)	Modelling and simulation of coastal flows	6.1
A. Rousseau	Laboratoire de Météorologie Dynamique (Ecole Polytechnique)	Stochastic Downscaling Method	
E.Blayo, A.Rousseau	LAMFA (Amiens), LAGA (Paris 13)	Coupling methods	6.1.2
A. Rousseau	IFREMER (Sète), UMR Ecosym (Montpellier)	Coupling fluids and life sciences	6.6
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	6.2.1
A. Vidard	LOCEAN (Paris)	Ocean Adjoint Modelling	6.2.1
A. Vidard	LPO (Brest), CERFACS	Ocean data assimilation	6.2.1
B.Lemieux	LSCE (Laboratoire des Sciences de l'Environnement et du Climat)	DatIce tool	5.3

8.2.3. Other National Initiatives:

- 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
- E. Blayo was a member of the 2012 ANR evaluation panel "Earth, Environment, Space".
- Nicolas Papadakis is involved in the SWOT-Ocean group in charge of the use of the high resolution data that will be provided by the future SWOT satellite (CNES/NASA mission). This work is realized in collaboration with Jacques Verron of the Laboratoire des Écoulements Géophysique et Industriels. 6.3.4
- M. Nodet is PI of the project "Méthodes inverses en glaciologie" supported by INSU-LEFE.
- M. Nodet is involved in GDR Calcul and GDR Ondes.
- C. Prieur chairs GdR MASCOT NUM, in which are also involved M. Nodet, E. Blayo, A. Rousseau, C. Helbert, L. Viry, A. Janon, S. Nanty, J.-Y. Tissot and G. Chastaing. http://www.gdr-mascotnum.fr/doku.php
- L. Debreu is the coordinator of the national group COMODO (Numerical Models in Oceanography)
- 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 6.2.1 .

8.2.4. ANR

- A 4-year ANR contract: ANR TOMMI (Transport Optimal et Modèles Multiphysiques de l'Image), see paragraphs 6.5.2 ,6.3.3 .

- A 4-year ANR contract: ANR ADAGe (Adjoint ice flow models for Data Assimilation in Glaciology, see paragraph 6.2.3) .

- A 4-year ANR contract: ANR Geo-FLUIDS (Fluid flows analysis and simulation from image sequences: application to the study of geophysical flows, see paragraph 6.3.3) .

- A 4-year ANR contract: ANR COSTA-BRAVA (Complex Spatio-Temporal Dynamics Analysis by Reduced Models and Sensitivity Analysis)http://www.math.univ-toulouse.fr/COSTA_BRAVA/index.html

- CITIES ANR project (numerical models project selected in 2012). http://steep.inrialpes.fr/?page_id=46

- A 4 year ANR contract (2011-2015): ANR COMODO (Communauté de Modélisation Océanographique) on the thematic "Numerical Methods in Ocean Modelling". (coordinator L. Debreu) 6.1.3

- A. Vidard was the coordinator of the ANR VODA (Variational Ocean Data Assimilation for multi-scales applications) 4-year contract ended mid 2012.

8.3. European Initiatives

8.3.1. 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: Vicent Caselles of the Pompeu Fabra University, Barcelona Spain

Subject: Image processing problems such as histogram transfer [18] or optical flow estimation. 6.5.1

Partner: European Centre for Medium Range Weather Forecast. Reading (UK)

World leading Numerical Weather Centre, that include an ocean analysis section in order to provide ocean initial condition fo 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.

Partner: Marine Hydrographic Institute, Natinal Ac.Sci. Ukraine, Sevastopol.

We have a long term collaboration about data assimilation with the Black Sea. This collaboration is getting to a new level with their plan to adopt NEMO and NEMOVAR for their operational forecasting system. On our side, we will benefit from their expertise on the Black Sea dynamics, that is an excellent test case for our developments and methods.

Partner: British Antarctic Survey, Cambridge, UK,

Subject: Antarctic ice core chronology (AICC2012).

Partner: University of Copenhagen, Ice and Climate Group, Denmark

Subject: Antarctic ice core chronology (AICC2012).

Partner: University of Strathclyde (Glasgow, UK)

Subject: Quasi-second order analysis for the propagation and characterization of uncertainties in geophysical prediction 6.4.5

Partner: Institute of Numerical Mathematics, Russian Academy of Sciences

Subject: Quasi-second order analysis for the propagation and characterization of uncertainties in geophysical prediction 6.4.5

8.4. International Initiatives

8.4.1. Participation In International Programs

- F.-X. Le Dimet collaborates with Vietnamese Academy of Sciences (Institute of Mechanics, Hanoi) on the quality of water ressources, that is an important problem for Vietnam (see 6.2.2)
- F.-X. Le Dimet collaborates with Florida State University on subjects of Identification of pollution (see 6.2.2) and Assimilation of Images (see 6.3.3).
- C. Prieur collaborates with Antonio Galves (University Sao Paulo) and Jose R. Leon (UCV, Central University of Caracas). She is a member of a USP-COFECUB project on the study of stochastic models with variable length memory (2010-2013) with University of Sao Paulo.
- 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

- Angie Pineda (invited 6 weeks in 2012 by C. Prieur through the ECOS Nord project),
- Jose R. León (invited 2 weeks in 2012 by C. Prieur through the ECOS Nord project).
- Victor Shutyaev, Institute of Numerical Mathematics, Russian Academy of Sciences, Moscow (invited for 2 weeks by F.-X. Le Dimet, see 6.4.5)
- Igor Gejadze, University of Strathclyde, Glasgow, UK (invited for 1 week by F.-X. Le Dimet, see 6.4.5)
- Nancy Nichols, University of Reading, invited for 1 week by A. Vidard and M. Nodet

8.5.2. Visits to International Teams

- F.-X. Le Dimet has been elected « Fellow of the American Meteorological Society », he is the second French scientist (after Michel Jarraud, General Secretary of the World Meteorological Organization) to get this distinction.
- F.-X. Le Dimet has been named « Adjunct Professor » at the Department of Mathematics at Florida State University, (USA) This nomination is valid from 2012 to 2016.
- F.X. Le Dimet has been invited to Caltech (USA) and Jet Propulsion Laboratory in May 2012 where he gave seminars on Assimilation of Images. Invited Speaker at the International Conference ACME in July 2012.

MORPHEME Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. LABEX SIGNALIFE

The MORPHEME team is member of the SIGNALIFE Laboratory of Excellence.

7.1.2. ARC DADA

Participants: Xavier Descombes [PI], Florence Besse, Huei Fang Yang, Alejandro Mottini.

The DADA project (Description et Analyse Dynamique de la Croissance Axonale) is a common projet with the SERPICO team from Inria Bretagne (Charles Kervrann). The goal is to develop new computational techniques to track axons during their growth. We consider 4D data obtained on a bi-photons microscope. In a longer term, we expect to model the morphological develepement of axons in different populations to characterize some disorders such as the fragile-X symdrom. (DADA).

7.1.3. ANR DIAMOND

Participants: Laure Blanc-Féraud [PI], Saima Ben Hadj.

In collaboration with the Pasteur Institute (Jean-Chritophe Olivo Marin) , the MIPS laboratory of Université de Haute Alsace (Alain Dieterlen, Bruno Colicchio) , the LIGM of Université Paris-Est (Jean-Christophe Pesquet, Caroline Chaux, Hugues Talbot), and INRA Sophia-Antipolis (Gilbert Engler).

(DIAMOND)

7.1.4. ANR MOTIMO

Participants: Laure Blanc-Féraud, Xavier Descombes, Eric Debreuve, Huei Fang Yang, Clarens Caraccio.

In collaboration with Institut de Mathématiques de Toulouse, INRA, Institut de Mécanique des Fluides de Toulouse, Laboratoire J-A Dieudonné, et IMV Technologies (PME).

7.1.5. 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.

7.1.6. Inria Large-scale initiative Morphogenetics

Participants: Grégoire Malandain, Xavier Descombes.

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.

7.1.7. PEPII 1

Participants: Laure Blanc-Féraud, Xavier Descombes [PI], Alejandro Mottini.

This project aims at studying graphs in biological context (axons, vascular networks ⋯). In collaboration with Institut de Mécanique des Fluides de Toulouse, CerCo (Toulouse) .

7.1.8. PEPII 2

Participants: Laure Blanc-Féraud [PI], Xavier Descombes, Eric Debreuve, Clarens Caraccio.

In collaboration with Institut de Mathématiques de Toulouse, INRA, Institut de Mécanique des Fluides de Toulouse, Laboratoire J-A Dieudonné, et IMV Technologies (PME).

7.1.9. Informal collaboration

Participant: Eric Debreuve.

- Partners: Barbara André, Mauna Kea Technologies, Paris, France
- Subject: Automatic classification of endomicroscopic videos

7.2. International Research Visitors

7.2.1. Visits of International Scientists

- Roberto Cavicchioli, PhD student, University de Modena and Reggio Emilia. Visting period 01/04/2012 - 30/06/2012; MAEE Research grant.
- Alexandre Dufour, Pasteur Institute, Unité d'Analyse d'Images Quantitative CNRS URA 2582 "Interactions et dynamique cellulaires". 3 december 2012, seminar at I3S.
- Caroline Fonta, CerCo, Toulouse, 7 december 2012, seminar at iBV.
- Charles Deledalle, Ceremade, Paris Dauphine, 3 august 2012, seminar at I3S.

<p style="text-align:center">**NEUROMATHCOMP Project-Team**</p>

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 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)

Duration: January 2011 - December 2014

Coordinator: Universitaet Ruprecht- Karls Heidelberg (Germany)

Others 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 Jülich GmbH, Jülich; EPFL LCN, Lausanne; EPFL-BBP, Lausanne; The University Of Manchester, Manchester; KTH, Stockholm; Universität Zürich, Zürich

See also: http://brainscales.kip.uni-heidelberg.de/

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 Brain-ScaleS 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. FACETS-ITN

Title: FACETS-ITN

Instrument: Initial Training Network (ITN)

Duration: September 2009 - August 2013

Coordinator: Universität Heidelberg- Ruprecht-Karls (Germany)

See also: http://facets.kip.uni-heidelberg.de/ITN/index.html

This 'Marie-Curie Initial Training Network' (funded by the EU) involves 15 groups at European Research Universities, Research Centers and Industrial Partners in 6 countries. It funds two PhD students in the NeuroMathComp group. Website: `http://facets.kip.uni-heidelberg.de/ITN/index.html`

6.2.1.3. 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)

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

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.

6.2.2. Collaborations in European Programs, except FP7

6.2.2.1. ERC NerVi

Program: ERC IDEAS

Project acronym: NerVi

Project title: From single neurons to visual perception

Duration: January 2009 - December 2013

Coordinator: Olivier Faugeras

Abstract: The project is to develop a formal model of information representation and processing in the part of the neocortex that is mostly concerned with visual information. This model will open new horizons in a well-principled way in the fields of artificial and biological vision as well as in computational neuroscience. Specifically the goal is to develop a universally accepted formal framework for describing complex, distributed and hierarchical processes capable of processing seamlessly a continuous flow of images. This framework features notably computational units operating at several spatiotemporal scales on stochastic data arising from natural images. Mean-field theory and stochastic calculus are used to harness the fundamental stochastic nature of the data, functional analysis and bifurcation theory to map the complexity of the behaviours of these assemblies of units. In the absence of such foundations, the development of an understanding of visual information processing in man and machines could be greatly hindered. Although the proposal addresses fundamental problems, its goal is to serve as the basis for ground-breaking future computational development for managing visual data and as a theoretical framework for a scientific understanding of biological vision.

6.3. International Initiatives

6.3.1. Inria Associate Teams

6.3.1.1. CORTINA

Title: Retina neural network coding

principal investigator: Frédéric Alexandre (Inria 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 - 2013

See also: http://cortex.loria.fr/Projects/Cortina

Much progress has been made in the last decades in understanding the basic organization and function of the nervous system in general. Contributions to this end have come from various domains including computational neuroscience and numerical science of the information in general.The goal of this associate team is to combine our complementary expertise, from experimental biology and mathematical models (U de Valparaiso and U Federico Santa-Maria) to computational neuroscience (CORTEX and NEUROMATHCOMP), in order to develop numerical tools for the study and characterization of neural coding and related sensory-motor loops. Recording and modeling spike trains from the retina neural network, an accessible part of the brain, is a difficult task that our partnership

can address, what constitute an excellent and unique opportunity to work together sharing our experience and to focus in developing computational tools for methodological innovations. To understand How the neural spike coding from natural image sequences works we are addressing the following issues: How visual signals are coded at earlier steps in the case of natural vision? What are their functions? What are the computational "coding" principles explaining (in artificial or biological system) the statistical properties of natural images? We wish to advance our actual knowledge in natural and artificial visual signals processing and apply it to the field of education; to foster better capacities for learning and memory; sensory prosthesis design, to will help unpaired sensory persons to sense the world and physical rehabilitation, among others. In the context of the cooperation between the Inria and Chile we propose to develop new neural decoding algorithms that are transverse to several field and applications.

6.3.2. Participation In International Programs

6.3.2.1. 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 - 2013

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

- Panagiota Theodoni, 11-15 september 2012.
- Gasper Tkacik, IST Austria, Wien, 04-07 July 2012.

- Olivier Marre, Institut de la Vision, Paris, 04-07 July 2012.
- Thierry Mora, Laboratoire de Physique Statistique, ENS Ulm Paris, 04-07 July 2012.
- Martin Golubitsky, Mathematical Biology Institute (Columbus Ohio) 09-13 June 2012
- Reiner Lauterbach, Mathematics Departement, Hambourg 09-13 June 2012
- Arnd Scheel, Mathematics Department, U of Minnesota (Minneapolis) 09-13 June 2012.

6.4.1.1. Internships

- Viktor Shcherbakov, Master 2, March-July 2012.

<p align="center" style="color:red">NUMED Project-Team</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

Vincent Calvez is head of on ingoing ANR contract on cell mobility.

8.1.2. Competitivity Clusters

Vincent Calvez organizes a special semester on mathematical biology within Lyon mathematical and computer science LABEX Milion.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. DDMoRE

Title: DDMoRE

Duration: February 2011 - January 2016

Coordinator: Pfizer (United Kingdom)

8.3. International Initiatives

8.3.1. Participation In International Programs

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Nuria BUIL-BRUNA (from Oct 2012 until Dec 2012)

Subject: Prediction of long-term clinical outcome in cancer patients based on the modeling of tumor size dynamic

Institution: University of Malaga (Spain)

8.4.2. Visits to International Teams

B. Ribba has visited UCSB in autumn.

<p style="text-align:center">**PARIETAL Project-Team**</p>

7. Partnerships and Cooperations

7.1. Regional initiatives

7.1.1. Digiteo/DIM

7.1.1.1. HIDINIM Digiteo project
Participants: Bertrand Thirion [Correspondant], Virgile Fritsch.

High-dimensional Neuroimaging– Statistical Models of Brain Variability observed in Neuroimaging

This is a joint project with Select project team and with SUPELEC Sciences des Systèmes (E3S), Département Signaux & Systèmes Électroniques (A. Tennenhaus).

Statistical inference in a group of subjects is fundamental to draw valid neuroscientific conclusions that generalize to the whole population, based on a finite number of experimental observations. Crucially, this generalization holds under the hypothesis that the population-level distribution of effects is estimated accurately. However, there is growing evidence that standard models, based on Gaussian distributions, do not fit well empirical data in neuroimaging studies.

In particular, Hidinim is motivated by the analysis of new databases hosted and analyzed at Neurospin that contain neuroimaging data from hundreds of subjects, in addition to genetic and behavioral data. We propose to investigate the statistical structure of large populations observed in neuroimaging. In particular, we will investigate the use of region-level averages of brain activity, that we plan to co-analyse with genetic and behavioral information, in order to understand the sources of the observed variability. This entails a series of modeling problems that we will address in this project: i) Distribution normality assessment and variables covariance estimation, ii) model selection for mixture models and iii) setting of classification models for heterogeneous data, in particular for mixed continuous/discrete distributions.

7.1.1.2. ICOGEN Digiteo project
Participants: Bertrand Thirion, Benoit Da Mota [Correspondant].

ICOGEN : Intensive COmputing for GEnetic-Neuroimaging studies

In this project, we design and deploy some computational tools to perform neuroimaging-genetics association studies at a large scale.

Unveiling the relationships between genetic variability and brain structure and function is one of the main challenges in neuroscience, which can be partly addressed through the information conveyed by high-throughput genotyping on the one hand, and neuroimaging data on the other hand. Finding statistical associations between these different variables is important in order to find relevant biomarkers for various brain diseases and improve patient handling. Due to the huge size of the datasets involved and the requirement for tight bounds on statistical significance, such statistical analysis are particularly demanding and cannot be performed easily at a large scale with standard software and computational tools. In ICOGEN, we design and deploy some computational tools to perform neuroimaging-genetics association studies at a large scale. We will implement and assess on real data the use of novel statistical methodologies and run the statistical analysis on various architectures (grids, clouds), in a unified environment.

Project supported by a Digiteo grant in collaboration with Inria's KerData Team, MSR-Inria joint centre, Supélec Engineer School, Imagen project and CEA/Neurospin.

7.1.1.3. 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 thesis of Alexandre Abraham).

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, i.e. for relapse prediction.

7.1.1.4. MMoVNI Digiteo project

Participants: Bertrand Thirion [Correspondant], Pierre Fillard, Viviana Siless, Stéphanie Allassonnière, Hao Xu.

This is a joint project with CMAP http://www.cmapx.polytechnique.fr/~allassonniere/, for the 2010-2013 period.

Modeling and understanding brain structure is a great challenge, given the anatomical and functional complexity of the brain organ. In addition to this, there is a large variability of these characteristics among the population. To give a possible answer to these issues, medical imaging researchers proposed to construct a template image. Most of the time, these analysis only focus on one category of signals (called modality), in particular, the anatomical one was the main focus of research these past years. Moreover, these techniques are often dedicated to a particular problem and raise the question of their mathematical foundations. The MMoVNI project aims at building atlases based on multi-modal images (anatomy, diffusion and functional) data bases for given populations. An atlas is not only a template image but also a set of admissible deformations which characterize the observed population of images. The estimation of these atlases will be based on a new generation of deformation and template estimation procedures that builds an explicit statistical generative model of the observed data. Moreover, they enable to infer all the relevant variables (parameters of the atlases) thanks to stochastic algorithms. Lastly, this modeling allows also to prove the convergence of both the estimator and the algorithms which provides a theoretical guarantee to the results. The models will first be proposed independently for each modality and then merged together to take into account, in a correlated way, the anatomy, the local connectivity through the cortical fibers and the functional response to a given cognitive task. This model will then be generalized to enable the non-supervised clustering of a population. This leads therefore to a finer representation of the population and a better comparison for classification purposes for example. The Neurospin center, partner of this project, will allow us to have access to databases of images of high-quality and high-resolution for the three modalities: anatomical, diffusion and functional imaging. This project is expected to contribute to making neuroimaging a more reliable tool for understanding inter-subject differences, which will eventually benefit to the understanding and diagnosis of various brain diseases like Alzheimer's disease, autism or schizophrenia.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. Vimagine project

Participants: Bertrand Thirion [Correspondant], Alexandre Gramfort, Michael Eickenberg, Fabian Pedregosa.

Vimagine is an ANR blanc project (2008-2012), which aims at building a novel view on the retinotopic organization of the visual cortex, based on MEG and MRI. Vimagine should open the way to understanding the dynamics of brain processes for low-level vision, with an emphasis on neuropathologies. This project is leaded by S. Baillet (Dynamic Neuroimaging Lab, McGill University), in collaboration with M.Clerc, T. Papadopoulos (Inria Sophia-Antipolis, Odyssée) and J. Lorenceau(LPPA, CNRS, Collège de France). The fMRI part of the project will be done by PARIETAL, and will consist in a study of spatially resolved retinotopic maps at the mm scale, the decoding of retinotopic information and the comparison of retinotopy with sulco-gyral anatomy.

7.2.1.2. 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.

7.2.1.3. 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 (2010-2013).

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.

7.2.1.4. Niconnect project
Participants: Bertrand Thirion, Gaël Varoquaux [Correspondant], Alexandre Abraham.

- **Context:** The project NiConnect 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 will push 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 structured from brain imaging. With regards to neuroimaging methods development, NiConnect will provide 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 will also play 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

7.3. International Initiatives

7.3.1. Inria Associate Teams

Title: Analysis of structural MR and DTI in neonates

Inria principal investigator: Pierre Fillard

International Partner:

Institution: University of Southern California (United States)

Laboratory: Image Lab at Children Hospital at Los Angeles

Researcher: Natasha Lepore

International Partner:

Institution: University of Pennsylvania (United States)

Laboratory: Penn Image Computing and Science Laboratory

Researcher: Caroline Brun

Duration: 2011 - 2013

See also: http://www.capneonates.org/

While survival is possible at increasingly lower gestational ages at birth, premature babies are at higher risk of developing mental disorders or learning disabilities than babies born at term. A precise identification of the developmental differences between premature and control neonates is consequently of utmost importance. Nowadays, the continuously improving quality and availability of MR systems makes it possible to precisely determine, characterize and compare brain structures such as cortical regions, or white matter fiber bundles. The objective of this project is to understand the developmental differences of premature versus normal neonates, using structural and diffusion MRI. This work will consist in identifying, characterizing and meticulously studying the brain structures that are different between the two groups. To do so, we propose to join forces between the Parietal team at Inria and the University of Southern California. Parietal has a recognized expertise in medical image registration and in statistical analyses of groups of individuals. USC has a broad knowledge in MR image processing. In particular, the Children's Hospital at Los Angeles (CHLA), which is part of USC, is in the process of collecting a unique database of several hundreds of premature and normal neonates MR scans. This joint collaboration is consequently a unique chance of addressing key questions pertaining to neonatal and premature development. It will make it possible to elaborate new tools to analyze neonate MR images while tremendously increasing our knowledge of neuroanatomy at such an early stage in life.

7.3.2. Inria International Partners

- LIAMA http://www.nlpr.ia.ac.cn/jiangtz/: B.Thirion, G.Varoquaux, V. Siless and Y. Schwartz visited LIAMA (contact person: Shan Yu) and gave a presentation. We plan to develop come collaborations on fMRI data analysis and functional connectivity in the future.

- Donders institute https://sites.google.com/a/distrep.org/distrep/marcel-van-gerven: We share with M. van Gerven some interest on biological vision and on the use of fMRI to probe specific hypotheses related to computational models of vision. We plan to exchange students in the next years.

- Biomedical Image analysis group, Imperial College, London http://www.doc.ic.ac.uk/~dr/. We have started some joint work on the comparison of functional and anatomical connectivity using machine learning tools.

- MIT, CSAIL http://www.csail.mit.edu/, P.Golland's group. We regularly visit each other and share common interests in the use of machine learning for neuroimaging, in the introduction of functional information into co-registration procedures, and in the study and comparison of anatomical and functional connectivity.

7.3.3. Participation In International Programs

Parietal has taken part to the program Inria@SiliconValley, and had a 18-months post-doc funded to work on the comparison of anatomical and functional connectivity (18 months, 2011-2013):

In this project, we would like to build probabilistic models that relates quantitatively the observations in anatomical and functional connectivity. For instance given a set of brain regions, the level of functional integration might be predicted by the anatomical connectivity measurement derived from the fibers in a given population of subjects. More generally, we will seek to extract latent factors explaining both connectivity measures across the population. Such models require specifically that a generative model is proposed to explain the observations in either domain, so that a meaningful and testable link is built between the two modalities. The inference problem can then be formulated as learning the coupling parameters that are necessary to model the association between modalities, and tested e.g. by assessing the ability of the learned model to generalize to new subjects. The aim is then to provide the mathematical and algorithmic tools necessary to build a standardized model of brain connectivity informed by both modalities, associated with confidence intervals to take into account between subject variability. Such an atlas is a long-term project, that requires adequate validation on high-resolution data, but it will probably be tightly linked to this project.

POMDAPI Project-Team

5. Partnerships and Cooperations

5.1. National Initiatives

ANR Fost: *Formal prOofs about Scientific compuTations*, with EPI Proval (Inria Saclay - Île-de-France), Laboratoire de Recherche en Informatique (University of Paris 11), and Laboratoire d'Informatique de l'Université Paris-Nord (University of Paris 13). Until May 31st.

ANR MANIF: *Problèmes mathématiques et numériques en simulation moléculaire ab initio*, with CER-MICS (Ecole Nationale des Ponts et Chaussées), and LJLL (Université Pierre et Marie Curie).

ARC Geofrac: Action de Recherche coopérative Inria "Large-scale computation of flow in complex 3D geological fractured porous media" rassemblant les équipes Inria Sage, Gamma3 et Pomdapi. From 2011.

5.2. European Initiatives

5.2.1. Collaborations in European Programs, except FP7

Program: ERC République tchèque

Project acronym: MORE

Project title: Implicitly constituted material models: from theory through model reduction to efficient numerical methods

Duration: September 2012 – August 2017

Coordinator: Josef Málek, Université Charles à Prague

Other partners: Université Charles à Prague, République tchèque; Institut des mathématiques, Académie des Sciences de la République tchèque, République tchèque; Oxford Centre for Nonlinear Partial Differential Equations, UK.

5.3. International Initiatives

5.3.1. Participation In International Programs

- Pomdapi is associated with LIRNE-Equipe d'ingéniérie mathématiques, université Ibn Tofaïl, Kenitra, Maroc (PHC Volubilis) in the project "Techniques multi-échelles adaptatives pour la résolution des problèmes d'écoulement et de transport en milieux poreux hétérogènes". From 2010.

- Pomdapi is part of the EuroMediterranean 3+3 program with the project HYDRINV (Direct and inverse problems in subsurface flow and transport). Besides Inria institutions participating in this project are Universitat Politècnica de Catalunya, Universidad de Sevilla, université Ibn Tofaïl (Kenitra, Maroc), University Centre of Khemis Miliana (Algeria), Ecole Nationale d'Ingénieurs de Tunis.

5.4. International Research Visitors

5.4.1. Internships

Mohamed Hedi Riahi (from May 2012 until Aug 2012)

Subject: Implémentation d'un algorithme d'estimation de paramètres

Institution: Ecole Nationale d'Ingénieurs de Tunis (Tunisia)

Fatma Cheikh (from Sep 2012 until Nov 2012)

Subject: Implémentation d'indicateurs de localisation de failles en milieux poreux

Institution: Ecole Nationale d'Ingénieurs de Tunis (Tunisia)

Emna Mejri (from Jun 2012 until Jul 2012)

Subject: Ecoulements eau-air en milieu poreux

Institution: Ecole Nationale d'Ingénieurs de Tunis (Tunisia)

5.4.2. Visits to International Teams

J. Jaffré and J. E. Roberts were invited by Rainer Helmig to visit the Department of Hydromechanics and Modelling of Hydrosystems (March 14 – April 6 2012).

REO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.2. ANR Project "M3RS"

Participants: Laurent Boudin, Muriel Boulakia, Paul Cazeaux, Anne-Claire Egloffe, Céline Grandmont [Principal Investigator], Bérénice Grec, Sébastien Martin, Irène Vignon-Clementel.

Period: 2008-2013.

This project, coordinated by C. Grandmont, aims at studying mathematical and numerical issues raised by the modeling of the lungs.

7.1.3. ANR Project "Epsilon"

Participants: Marina Vidrascu, Sofiene Hendili.

Period: 2009-2013

This project, coordinated by Jean-Jacques Marigo (LMS-Ecole polytechnique) aims to study Domain decomposition and multi-scale computations of singularities in mechanical structures.

7.1.4. ANR Project "EXIFSI"

Participants: Miguel Ángel Fernández Varela, Mikel Landajuela Larma, Vincent Martin, Marina Vidrascu.

Period: 2012-2016

The aim of this project, coordinated by Miguel Ángel Fernández Varela is to study mathematically and numerically new semi-explicit fluid-structure interaction schemes.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. EUHEART

Title: euHeart

Type: COOPERATION (ICT)

Defi: Virtual Physiological Man

Instrument: Integrated Project (IP)

Duration: June 2008 - September 2012

Coordinator: Philips Technologie GmbH Forschungslaboratorien (Germany)

Others partners: Philips Technologie GmbH (DE), The University of Oxford (UK), Universitat Pompeu Fabra (SP), The University of Sheffield (UK), Inria, French National Research Institute in Informatics and Mathematics (FR), King's College London (UK), Academisch Medisch Centrum bij de Universiteit van Amsterdam (NL), Universität Karlsruhe (TH) (DE), Institut National de la Santé et de la Recherche Médicale, INSERM (FR), Philips Medical Systems Nederland BV (NL), Berlin Heart GmbH (DE), HemoLab BV (NL), Universitätsklinikum Heidelberg (DE), Volcano Europe SA / NV (BE), Hospital Clínico San Carlos de Madrid (SP), Philips Ibérica S.A. (SP)

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

Abstract: The euHeart project (Ref 224495), is a 4-year integrated European project which aims at developing personalized, and clinically validated multi-physics, multi-level models of the heart and great vessels.

7.3. International Initiatives

7.3.1. Inria Associate Teams

Participants: Grégory Arbia, Cristóbal Bertoglio Beltran, Miguel Ángel Fernández Varela, Jean-Frédéric Gerbeau, Céline Grandmont, Irène Vignon-Clementel [coordinator].

Period: 2008-2014

CARDIO: The aim of this project is to foster the collaboration between the Cardiovascular Biomechanics Research Laboratory (CVBRL) of C.A. Taylor (Stanford University, USA) and colleagues such as Dr. Feinstein, and the project-team REO, through research on cardiovascular and respiratory related topics (boundary conditions for complex flow, patient-specific modeling of congenital heart disease, image-based fluid solid interaction, postprocessing of numerical simulations). The associated team has been extended to other partners: team-project MACS at Inria, the Marsden group at USCD and the Flow physics group at IIT. CA Figueroa is now at KCL, UK.

7.3.2. *Inria International Partners*

7.3.3. *Trans-Atlantic Network of Excellence for Cardiovascular Research*

Participants: Grégory Arbia, Jean-Frédéric Gerbeau, Irène Vignon-Clementel [correspondant].

Period: 2010-2014

This network, funded by the Leducq fondation, is working on the multi-scale modeling of single ventricle hearts for clinical decision support [3].

7.3.4. *German BMBF national project Lungsys II*

Participant: Irène Vignon-Clementel.

"Systems Biology of Lung Cancer "Dynamic Properties of Early Spread and Therapeutic Options". In collaboration with Dirk Drasdo EPI Bang, Inria & Paris 6 UPMC

ICI Vous pouvez ecrire du texte

7.4. International Research Visitors

7.4.1. *Visits of International Scientists*

- André Garon, Département Génie Mécanique de l'Ecole Polytechnique de Montréal, 10-18 may, 2012
- Michel Delfour, Département de Mathématiques et Statistiques, Université de Montréal, 12-16 may, 2012
- C. Alberto Figueroa, KCL, London, UK, Feb 7-8th 2012
- Maxim Solovchuk, Taida Institute of Mathematical Sciences, National Taiwan University, 15–30 july, 2012
- Chang-Shou Lin, Taida Institute of Mathematical Sciences, National Taiwan University, 22-24 november, 2012
- Jessica Oakes, University of California at San Diego, USA, 17-21 december, 2012

7.4.1.1. Internships

- Frédéric Jamin, MS student, Imperial College, London, UK, May 15th-Sept 14th 2012

---

[3] http://modelingventricle.clemson.edu/home

SAGE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR-MN: H2MNO4 project

Participants: Thomas Dufaud, Jocelyne Erhel, Grégoire Lecourt, Aurélien Le Gentil, 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.
Web page: http://www.irisa.fr/sage/
Abstract: The project H2MNO4 will develop 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 6.4.1 , 6.4.3 , 5.1).

8.1.2. Inria Large Wingspan intiative: HEMERA project

Participants: Jocelyne Erhel, Géraldine Pichot.

Title: Hemera
Duration: from September 2010.
Coordination: C. Perez, GRAAL team.
Partners: 22 Inria teams.
Webpage: http://www.grid5000.fr/mediawiki/index.php/Hemera
Abstract: Hemera is an Inria Large Wingspan project, 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 team Sage is the leader of the Scientific Challenge Hydro: Multi-parametric intensive stochastic simulations for hydrogeology. The objective is to run multiparametric large scale simulations (see 6.4.1 , 6.5).

8.1.3. Inria Large Wingspan intiative: C2S@EXA project

Participants: Édouard Canot, Thomas Dufaud, Jocelyne Erhel, Géraldine Pichot, Souhila Sabit.

Title: C2S@EXA
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 large-scale initiative 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 6.1.2 , 6.1.3 , 6.1.5 , 6.4.5). The team participated in the first workshop France-Brazil on HPC (Nice, July 2012).

8.1.4. Inria Technological development actions: H2OGuilde project

Participants: Jocelyne Erhel, Aurélien Le Gentil, Géraldine Pichot.

Title: H2OGuilde
Duration: October 2011 - October 2013.
Coordination: J. Erhel and G. Pichot.
Partner: Charles Deltel, SED Inria Rennes
Webpage: http://www.irisa.fr/sage/
Abstract: The project H2OGuilde aims at developing an interface for the platform H2OLab (see 5.1) and at designing software libraries with a large academic diffusion (see 6.4.1 ,6.5 , 8.1.1).

8.1.5. *Inria Collaborative Research Action: GEOFRAC project*

Participants: Thomas Dufaud, Jocelyne Erhel, Géraldine Pichot.

Title: GEOFRAC
Duration: June 2011-June 2013.
Coordinator: J. Erhel and G. Pichot.
Partners: Pomdapi and Gamma3 Inria teams, Géosciences Rennes.
Webpage: http://www.irisa.fr/sage/geofrac/
Abstract: In the last twenty years, the interest of geological fractured rocks has been renewed by a variety of energy-related applications, such as carbonate oil reservoirs, geothermic energy production, geological storage of high level nuclear waste, geological sequestration of CO2. Fractures are highly permeable pathways within a less pervious but more porous medium generally called matrix. The discrete modeling of fractures faces at least two challenging numerical issues. First, the fracture and matrix phases have very different hydraulic properties. Permeability is at least two orders of magnitude larger in the fractures than in the matrix. Second, the fracture structure complexity yield intricate geometrical configurations difficult to mesh. We propose to address these limitations by developing new numerical methods (see 6.5 , 5.1).

8.1.6. *GENCI: project on advanced linear solvers*

Participants: Édouard Canot, Jocelyne Erhel, Grégoire Lecourt, Aurélien Le Gentil, 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 software H2OLab, AGMRES, GRT3D and MUESLI (see 5.1 , 5.9 , 5.6 , 5.11). We obtained and used computing time on machines located at Idris supercomputing center (see 6.1.2 , 6.1.3 , 6.4.1 , 6.5).

8.1.7. *GNR MOMAS: project on reactive transport*

Participants: Jocelyne Erhel, Souhila Sabit.

Webpage: http://momas.univ-lyon1.fr/

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.

8.2. European Initiatives

8.2.1. 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 , 6.4.1 , 6.5).

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 editing a book, in writing a book, and in common research on low rank approximations of matrix functions (see 6.2.1).

ERCIM: working group on numerical algorithms, high performance computing.

8.3. International Initiatives

8.3.1. Inria International Partners

University of Kent (USA)

Krylov methods (see 6.1.1)

University of Purdue (USA)

High Performance Scientific Computing (see 6.2.1)

8.3.2. Cedre (Lebanon): MODNUM project

Participants: Édouard Canot, Jocelyne Erhel, Bernard Philippe.

Program: CEDRE Lebanon

Title: Modélisation numérique pour des applications libanaises

Inria principal investigator: Jocelyne Erhel and Bernard Philippe

International Partner (Institution - Laboratory - Researcher): American University of Beirut (Lebanon)

Duration: Jan 2012 - Dec 2013

Abstract: the project deals with numerical parallel algorithms and with applications to archaeology.

8.3.3. 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.

8.3.4. Inria Euro Med 3+3: HYDRINV project

Participants: Amine Abdelmoula, 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 Anålisis 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

Abstract: 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.

8.3.5. LIRIMA laboratory: MOMAPLI 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 Yaounde, Cameroon - Norbert Noutchegueme

Duration: 2010-2013

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 (see 6.2.2).

8.3.6. LIRIMA laboratory: EPIC team (Tunisia)

Participants: Amine Abdelmoula, Bernard Philippe, Jocelyne Erhel, Sinda Khalfallah.

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: 2011-2013

See also: http://www.lirima.uninet.cm/index.php/recherche/equipes-de-recherche/epic

Abstract: The team deals with nonlinear and inverse problems.

8.3.7. Joint Laboratory for Petascale Computing (USA)

Participant: Jocelyne Erhel.

Program: Joint Laboratory for Petascale Computing

Inria principal investigator: Franck Cappello and Laura Grigori, Grand Large team

International Partner (Institution - Laboratory - Researcher): University of Illinois at Urbana-Champaign, USA - Marc Snir and Bill Gropp

Duration: 2011-2013

See also: http://jointlab.ncsa.illinois.edu/

abstract: The team works on deflation methods and their integration into the software PETSc (see 6.1.2) and on domain decomposition methods (see 6.5.4). The team Sage participated in the workshop organized in June in Rennes (France).

8.3.8. Joint supervision of M. Oumouni's PhD (Morroco)

Program: International joint supervision of PhD agreement

Title: Méthodes numériques et leur analyse pour la résolution des équations de l'écoulement et de transport en milieux poreux hétérogènes et aléatoires

Inria principal investigator: Jocelyne Erhel

International Partner (Institution - Laboratory - Researcher): University Ibn Tofail - Faculté des Sciences de Kénitra (Morocco) - Zoubida Mghazli

Duration: Jan 2009 - Aug 2012

Abstract: see 6.4.4 .

8.3.9. Joint supervision of S. Khalfallah's PhD (Tunisia)

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 - 2013

Abstract: The objective is to solve data completion problems applied to hydrogeology (see 8.3.4 , 8.3.6).

8.3.10. Joint supervision of A. Abdelmoula's PhD (Tunisia)

Program: International joint supervision of PhD agreement

Title: Résolution de problèmes inverses en géodésie physique

Inria principal investigator: Bernard Philippe

International Partner (Institution - Laboratory - Researcher): Ecole Nationale d'Ingénieurs de Tunis - LAMSIN (Tunisia) - Maher Moakher

Duration: 2005 - 2013

Abstract: The objective is to compute a set of point-mass which generate an a priori given gravitational field (see 8.3.4 , 8.3.6).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Basile Louka, 3 weeks, December 2011-January 2012; see 8.3.5 .
- Norbert NOUTCHEGUEME, 2 weeks, January 2012; see 8.3.5 .
- Stratis Gallopoulos, 1 week in January 2012 and 1 week in December 2012; see 6.2.1 , 8.2.1 .
- Ahmed Sameh, 1 week in January 2012 and 1 week in December 2012; see 6.2.1 , 8.3.1 .
- Emmanuel Kamgnia, 2.5 months, March-April 2012 and December; see 8.3.5 , 6.2.2 .
- Dani Mezher, 1 week, March 2012.
- Nabil Nassif, 1.5 month, June-July 2012; see 6.2.3 .
- Noha Makhoul, 1 week, July 2012; see 6.2.3 .
- Myriam El Fergougui, 1 month, March 2012.

8.4.2. Internships

- Salwa Mansour, 1.5 month, June-August 2012; see 8.3.2 , 6.3.1 .
- Mestapha Oumouni, 1.5 month, May-June 2012; see 8.3.8 , 6.4.4 .

8.4.3. Visits to International Teams

- B. Philippe, 2 weeks, February 2012, University of Yaoundé I, Cameroon; see 8.3.5 , 6.2.2 .
- B. Philippe, 2 weeks, May 2012, Purdue University, USA; see 8.3.1 , 6.2.1 .
- B. Philippe, 1 week, December 2012, ENIT, Tunisia; see 8.3.6 , 8.3.4 , 8.3.10 .

<p style="text-align:center;color:red;font-weight:bold;">SERPICO Team</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Computing and storage facilities

Participants: Tristan Lecorgne, Charles Kervrann.

The aim is to design a computing architecture to process bioimaging data sets and to deal with the data flow from the different imaging microscopy platforms. The software packages will manage the needs of end users in Rennes, where interactivity with the imaging devices and information systems are desirable.

Funding: Rennes-Metropole - "Allocation Installation Scientifique"

8.2. National Initiatives

8.2.1. Quaero project

Participants: Charles Kervrann, Patrick Bouthemy, Denis Fortun, Solène Ozeré.

Quaero is a European collaborative research and development program with the goal of developing multimedia and multi-lingual indexing and management tools for professional and public applications. SERPICO team participates in the Work Package 9 on Video Processing (WP9) of QUAERO Core Technology Cluster Project (CTC). Within WP9, former Vista project-team leaded three tasks: "Motion Recognition", "Object Tracking" and "Event Recognition". Since October 2010, SERPICO has conducted activities in object tracking and indexing for video-microscopy analysis (Denis Fortun PhD grant (6.3 and 6.4) and Solène Ozeré Internship (6.1)).

 Funding: Quaero (no. Inria Alloc 3184), duration: 30 months
 Partners: 24 academic and industrial partners leaded by Technicolor

8.2.2. 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 will develop methods and software for the computation of mean velocity as well as other descriptors of swimmers bacteria dynamics inside biofilm image sequences. We will investigate spatio-temporal features and descriptors for comparison, classification, indexing and retrieval.

 Funding: ANR, duration: 24 months
 Partners: INRA, AgroParisTech, Naturatech company

8.2.3. LI-FLIM project

Participants: Charles Kervrann, Philippe Roudot.

The goal is to develop lifetime estimation methods of moving vesicles in FLIM microscopy. Grant to support collaboration between SERPICO team and UMR 144 CNRS PICT-IBiSA Institut Curie (P. Roudot's PhD (6.5))

Funding: GdR 2588 "Microscopie Fonctionnelle du Vivant" - Mobility grant
Partner: UMR 144 CNRS PICT IBiSA Institut Curie

8.2.4. DADA project

Participant: Charles Kervrann.

The accurate control of the growing and guidance of neuronal extensions to their target is a very important step for the maturation of the nervous system. The goal of this project (http://www-sop.inria.fr/members/Xavier. Descombes/DADA/home.html) is to develop new computational techniques to analyze image sequences of 3D volumes containing a population of growing axons (see Fig. 3) .

Funding: Inria ARC (2011-2012)
Partners: Inria Morpheme team and IBDC, laboratory from University of Nice Sophia Antipolis

8.2.5. France-BioImaging project

Participants: Charles Kervrann, Tristan Lecorgne.

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.

Funding: Investissement d'Avenir - Infrastructures Nationales en Biologie et Santé (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 to 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. (3-year Preparatory Phase / start: December 2010). SERPICO also participates to 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 8.2.5 .

8.4. International Research Visitors

8.4.1. Visits to International Teams

- Collaboration with University of Saarland (Germany), Prof. J. Weickert, on optical flow computing (D. Fortun's visit in 2012, 3 months, Rennes-Metropole grant).

- Collaboration with Harvard Medical School (Boston, MA), Prof. G. Danuser, on object tracking in video-microscopy (P. Roudot's visit in 2012-2013, 3 months, Inria & CNRS grant).

8.4.2. Others

Collaboration with University of California - San Francisco (USA), J. Sedat and D. Agard, on image denoising in cryo-electron microscopy.

<p style="text-align:center">**SHACRA Project-Team**</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. *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, EVASION and ASCLEPIOS. The development program of the ADT started in 2007. After 3 years of development, more than 600,000 lines of code have been developed, 80,000 downloads of SOFA have been counted on the Inria gForge, and we are about to finalize a new version of the public release.

8.1.2. *Sofa Intermeds, AEN*

SOFA Large Scale Initiative on Medical Simulation (AEN): The variety and complexity of Medicine, as well as its ethical importance in today's society, have been a strong motivation in many scientific and technical disciplines. The medical field has already been a domain of application for computer science and several tools, such as image processing, are now an integral part of modern medicine. Yet, there is no question that the integration of new technologies in Medicine will continue to rise in the future. In this context, the simulation of medical procedures, whether it is targeted at education, planning of interventions, or even guidance during complex procedures, will be a major element of the Medicine of the twenty-first century. The main objective of this large scale initiative is to leverage expertise from a few research teams at Inria to speed up the development of new ideas, models, algorithms in this very multi-disciplinary field. This initiative started in 2008, and involves several teams at Inria: SHACRA, EVASION, ASCLEPIOS, MOAIS, MAGRIT, and BUNRAKU. This program has been evaluated by a group of international experts in October 2010.

8.1.3. *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.

8.1.4. *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. For this reason, Stephane Cotin has moved to Strasbourg for two years (Sept 2011 to July 2013).

8.1.5. 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.

8.2. International Research Visitors

8.2.1. Internships

Yiyi WEI (from Jan 2012 until Mar 2012)

Subject: Simulation of Coil Embolization using the Discrete Exterior Calculus Approach

Institution: Beihang University of Aeronautics and Astronautics (China)

<div align="center">

SISYPHE Project-Team

</div>

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Paris Region ASTech project MODIPRO: Modeling for diagnosis and prognosis

Participants: Abdouramane Moussa Ali, Qinghua Zhang.

In order to improve the safety and reliability of airplanes, the MODIPRO project (Modélisation pour le Diagnostic et le Pronostic) funded by the Pôle de Compétitivité Aérospatial ASTech of Paris Region from 2009 to 2012 aims at developing a software for deriving airplane functional models for the purpose of fault diagnosis and prognosis, by analyzing the flight data of a fleet of airplanes. The involved partners are Dassault Aviation (project leader), Snecma, IT4Control, Bayesia, KBS, UPMC, Supelec and Inria.

7.2. National Initiatives

7.2.1. ANR project DMASC: Scaling Invariance of Cardiac Signals, Dynamical Systems and Multifractal Analysis

Participants: Julien Barral, Claire Médigue, Michel Sorine.

Collaboration with Denis Chemla (Kremlin-Bicêtre Hospital), Paulo Gonçalves (Inria Rhônes-Alpes) and Stéphane Seuret (Paris 12 University).

The ANR project DMASC (Program SYSCOMM 2008) started in January 2009 under the coordination of J. Barral.

Numerical studies using ideas from statistical physics, large deviations theory and functions analysis have exhibited striking scaling invariance properties for human long-term R-R interval signals extracted from ECG (intervals between two consecutive heartbeats). These numerical studies reveal that the scaling invariance may have different forms depending upon the states of the patients in particular for certain cardiac diseases. These observations suggest that a good understanding of multifractal properties of cardiac signals might lead to new pertinent tools for diagnosis and surveillance. However, until now, neither satisfactory physiological interpretations of these properties nor mathematical models have been proposed for these signals. For medical applications we need to go beyond the previously mentioned works and achieve a deepened study of the scaling invariance structure of cardiac signals. This is the aim of DMASC.

New robust algorithms for the multifractal signals processing are required ; specifically, it seems relevant to complete the usual statistical approach with a geometric study of the scaling invariance. In addition, it is necessary to apply these tools to a number of data arising from distinct pathologies, in order to start a classification of the different features of the observed scaling invariance, and to relate them to physiology. This should contribute to develop a new flexible multifractal mathematical model whose parameters could be adjusted according to the observed pathology. This multifractal analysis can be applied to another fundamental signal, the arterial blood pressure, as well as to the couple (R-R, Blood Pressure). The main results of this project can be found in [15].

7.2.2. ANR project EBONSI: Extended Block-Oriented Nonlinear System Identification

Participants: Pierre-Alexandre Bliman, Michel Sorine, Qinghua Zhang.

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) from 2011 to 2014. The project partners are the SISYPHE project-team of Inria (project leader), the Centre de Recherche en Automatique de Nancy (CRAN), and the Laboratory of Industrial Process Monitoring and Optimization of Peking University.

7.2.3. ANR project 0-DEFECT: On-board fault diagnosis for wired networks in automotive systems

Participants: Mohamed Oumri, Michel Sorine, Qinghua Zhang.

The number of electric and electronic equipments is increasing rapidly in automotive vehicles. Consequently, the reliability of electric connections is becoming more and more important. The project entitled "Outil de diagnostic embarqué de faisseaux automobiles" (0-DEFECT) aims at developing tools for on-bord diagnosis of failures in electric wire connections in automotive systems. This project is funded by Agence Nationale de la Recherche (ANR) from 2009 to 2012. The involved partners are CEA LIST (project leader), Renault Trucks, Freescale, PSA, Delphi, Supelec LGEP and Inria.

7.2.4. ANR project INSCAN: Fault diagnosis for security critical long distance electric transmission lines

Participants: Leila Djaziri, Michel Sorine, Qinghua Zhang.

The wired electric networks of the French railway system cover more than 50000 km. The electric insulation of the signaling lines along the railways is monitored by regular inspections. Today these inspections are based on an expensive procedure realized by human operators located at both ends of each section of a transmission line. The service of signaling devices has to be interrupted during this procedure, and so does the railway traffic. The in situ monitoring of the transmission lines, without interruption of service, is thus an important economic issue. For this purpose, the project entitled "Diagnostic de câbles électriques sécuritaires pour grandes infrastructures" is funded by ANR from 2009 to 2012 in order to study the feasibility of in situ monitoring tools for these transmission lines. The involved partners are SNCF (project leader), CEA LIST and Inria.

7.2.5. ANR project SODDA: Soft Defects Diagnosis in wired networks

The need for detection, localization and characterization of defects in a cables network has led to several projects, funded by the ANR: SEEDS followed by 0-DEFECT in the automotive domain, INSCAN for cables along railways. These co-operative works made it possible to 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 the SODDA project 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 will be 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 POEMS and Sisyphe.

7.2.6. ANR project EPOQ2: Estimation PrOblems for Quantum & Quantumlike systems

Participants: Hadis Amini, Zaki Leghtas, Mazyar Mirrahimi, Pierre Rouchon, Michel Sorine.

The project EPOQ2 is an ANR "Young researcher" project led by Mazyar Mirrahimi (Sisyphe). It has for goal to address a class of inverse problems rising from either the emerging application domain of "quantum engineering" or from some classical applications where a natural quantization lead to quantum-like systems, as it is the case in particular for inverse scattering for transmission lines. This research is in collaboration with the Pierre Aigrain laboratory (LPA) at ENS Paris and the Quantronics Laboratory (Qlab) of Michel Devoret and the Rob Schoelkopf Lab at Yale University and Pierre Rouchon from Ecole Nationale Supérieure des Mines de Paris.

7.2.7. *Inria Large Scale Initiative Action REGATE*

REGATE (REgulation of the GonAdoTropE axis) is a 4-year Large Scale Initiative Action funded by Inria in May 2009 dedicated to the modeling, simulation and control of the gonadotrope axis.

The action is coordinated by Frédérique Clément. The Inria participants to this action are researchers of 2 Inria research teams, Contraintes and Sisyphe. There are also participants from INRA, Université Libre de Bruxelles (Unité de Chronobiologie théorique) and Université Paris 6 (Laboratoire Jacques-Louis Lions).

7.3. European Initiatives

7.3.1. *Collaborations in European Programs, except FP7*

7.3.1.1. ERNSI

The SISYPHE project-team is involved in the activities of the European Research Network on System Identification (ERNSI) federating major European research teams on system identification.

- Program: Funded as a SCIENCE project (1992 - 1995), HCM Project (1993-1996), TMR Project (1998 - 2003).
- Project acronym: ERNSI
- Project title: European Research Network System Identification
- Duration: 1992 —
- Coordinator: The network ERNSI is currently coordinated by Bo Wahlberg, Automatic Control, KTH SE 100 44 Stockholm, Sweden.
- Other partners: KTH (Sweden), Inria (France), TUD (Technische Universität Darmstadt), TUW (Vienna University of Technology), UCAM-DENG (University of Cambridge), ELEC (Vrije Universiteit Brussel), ULIN (Sweden), UNIPD (Italy).
- Abstract: Modeling of dynamical systems is fundamental in almost all disciplines of science and engineering, ranging from life science to process control. Engineering uses models for the design and analysis of complex technical systems. System identification concerns the construction, estimation and validation of mathematical models of dynamical physical or engineering phenomena from experimental data.

7.3.1.2. MODRIO
Participants: Abdouramane Moussa Ali, Qinghua Zhang.

The SISYPHE project-team, with two other Inria project-teams (PARKAS, S4) participates in the MODRIO project regrouping partners from 7 european countries.

- Program: ITEA 2.
- Project acronym: MODRIO.
- Project title: Model Driven Physical Systems Operation.
- Duration: 2012 – 2015
- Coordinator: Daniel Bouskela, EDF, France.

- Other partners: ABB (Sweden AB), ABB AG (Germany), AIT Austrian Institute Of Technology (Austria), Ampère Laboratory-CNRS-University of Lyon (France), Bielefeld University of Applied Sciences (Germany), Dassault Aviation (France), Deutsches Zentrum für Luft- und Raumfahrt (DLR) (Germany), Digital Product Simulation (DPS) (France), DS AB (Sweden), EADS (France), Enicon Eco-Energy-Consulting GmbH (Austria), Equa Simulation AB (Sweden), IFP Energies nouvelles (France), Ilmenau University of Technology (Germany), Inria (France), ITI (Germany), Katholieke Universiteit Leuven (Belgium), Knorr-Bremse (Germany), Linkping University (Sweden), LMS Imagine (France), LMS International (Belgium), MathCore Engineering AB (Sweden), Modelon AB (Sweden), Pöyry Finland Oy (Finland), Qtronic (Germany), Scania (Sweden), Semantum Oy (Finland), Sherpa Engineering (France), Siemens AG (Germany), Siemens Industrial Turbomachinery AB Industrial Turbomachinery A.B. (Sweden), Simpack AG (Germany), Supmeca (France), Triphase (Belgium), University of Calabria (Italy), Vattenfall (Sweden), VTT Technical Research Centre of Finland Tec (Finland), Wapice Ltd (Finland).

- Abstract: 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. 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). The involved Inria project-teams are PARKAS, S4 and SISYPHE.

7.4. International Initiatives

7.4.1. Inria International Partners

Mazyar Mirrahimi closely collaborates with the Quantronics Laboratory (Qlab) of Michel Devoret and the Rob Schoelkopf Lab at Yale University.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

Patrick FLETCHER (two months: February and July 2012)

Subject: Regulation of hormone production by the frequency of a periodic stimulating signal

Institution: Florida State University (United States)

7.5.2. Visits to International Teams

Mazyar Mirrahimi spent one year in the Quantronics Laboratory (Qlab) of Michel Devoret and the Rob Schoelkopf Lab at Yale University.

Qingua Zhang visited the Laboratory of Industrial Process Monitoring and Optimization of Peking University, in the framework of the ANR EBONSI project.

STEEP Exploratory Action

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. 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.

8.1.2. 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 co-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.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7

Program: European Space Agency call: "Camera-aided Mars Landing and Rendezvous Navigation System"

Project acronym: MREP Camera

Project title: Camera-aided Mars Landing and Rendezvous Navigation System

Duration: Apr 2012 – Dec 2013

Coordinator: EADS Astrium (France)

Other partners: DEIMOS (Portugal), TNO (Netherlands), Sodern (France), NGC Aerospace (France)

Abstract: Our main goal in this project is the 3D modeling of planetary surfaces and the detection of potential landing zones of space vessels.

8.2.2. Collaborations with Major European Organizations

Partner 1: organisme 1, labo 1 (pays 1)

Sujet 1 (max. 2 lignes)

8.3. International Initiatives

8.3.1. Inria International Partners

Universidad Central de Venezuela (Urban Department) and its spin-off Modelistica: The TRANUS model was developed there. Prof. Tomás de la Barra visited us in 2011 and is an associated partner of our ANR project CITiES.

8.3.2. Participation In International Programs

TRACER   (*TRanus, Analyse de la Calibration et des Erreurs, Retours sur Grenoble et Caracas*)
Program: ECOS NORD Venezuela
Duration: 2012 – 2016
Coordinators: Laurence Tubiana (IDDRI), Tomás de le Barra (*Universidad Central de Venezuela*)
Other partners: IDDRI, STEEP, Universidad Central de Venezuela (Urban Institute)
Abstract: The objective of this project is to study robustness and calibration issues on the TRANUS land use model.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Juho Kannala, Feb+Mar 2012, Oulu University, Finland

8.4.2. Internships

Franco Pestarini (from Apr 2012 until Sep 2012)

Subject: Re-implementation of a land use / transport model

Institution: National University of Rosario (Argentina)

Martin Crespo (from Jul 2012 until Dec 2012)

Subject: Parameter optimization algorithm for a Transport/land use model via adjoint method.

Institution: Universidad National de Rosario (Argentina)

8.4.3. Visits to International Teams

Anthony Tschirhard carried out his MSc project at UC Berkeley, under the supervision of Paul Waddell, the chief developer of the UrbanSim model.

VIRTUAL PLANTS Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. OpenAlea

Participants: Christophe Pradal, Christophe Godin, Christian Fournier [INRA, LEPSE].

Funding: Agropolis foundation (Contractors for Virtual Plants: CIRAD and Inria from 2009 to 2013)

The aim of this project is to foster the development and the national and international diffusion of the platform OpenAlea. This opensource platform provides an easy-to-use environment for plant modelers through a visual programming interface to efficiently use and combine models or computational methods from different scientific fields in order to represent, analyze and simulate complex plant systems at different scales, from meristems to plant canopy. OpenAlea makes it possible to assemble highly reusable, heterogeneous components. The central point of its architecture is to allow to integrate existing components or modules developed by different teams without rewriting them. These components are developed in multi-languages like C, C++, Fortran or Java as well as Python. Work comprises development of standard data structures, deployment tools, documentation, training, software engineering, user interface, ...

6.1.2. Fruit3D

Participants: Mik Cieslak, Frédéric Boudon, Christophe Godin, Nadia Bertin [PSH, Avignon].

Funding: Agropolis foundation (Contractor for Virtual Plants: INRA, from 2009 to 2012)

The aim of this project is to develop a virtual tomato that contains the geometrical description of a growing fruit, physiological models (for sugar and hormone transfers) and mechanical model. The project gathers the competences of plant modelers, physicists and ecophysiologists. Physical and biological laws involved in tissue differentiation and cell growth, in relation to fruit growth and compartmentalization, and a number of related traits of quality (e.g. size, composition and texture) are modeled and integrated within the virtual tomato. Magnetic Resonance Imaging (MRI) techniques are used to provide an in vivo validation of the model by non invasive measurements.

Partners: PSH, INRA, Avignon; LCVN, IES, Université Sud de France, Montpellier.

6.1.3. PlantScan3D

Participants: Frédéric Boudon, Chakkrit Preuksakarn, Jean-Baptiste Durand, Christophe Godin, Christian Fournier.

Funding: Agropolis foundation (Contractor for Virtual Plants: CIRAD, From 2009 to 2012)

Automatic acquisition of plant phenotypes, and in particular of architecture phenotypes, constitutes a major bottleneck of the construction of quantitative models of plant development. Recently, 3D Laser scanners have made it possible to acquire 3D images on which each pixel has an associated depth corresponding to distance between camera and the pinpointed surface of the object. The objective of this project is to develop the use of laser scanner for plant geometry reconstruction. For this, we develop methodologies for the automation of numerical 3D acquisition of vegetal structures of different sizes, and new methods for the reconstruction of parsimonious geometrical and structural models usable in agronomic and biological contexts.

Partners: AFEF Team, UMR AGAP, UMR LEPSE (Montpellier), UMR PIAF (INRA Clermont Ferrand), UMR URP3F (Inra Lusignan), EPI Galaad (Inria Sophia Antipolis), EPI Imagine (Inria Grenoble). University of Helsinki, Finland.

6.1.4. *Agropolis computational plant seminar*

Participants: Yann Guédon, Christine Granier [INRA, LEPSE], Soazig Guyomarc'h [Montpellier 2 University, DIADE].

Funding: Agropolis foundation (Contractor for Virtual Plants: CIRAD. From 2008 to 2012)

In the context of the creation of a world-level pole on plant science in the région Languedoc-Roussillon, we created a monthly seminar on plant modeling and its applications. The seminar is organized by Yann Guédon, Christine Granier (INRA, LESPE) and Soazig Guyomarc'h (Montpellier 2 University, DIADE) with the support of Agropolis International and Agropolis Foundation.

6.1.5. *Rhizopolis*

Participants: Frédéric Boudon, Christophe Godin, Yann Guédon, Christophe Pradal.

Funding: Agropolis foundation (Contractor for Virtual Plants: INRA, from 2011 to 2013)

Rhizopolis is a multidisciplinary project on the biology and ecology of the plant root that addresses the broad roles of this organ in mineral nutrient and water acquisition. The consortium addresses central issues of root development, that are operationally divided into 3 work packages.

- WP A: Integration of membrane transport activity and structure-function relationships in roots and root symbioses.
- WP B: Key tools for imaging root development: (i) a world unique platform for 4D root imaging of root cell division and root primordia formation, and (ii) an innovative image analysis software for high-throughput phenotyping of root system architecture. These tools will be used to identify mechanisms and traits associated with root system efficiency and plasticity
- WP C: Integrating root-soil interactions in the rhizosphere at the whole root system level – application to water and nutrient acquisition by plants.

Virtual Plants is mainly involved in WP B and in particular in the development of a tool to automatically reconstruct root systems from 2D imaging.

Partners: DAR Team, UMR AGAP, UMR BPMC and UMR LEPSE (Montpellier).

6.2. National Initiatives

6.2.1. *ANR*

6.2.1.1. *Morpholeaf*

Participants: Christophe Godin, Etienne Farcot.

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. The leaf is the main photosynthetic organ of the plant and its margin can show diverse levels of dissections ranging from no (entire margin), mild (serration) to strong (lobes) incisions. The leaf itself can be either simple or dissected into units called leaflets. The CUC genes are part of a network involving negative regulation by a miRNA, miR164 and possible response of the signalling molecule auxin. However, the interplay between the three actors of this network (CUC, miR164 and auxin) is not understood yet. Nor are known the cellular effects of the expression of the CUC genes and their link with differential growth of the leaf margin leading to serration. 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. By combining biological observations and manipulations, quantitative measurements and modeling, 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. We will, stepwise, build, test and validate a model of leaf margin development integrating a regulatory network, cellular behaviour and morphogenesis.

Partners: RDP ENS-Lyon; INRA Versailles.

6.2.1.2. HydroRoot

Participants: Mikaël Lucas [IRD], Christophe Pradal, Christophe Godin, Christophe Maurel [BPMP].

Funding: ANR (Contractor for Virtual Plants: Cirad, From 2012 to 2014)

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.

6.2.2. Other national grants

6.2.2.1. 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

6.2.2.2. 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. This is a demonstration project focusing on the wheat septoria system, but the modeling approach is generic and intended to apply to other pathosystems. The originality of the project is based on: (i) the plant material used, consisting of innovative wheat varieties selected for their ability to produce contrasting architectures, (ii) the development of an integrative modeling tool coupling the canopy development, the fate of fungicides and the dynamics of the pathogen, and (iii) a proposed approach to multicriteria evaluation of protection strategies including estimation of yields, assessments of environmental impact of pesticides and erosion of efficacy. The project focuses on the development of a modeling tool. This tool is organized around three components: (1) the effect of the architecture of crops on epidemics, (2) the effect of fungicides on infection cycles and (3) the effect of canopy architecture on the fate of fungicides after application. The integration of the three components are performed within the OpenAlea platform that will allow the multicriteria evaluation of various scenarios (climate / varieties / architecture / fungicides) and help design new practices. Field experiments allow testing of treatment strategies associated with a variety of architectures. Data will be used to validate the modeling tool developed. Thanks to the integrated model various scenarios combining climate architecture x fungicide treatment will be simulated to identify and propose efficient strategies for 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 .

6.2.2.3. Morphogenetics

Participants: Christophe Godin, Frédéric Boudon, Christophe Pradal, Etienne Farcot, Yann Guédon.

Funding: Inria Action d'Envergure(From 2011 to 2015)

Morphogenetics is an Inria transversal project gathering 3 Inria teams and two Inra teams. It is aimed at understanding how flower shape and architecture are controlled by genes during development. To do so, we study the spatio-temporal relationship between genetic regulation and flower shape utilizing recently developed imaging techniques together with molecular genetics and computational modeling. The project addresses flower development at different scales using the Arabidopsis flower, currently one of the best-characterised plant systems. The workplan is divided into three major parts:

- Through 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. In particular, by using induced gene disruption together with careful live-imaging analysis, we will obtain dynamic, quantitative and causal data that link gene expression and molecular interactions to morphogenesis at a higher scale.

- We will integrate the results generated from these experiments in a specially designed database called a 3D Atlas.

- We will use these detailed, multidimensional data as direct input to new predictive computational models for morphogenesis and gene regulation that 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).

6.2.2.4. Rose

Participants: Christophe Godin, Frédéric Boudon, Christophe Pradal.

Funding: INRA - Projet de Pari Scientifique (From 2012 to 2014)

Lateral bud outgrowth of aerial stems in plants is known to regulated by hormonal signals such as auxin and cytokinin.Recently detailed modeling approaches have been successfully developed to explain such regulation. However, it is known that on many species the sugar status of the plant also plays a role in shoot branching. In this project we want to quantify this role and to understand how sugars interfere with hormonal signals to regulate bud outgrowth. For this, 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. As a result, it is expected that main branching habits can be reproduced with the model and that experiments can be designed in order to test model predictions.

Partners: UMR SAGAH, Angers

6.3. International Bilateral Relations

6.3.1. ERASysBio+ iSAM

Participants: Christophe Godin, Etienne Farcot, Jan Traas, Teva Vernoux, James A.H. Murray [Univ. Cardiff, UK], Yrjö Helariutta [Univ. Helsinki, Finland].

(Contractor for Virtual Plants: Inria. From September 2008 to September 2011)

This project essentially aims at improving our knowledge of shoot apical meristem, and more specifically the combined action of auxin and cytokinin, using a systems biology approach. It is part of a wider program, the ERASysBio initiative, a consortium of European funding bodies, ministries and project management agencies. The purpose of this consortium is to develop fundamental and strategic collaboration in the funding of systems approaches to biological research. The iSAM project is one of the 16 transnational consortia that have been selected out of 51 proposals; in total they comprise 85 working groups from 14 countries. Four partners are involved in iSAM: the group of J. Murray will focus on mutants of cell cycle regulation, the group of Y. Helariutta is specialized in several aspects of cytokinin regulation, while the group of J. Traas in Lyon provides input regarding auxin regulation and transport, and Virtual Plants is in charge of the modeling aspects, in synergy with the three other groups.

More information on the project can be found at http://www.erasysbio.net/index.php?index=277.

6.3.2. *Other bilateral relations*

Yann Guédon is working with Claudia Negron (PhD student) and Ted DeJong (University of California, Davis) on the influence of water stress and pruning practices on the branching and axillary flowering structures of almond shoots.

6.4. International Initiatives

6.4.1. *Inria 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. In this context, both groups have regular meetings and visio conference to progress jointly on the definition of the platform. In particular, C. Godin, M. Walker and E. Farcot went to a 1-week meeting on tissue data-structure definition and several researchers from CPIB came to Montpellier to continue this work and start implementation.

The team of Pr. Prusinkiewicz at the University of Calgary (Canada) has been an *associated team* of *Virtual Plants* from 2009 to 2011. see http://www-sop.inria.fr/virtualplants/wiki/doku.php?id=projects:eqass-vp-uc. In 2012 the collaboration continued and a major paper the L-Py language for modeling plants was published in the context of this collaboration.

6.5. International Research Visitors

6.5.1. *Visits of International Scientists*

The team received several visitors from exterior research groups in 2012:

- Farah Ben Naoum, from Sidi Bel Abbes University, Algeria, visited the team last spring for 1 month. She worked with C. Godin on combinatorial algorithms to compress trees.
- Risto Sievanen, from University of Helsinki, visisted the team for 3 months sabbatical leave in spring. He worked in particular with C. Pradal and C. Godin to integrate the model Lignum developed in his group within OpenAlea.
- Philip Benfey, from the University of Duke, USA, visited the group for 1 day at spring. Contacts have been established to exchange students/researchers between the labs for short periods. Julien Diener, working on automated methods for 2D root reconstruction from 2D images, should pay a visit to their lab in 2013.
- Xavier Sirault, from CSIRO and the High Resolution Plant Phenomics Centre in Canberra, Australia, visited the team during one day. It was decided during this visit to launch a project for coupling the phenotyping platform developed in Australia, a similar one developed in Montpellier by the group of F. Tardieu, and OpenAlea. The objective of this project will be to develop an integrated pipeline allowing the thorough analysis of a large number of genotypes, in particular assessment of growths of individual organs, of plant geometry, and of derived variables such as light interception. There is a strong complementarity between the three teams and the combination of expertise brought in the project by the different groups can result in a reference pipeline of model-assisted image analysis for plant phenotyping.

6.5.2. Visits to International Teams

Yann Guédon was invited by Miroslava Rakocevic (IAPAR, Londrina, Parana state) in Brazil during two weeks in september. This visit was funded by an Embrapa project. He visited three research centers: (i) EPAGRI, Caçador, Santa Catarina state; IAPAR, Londrina, Parana state; Embrapa, Campinas, Sao Paulo state. He gave a 8h course about plant architecture analysis at Londrina and gave a talk at Campinas.

Christophe Godin was invited at the Sainsbury Lab in Cambridge. A first collaboration with Henrik Jonsson based on the joint supervision of a post-doc fellow coming from Virtual Plants to Sainsbury was assessed. Other collaboration projects about meristem modeling and imaging were discussed.

<p style="text-align:center; color:red; font-weight:bold">VISAGES Project-Team</p>

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 2012, 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, ie 30k€. Two projects were selected by the COREC. The first one led by radiologist Jean-Christophe Ferré will compare the ability of functional BOLD MRI and perfusion ASL MRI to detect language areas in patients with brain tumor. The second one led by Erwan Donal, physician at CHU-Rennes, will apply advanced MRI acquisition techniques in cardiac pathology.

8.1.3. Projet CRITT Santé Bretagne : AfaCorVis3D

Participants: Elise Bannier, Isabelle Corouge, Christian Barillot.

duration: 12 months from November 2011

A research projet in fMRI involving 3D visual stimulation was performed to try and differentiate areas activated by 2D versus 3D visualisation, whether static or dynamic. The task was evaluated on 10 volunteers in the context of the Master Research Projet of Guillaume Koch. Areas activated specifically by 3D visualisation were extracted.

8.1.4. Défis Scientifiques Emergents - Université de Rennes I

Participants: Aurore Esquevin, Isabelle Corouge, Elise Bannier, Jean-Christophe Ferré, Christian Barillot, Jean-Yves Gauvrit.

duration: 22 monts from March 2012 (end : December 31, 2013)

The ASLDEM project was partially funded the University of Rennes 1 "Défis Scientifiques Emergents" grant (7000 euros). The ASLDEM project is described in Sect. 6.4.7

8.1.5. Fondation de l'Avenir 2012 - Depression, suicide and fMRI

Participants: Elise Bannier, Isabelle Corouge, Jean-Christophe Ferré, Christian Barillot.

duration: 12 months from November 2012

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 will start early 2013.

8.1.6. Fondation de l'Avenir 2012 - 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

A complementary funding (20 000€) was obtained to support a new research project on rehabilation of stroke patients. The fMRI protocol was setup, the task developed and validation on volunteers is ongoing. Patient inclusions will start in spring 2013.

8.1.7. *Fondation Planiol 2012*

Participants: Elise Bannier, Hélène Raoult, Jean-Yves Gauvrit.

duration: 12 months from November 2012

In the context of a neurovascular imaging research study, funding (13500€) was obtained to perform a phantom study on test objects representing carotid stenosis, with a circulating flow. This project will be performed as part of a collaboration with Dr Cavaro Ménard - Angers (LISA), Dr Langevin - Compiègne (UTC) and Pr Saint Jalmes - PRISM (UR1).

8.2. National Initiatives

8.2.1. *ANR*

8.2.1.1. *ANR "Neurological and Psychiatric diseases" NUCLEIPARK*
Participants: Christian Barillot, Sylvain Prima, Juan Francisco Garamendi.

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 Benoît Combès et al. [48]. 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, Caudatge, 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.

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. *ANR Cosinus VIP*
Participants: Fang Cao, Olivier Commowick, Christian Barillot.

VIP is collaborative project supported by ANR "Conception and Simulation"; it was accepted in 2009 (around 1 million euros). VIP aims at building a computing environment enabling multi-modality, multi-organ and dynamic (4D) medical image simulation, using GRID infrastructure. The goal is to integrate proven simulation software of the four main imaging modalities (MRI, US, PET and X-Ray/CT), and to cope interoperability challenges among simulators. The partners are CREATIS in Lyon (main contractor, Principal Investigator: Tristan Glatard), UNS-I3S in Nice, CEA-LETI in Grenoble and MAAT-G Maat G, a spanish company. The role of VISAGES in this project concerns primarily Task 1.1 and Task 3.3, focusing respectively on ontologies development and application to multiple sclerosis images simulation. This grant serves as support for the positions of Olivier Luong (PhD student) and Germain Forestier (post-doc).

8.2.1.3. *AINSI Inria joint project*
Participants: Christian Barillot, Pierre Maurel, Jean-Christophe Ferré, Elise Bannier, Camille Maumet, Isabelle Corouge.

We have been involved in a 2-year Inria ARC project AINSI (http://thalie.ujf-grenoble.fr/ainsi). AINSI stands for "Modeles statistiques pour l'Assimilation d'Informations de Neuroim- agerie fonctionnelle et de perfuSIon cerebrale". The goal is to propose an innovative statistically well-based solution to the joint determination of neural activity and brain vascularization by combining BOLD constrast images obtained in functional MRI and quantitative parametric images (Arterial Spin Labelling: ASL). The partners involved are the Mistiss project from Inria in Grenoble (Lead F. Forbes) and Parietal in Saclay, the INSERM Unit U594 (Grenoble Institute of Neuroscience) and the LNAO laboratory from CEA NeuroSpin.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: COST

Project acronym: AID (oc-2010-2-8615)

Project title: Arterial spin labelling 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 Labelling (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.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. BARBANT

Title: Boston and Rennes, Brain image Analysis Team

Inria principal investigator: ChristianBarillot

International Partner (Institution - Laboratory - Researcher):

Children's Hospital Boston - Harvard Medical School (United States) - Computational Radiology Laboratory - Simon K. Warfield

Duration: 2012 - 2014

See also: https://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.

<p style="text-align:center; color:red;">**ACES Project-Team**</p>

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. Bin That Thinks

- Partners: ACES (Inria Rennes) and POPS (Inria Lilles), Veolia Propreté, and Etineo (a start up company focused on M2M communications and ambient networking)
- Starting: November 2010; ending: November 2013

Bin That Think is a research project funded by the ANR Ecotech program, which aims at sorting domestic waste at early stage in order to reduce costs and risks in waste sorting center, as well as helping citizens to adopt environment respectful. To this end, Bin That Think introduces a new system for (1) identifying the waste which involve a reject during waste collection, (2) detecting incompatible products and (3) implementing a reporting infrastructure enabling an efficient management/planning of the waste collecting process. Bin That Think will use RFID and embedded sensors to enable waste containers as an intelligent waste infrastructure and a network of smart sensors.

ADAM Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Adapt   is a local ADT (Action de Développement Technologique) of the Inria Lille - Nord Europe Center and aims at building a demonstrator of our ADAM software technologies in the application domain of smart digital homes. Firstly, this demonstrator will show adaptive and reflective capabilities of FraSCAti (see Section 5.5), *i.e.*, supporting various implementation languages (*e.g.*, Java, WS-BPEL, scripting languages, template technologies) to develop business components, supporting various remote communication protocols (*e.g.*, SOAP, REST, JMS, JGroups) to access and expose services, supporting various non functional properties, deploying business components on demand, and reconfiguring business applications/components/services at runtime. Secondly, these capabilities will be illustrated on several ambient intelligence scenarios, *e.g.*, Fire Emergency and Home Automation. Thirdly, this demonstrator will integrate our recent and future scientific results in the domains of dynamic software product lines, autonomic computing, control loops, complex event processing, energy control, etc. Gwenael Cattez (recent graduated engineer) has been recruited in the context of this ADT.
Participants: Gwenael Cattez, Philippe Merle.

8.2. National Initiatives

8.2.1. ANR

SALTY   is a 36-month ANR ARPEGE project started in November 2009 and involving University of Nice, Deveryware, EBM WebSourcing, Inria ADAM, MAAT-G France, Thales, University Paris 8 and University Paris 6. The main objective of the SALTY project is to provide an autonomic computing framework for large-scale service-oriented architectures and infrastructures. The SALTY project will result in a coherent integration of models, tools and runtime systems to provide a first end-to-end support to the development of autonomic applications in the context of large-scale SOA in a model-driven way, including never-covered aspects such as the monitoring requirements, the analysis (or decision-making) model, and an adaptation model tackling large-scale underlying managed components. The project will be validated by two large use-cases: a neurodegenerative disease study for exploring the capacity of grid infrastructures and a path tracking application for exploiting the different positioning methods and appliances on a fleet of trucks.
Participants: Laurence Duchien, Russel Nzekwa, Romain Rouvoy, Lionel Seinturier.

SocEDA   is a 36-month ANR ARPEGE project started in November 2010 and involving EBM WebSourcing, ActiveEon, EMAC, I3S, LIG, LIRIS, Inria ADAM, France Telecom and Thales Communications. The goal of SocEDA is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex event-driven interaction in large highly distributed and heterogeneous service systems. Such architecture will enable exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize their execution, according to social network information. The main outcome will be a platform for event-driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements.
Participants: Nabil Djarallah, Gabriel Hermosillo, Fawaz Paraiso, Romain Rouvoy, Lionel Seinturier.

MOANO (Models & Tools for Pervasive Applications focusing on Territory Discovery) is a 36-month project of the ANR CONTINT program which started in January 2011. The partners are LIUPPA/University of Pau and Pays de L'Adour, University of Toulouse/IRIT, University of Grenoble/LIG, University of Lille/LIFL/Inria. 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.

Participants: Nabil Djarallah, Laurence Duchien, Nicolas Petitprez.

YourCast (Software Product Lines for Broadcasting Systems) is a 18-month ANR Emergence project that started in 2012 and that involves University of Nice Sophia Antipolis, Valorpaca and Inria ADAM. 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.

Participants: Laurence Duchien, Daniel Romero.

8.2.2. Competitivity Clusters

Macchiato is a 36-month project of the competitivity cluster PICOM (Pôle des Industries du COMmerce), which has started in January 2011. The partners of this project are Auchan (leader), University of Bordeaux/LABRI, Inria, and the Web Pulser SME. The Macchiato project aims at rethinking the design of e-commerce sites to better integrate the Internet of Things and facilitate online sales. In addition to setting up an infrastructure and a common application base, this challenge needs to refocus the design of e-commerce sites on the concept of "single electronic cart". We believe that including the next generation of e-commerce sites will enable to offer a personalized offer to consumers by adapting the content and form of the web sites to their preferences and needs and will allow them to manage their purchases uniformly with a single electronic cart [118].

Participants: Nabil Djarallah, Laurence Duchien, Nicolas Petitprez, Romain Rouvoy.

EasySOA is a 24-month project funded by FUI and labelized by the Systematic competitivity cluster for Open Source Software. The project started in 2011. The partners of this project include Open Wide (leader), Bull, Easyfab, Inria, Nuxeo, Talend. The EasySOA goal is to add an open, light, agile layer on top of "traditional" SOA, thanks to an online, social and collaborative approach, involving all actors of the SOA process. Beyond cartography and documentation, it helps gathering and fast-prototyping the business needs, and eases the transition to final implementations in the existing SOA solution.

Participants: Antonio de Almeida Souza Neto, Michel Dirix, Jonathan Labéjof, Philippe Merle, Christophe Munilla.

EconHome is a 30-month project funded by FUI and labelized by the Minalogic and Systematic competitivity clusters. The project started in 2011. The partners of this project include Sagemcom, Orange, STMicroelectronics, ST-Ericsson, SPiDCOM, Utrema, COMSIS, DOCEA, CEA, ETIS. The project aims at reducing the energy consumption of home and middleware networks. The target is to reduce of at least 70% the energy consumption of devices such as residential gateways, set top boxes, CPL plugs. Two axes are investigated: the optimization of the energy consumption of individual devices with innovative low power and sleep modes, and the optimization of the overall network with innovative techniques, such as service migration and energy aware service feedbacks to the user.

Participants: Aurélien Bourdon, Rémi Druilhe, Laurence Duchien, Adel Noureddine, Romain Rouvoy, Lionel Seinturier.

Hermes is a 36-month project funded by FUI and labelized by the PICOM (Pôle des Industries du COMmerce) competitivity cluster which has started in November 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.

Participants: Laurence Duchien, Romain Rouvoy, Lionel Seinturier.

8.2.3. Inria

ARC SERUS (Software Engineering for Resilient Ubiquitous Systems) is founded by the Inria collaboration program. The partners are Inria ADAM, Inria PHOENIX and TSF-LAAS (CNRS). Resilience is defined as the ability of a system to stay dependable when facing changes. For example, a building management system (*e.g.*, anti-intrusion, fire detection) needs to evolve at runtime (*e.g.*, deployment of new functions) because its critical nature excludes interrupting its operation. Resilience concerns occur in various application domains such as civil systems (civil protection, control of water or energy, etc.) or private systems (home automation, digital assistance, etc.). The objectives of this project is to propose a design-driven development methodology for resilient systems that takes into account dependability concerns in the early stages and ensures the traceability of these requirements throughout the system life-cycle, even during runtime evolution. To provide a high level of support, this methodology will rely on a design paradigm dedicated to sense/compute/control applications. This design will be enriched with dependability requirements and used to provide support throughout the system life-cycle.

Participants: Laurence Duchien, Alexandre Feugas, Lionel Seinturier.

ADT AntDroid (2012–2014) is a technology development initiative supported by Inria that aims at pushing the results of Nicolas Haderer's PhD thesis into production. AntDroid therefore focuses on deploying and disseminating the *Bee.sense* software platform to the public and to support the users of the platform. Bee.sense is a distributed platform dedicated to crowd-sensing activities. Bee.sense exploits the sensors of mobile devices that are shared by participants to observe physical or behavioral phenomenons. The challenges related to the development of such a platform encompasses user privacy and security, battery preservation, and user accessibility.

Participants: Romain Rouvoy, Nicolas Haderer.

8.3. European Initiatives

8.3.1. FP7 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, Romain Rouvoy, Lionel Seinturier.

Program: FP7 FET

Project acronym: DIVERSIFY

Project title: More software diversity. More adaptivity in CAS.

Duration: 36 months

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. 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.

Participant: Martin Monperrus.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. SEAS

Title: Middleware for Sensor as a Service

Inria principal investigator: Romain Rouvoy

International Partner (Institution - Laboratory - Researcher):

    University of Oslo (Norway) - Department of informatics

Duration: 2010–2012

See also: http://seas.ifi.uio.no

Middleware for Sensor as a Service (SeaS) is a collaboration initiative that intends to contribute to the vision of the Future Internet as an open-source middleware platform, based on robust Web standards, breaking existing IT silos and leveraging the development of innovative hybrid service-oriented architectures spanning from Wireless Sensor Networks to Ubiquitous and Cloud Computing. Given that one of the objectives of Europe is to develop the convergence of IT networks (being it mobile or fixed) and the fact that many of the upcoming mobile devices are integrating services (from phones down to sensors and radio frequency identification), we believe that one of the challenges for the next generation society will consist in enabling a distributed middleware platform for the dynamic

provision of hybrid services and the scalable dissemination of data. In particular, we believe that the sensor capabilities can be reflected as a service accessible from the Internet or any IT system using standard Web protocols. The resulting services will be hybrid in the sense that they will reflect the wide diversity of sensor devices available nowadays, but we aim at providing a uniform solution to leverage the development of applications on top of physical or virtual sensors. This platform includes not only the sensor level (description, discovery, communication, reconfiguration...), but also the platform level services (dissemination, storage, query, adaptation...) that are required for enabling such a vision. The resulting platform will bring additional opportunities for the development of innovative service-based systems by exploiting the emergence of Wireless Sensor Networks (WSN), Ubiquitous Computing, and Cloud Computing environments.

8.4.2. Inria International Partners

8.4.2.1. OW2

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.

Participants: Philippe Merle, Romain Rouvoy, Lionel Seinturier.

8.4.2.2. ERCIM Working Group on Software Evolution

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.

Participant: Laurence Duchien.

8.4.2.3. University of Los Andes, Bogota, Colombia

The ADAM project-team has a long term collaboration since 2005 with this university. Over the years, four PhD thesis (Carlos Noguera, Carlos Parra, Daniel Romero, 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 [67], [66] and in the PhD thesis document itself [12].

Participant: Laurence Duchien.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Patrick Heymans (1 January 2012 to 30 April 2012).

Subject: Software and Information Systems Engineering, Requirements Engineering, Software Product Lines, Software Evolution.

Institution: University of Namur (Belgium).

Gabriel Tamura (October 2012).

Subject: Software architecture, dynamic software adaptation, and engineering of self-adaptive software systems.

Institution: University ICESI (Cali, Colombia).

Norha Villegas (October 2012).

> Subject: Application of software engineering models, techniques and architectures to the development of self-adaptive and self-managing systems.

> Institution: University of Victoria, Canada.

8.5.1.1. Internships

Diego Mendez (from June 2012 until November 2012).

> Subject: Characterization of API Usage Diversity for Driving API-based Software Repair.

> Institution: National University of the Center of the Buenos Aires Province (Argentina).

Daniel René Fouomene Pewo (from May 2012 until October 2012).

> Subject: Elastic solution to tolerate peak load of users and queries generated by the so-called Slashdot effect.

> Institution: University of Youndé (Cameroun).

Maxence G. de Montauzan (from March 2012 until July 2012).

> Subject: An Empirical Study of Exception-Handling Design Strategies In Open-Source Applications.

> Institution: University Lille 1 (France).

Anthony Da Costa Maia (from March 2012 until July 2012).

> Subject: Extracting Knowledge from the Q&A Website StackOverflow at Debug Time.

> Institution: University Lille 1 (France).

Sébastien Poulmane (from June 2012 until August 2012).

> Subject: Integrating third-party sensors in the Bee.sense platform.

> Institution: University Lille 1 (France).

<p align="center" style="color:red">ALGORILLE Project-Team</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

CPER MISN, EDGE project (2010-2013, 468k€).   M. Quinson and L. Nussbaum are leading a project of the regional CPER contract, called *Expérimentations et calculs distribués à grande échelle* (EDGE). It focuses on maintaining and improving the local Grid'5000 infrastructure, and animating both the research on experimental grids and the research community using these facilities. More information is available at http://misn.loria.fr/spip.php?rubrique8.
Other partners: EPI CARAMEL, VERIDIS

Lorraine Region   (2011-2013, 30k€). The project *"Systèmes dynamiques : étude théorique et application à l'algorithmique parallèle pour la résolution d'équation aux dérivées partielles"* lead by S. Contassot-Vivier is the sequel of his research on dynamical systems and consists in designing more efficient algorithmic schemes for parallel iterative solvers. This project is closely linked to the collaboration with the Lemta as the real case application provided by F. Asllanaj will be the target of our future developments in this field.

8.2. National Initiatives

8.2.1. 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 (IFP, EDF, CETIAT). We will contribute to the design and development of the platform.

USS-SimGrid   (2009–2012, 840k€) Martin Quinson is the principal investigator, funded by the ANR ARPEGE program. USS-SimGrid (Ultra Scalable Simulation with SimGrid) aims at improving the scalability of the SimGrid simulator to allow its use in Peer-to-Peer research in addition of Grid Computing research. The challenges to tackle included models being more scalable at the eventual price of slightly reduced accuracy, automatic instantiation of these models, tools to conduct experiments campaigns, as well as a partial parallelization of the simulator tool. This project was successfuly completed this year.

ANR SONGS   (2012–2015, 1800k€) Martin Quinson is also the principal investigator of a 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 projects, which allows the improvement of our tool even further and set it as the reference in its domain (see Sections 6.3.1 and 6.3.2).

8.2.2. Inria financed projects and clusters

AEN Hemera   (2010-2013, 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 (2007-2015, 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, RUN-TIME, IRIT (Toulouse), Université de Reims - Champagne Ardennes

ADT Kadeploy   (2011-2013, AlGorille is the only partner, 90k€) focuses on the Kadeploy software, a tool for efficient, scalable and reliable cluster deployment. It is used on several clusters at INRIA and playing a key role on the Grid'5000 testbed. This ADT allows the continuation of the development to improve its performance, reliability and security, and aims at a larger distribution to industry and other INRIA platforms with similar needs.

ADT Solfége   (2011-2013, AlGorille is the only partner, 100k€), for *Services et Outils Logiciels Facilitant l'Experimentation à Grande Échelle* aims at developing or improving a tool suite for experimentation at large scale on testbeds such as Grid'5000. Specifically, we will work on control of a large number of nodes, on data management, and on changing experimental conditions with emulation. E. Jeanvoine (SED) is delegated in the AlGorille team for the duration of this project.

INRIA Project Lab MC   (2012-) 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, will strengthen the collaboration within this project.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

8.3.1.1. Internships

Maximiliano GEIER (09/2012 - 03/2013)

Subject: Leveraging multiple experimentation methodologies to study P2P broadcast

Institution: University of Buenos Aires (Argentina)

8.3.2. Visits to International Teams

Martin Quinson was hosted as a visiting professor at university of Hawai'i at Manoa for one month in April 2012. He was invited by Prof. Casanova to pursue the collaboration on SimGrid, originally started by Prof. Casanova.

<p style="text-align:center;color:red">ARLES Project-Team</p>

7. Partnerships and Cooperations

7.1. National Grants

7.1.1. ANR

7.1.1.1. ANR MURPHY: Dependability-focused Evaluation of Sensor Networks
    Participant: Animesh Pathak [correspondent].

- **Name:** MURPHY – *Dependability-focused Evaluation of Sensor Networks*
- **Related activities:** § 6.5
- **Period:** [January 2011 – December 2013]
- **Partners:** CNAM, Inria ARLES, 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 which 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 (i) enable the dynamic and distributed insertion of faults and (ii) hide from the end user the complexity related to this task,
- 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 D2T Action de Developpement Technologique MobiTools
    Participants: Valérie Issarny, Bachir Moussa Tari Bako.

- **Name:** *MobiTools – Environnement de développement logiciel pour plateforme mobiles*
- **Period:** [January 2011 – December 2012]
- **Partners:** Inria (CRI Paris-Rocquencourt, EPI ARLES)

As part of the development of our software prototypes, MobiTools focuses on setting a supporting continuous integration platform (compilation, test, profiling, quality).

7.1.2.2. Inria D2T Action de Developpement Technologique Yarta
    Participants: Animesh Pathak, George Rosca.

- **Name:** *Yarta – Middleware for mobile social ecosystems*
- **Period:** [October 2012 – September 2013]
- **Partners:** Inria (CRI Paris-Rocquencourt, EPI ARLES)

This project targets the development of Yarta, 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 will be used to support the public open source release and evolution of the Yarta middleware, which is currently a research prototype.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. FP7 ICT FET IP CONNECT
Participant: Valérie Issarny [correspondent].

> **Name:** CONNECT – *Emergent Connectors for Eternal Software Intensive Networked Systems*
>
> **URL:** http://www.connect-forever.eu/
>
> **Type:** COOPERATION (ICT)
>
> **Defi:** ICT forever yours
>
> **Instrument:** Integrated Project (IP)
>
> **Related activities:** § 6.2
>
> **Period:** [February 2009 - November 2012]
>
> **Partners:** Inria (CRI Paris-Rocquencourt) [**project coordinator**], Ambientic (France), CNR (Italy), DoCoMo (Germany), Lancaster University (UK), Thales Communications SA (France), Universita degli Studi L'Aquila (Italy), Technische Universitaet Dortmund (Germany), University of Oxford (UK), Uppsala Universitet (Sweden), Peking University (China).

The CONNECT Integrated Project aims at enabling continuous composition of networked systems to respond to the evolution of functionalities provided to and required from the networked environment. At present the efficacy of integrating and composing networked systems depends on the level of interoperability of the systems's underlying technologies. However, interoperable middleware cannot cover the ever growing heterogeneity dimensions of the networked environment. CONNECT aims at dropping the interoperability barrier by adopting a revolutionary approach to the seamless networking of digital systems, that is, synthesizing on the fly the connectors via which networked systems communicate. The resulting emergent connectors are effectively synthesized according to the behavioral semantics of application- down to middleware-layer protocols run by the interacting parties. The synthesis process is based on a formal foundation for connectors, which allows learning, reasoning about and adapting the interaction behavior of networked systems at run-time. Synthesized connectors are concrete emergent system entities that are dependable, unobtrusive, and evolvable, while not compromising the quality of software applications. To reach these objectives the CONNECT project undertakes interdisciplinary research in the areas of behavior learning, formal methods, semantic services, software engineering, dependability, and middleware. Specifically, CONNECT investigates the following issues and related challenges: (i) Modeling and reasoning about peer system functionalities, (ii) Modeling and reasoning about connector behaviors, (iii) Runtime synthesis of connectors, (iv) Learning connector behaviors, (v) Dependability assurance, and (vi) System architecture. The effectiveness of CONNECT research is assessed by experimenting in the field of wide area, highly heterogeneous systems where today's solutions to interoperability already fall short (e.g., systems of systems).

7.2.1.2. FP7 ICT IP CHOReOS

Participants: Nikolaos Georgantas [correspondent], Valérie Issarny [correspondent].

Name: CHOReOS – *Large Scale Choreographies for the Future Internet*

URL: http://www.choreos.eu/

Type: COOPERATION (ICT)

Defi: Internet of Services, Software & Virtualisation

Instrument: Integrated Project (IP)

Related activities: § 6.3 & § 6.4

Period: [February October 2010 - September 2013]

Partners: NoMagic Europe (Lithuania), CEFRIEL (Italy), CNR (Italy), Linagora (France), Inria (CRI Paris-Rocquencourt) [**scientific leader**], MLS Multimedia A.E. (Greece), OW2 Consortium, Thales Communications S.A. (France) [**coordinator**], The City University, London (UK), Università degli Studi dell'Aquila (Italy), Universidade de São Paulo (Brazil), University of Ioannina (Greece), SSII VIA (Latvia), Virtual Trip Ltd. (Greece), Wind Telecommunicazioni S.p.A (Italy).

CHOReOS aims at assisting the engineering of software service compositions in the revolutionary networking environment created by the Future Internet. Indeed, sustaining service composition and moving it closer to the end users in the Future Internet is a prime requirement to ensure that the wealth of networked services will get appropriately leveraged and reused. This again stresses the required move from static to dynamic development, effectively calling for adequate support for service reuse; much like software reuse has been a central concern in software engineering over the last two decades. This is why CHOReOS adopts the Service Oriented Computing (SOC) paradigm, where networked resources are abstracted as services so as to ease their discovery, access and composition, and thus reuse. However, although latest advances in the SOC domain enable facing (at least partly) the requirements of today's Internet and related networking capabilities, engineering service compositions in the light of the Future Internet challenges — in particular the ultra large scale (ULS) on all imaginable dimensions as well as the evolution of the development process from a mostly static process to a dynamic user-centric one — is far from adequately addressed. Therefore, the CHOReOS goal is to address these challenges by devising a dynamic development process, and associated methods, tools and middleware, to sustain the composition of services in the Future Internet.

7.2.1.3. FP7 PEOPLE Requirements@run.time

Participant: Nelly Bencomo [correspondent].

Name: Requirements@run.time: *Requirements-aware systems*

URL: https://www-roc.inria.fr/arles/index.php/members/220-marie-curie-project-requirements-aware-systems-requirementsruntime

Type: PEOPLE

Instrument: Marie Curie Intra-European Fellowships for Career Development (IEF)

Related activities: § 6.6

Period: [May 2011 - May 2013]

Partners: Inria (CRI Paris-Rocquencourt).

This project uses the novel notion of requirements reflection, that is, the ability of a system to dynamically observe and reason about its requirements. It aims to address the need of having systems requirements-aware by reifying requirements as run-time objects (i.e. requirements@run.time). These systems provide a runtime model of their requirements that allow them to reason, evaluate and report on their conformance to their requirements during execution.This project contributes towards development of conceptual foundations, engineering techniques, and computing infrastructure for the systematic development of dynamically-adaptive systems based on the principle of requirements reflection The researchers build upon their extensive expertise in the area of reflective middleware and reflective architectures and research projects like CONNECT.

7.2.1.4. 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
>
> **Period:** [October 2010 - March 2013]
>
> **Partners:** Atos Origin (Spain), CNR (Italy) [**coordinators**], ETH Zürich (Switzerland), IMDEA Software (Spain), Inria (EPI ARLES, 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 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. 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. NESSoS integrates the research labs involved; NESSoS re-addresses, integrates, harmonizes and fosters the research activities in the necessary areas, and increases and spreads the research excellence. NESSoS also impacts training and education activities in Europe to grow a new generation of skilled researchers and practitioners in the area. NESSoS collaborates with industrial stakeholders to improve the industry best practices and support a rapid growth of software-based service systems in the Future Internet.

7.2.1.5. FP7 ICT CA EternalS

Participant: Valérie Issarny [correspondent].

> **Name:** EternalS – *Trustworthy Eternal Systems via Evolving Software, Data and Knowledge*
>
> **URL:** http://www.eternals.eu
>
> **Type:** CAPACITIES (ICT)
>
> **Defi:** FET - Proactive
>
> **Instrument:** Coordination and Support Action (CSA)
>
> **Related activities:** § 6.2
>
> **Period:** [March 2010 - February 2013]
>
> **Partners:** Inria (CRI Paris-Rocquencourt), KU Leuven (Belgium), Queen Mary University (UK), University of Chalmers (Sweden), University of Trento (Italy), Waterford Institute of Technology (Ireland).

Latest research work within ICT has allowed to pinpoint the most important and urgently required features that future systems should possess to meet users' needs. Accordingly, methods making systems capable of adapting to changes in user requirements and application domains have been pointed out as key research areas. Adaptation and evolution depend on several dimensions, e.g., time, location, and security conditions, expressing the diversity of the context in which systems operate. A design based on an effective management of these dimensions constitutes a remarkable step toward the realization of Trustworthy Eternal Systems. The EternalS Coordination Action specifically aims at coordinating research in that area based on a researcher Task Force together with community building activities, where the organization of large workshops and conferences is just one of the tools that will be used to conduct a successful CA.

7.3. International Initiatives

7.3.1. Participation In International Programs

7.3.1.1. Project M@TURE – International scientific cooperation programme Inria/Brazil
Participant: Nikolaos Georgantas [Correspondant].

> **Name:** M@TURE – Models @ runtime for self-adaptive pervasive systems: enabling user-in-the-loop, requirement-awareness, and interoperability in ad hoc settings
>
> **Instrument:** Inria-Brazil cooperation programme
>
> **Period:** [October 2012 – September 2014]
>
> **Partners:** Joint project with Institute of Informatics, Federal University of Goias, Brazil.

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 will 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 will be 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. Visits of International Scientists

7.4.1.1. Internships

> Amel Belaggoun (from Apr 2012 until Sep 2012)
>
> > Subject: Exploring the Use of Dynamic Decision Networks for Self-Adaptive Systems
> >
> > Institution: Université de Versailles Saint-Quentin-en-Yvelines (France)
>
> Ajay Chhatwal (from Jan 2012 until Mar 2012)
>
> > Subject: Supporting Application Development for the Future Internet of Smart Things and Services
> >
> > Institution: Indian Institute of Technology, Banaras Hindu University, Varanasi (India)
>
> Guilherme Nogueira (from Apr 2012 until Oct 2012)
>
> > Subject: Facilitating the Specification of Fault Tolerance Requirements in Sensor Network Macroprograms
> >
> > Institution: University of São Paulo (Brazil)

ASAP Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. LABEX CominLabs

Participants: Anne-Marie Kermarrec, Davide Frey, Stéphane Weiss.

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.

8.1.2. ANR ARPÈGE project Streams

Participants: Marin Bertier, Michel Raynal, Stéphane Weiss.

The Streams project started in November 2010. Beside the ASAP group, it includes Teams from Inria Nancy and PARIS. Its aim it to design a real-time collaborative platform based on a peer-to-peer network. For this it is necessary to design a support architecture that offers guarantees on the propagation, security and consistency of the operations and the updates proposed by the different collaborating sites.

8.1.3. ANR VERSO project Shaman

Participants: Marin Bertier, Anne-Marie Kermarrec, Michel Raynal.

The Shaman project started in 2009, gathering several members of the team working on distributed systems and distributed algorithms. The aim of this project is to propose new theoretical models for distributed algorithms inspired from real platform characteristics. From these models, we elaborate new algorithms and try to evaluate their theoretical power.

8.1.4. ANR Blanc project Displexity

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

The Displexity project started in October 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 Projects

8.2.1.1. ALLYOURS ERC Proof of Concept

       Title: AllYours, a distributed Privacy-aware Instant Item Recommender

       Type: IDEAS

       Instrument: ERC Proof of Concept Grant (Starting)

       Duration: January 2013 - December 2013.

       Coordinator: Inria (France)

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

Abstract: The goal of this PoC proposal is to boost the creation of a start-up (AllYours) targeting both Internet users as well as small to medium companies (SME) offering full-fledged personalization in notification systems. AllYours is a direct outcome from the GOSSPLE ERC Starting Grant, and more specifically from one of the activities conducted within the project, that today (after 3.5 years of the GOSSPLE ERC SG) involves most of the team and forces. In the GOSSPLE ERC SG project, we have invented the concept of implicit social network, built and maintained in a fully decentralized manner so that each user is in charge of her own personalized data, addressing both the privacy concern that users may have with respect to Big Brother-like companies, and scalability as the resources present at the edges of the Internet can then be fully leveraged. The GOSSPLE social network has been the basis of several Web 2.0 applications in order to personalize Web functionalities within the project, such as search, recommendation, query expansion, top-k queries, etc. More specifically, we have been applying the GOSSPLE social network to personalized notification, defining on top of it a novel dissemination protocol. This is P2P-AllYours currently under development. AllYours is investigating how to turn such inventions into a successful innovation with high potential targeting both end users and SMEs with an enterprise, semi-centralized, version of the system.

8.2.1.2. TOWARD THE ALLYOURS START-UP

Title: TOWARD THE ALLYOURS START-UP: focus on the mobile version

Type: EIT-ICT Labs

Instrument: ACLD Computing in the Cloud

Duration: January 2013 - December 2013.

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. This proposal will focus on the mobile versions of AllYours software. While the wired setting is a goal of the foreseen startup, this proposal will focus on the mobile versions of E-AllYours and P2P AllYours that will be experimented on the live platform provided by the TrentoRise partners.

8.2.1.3. ERC SG Gossple

Title: GOSSPLE

Type: IDEAS

Instrument: ERC Starting Grant

Duration: September 2008 - August 2013

Coordinator: Inria (France)

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

Abstract: Anne-Marie Kermarrec is the principal investigator of the GOSSPLE ERC starting Grant (Sept. 2008 - Sept. 2013). GOSSPLE aims at providing a radically new approach to navigating the digital information universe. This project has been granted a 1.250.000 euros budget for 5 years.

GOSSPLE aims at radically changing the navigation on the Internet by placing users affinities and preferences at the heart of the search process. Complementing traditional search engines, GOSSPLE will turn search requests into live data to seek the information where it ultimately is: at the user. GOSSPLE precisely aims at providing a fully decentralized system, self-organizing, able to discover, capture and leverage the affinities between users and data.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. Transform Marie Curie Initial Training Network

Participants: Tyler Crain, Eleni Kanellou, Anne-Marie Kermarrec, Michel Raynal.

Program: Marie Curie Initial Training Network

Project acronym: Transform

Project title: Theoretical Foundations of Transactional Memory

Duration: May 2010 - October 2013

Grant agreement no.: 238639

Date of approval of Annex I by Commission: May 26, 2009

Coordinators: Michel Raynal - Panagiota Fatourou

Other partners: Foundation for Research and Technology Hellas ICS FORTH Greece, University of Rennes 1 UR1 France, Ecole Polytechnique Federale de Lausanne EPFL Switzerland, Technische Universitaet Berlin TUB Germany, and Israel Institute of Technology Technion.

Abstract: Transform is a Marie Curie Initial Training Networks European project devoted to the Theoretical Foundations of Transactional Memory (Major chip manufacturers have shifted their focus from trying to speed up individual processors into putting several processors on the same chip. They are now talking about potentially doubling efficiency on a 2x core, quadrupling on a 4x core and so forth. Yet multi-core is useless without concurrent programming. The constructors are now calling for a new software revolution: the concurrency revolution. This might look at first glance surprising for concurrency is almost as old as computing and tons of concurrent programming models and languages were invented. In fact, what the revolution is about is way more than concurrency alone: it is about concurrency for the masses. The current parallel programming approach of employing locks is widely considered to be too difficult for any but a few experts. Therefore, a new paradigm of concurrent programming is needed to take advantage of the new regime of multicore computers. Transactional Memory (TM) is a new programming paradigm which is considered by most researchers as the future of parallel programming. Not surprisingly, a lot of work is being devoted to the implementation of TM systems, in hardware or solely in software. What might be surprising is the little effort devoted so far to devising a sound theoretical framework to reason about the TM abstraction. To understand properly TM systems, as well as be able to assess them and improve them, a rigorous theoretical study of the approach, its challenges and its benefits is badly needed. This is the challenging research goal undertaken by this MC-ITN. Our goal through this project is to gather leading researchers in the field of concurrent computing over Europe, and combine our efforts in order to define what might become the modern theory of concurrent computing. We aim at training a set of Early Stage Researchers (ESRs) in this direction and hope that, in turn, these ESRs will help Europe become a leader in concurrent computing. Its keywords are Transactional Memory, Parallelization Mechanisms, Parallel Programming Abstractions, Theory, Algorithms, Technological Sciences

8.2.3. Collaborations with Major European Organizations

Ecole Polytechnique Federale de Lausanne EPFL Switzerland
collaboration on the ERC SG GOSSPLE and Transform.

Foundation for Research and Technology Hellas ICS FORTH Greece
Transform

Lancaster University
collaboration on the ERC SG GOSSPLE

Imperial College London
collaboration on the Map-Reduce systems

8.3. International Initiatives

8.3.1. Inria International Partners

University of Calgary

Universidad Nacional Autonoma de Mexico

8.3.2. Participation In International Programs

8.3.2.1. Demdyn: Inria/CNPq Collaboration

Participants: Marin Bertier, Michel Raynal.

The aim of this project is to exploit dependable aspects of dynamic distributed systems such as VANETs, WiMax, Airborn Networks, DoD Global Information Grid, P2P, etc. Applications that run on these kind of networks have a common point: they are extremely dynamic both in terms of the nodes that take part of them and available resources at a given time. Such dynamics results in instability and uncertainty of the environment which provide great challenges for the implementation of dependable mechanisms that ensure the correct work of the system.

This requires applications to be adaptive, for instance, to less network bandwidth or degraded Quality-of-Service (QoS). Ideally, in these highly dynamic scenarios, adaptiveness characteristics of applications should be self-managing or autonomic. Therefore, being able to detect the occurrence of partitions and automatically adapting the applications for such scenarios is an important dependable requirement for such new dynamic environments.

8.4. International Research Visitors

The team welcomed the following research visitors in 2012.

Swan Dubois, Lip 6, 27 January 2012.

Paolo Costa, Imperial College London, from 8 to 10 February 2012 and one week in November.

Rachid Guerraoui, several one week visits in 2012.

Gregor Von Bochmann, University of Ottawa, from 12 to 17 March 2012.

Zekri Lougmiri, Faculté de Sciences d'Oran, 23 April to 4 May 2012.

Zhu Weiping, Hong Kong Polytechnic University, from 15 November 2011 until 14 May 2012.

Anna-Kaisa Pietilainen ; Technicolor Paris, 31 May 2012.

Jean-Pierre Lozzi, Lip 6, 1 June 2012.

Vincent Leroy, Université Joseph Fourier de Grenoble, 29 to 31 October 2012.

Bin Xiao, Hong Kong Polytechnic University, 26 December 2012.

8.4.1. Internships

Mathieu GOESSENS; 6 February 2012 to 6 July 2012. "Peer-to-peer content dissemination". Supervised by Davide Frey and Anne-Marie Kermarrec.

Ilham IKBAL; 1 March 2012 to 15 August 2012. "Integration du routage en oignon (TOR) dans les protocoles epidemiques". Supervised by Davide Frey.

Imane ALIFDAL; 1 March 2012 to 31 August 2012. "Integration du routage en oignon (TOR) dans les protocoles epidemiques". Supervised by Davide Frey.

Benjamin Girault; 19 March to 31 August 2012. "Heterogeneous gossip protocols for news recommendation". Supervised by Anne-Marie Kermarrec.

Asiff Shaik; 3 August 2012 to 2 January 2013. "Understanding offline social networks and its advantages over the online social network ; resolving some challenges in the offline social networks such as privacy, trust, security and scalability.". Supervised by Anne-Marie Kermarrec.

8.4.2. Visits to International Teams

Anne-Marie Kermarrec has been a part-time (50%) visiting professor at EPFL Lausanne since September 2012.

ASCOLA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. CESSA: Compositional Evolution of Secure Services with Aspects (ANR/ARPEGE)
Participants: Mario Südholt [coordinator], Diana Allam, Rémi Douence, Hervé Grall, Jean-Claude Royer.

The project CESSA is an (industrial) ANR project running for 3 years months, with funding amounting to 290 KEUR for ASCOLA from Jan. 10 on. Three other partners collaborate within the project that is coordinated by ASCOLA: a security research team from Eurecom, Sophia-Antipolis, the Security and Trust team from SAP Labs, also located at Sophia-Antipolis, and IS2T, an innovative start-up company developing middleware technologies located at Nantes. The project deals with security in service-oriented architectures.

This year our group has contributed several scientific publications as part of the project. All partners have been involved in the publication of a unifying model for WD*/SOAP-based and RESTful web services. Furthermore, we have formally defined a type system that is safe in the presence of malicious attackers and insecure communication channels.

All information is available from the CESSA web site: http://cessa.gforge.inria.fr.

8.1.1.2. Entropy (ANR/Emergence)
Participants: Jean-Marc Menaud [coordinator], Thomas Ledoux, Adrien Lèbre.

The Entropy project is an (industrial) ANR/Emergence project running for 18 months. It was accepted in December 2010 for funding amounting to 242 KEUR (ASCOLA only).

The objective of this project is to conduct studies on economic feasibility (market, status, intellectual property, website) for creating a industrial business on the Entropy software.

Some task must complete the Entropy core solution with a graphical unit interface to produce convincing demonstrators and consolidate our actual and future results. At the end of the project, the goal is to create a company whose objective is to sell the service, support and software building blocks developed by this ANR Emergence project.

8.1.1.3. MyCloud (ANR/ARPEGE)
Participants: Thomas Ledoux [coordinator], Jean-Marc Menaud, Yousri Kouki, Frederico Alvares.

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.

This year, the ASCOLA project-team has proposed (i) CSLA, a novel language to describe QoS-oriented SLA associated with cloud services [23]; (ii) a SLA-driven capacity planning for cloud applications [24].

8.1.1.4. SONGS (ANR/INFRA)

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

The SONGS project (Simulation of Next Generation Systems) is an ANR/INFRA project running for 48 months (starting from 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. 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. The ASCOLA involvement will start in 2013 with the arrival of Takahiro Hirofuchi from the AIST institute in Japan.

8.1.2. FUI

8.1.2.1. Cool-IT (FUI)

Participant: Jean-Marc Menaud [coordinator].

The Cool-IT project is an (industrial) FUI project running for 24 months. It was accepted in September 2010 for funding amounting to 130 KEUR (ASCOLA only).

The objective of this project is to design systems adapted to new standards of "Green IT" to reduce the data centers electrical consumption.

To this end, the COOL IT project will develop processes for cooling computer servers, optimize the server power chain supply, implement tools and methods of collecting energy data in real time, and specify methods for controlling the data centers consumption as a tradeoff between the computational power needed, the availability, and the energy consumption.

8.1.3. FSN

8.1.3.1. 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 accross Cloud layers) and "Run" (virtual machine manager for datacenters and placement constraints).

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. A4Cloud: Accountability for the Cloud (Integrated Project)

Participants: Mario Südholt [coordinator], Omar Chebaro, Ronan-Alexandre Cherrueau, Rémi Douence, Hervé Grall, Jean-Claude Royer.

The A4Cloud project is an integrated EU project, coordinated by HP, UK, on the topic of accountability, that is, the responsible stewardship of private data, in the Cloud. This 42-months project started in Oct. 2012 and Ascola's funding amounts to 600 KEuro.

The project involves 13 partners: in addition to HP, two enterprises (SAP AG, Germany; ATC, Greece), a non-governmental organisation (the Cloud Security Alliance, CSA) and 9 universities and research organisations (EMNantes and Eurecom, France; HFU. Furtwangen, Germany; Karlstadt U., Sweden; U. Malaga, Spain; Queen Mary U., U.K.; U. Stavanger and Sintef, Norway; Tilburg U., The Netherlands).

A4Cloud will create solutions to support users in deciding and tracking how their data is used by cloud service providers. By combining methods of risk analysis, policy enforcement, monitoring and compliance auditing with tailored IT mechanisms for security, assurance and redress, A4Cloud aims to extend accountability across entire cloud service value chains, covering personal and business sensitive information in the cloud.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. SCALUS: SCALing by means of Ubiquitous Storage (MC ITN)
Participants: Adrien Lèbre [coordinator], Mario Südholt, Gustavo Bervian Brand.

The vision of the Scalus Marie Curie international training network (MC ITN) is to deliver the foundation for ubiquitous storage systems, which can be scaled with respect to multiple characteristics (capacity, performance, distance, security, ...).

Providing ubiquitous storage will become a major demand for future IT systems and leadership in this area can have significant impact on European competitiveness in IT technology. To get this leadership, it is necessary to invest into storage education and research and to bridge the current gap between local storage, cluster storage, grid storage, and cloud storage. The consortium will proceed into this direction by building the first interdisciplinary teaching and research network on storage issues. It consists of top European institutes and companies in storage and cluster technology, building a demanding but rewarding interdisciplinary environment for young researchers.

The network involves the following partners: University of Paderborn (Germany, coordinator), Barcelona Super Computing (Spain), University of Durham (England), University of Frankfurt (Germany), ICS-FORTH (Greece), Universidad Polytecnica de Madrid (Spain), EMN/ARMINES (France), Inria Rennes Bretagne Atlantique (France), XLAB (Slovenia), University of Hamburg (Germany), Fujistu Technology Systems (Germany).

The overall funding of the project by the European Union is closed to 3,3 MEUR. ASCOLA's share amounts to 200 KEUR.

8.2.2.2. COST IC0804

Program: Energy efficiency in large sclae distributed systems

Project acronym: COST IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: Jan. 2009 - May 2013

Coordinator: Jean-Marc Pierson (IRIT, France)

Participating countries: AT, BE, CH, CY, DE, DK, EE, FI, FR, GR, HU, IE, IL, IT, LU, PL, PT, RO, SE, SP, TR, UK,

Abstract: The COST IC 0840 Action will propose realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and storage resources, their energy consumption is drastically increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, networks and applications. The action will characterize the energy consumption and energy efficiencies of distributed applications. http://www.cost804.org/

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. RAPIDS

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

Inria principal investigator: Jacques Noyé

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - PLEIAD - Éric Tanter

Duration: 2010 - 2012

See also: http://rapids.gforge.inria.fr/doku.php

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. International Research Visitors

8.4.1. Internships

Rahma CHAABOUNI (from April 2012 until June 2012)

Subject: Flexible evolution of service-oriented systems

Institution: ENIS school, Sfax, Tunisie

Ismael FIGUEROA (from May 2012 until Jul 2012)

Subject: Exploring membranes for aspect oriented programming

Institution: University of Chile (Chile)

<p style="text-align:center; color:red">ATLANMOD Team</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

Program: Pays de la Loire regional funding. Call: Soutenir et accompagner la constitution et/ou l'implantation de nouvelles équipes sur des thématiques émergentes

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.

Program: Pole de competitivite Images et Reseaux - Appel Projets PME 2011

Project title: StreamMaster

Duration: 2012 - 2014

Coordinator: Data Syscom

Other partners: Research and University (Universite de 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.

8.2. National Initiatives

8.2.1. ANR

Program: ANR - ARPEGE program

Project acronym: Galaxy

Project title: Galaxy

Duration: 2010 - 2013

Coordinator: Airbus

Other partners: Industry (Airbus), Research and University (Armines -AtlanMod-, IRIT, LIP6) and Vendors and service providers (AKKA, Softeam)

Abstract: GALAXY (http://galaxy.lip6.fr) proposes to deal with the model driven collaborative development of complex systems. Galaxy aims at defining an open and flexible architecture particularly designed to be scalable. One of the key points is related to the fragmentation and distributiveness of huge models, their synchronization and relationship with communication means classically used by development teams. The work is being driven by use cases provided by a company (Airbus), which describe scalability issues they face during systems developments. Our work in this project is composed of two main parts: 1) the conception of efficient mechanisms for multiple views of complex (large) models; 2) the definition of a solution for the automation of modeling tasks on large model repositories, like the execution of large amounts of transformations, the orchestration of their execution, and the effective browsing of repositories for finding specific models. In this context we have developed MoScript, a scripting language (and corresponding execution engine) to write batch processing modeling tasks.

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 is 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 will allow 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 are notably using in practice (and improving) some of our works such as Virtual EMF, ATL or some MoDisco components.

8.3. European Initiatives

8.3.1. FP7 Projects

Title: Advanced software-based seRvice provisioning and migraTIon of legacy Software

Type: FP7, COOPERATION (ICT)

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

Instrument: Integrated Project (IP)

Duration: October 2012 - September 2015

Coordinator: Atos Origin R&I (Spain)

Others partners: Tecnalia (Spain), Inria (France), Fraunhofer (Germany), TUWIEN (Austria), ENG (Italy), ICCS (Greece), SPARX (Austria), ATC (Greece), SPIKES (Belgium)

See also: http://www.artist-project.eu/

Abstract: Successful software has to evolve to keep it compatible and up to date. Up to 90% of software cost is spent on maintenance and of this 75% is spent on the development of new features for staying competitive. The industry progresses through periods of incremental development interlaced with true paradigm shifts. Accordingly, more and more traditional software vendors notice the need to transform their current business and technology model in order to remain competitive. Software-as-a-Service (SaaS) is seen as the most promising way to achieve this change. However, this transition from Software-off-the-shelf (often residing as legacy applications) to SaaS is a tremendous challenge comprising business, application and technical issues. Having an automated, vendor, technology and hardware independent way to migrate an application would permit the software to evolve easily even in case of transition to new paradigms. ARTIST proposes a software migration approach covering the premigration and postmigration phases. The premigration phase analyzes the technical and non-technical consequences of migrations, supporting the decision-making process on how a migration should be done. The migration phase itself is based on Model Driven Engineering techniques to automate the reverse engineering of the legacy applications to platform independent models. These models are the input for the forward engineering process to generate and deploy modernized applications and to support future migrations. In the postmigration

phase, the modernized applications are certified with respect to the stated goals of the premigration phase. ARTIST will reduce the risk, time and cost of migrating legacy software. It will lower the barriers for companies (with existing software) wanting to take advantage of the latest technologies and business models, particularly when considering the current benefits of Cloud Computing and SaaS.

Title:Cost-Efficient methods and processes for SAfety Relevant embedded systems

Program: Artemis

Project acronym: CESAR

Duration: 2009 - 2012

Coordinator:

Other partners: More than 50 partners

Abstract: The three transportation domains, automotive, aerospace, and rail, as well as the automation domain share the need to develop ultra-reliable embedded systems to meet social demands for increased mobility and safety in a highly competitive global market.To maintain the European leading edge position in the transportation as well as automation market, CESAR aims to boost cost efficiency of embedded systems development and safety and certification processes by an order of magnitude. CESAR pursuits a multi-domain approach integrating large enterprises, suppliers, SME's and vendors of cross sectoral domains and cooperating with leading research organizations and innovative SME's. In particular, we work on the Reference Technology Platform, which aims at tool integration. We propose to achieve tool integration by means of metamodeling and model transformations [42]. In the context of this project we are developing VirtualEMF (http://code.google.com/a/eclipselabs.org/p/virtual-emf/) , an approach and tool for the transparent composition, weaving and linking of heterogeneous models.

Title:Open Platform for the Engineering of Embedded Systems

Program: ITEA2

Project acronym: OPEES

Duration: 2009 - 2012

Coordinator: Obeo

Other partners: Many other research labs and companies. Our main partner was the Obeo company.

Abstract:OPEES (http://www.opees.org) mission statement is to settle a community and build the necessary means and enablers to ensure long-term availability of innovative engineering technologies in the domain of dependable or critical software-intensive embedded systems. In particular, within OPEES, our schema of open source industrial collaboration [3] (e.g. around ATL) will be tested and developed as a team contribution to this project. AtlanMod is also responsible for providing a model-driven interoperability solution for the integration of the ecosystem of OPEES components, based on metamodeling the domain data of each component and bridging, by model transformation, the specific data representations.

8.3.2. Collaborations in European Programs, except FP7

Program: Leonardo da Vinci (LifeLong learning programme)

Project acronym: MDEExpertise

Project title:Exchanging knowledge, techniques and experiences around Model Driven Engineering education

Duration: 2010 - 2012

Coordinator: Lublin University of Technology

Other partners: Potecnico di Milano, Universidad de Alicante

Abstract: MDE Expertise (http://www.learnMDE.org) is an European Leonardo da Vinci project focused on the development of common educational materials for the Model Driven Engineering (MDE) area. The main aim of the project is to transfer and adapt the education in Model Driven Engineering concepts to the local IT education societies of the partner's countries, thus improving the partners' knowledge about up to date current software development methods. This results in the best preparation for professionals competing on the IT market. Direct results include: development of common MDE teaching methods, suited for the partners' local needs and market requirements; creation of teaching materials (with online version) localized for the partners' languages and definition of tools for e-learning and knowledge exchange. Indirect effects include improving the capability of local SMEs in solving complex software design problems through modeling, and evolving the software development job market.

8.4. International Initiatives

8.4.1. Inria International Partners

The three 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

With all three teams we have published several papers and made research visits this year.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

In 2012 the following visitors did a research stay with AtlanMod:

- Ralf Lammel (University of Koblenz-Landau, Germany), February
- Soichiro Hidaka (National Institute of Informatics (NII), Tokyo, Japan), September
- David Ameller (Universitat Politècnica de Catalunya), June
- Juan Manuel Dodero (University of Cádiz, Spain), June
- Jokin García (University of Basque Country, Spain), May-August

AVALON Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. FUI CompatibleOne Project, 2010-2012

Participants: Laurent Lefevre, Julien Carpentier, Maxime Morel, Olivier Mornard.

The project CompatibleOne (Nov 2010-Nov 2012) funded by the Fonds Unique Interministériel (FUI) is dealing with the building of a Cloud architecture open software stack.

CompatibleOne is an open source project with the aim of providing interoperable middleware for the description and federation of heterogeneous clouds comprising resources provisioned by different cloud providers. Services provided by Inria participation (module COEES) should allow to act on the system's core by offering a scenario for the broker using energy constraints. These constraints should allow virtual machines placement and displacement using energy profile. Collected data must be available for CO and other systems for future researches. We took part in the analysis of the specification of the system. Mainly, we are in charge of the energy efficiency module. We also had participation in several modules like COMONS (monitoring module), ACCORDS (brokering module), EZVM (virtualization module) and CONETS (networking module). To make energy measurement, we used hardware probes and we studied software probes too. We evaluated several probes providers like Eaton and Schleifenbauer which provide smart PDU (Power Distribution Unit). We also evaluated IPMI board provided by DELL, our computers manufacturer, and OmegaWatt, a small company which provides custom hardware for energy measurement.

In this project, our work is focused on the design and provisioning of energy aware and energy efficient components in order to include energy aspects in QoS, SLAs and billing in clouds architectures. We lead the task T3.4 on energy management and will participate in activities on virtual machines design and migration [13].

7.1.2. FSN XLcloud, 2012-2014

Participants: Jean-Patrick Gelas, Laurent Lefevre, Francois 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.

7.1.3. 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, 2010-2013

Participants: Frédéric Desprez, Gilles Fedak, Sylvain Gault, Christian Pérez, 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.

7.1.4. ANR grant: COOP (Multi Level Cooperative Resource Management), 3.5 years, ANR-09-COSI-001-01, 2009-2013

Participants: Frédéric Desprez, Cristian Klein, Christian Pérez.

The main goals of this project are to set up a cooperation as general as possible between programming models and resource management systems and to develop algorithms for efficient resource selection. In particular, the project targets the SALOME platform and the GRID-TLSE expert-site (http://gridtlse.org/) as an example of programming models, and PadicoTM, DIET and XtreemOS as examples of communication manager, grid middleware and distributed operating systems.

The project is led by Christian Pérez.

7.1.5. ANR grant SPADES (Servicing Petascale Architectures and DistributEd System), 3.5 years, 08-ANR-SEGI-025, 2009-2012

Participants: Eddy Caron, Florent Chuffart, Frédéric Suter, Haiwu He.

Today's emergence of Petascale architectures and evolutions of both research grids and computational grids increase a lot the number of potential resources. However, existing infrastructures and access rules do not allow to fully take advantage of these resources. One key idea of the SPADES project is to propose a non-intrusive but highly dynamic environment able to take advantage of the available resources without disturbing their native use. In other words, the SPADES vision is to adapt the desktop grid paradigm by replacing users at the edge of the Internet by volatile resources. These volatile resources are in fact submitted via batch schedulers to reservation mechanisms which are limited in time or susceptible to preemption (best-effort mode).

One of the priorities of SPADES is to support platforms at a very large scale. Petascale environments are therefore particularly considered. Nevertheless, these next-generation architectures still suffer from a lack of expertise for an accurate and relevant use. One of the SPADES goal is to show how to take advantage of the power of such architectures. Another challenge of SPADES is to provide a software solution for a service discovery system able to face a highly dynamic platform. This system will be deployed over volatile nodes and thus must tolerate failures. SPADES will propose solutions for the management of distributed schedulers in Desktop Computing environments, coping with a co-scheduling framework.

7.1.6. ANR grant: USS SimGrid (Ultra Scalable Simulation with SimGrid), 3.8 years, ANR-08-SEGI-022, 2008-2012

Participants: Frédéric Desprez, Matthieu Imbert, Georges Markomanolis, Frédéric Suter.

The USS-SimGrid project aims at Ultra Scalable Simulations with SimGrid. This tool is leader in the simulation of HPC settings, and the main goal of this project is to allow its use in the simulation of desktop grids and peer-to-peer settings. The planned work is to improve the models used in SimGrid (increasing their scalability and easing their instantiation), provide associate tools for experimenters (result analysis assistants and test campaign managers), and increase the simulation kernel scalability by parallelization and optimization. The project also aims at producing a scientific instrument directly usable by a large community and is well adapted to the needs of various users.

7.1.7. ANR grant: SONGS (Simulation Of Next Generation Systems), 4 years, ANR-12-INFRA-11, 2012-2015

Participants: Frédéric Desprez, Georges Markomanolis, 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.

7.1.8. ANR JCJC: Clouds@Home (Cloud Computing over Unreliable, Shared Resources), 4 years, ANR-09-JCJC-0056-01, 2009-2012

Participants: Gilles Fedak, Bing Tang.

Recently, a new vision of cloud computing has emerged where the complexity of an IT infrastructure is completely hidden from its users. At the same time, cloud computing platforms provide massive scalability, 99.999% reliability, and improved performance at relatively low costs for complex applications and services. This project, lead by D. Kondo from Inria MESCAL investigates the use of cloud computing for large-scale and demanding applications and services over unreliable resources. In particular, we target volunteered resources distributed over the Internet. In this project, G. Fedak leads the Data management task (WP3).

7.1.9. Inria ADT BitDew, 2 years, 2010-2012

Participants: Gilles Fedak, José Saray.

ADT BitDew is an Inria support action of technological development for the BitDew middleware. Objectives are several fold : i/ provide documentation and education material for end-users, ii/ improve software quality and support, iii/ develop new features allowing the management of Cloud and Grid resources.

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

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

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).

7.1.11. Inria Large Scale Initiative HEMERA, 4 years, 2010-2013

Participants: Daniel Balouek, Christian Pérez, Laurent Pouilloux.

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; D. Balouek and L. Pouilloux are managing scientific challenges on GRID'5000.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. EDGI

Title: EDGI: European Desktop Grid Initiative

Type: CAPACITIES (Infrastructures)

Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUPPORT ACTIONS (CPCSA)

Duration: June 2010 - May 2012

Coordinator: MTA SZTAKI (Hungary)

Others partners: CIEMAT, ES; Fundecyt, ES; University of Westminster, UK; Cardiff University, UK; University of Coimbra, PT; CNRS, FR, AlmerGrid, NL

See also: http://edgi-project.eu/

Abstract: The project EDGI will develop middleware that consolidates the results achieved in the EDGeS project concerning the extension of Service Grids with Desktop Grids in order to support EGI and NGI user communities that are heavy users of DCIs and require extremely large number of CPUs and cores. EDGI will go beyond existing DCIs that are typically cluster Grids and supercomputer Grids, and will extend them with public and institutional Desktop Grids and Clouds. EDGI will integrate software components of ARC, gLite, Unicore, BOINC, XWHEP, 3G Bridge, and Cloud middleware such as OpenNebula and Eucalyptus into SG→ DG → Cloud platforms for service provision and as a result EDGI will extend ARC, gLite and Unicore Grids with volunteer and institutional DG systems. In this project, G. Fedak is the Inria representative and lead the JRA2 work package which is responsible for providing QoS to Desktop Grids.

7.2.1.2. PRACE 2IP

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 2013

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.

7.2.1.3. PaaSage

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.

7.2.2. Collaborations in European Programs, except FP7

Program: Celtic-Plus

Project acronym: SEED4C

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

Duration: 2012-2015

Coordinator: Bertrand Marquet (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.

Program: COST

Project acronym: COST IC804

Project title: : Energy efficiency in Large Scale Distributed Systems

Duration: 2009-2013

Coordinator: J.M. Pierson (IRIT)

Other partners: 26 research institute and countries

Abstract: The COST Action IC0804 proposes realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and Storage resources, their energy consumption is exponentially increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, network and applications. This Action characterizes the energy consumption and energy efficiencies of distributed applications. Then based on the current hardware adaptation possibilities and innovative algorithms it proposes adaptive and alternative approaches taking into account the energy saving dimension of the problem. This Action also characterizes the trade-off between energy savings and functional and non-functional parameters, including the economic dimension. Deliverables includes workshop proceedings, books, good practice leaflets fostering consciousness rise at ICT researchers, scientists, managers and users levels. Finally, benefits addresses scientific and societal needs.

Program: COST

Project acronym: IC0805

Project title: Open Network for High-Performance Computing on Complex Environments (ComplexHPC)

Duration: 2009-2013

Coordinator: Emmanuel Jeannot (Inria Bordeaux - Sud Ouest)

Other partners: 26 research institute and countries

Abstract: The main objective of the Action is to develop an integrated approach for tackling the challenges associated with heterogeneous and hierarchical systems for High Performance Computing.

Program: Intelligent Energy in Europe

Project acronym: PrimeEnergyIT

Project title: PrimeEnergyIT: Efficient Data Centers

Duration: 2010-2012

Coordinator: B. Schappi (Austrian Energy Agency)

Other partners: organisme, labo (pays)

Abstract: The increasing use of powerful IT services in all public and private service sectors as for example administration, health services and entertainment has lead to a growing energy demand for centralized IT equipment in data centers and central IT units of companies. According to EU and US studies this trend will continue unless energy efficient technology and efficient operation of equipment is broadly implemented. Business-as-usual would lead to a doubling of energy consumption within a few years thereby also significantly increasing energy costs in data centers. The implementation of energy efficient technologies and optimized hardware operation however allows energy and cost savings of up to 60%. PrimeEnergyIT supports the market development and demand for energy efficient central IT hardware and infrastructure providing tools and services for IT and infrastructure managers, consultants and other relevant experts. The PrimeEnergyIT initiative is operated by an international consortium of national agencies and research institutions in cooperation with a number of associate partners from industry [44], [36].

7.3. International Initiatives

7.3.1. Participation In International Programs

7.3.1.1. Inria-UIUC-NCSA Joint Laboratory for Petascale Computing
Participants: Eddy Caron, Frédéric Desprez, Mohammed El Mehdi Diouri, Olivier Glück, Cristian Klein, Vincent Lanore, Laurent Lefevre, Christian Pérez, 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.

7.3.1.2. PICS CNRS 5473: Dimensioning through Simulation
Participants: Frédéric Desprez, Georges Markomanolis, Frédéric Suter.

This International Scientific Collaboration Project with the University of Hawai'i at Manoa (2009-2012) aims at comparing, solidifying and integrating within a single framework, namely SimGrid, several approaches to dimension infrastructures thanks to simulation.

7.3.1.3. GreenTouch
Participants: Laurent Lefevre, Jean-Patrick Gelas.

GreenTouch is a consortium of leading Information and Communications Technology (ICT) industry, academic and non-governmental research experts dedicated to fundamentally transforming communications and data networks, including the Internet, and significantly reducing the carbon footprint of ICT devices, platforms and networks.

In this project, we explore the design of virtual home gateway at large scale [18], [29] and participate in the SEASON project.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- L. Lefevre: Hosting Teferi Assefa, PhD student from Addis Abeba University Ethiopia (from sept to dec. 2012) - Joint work on Virtualization of Virtual Home Gateways in link with the GreenTouch initiative.

- G. Fedak: Hosting Matei Ripenau, ENS Visiting Professor from University of British Columbia (Canada). Joint work on large-scale data management. Hosting Mircea Moca, lecturer University of Babes Bolaj, Romania. Joint work on scheduling for hybrid distributed infrastructure.

7.4.1.1. Internships

- F. Suter: Hosting 2 Short Term Scientific Missions in the context of the COST Action IC0805. H. Arabnejab (University of Porto, Portugal) and Z. Papazachos (University of Thessaloniki, Greece).

- G. Fedak: Hosting Asma Ben Cheick (Msc, Faculté des sciences de Tunis), 1 month, Haidau Andrei, University of Cluj-Napoca, 3 months.

- F. Desprez, J. Rouzaud-Cornabas: Hosting Jose Luis Lucas, PhD student from Madrid (Spain), 3 months. Joint work on the resource provisioning in Clouds taking into account performance and cost.

<h1 style="color:red; text-align:center">CEPAGE Project-Team</h1>

7. Partnerships and Cooperations

7.1. Regional Initiatives

+ **CRA Region** (participants: CEPAGE). This project, entitled "Services for large-scale distributed platforms", is an effort for the designing efficient algorithms for clustering and discovering resources in large scale distributed networks. This project provided the funding for the PhD thesis of Hubert Larcheveque.

+ **CRA Region** (participants: CEPAGE, RUNTIME (Bordeaux)). This project, entitled "Performance modeling for heterogeneous platforms", is an effort for the modeling of the behavior of applications on two different types of platforms: multicore architectures within the RUNTIME team, and large scale platforms within CEPAGE. This project provides the funding for the PhD thesis of Przemyslaw Uznanski.

7.2. National Initiatives

- **ANR ALADDIN** (Algorithm Design and Analysis for Implicitly and Incompletely Defined Interaction Networks; GANG and CEPAGE project-teams): the members of Cepage have been participating to the ANR project "blanc" (i.e. fundamental research) about the fundamental aspects of large interaction networks enabling massive distributed storage, efficient decentralized information retrieval, quick inter-user exchanges, and/or rapid information dissemination. The project is mostly oriented towards the design and analysis of algorithms for these (logical) networks, by taking into account proper ties inherent to the underlying infrastructures upon which they are built. The infrastructures and/or overlays considered in this project are selected from different contexts, including communication networks (from Internet to sensor networks), and societal networks (from the Web to P2P networks).

- **ANR USS-SIMGRID** (Ultra Scalable Simulations with SimGrid; participants: AlGorille (LORIA, Nancy), ASAP (Saclay), CEPAGE, Univ. of Hawai'i, GRAAL (LIP, ENS Lyon), MESCAL (Grenoble), MASCOTTE (Sophia Antipolis)). The members of CEPAGE were part of this project (2008-2011), whose goal was to extend the SimGrid simulation framework, originally developed for HPC, to provide a reasonable and quantifiable level of accuracy for the simulation of large scale application. This allowed to attend both the rising need for scalability of the HPC community and the need for simulation accuracy of the distributed computing community. SimGrid was extended to provide a family of models which offer different levels of accuracy at different simulation scales.

- **ANR SONGS** (Simulation of Next Generation Systems; participants: AlGorille (LORIA, Nancy), MESCAL (Grenoble), GRAAL (ENS Lyon), IN2P3 (Lyon), CEPAGE, HiePACS, RUNTIME (Bordeaux), LSIIT (Strasbourg), ASCOLA (Nantes), MASCOTTE, MODALIS (Sophia Antipolis)). This project started in 2012 as a follow-up of the USS-SIMGRID project. The aim is to further extend the domain of SimGrid, by designing a unified simulation framework for the four application domains: Grids, Peer-to-Peer systems, High Performance Computing, and Cloud systems. Achieving this goal mandates careful representation and modeling of the underlying concepts presented by each domain (memory, disks, energy, network and volatility) and of the interfaces specific to each domain. It also requires a transversal work on the simulation framework itself. CEPAGE is actively involved in this project, both for the peer-to-peer use cases and for the coordination of the modeling effort of the project.

- **ANR Displexity** (Calcul DIStribué: calculabilité et comPLEXITé; participants: CEPAGE, GANG and ASAP projects). The main goal of DISPLEXITY is to establish the scientific foundations of a theory of calculability and complexity for distributed computing. Displexity started in 2012.

- **ANR IDEA** ANR program "defis": project IDEA (2009-2012). The goal of this ANR is the study of identifying codes in evolving graphs. Ralf Klasing is the overall leader of the project.
- **ANR "Jeunes chercheurs" EGOS - Embedded Graphs and their Oriented Structures** (2012-2014) (see http://www.lirmm.fr/egos/)

  Participants: CEPAGE/LaBRI(Bordeaux) LIRMM(Montpellier), LIX(Palaiseau) The goal of this project is the study oriented structures on graphs of arbitrary genus.
- **AMADEUS** (CNRS funding on "BIG DATA": 2012-): Analysis of MAssive Data in Earth and Universe Sciences. This a multidisciplinary research project between computer science teams (LIRMM: University of Montpellier, LIF: University of Marseille) and CEPAGE), earth and climate science (CEREGE: Montpellier and IRD: Aix) and astronomy (LAM: University of Marseille). The aim of the project is to propose effective techniques for mining large data by essentially using distributed computing, visualization, summarization and approximation.

7.3. European Initiatives

7.3.1. EULER

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 - September 2013

Coordinator: ALCATEL-LUCENT (Belgium)

Others partners:
Alcatel-Lucent Bell, Antwerpen, Belgium
3 projects from Inria: CEPAGE, GANG and MASCOTTE, France
Interdisciplinary Institute for Broadband Technology (IBBT),Belgium
Laboratoire d'Informatique de Paris 6 (LIP6), Université Pierre Marie Curie (UPMC), France
Department of Mathematical Engineering (INMA) Université Catholique de Louvain, Belgium
RACTI, Research Academic Computer Technology Institute University of Patras, Greece
CAT, Catalan Consortium: Universitat Politecnica de Catalunya, Barcelona and University of Girona, Spain

See also: http://www-sop.inria.fr/mascotte/EULER/wiki/

Abstract: The title of this study is "Dynamic Compact Routing Scheme". The aim of this projet is to develop new routing schemes achieving better performances than current BGP protocols. The problems faced by the inter-domain routing protocol of the Internet are numerous:

The underlying network is dynamic: many observations of bad configurations show the instability of BGP;

BGP does not scale well: the convergence time toward a legal configuration is too long, the size of routing tables is proportional to the number of nodes of network (the network size is multiplied by 1.25 each year);

The impact of the policies is so important that the many packets can oscillated between two Autonomous Systems.

In this collaboration, we mainly focus on the scalability properties that a new routing protocol should guarantee. The main measures are the size of the local routing tables, and the time (or message complexity) to update or to generate such tables. The design of schemes achieving sub-linear space per routers, say in n where n is the number of AS routers, is the main challenge. The target networks are AS-network like with more than 100,000 nodes. This projet, in collaboration with the MASCOTE Inria-project in Nice Sophia-Antipolis, makes the use of simulation, developed at both sites.

7.3.2. Collaborations in European Programs, except FP7

Program: European COST

Project acronym: Complex HPC IC0805.

Project title: Open Network for High-Performance Computing on Complex Environments

Duration: 2010-2013

Coordinator: Inria

Other partners: 26 countries, see list at http://www.cost.eu/domains_actions/ict/Actions/IC0805?parties

Abstract: The main objective of this COST action is to coordinate European groups working on the use of heterogeneous and hierarchical systems for HPC as well as the development of collaborative activities among the involved research groups (http://complexhpc.org/index.php).

7.4. International Initiatives

7.4.1. Participation In International Programs

- **Royal Society Grant with the University of Liverpool.** International Joint Project, 2011-2013, entitled "SEarch, RENdezvous and Explore (SERENE)", on foundations of mobile agent computing, in collaboration with the Department of Computer Science, University of Liverpool. Funded by the Royal Society, U.K. Principal investigator on the UK side: Leszek Gasieniec. Ralf Klasing is the principal investigator on the French side.

  Participants: Nicolas Hanusse, David Ilcinkas, Ralf Klasing, Adrian Kosowski.

- **Spanish program CLOUDS**: Cloud Computing for Scalable, Reliable and Ubiquitous Services (http://lsd.ls.fi.upm.es/clouds). This is a large scale program which aims at advancing research in the area of Cloud Computing. CEPAGE is more particularly in contact with the LaDyr team of Univ. Rey Juan Carlos in Madrid, on the topic of resource allocation problems for Cloud providers.

  Participants: Olivier Beaumont, Lionel Eyraud-Dubois.

- **Collaboration with Canada.**

  Members of CEPAGE have a long-standing collaboration with researchers from the Chair of Distributed Computing at the University of Quebec in Outaouais and the Department of Computer Science at Carleton University. Sources of financing include: personal NSERC grants of Canadian professors (Prof. Andrzej Pelc, Prof. Jurek Czyzowicz, Prof. Evangelos Kranakis), funding from other Canadian grant agencies (a travel grant from Mitacs Inc.), and University of Bordeaux funding (a 3-month invited professorship for Prof. Jurek Czyzowicz).

  Participants: David Ilcinkas, Ralf Klasing, Adrian Kosowski.

- **Collaboration with Chile.**

  Adrian Kosowski is a foreign partner of the Chilean ministry grant (ANILLO CONICYT programme) entitled "Mathematical modeling for industrial and management science applications: a multidisciplinary approach". The Project Director is Eric Goles from Universidad Adolfo Ibañez, and collaborating researchers on the Chilean side include Karol Suchan and Ivan Rappaport. The collaboration has led to 2 joint papers.

  Participants: Adrian Kosowski.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Visits to Cepage Members

- Ljubomir Perkovic, De Paul University Chicago, (September 2011 – June 2012)
- Prosenjit Bose, Carleton University Ottawa, (25/11/12 – 29/11/12)
- George Mertzios, Durham University, UK, (15/06/12 – 14/07/12)
- Leszek Gasieniec, University of Liverpool, UK, (08/06 – 22/06/12)
- Jurek Czyzowicz, Université du Québec, Canada, (08/06 – 22/06/12)
- Darek Dareniowski, Gdansk University of Technology, Poland, (08/06 – 28/06/2012)
- Miroslaw Korzeniowski, Technical University of Wroclaw, (March 2012 – September 2012)

7.5.1.2. Visits of Cepage Members

- Cyril Gavoille, MicroSoft Research, Mountainview, CA, two weeks in April 2012.

<p style="text-align:center;">**CIDRE Project-Team**</p>

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 »**

  POSEIDON deals with the protection of data in outsourced or mutualized 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 study is conducted in cooperation with Télécom Bretagne and Université de Rennes 1.

- **Labex COMINLAB contract (2012-2015): « SecCloud »**

  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).

8.2. National Initiatives

8.2.1. ANR

- **ANR ARPEGE Project: DALI (2009-2012) - http://dali.kereval.com/**

  DALI aims at developing innovative design solutions to enhance the capabilities of current intrusion detection systems at the application level as well as new methodologies and tools for assessment and evaluation of the proposed solution with respect to their ability to detect potential intrusions. This project is led by Kereval and involves Supélec, Télécom Bretagne, and the LAAS/ CNRS.

Our activity consists in the design and development of a mechanism to discover invariants in web applications. These invariants are weaved in the application source code, in order to be dynamically checked at runtime. The approach has been applied on an e-commerce application. The assessment phase which has been carried out by the LAAS-CNRS demonstrated a good detection rate of our mechanisms. This projet has been evaluated during the ANR « Grand Colloque STIC » January 2012 and has reached an end in June 2012.

- **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 1, Supélec, LAAS-CNRS, Mobigis and Tisséo. The research project AMORES received the Innovation Award at the Toulouse Space Show last June. Simon Boche and Paul Lajoie-Mazenc are doing their PhD in the context of this project.

- **ANR INS Project: LYRICS (2011-2014) - 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 1.

8.2.2. Inria Large-scale Actions

- **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, CNRS, Université de Rennes 1, Supélec, Université de Namur, Eurecom, and Université de Versailles.

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. The project is joint between Université de Rennes 1, Inria and Supélec.

8.2.4. Competitivity Clusters

The following projects are recognized by the Images & Réseaux cluster:

- DALI (ANR ARPEGE 2008): http://www.images-et-reseaux.com/en/content/dali
- AMORES (ANR INS 2011): http://www.images-et-reseaux.com/en/content/amores

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: EIT KICs

Project acronym: EIT ICT Labs

Project title: action line « Security, Privacy and Trust in the Information Society »

Duration: 2012-

Coordinator: Sébastien Gambs (until September 2012 and since then Guido Bertoni, STMictoelectronics)

Abstract: Information Technologies have invaded many aspects of people's daily lives, creating new possibilities but also raising concerns in term of privacy and trust. Protecting the privacy of individuals is one of the main challenges of the Information Society but it is difficult to achieve as individuals constantly leave digital traces of their lives, often without even being aware of this. If an unauthorized entity gathers these digital traces, he (or she) can use them for malicious purposes ranging from targeted spam to profiling, and even identity theft. From the technology viewpoint, a number of Privacy Enhancing Technologies (PETs) and Privacy Aware Architectures have been proposed. So far, these technologies have not stimulated a strong public interest and are not widely used yet. However, the European Commission is putting forward the "privacy by design" principle, which integrates the privacy issues in the design phase of a system or application.

Security and trust can be seen as complementary requirements to privacy. Large scale adoption of digital devices, like in eHealth and smart cities, requires trustworthy products and communication. These requirements are not (always) completely understood and off-the-shelf solutions could not fulfill the security, trust and privacy needs. There is a large gap between what is applied, usability requirements and the right level of security. This gap represents a strategic opportunity where European players have a recognized know-how and where leadership should be leveraged and nurtured.

While the action line was originally intended to focus on privacy (created by a joint effort from Sébastien Gambs, Daniel Le Métayer and Claude Castelluccia from Inria Rhône-Alpes), its scope was recently extended to include security and trust thus being renamed as "Security, Privacy and Trust in the Information Society". In 2012, a "location privacy" activity leaded by Sébastien Gambs was created that involves CIDRE and other partners (namely KTH, Alcatel-Lucent, University of Trento, Inria Rhône-Alpes, Nokia) coming from 3 different nodes of EIT ICT labs. An engineer funded by the project (Izabela Moise) is currently working on the development of a distributed version of GEPETO based on the MapReduce paradigm and the Hadoop framework, in order to make it able to deal with datasets composed of millions of mobility traces. In 2013, this activity will be extended to also address the issues of privacy and security for location-based services, thus being renamed "Security and privacy for location-based services".

8.3.2. Collaborations with Major European Organizations

Quaero

CIDRE is involved in the Quaero project. Quaero is a program promoting research and industrial innovation on technologies for automatic analysis and classification of multimedia and multilingual documents. The partners collaborate on research and the realisation of advanced demonstrators and prototypes of innovating applications and services for access and usage of multimedia information, such as spoken language, images, video and music. The Quaero consortium (composed of French and German public and private research organisations) is coordinated by Technicolor.

Our activity focuses on a task (leaded by Amedeo Napoli, équipe Inria Orpailleur) of the Quaero project whose aim is to study the implications in terms of privacy for a user to participate in personalized applications (such as video-on-demand) adapted to the user context, background and preferences as well as proposing solutions that can contribute to enhance this privacy. On one hand using personal data to tailor the content to the user needs may be important for improving the quality of service and its relevance but on the other hand this raises serious privacy issues regarding how this

data will be collected, used and disseminated. The main purpose of the solutions developed in this task is to enable an individual to access personalized content/service in a privacy-preserving manner and without having to disclose any unnecessary personal information. From November 2011 until November 2012, Julien Lolive has worked on the project as an engineer. Izabela Moise has also joined the Quaero project since October 2012.

8.4. International Initiatives

8.4.1. Inria International Partners

CANADA: Sébastien Gambs was co-supervising Ai Thanh Ho, a PhD student from the Université de Montréal with whom he has been actively collaborating since many years on the subject of privacy issues in social networking sites. The main supervisor of Ai Thanh Ho is Esma Aïmeur (full professor, Université de Montréal). Ai Thanh Ho has successfully defend her PhD thesis in June 2012.

AUSTRALIA: With Queensland University of Technology (QUT, Brisbane) we cooperate to study policy-based intrusion detection problems. The PhD thesis of Christophe Hauser, "Détection d'intrusions dans les systèmes distribués", started in october 2009, is supervised jointly with Queensland University of Technology, Brisbane, Australia. From February 2011 to February 2012, Christopher Hauser has worked in Brisbane. His one year visit was supported by a grant from Rennes Métropole.

STIC Algeria (Program Inria/DGRST, 2011-2013): This cooperation project is managed by Adlen Ksentini (member of the Inria Project DIONYSOS, Rennes) and Abdelouahid Derhab (member of CERIST, Centre de Recherche sur l'Information Scientifique et Technique, Alger). This collaboration aims at defining new protocols for data collecting in Wireless Sensor Networks, and evaluate them with the senslab platform. After validating the proposed protocols, CERIST intends to deploy them in the context of the project (Algerian) "Sensirrig", which aims at using sensors for agricultural irrigation. With L. Zeghache and N. Badache (CERIST), we investigate the use of Mobile Transactional Agents.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

CANADA: Jean-Marc Robert, Professor Professor of ETS (École de Technologie Supérieure) at Montreal was visiting us during a period of four months (September 2012 - December 2012). The joint works focus mainly on privacy in pro-active ad hoc routing protocols. Based on the OLSR protocol, we have proposed a privacy preserving ad hoc proactive routing protocol that preserves the anonymity of the participants, and assure the unlinkability of two different packet flows between two given nodes.

8.5.2. Internships

CHINA: Chuanyou Li, PhD student at Southeast University (Nanjing, China) was visiting us during a period of one year (december 2011 - november 2012). Since the end of a LIAMA project (2000-2002), strong relationships are maintained with the research team of Prof. Yun Wang of Southeast university. The joint works focus mainly on fault-tolerance in distributed systems and security in ad hoc networks.

<p style="text-align:center">**DANTE Team**</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

The ESPAD (Embedded Sport Performance Analysis Data) is bio-mechanics / physiology logging project funded by FEDER. The goal is to contributed to the design of a distributed multi-sensor architecture that can be worn by an individual and that records bio-mechanical, physiological and environmental data.

8.2. National Initiatives

8.2.1. ANR

- The purpose of the SensLAB project is to deploy a very large scale open wireless sensor network platform. SensLAB's main and most important goal is to offer an accurate and efficient scientific tool to help in the design, development, tuning, and experimentation of real large-scale sensor network applications. The sensLAB platform is distributed among 4 sites and is composed of 1,024 nodes. Each location hosts 256 sensor nodes with specific characteristics in order to offer a wide spectrum of possibilities and heterogeneity. The four test beds are however part of a common global testbed as several nodes will have global connectivity such that it will be possible to experiment a given application on all 1K sensors at the same time.

- Equipex FIT (Futur Internet of Things) 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 $5.8\sqrt{¢¬Ç¬¨}$ million grant from the French government Running from 22.02.11 $\sqrt{¢¬Ä¬ì}$ 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.

- As proposed by initiatives in Europe and worldwide, enabling an open, general-purpose, and sustainable large-scale shared experimental facility will foster the emergence of the Future Internet. There is an increasing demand among researchers and production system architects to federate testbed resources from multiple autonomous organizations into a seamless/ubiquitous resource pool, thereby giving users standard interfaces for accessing the widely distributed and diverse collection of resources they need to conduct their experiments. The F-Lab project builds on a leading prototype for such a facility: the OneLab federation of testbeds. OneLab pioneered the concept of testbed federation, providing a federation model that has been proven through a durable interconnection between its flagship testbed PlanetLab Europe (PLE) and the global PlanetLab infrastructure, mutualizing over five hundred sites around the world. One key objective of F-Lab is to further develop an understanding of what it means for autonomous organizations operating heterogeneous testbeds to federate their computation, storage and network resources, including defining terminology, establishing universal design principles, and identifying candidate federation strategies. On the operational side, F-Lab will enhance OneLab with the contribution of the unique sensor network testbeds from SensLAB, and LTE based cellular systems. In doing so, F-Lab continues the expansion of OneLab?s capabilities through federation with an established set of heterogeneous testbeds with high international visibility and value for users, developing the federation concept in the process, and playing a major role in the federation of national and international testbeds. F-Lab will also develop tools to conduct end-to-end experiments using the OneLab facility enriched with SensLAB and LTE.

  F-Lab is a unique opportunity for the French community to play a stronger role in the design of federation systems, a topic of growing interest; for the SensLAB testbed to reach an international visibility and use; and for pioneering testbeds on LTE technology.

- ANR RESCUE started in December 2010: Access and metropolitan networks are much more limited in capacity than core networks. While the latter operate in over-provisioning mode, access and metropolitan networks may experience high overload due to evolution of the traffic or failures. In wired networks, some failures (but not all) are handled by rerouting the traffic through a backup network already in place. In developed countries, backup networks are adopted wherever possible (note that this is generally not the case for the links between end users and their local DSLAM). Such a redundant strategy may not be possible in emerging countries because of cost issues. When dedicated backup networks are not available, some operators use their 3G infrastructure to recover some specific failures; although such an alternative helps avoid full network outage, it is a costly solution. Furthermore, availability of 3G coverage is still mainly concentrated in metropolitan zones. 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 (2010-2013), 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.

  http://rescue.lille.inria.fr/

- ANR PETAFLOW (Appel Blanc International) started in march 2010 and will end in october 2013. It is a collaborative project between the GIPSA Lab (Grenoble), MOAIS (Inria Grenoble), RESO (Inria Grenoble), the University of Osaka (the Cybermedia Center and the Department of Information Networking) and the University of Kyoto (Visualization Laboratory).

  We aim at proposing network solutions to guarantee the Quality of Service (in terms of reliability level and of transfer delay properties) of a high speed, long-distance connection used in an interactive, high performance computing application. Another specificity of this application is the peta-scale volume of the treated data corresponding to the upper airway flow modeling.

  http://petaflow.gforge.inria.fr/

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: Life Science Health Priority of the Sixth Framework Program

Project acronym: MOSAR

Project title: Mastering hOSpital Antimicrobial Resistance and its spread into the community.

Duration: 06 2008 - 07 2012

Coordinator: INSERM

Other partners: University of Antwerp, National Medicines Institute (NMI), August Pi i Sunyer biomedical research Institute (IDIBAPS), University Medical Center Utrecht (UMCU), University of Geneva Hospitals (UNIGE), Tel Aviv Medical Center (TASMC), Health Protection Agency (HPA), Medical school of Paris 12 University (UPVM), Pasteur Institute, Inserm-Transfert, Ingen Biosciences, BiologischeAnalysensystemGmbH (BAG), AmpTec GmbH, Array-On GmbH, Inria

Abstract: MOSAR brings together internationally recognized experts to address the issue of antimicrobial resistance in a comprehensive manner. MOSAR consideres the major issue of antimicrobial resistance in the perspective of a complex system and not only through the prism of a single discipline.

To achieve its objectives MOSAR builds on advances generated by basic sciences, through dedicated and trans-disciplinary cooperation. This project integrates studies from epidemiology and basic laboratory sciences, clinical medicine, statistical sciences, behavioural sciences, and health economics. MOSAR network is structured into 10 interacting groups centered on the patients.

MOSAR focuses on major endemic and epidemic nosocomial pathogens such as Methicillin-resistant Staphylococcus aureus (MRSA), Vancomycin-resistant Enterococci (VRE), Extended-Spectrum Beta-Lactamases (ESBL) Enterobacteriaeceae, and Carbapenem-resistant Acinetobacter spp, and in interventional trials in high-risk areas (Intensive Care Units, Surgery and Rehabilitation centers) of countries with high-level of resistance.

8.3.2. FP7 Projects

8.3.2.1. GEYSERS

Title: Generalsed Architecture for dynamic infrastructure services

Type: COOPERATION (ICT)

Defi: The Network of the Future

Instrument: Integrated Project (IP)

Duration: January 2010 - march 2013

Coordinator: Interoute (Italy)

Others partners: Interoute (Italy), martel Martel GmbH (Switzerland), ADVA AG Optical Networking (Germany), SAP AG (Germany), Alcatel-Lucent Italia S.p.A. (Italy), Telefonica I+D (Spain), Telekomunikacja Polska S.A. (Poland), Instytut Chemii Bioorganicznej PAN, Poznan Supercomputing and Networking Centre (Poland), Nextworks s.r.l (Italy), Fundacio i2CAT, Internet i Innovacio Digital a Catalunya (Spain), Universiteit van Amsterdam (The Netherlands), University of Essex (UK), Research and Education Society in Information Technologies (Greece), Technical University of Braunschweig (Germany), Interdisciplinary Institute for BroadBand Technology VZW (belgium), Indian Institute of Technology (India), LYaTiss (France), ADVA Optica Networking Sp.zo.o. (Poland)

Abstract: GEYSERS's vision is to qualify optical infrastructure providers and network operators with a new architecture, to enhance their traditional business operations. Optical network infrastructure providers will compose logical infrastructures and rent them out to network operators; network operators will run cost-efficient, dynamic and mission-specific networks by means of integrated control and management techniques. GEYSERS's concept is that high-end IT resources at users' premises are fully integrated with the network services procedures, both at the infrastructure-planning and connection-provisioning phases. Following this vision, GEYSERS will specify and implement a novel optical-network architecture able to support 'Optical Network + Any-IT' resource provisioning seamlessly and efficiently. Energy-consumption metrics for the end-to-end service routing are part of this efficiency. GEYSERS proposes to:

- Specify and develop mechanisms that allow infrastructure providers to partition their resources (optical network and/or IT), compose specific logical infrastructures and offer them as a service to network operators. This will be done overcoming the current limitations of networks/domain segmentation, and will support dynamic and on-demand changes in the logical infrastructures

- Specify and develop a Network Control Plane for the optical infrastructure, by extending standard solutions (ASON/GMPLS and PCE), able to couple optical network connectivity and IT services automatically and efficiently, and provide them in 1 step, dynamically and on-demand, including infrastructure re-planning mechanisms.

These achievements will enable infrastructure providers, network operators and application providers to participate in new business scenarios where complex services with complex attributes and strict bandwidth requirements can be offered economically and efficiently to users and applications. GEYSERS's outcomes will be validated in an EU-wide optical network test-bed.

8.3.2.2. SAIL

Title: Scalable and Adaptive Internet Solutions

Type: COOPERATION (ICT)

Defi: The Network of the Future

Instrument: Integrated Project (IP)

Duration: August 2010 - January 2013

Coordinator: Ericsson (Sweden)

Others partners: Ericsson AB (Sweden), Alcatel-Lucent Deutschland (Germany), Nokia Siemens Networks OY(Finland), NEC Europe LTD (United Kingdom), France Telecom SA(France), Telef$\sqrt{\geq}$nica Investigacion y Desarrollo (Spain), Telecom Italia (Italy), Portugal Telecom Inovation (Portugal), Swedish institute of Computer science (Sweden), Instituto Superior Tecnico Address (Portugal), Universitaet Paderborn (Germany), Aalto-Korkeakoulus ti (Finland), Kungliga Tekniska Hogskolan (Sweden), Fraunhofer Gesellschaft zur Forderung der angewandten Forschung (Germany),Universitaet Bremen (Germany), Hewlett-Packard Limited (United Kingdom), Fundacion Tecnalia Research and Innovation (Spain), Institut Telecom (France), Technion? Israel Institute of Technology (Israel), DOCOMO Communication Laborototies Europe (Germany), The Provost Fellows & Scholars of the College of the Holy and undivided Trinity of Queen Elizabeth (Ireland), National ICT Australia Limited (Australia), Universidad de Cantabria (Spain), Lyatiss (France)

See also: https://twiki.verkstad.net/bin/view/Main/WebHome

Abstract: SAIL? objective is the research and development of novel networking technologies using proof-of-concept prototypes to lead the way from current networks to the Network of the Future. SAIL leverages state of the art architectures and technologies, extends them as needed, and integrates them using experimentally-driven research, producing interoperable prototypes to demonstrate utility for a set of concrete use-cases. SAIL reduces costs for setting up, running, and combining networks, applications and services, increasing the efficiency of deployed resources (e.g., personnel, equipment and energy). SAIL improves application support via an information-centric paradigm, replacing the old host-centric one, and develops concrete mechanisms and protocols to realize the benefits of a Network of Information (NetInf). SAIL enables the co-existence of legacy and new networks via virtualization of resources and self-management, fully integrating networking with cloud computing to produce Cloud Networking (CloNe). SAIL embraces heterogeneous media from fibre backbones to wireless access networks, developing new signaling and control interfaces, able to control multiple technologies across multiple aggregation stages, implementing Open Connectivity Services (OConS). SAIL also specifically addresses cross-cutting themes and non-technical issues, such as socio-economics, inclusion, broad dissemination, standardization and network migration, driving new markets, business roles and models, and increasing opportunities for both competition and cooperation. SAIL gathers a strong industry-led consortium of leading operators, vendors, SME,

universities and research centers, with a valuable experience acquired in previous FP7 projects, notably 4WARD. The impact will be a consensus among major European operators and vendors on a well-defined path to the Network of the Future together with the technologies required to follow that path.

8.4. International Initiatives

8.4.1. Participation In International Programs

Inria/FAPERJ Project CoDyN (Complex Dynamic Networks) between LNCC and DNET/Inria. The main goal of the CoDyN project is to lay solid foundations to the characterization of dynamically evolving networks, and to the field of dynamical processes occurring on large scale dynamic interaction networks.

PICS CNRS Combinatorial Structures for Complex Network Modeling DANTE is a member of a PICS project of the CNRS between the Academy of Science and Technology in Vietnam and the Laboratoire d'Informatique de Paris 6 (LIP6) and Université Claude Bernard Lyon 1 in France. The project started on january 2010 and will end in december 2012. Its goal is to design models of complex networks that are able to capture at the same time two of their most relevant properties : their heterogeneous degree distribution and their high local density. The goal is to provide very general models that do not make stronger assumptions on the structure of the graphs to be modeled. Our approach is based on the overlapping structure of cliques in complex networks and uses mainly tools coming from combinatorics, graph theory and statistics.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Phan Thi Ha Duong, Hanoï, Vietnam, May-June 2012.
- Renault Lambiotte, Namur, January 2012.
- Klaus Wehmuth, LNCC Brasil, April 2012.
- Prasan Kumar Sahoo, Chang Gung University, Taïwan, November 2012.

8.5.1.1. Internships

- Pranav Jindal, IIT Bombay, India, from May to July 2012

<p align="center">**DIONYSOS Project-Team**</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. ARED Région Bretagne

Participant: Bruno Tuffin.

ARED contract (with Région Bretagne) for the PhD thesis of Sagga Samira on rare event simulation with applications in telecommunications.

7.2. National Initiatives

7.2.1. ARC MENEUR

Participant: Bruno Tuffin.

We coordinate an Inria Cooperative Research Action on Network Neutrality, called MENEUR ("Modélisation en Économie des rśeaux et NEUtRalité du Net"). This action runs over 2011–2012 with Inria teams MAE-STRO and MESCAL, Orange Labs, ALU-Bell Labs France, Telecom Bretagne, FTW (Austria), Columbia University and Penn State University.

The goal of this project is to study the interest of network neutrality, a topic that has recently gained a lot of attention. The project aims at elaborating mathematical models that will be analyzed to investigate its impact on users, on social welfare and on providers' investment incentives, among others, and eventually propose how (and if) network neutrality should be implemented.

See http://www.irisa.fr/dionysos/pages_perso/tuffin/MENEUR/

7.2.2. ANR CAPTURES

Participant: Bruno Tuffin.

We coordinate the ANR Verso CAPTURES: Competition Among Providers for Telecommunication Users: Rivalry and Earning Stakes.
ANR project Dec. 2008- Nov. 2012, in cooperation with Telecom Bretagne and France Telecom R&D.

The goal of this project is to deal with competition among providers in telecommunications. We need to study the distribution of customers among providers as a first level of game, and then to focus on a second higher level, the price and QoS war. See http://captures.inria.fr/

7.2.3. ANR VIPEER

Participants: Yassine Hadjadj-Aoul, Gerardo Rubino.

VIPEER is a 3-year ANR project (end 2009-end 2012). VIPEER stands for Video Traffic Engineering in an Intra-Domain Context using Peer-to-Peer Paradigms. The VIPEER project proposes to develop a distributed Content Delivery Network (dCDN) that combines classic CDN technologies with P2P concepts. Our main application in the project is IPTV. Dionysos will mainly cover the QoE assessments activities of VIPEER. Our partners are Télécom Bretagne, Eurecom, Envivio, Orange Labs and NDS Technologies.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. FP7 PROBE-IT

Participants: César Viho, Nanxing Chen, Arulnambi Nandagoban, Anthony Baire.

PROBE-IT is a two years European project that aims at supporting exploitation of European research advances in IoT deployments. The work plan is split in three main areas : benchmarking, roadmap and interoperability testing. PROBE-IT comprises ten international partners from Europe, China, Brazil and Africa. Dionysos is leader of the work-package WP4 dedicated to testing roadmap and solutions to provide stakeholders with elements to validate technologies conformance and interoperability. See http://www.probe-it.eu.

7.3.2. Collaborations in European Programs, except FP7

7.3.2.1. NoE EuroNF
Participants: Gerardo Rubino, Bruno Tuffin.

EuroNF Euro-NF is a Network of Excellence on the Network of the Future, formed by 35 institutions (from the academia and industry) from 16 countries. Its main target is to integrate the research effort of the partners to be a source of innovation and a think tank on possible scientific, technological and socio-economic trajectories towards the network of the future. It has started in January 2008 and is ended in June 2012 (see http://euronf.enst.fr/en_accueil.html) .

Bruno Tuffin is the Inria team leader in this project.

The group is contributing to the following working packages (Joint Research Activities):

- WP.JRA.2.2: Traffic Engineering, Mechanisms and Protocols for Controlled Bandwidth Sharing;
- WP.JRA.2.4: Routing and Traffic Management in a Multi-Provider Context;
- WP.JRA.2.5: Design of Optimal Highly Dependable Networks;
- WP.JRA.3.2: SLAs, Pricing, Quality of Experience;
- WP.JRA.3.3: Cost Models.

7.3.2.2. INNIS project
Participant: Bruno Tuffin.

Program: Euro-NF NoE

Project acronym: INNIS

Project title: Impacts of Network Neutrality on the Internet Stakeholders

Duration: November 2011 – June 2012

Coordinator: Bruno Tuffin, Dionysos

Other partners: TELECOM Bretagne, the polytechnic University of Valencia (Spain), the University of Rome 2, and the Italian Data Protection Authority

7.3.3. Collaborations with Major European Organizations

Partner 1: FTW, Vienna (Austria)

We work with FTW on network economics.

Partner 1: Vrije University (The Netherlands)

We work with Vrije University on rare event simulation.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. MOCQUASIN

Title: Monte Carlo and Quasi-Monte Carlo for rare event simulation

Inria principal investigator: Bruno Tuffin

International Partner (Institution - Laboratory - Researcher):

University of Montreal (Canada) – Département d'informatique et recherche opérationnelle – Pierre L'Ecuyer

Duration: 2008 - 2013

See also: http://www.irisa.fr/dionysos/pages_perso/tuffin/MOCQUASIN/

The goal of MOCQUASIN is to design efficient Monte Carlo and quasi-Monte Carlo simulation methods and to apply them to models in telecommunications. Simulation is indeed often the only method to analyse complex and/or large systems, but also suffers from inefficiency. Two specific situations on which we will focus are rare events, and revenue management. In the two cases, we want to deal with dependent individual events or decisions, a realistic situation requiring adapted solution techniques. The inefficiency of the standard simulation is a known issue to compute the probability of rare event since getting it only once requires in average a long simulation time, but most of the literature has up to now assumed independence in the models. The other framework, revenue management in telecommunications, is the situation of providers trying to define valid offers and capacity investments in front of complex demand models. Here too, a change in the decision of an actor has an impact on the others that has to be taken into account.

7.4.2. Inria International Partners

Our other main international partners are:

- José Blanchet (from Columbia University) and Peter Glynn (from Stanford University), on rare event simulation

- Peter Reichl (from FTW, Vienna, Austria), on pricing and security issues

- Héctor Cancela and Franco Robledo (from Uniov. of the Republic, Montevideo, Uruguay), on simulation issues

- Tarik Taleb (from NEC Europe), on LTE issues

- Alan Krinik (from CalPoly, California, USA), on transient analysis of Markovian queues

- Reinaldo Vallejo (from UFSM, Valparaíso, Chile), on solving techniques for Markov models

7.4.3. CNRS/NFSC IRON

Title: Ensuring Interoperability of new generation networks (IRON)

Principal investigator: César Viho

International Partner:

Institution: BUPT Beijing Univ. of Post and Telecommunication (China)

Inria: Dionysos

Researcher: Pr. Xiaohong Huang

Duration: 01/01/2012 - 31/12/2012

Abstract: Future networks will continue to be heterogeneous. The risk of non-interoperability will increase. This may lead to unavailability of some critical network services, for instance in emergency management, etc. It is important to guarantee that network components will interoperate. One important way among others is to provide efficient testing methodology that help in guaranteeing interoperability of the underlying protocols. The classical testing approach of a single testing system dealing with all tested components and the test execution is no more applicable. To be more confident in the real interoperability of these components, testing has to be done in a close to real operational environment that may be unreliable. Thus, this project aims at providing interoperability testing solutions for distributed communicating systems in unreliable environments.

7.4.4. Participation In International Programs

7.4.4.1. STIC Algérie

Program: DGRSDT Inria Algeria

Title: Réseaux de capteurs

Inria principal investigator: Adlen Ksentini

International Partner (Institution - Laboratory - Researcher):

Centre de Recherche sur l'Information Scientifique et Technique (Algeria)

Duration: Jan 2011 - Dec 2012

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Professors

Pr. Xiaohong Huang

Subject: Ensuring Interoperability of new generation networks (IRON)

Institution: BUPT Beijing Univ. of Post and Telecommunication (China)

Duration: 15/09/2012 - 30/09/2012

7.5.1.2. Internships

Leila GHAZZAI (from Feb 2012 until Aug 2012)

Subject: Caching strategies for adaptive video streaming over Content Centric Networks

Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

Abhimanyu PANWAR (from May 2012 until Jul 2012)

Subject: Video on Demand over a distributed Content Distribution Network

Institution: IIT Bhubaneswar (India)

<p style="text-align:center">**DISTRIBCOM Project-Team**</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ESTASE
Participant: Axel Legay.

- Title: Estase
- Type: Regional project
- Defi: New techniques for statistical model checking
- Instrument: Regional project
- Duration: March 2011 - February 2014
- Coordinator: Inria Rennes

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. IMPRO
Participant: Loïc Hélouët.

Title: IMPRO

Type: ANR

Defi: Implementability and Robustness of Timed Systems

Duration: march 2011 - march 2014

Coordinator: IRCCYN Nantes

Others partners: IRCCyN (Nantes), IRISA (Rennes), LIP6 (Paris), LSV (Cachan), LIAFA (Paris), LIF (Marseilles)

See also: http://anr-impro.irccyn.ec-nantes.fr/

Abstract: 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 their good properties. We will first define a generic mathematical framework to reason about and measure implementability, and then study the possibility to integrate implementability constraints in the models. We will particularly focus on the combination of several sources of perturbation such as resource allocation, the distributed architecture of applications, etc. We will also study implementability through control and diagnostic techniques. We will finally apply the developed methods to a case study based on the AUTOSAR architecture, a standard of the automotive industry.

8.3. European Initiatives

8.3.1. DISC
Participant: Eric Fabre.

The DISC Eu project (STREP) officially ended in Dec. 2011, and the final review took place in Feb. 2012. This project was oriented toward the development of supervision and control methods for large systems. Inria was involved in particular for the diagnosis of stochastic systems, and for distributed planning methods. These activities are still going on, with several publications in 2012 and others in preparation. Among the salient facts related to DISC in 2012 were Loig Jezequel's PhD defense (Dec. 2012), and the contribution to 2 chapters of the book "Control of discrete-event systems" seatzu:silva:vanschuppen:2013, to appear in 2013.

8.3.2. *Sys2SOFT*

Participant: Axel Legay.

Title: SyS2SOFT

Type: Grand emprunt

Defi: Designing for adaptability and evolution in systems of sytems engineering

Instrument: Grand emprunt

Duration: Juin 2012 - Mai 2015

Coordinator: DASSAULT

8.3.3. *FP7 Projects*

8.3.3.1. Dali

Participant: Axel Legay.

- Title: Dali
- Type: COOPERATION (ICT)
- Defi: design of a device for assisted living.
- Instrument: Strep.
- Duration: November 2011 - October 2014
- Coordinator: Trento (Italy)

8.3.3.2. DANSE

Participant: Axel Legay.

Title: DANSE

Type: COOPERATION (ICT)

Defi: Designing for adaptability and evolution in systems of sytems engineering

Instrument: Integrated Project (IP)

Duration: November 2011 - October 2014

Coordinator: OFFIS (Germany)

Abstract: DANSE represents the next step in research about component based design and it is thus central in our research activities. The purpose of this project is the development of a new methodology for the design of Systems of Systems (SoS). SoS are modeled using the UPDM Language. In these settings, Statistical Model Checking is the solution to evaluate the SoS capabilities to ensure some properties. During the first period (Nov. 2011 - Nov. 2012), we and ALES company both worked to interface PLASMA and DESYRE to provide the first statistical model-checker tool for the UPDM modeling framework. PLASMA-DESYRE is available and run under the Eclipse environment. To obtain the first prototype of PLASMA-DESYRE we provide a new release of Plasma. It is specially designed to perform SMC using different simulation engines, by reducing the adaptation effort: it can be connected to DESYRE, SciLab, MatLab, and some simulators dedicated to Bio or Prism languages. We also extended UPDML specification with a new contract language designed to specify some requirements. These requirements are viewed as behavioral objectives that lead the system architect for designing some good strategies of the SoS. These requirements (called contracts) are written in English using some patterns that are simple to handle and have a strong semantics

expressed with the Bounded Linear-Temporal-Logic (B-LTL), the property language of PLASMA. This new language is defined using the standard OCL language to define state constraints of the SoS, English temporal patterns that overlay the state constraints to specify some contracts about the behavior of the SoS. It adds the time support that is not initially provided by OCL. These contracts are then compiled into B-LTL formulas and checked by PLASMA-DESYRE, the SoS Statistical Model Checker, against a compiled implementation of the UPDM model. The result estimates the satisfiability of the contract, e.g. the probability that the model satisfies the contract.

8.3.3.3. Univerself

Participant: Eric Fabre.

Title: Univerself

Type: COOPERATION (ICT)

Defi: The Network of the Future

Instrument: Integrated Project (IP)

Duration: September 2010 - August 2013

Coordinator: Alcatel Lucent (France)

Others partners:

Universiteit Twente,

Alcatel Lucent Ireland,

Alcatel Lucent Deutschland,

Valtion Teknillinen Tutkimuskeskus (Finland),

University of Piraeus,

France Telecom,

Telecom Italia,

National University of Athens,

Fraunhofer-Gesellschaft zur F$\sqrt{\partial}$rderung der Angewandten Forschung,

Interdisciplinary Institute for Broadband Technology,

Telefonica Investigacion y Desarrollo,

Thales Communications,

Inria,

Nec Europe,

University of Surrey,

University College London

IBBT (Belgium).

See also: http://www.univerself-project.eu/

Abstract: UniverSelf unites 17 partners with the aim of overcoming the growing management complexity of future networking systems, and to reduce the barriers that complexity and ossification pose to further growth. Univerself has been launched in October 2010 and is scheduled for four years.

8.3.3.4. SENSATION

Participant: Axel Legay.

- Title: Sensation
- Type: COOPERATION (ICT)
- Defi: Study of new techniques for energy saving
- Instrument: Strep.
- Duration: October 2012 - September 2015
- Coordinator: Aalborg (Denmark)

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. FOSSA

Participants: Claude Jard, Albert Benveniste.

The associated team FOSSA studies the **formalization of service orchestrations in the open world** of the Internet. The original FOSSA consortium involved two teams on the Inria side, namely Distribcom (Albert Benveniste and Claude Jard, Rennes, leader of FOSSA) and Mexico (Stefan Haar, Saclay). In early 2011, both teams agreed that Mexico did not have the resources to participate in FOSSA at an appropriate level. So they agreed that Mexico would no longer participate in FOSSA. The team of Cook and Misra at the Computer Science Department, University of Texas at Austin, is among the leading teams on wide area distributed systems and programming. Jayadev Misra [1] has a long record of results tracing back to the 1980's with his work on the Unity language. Since 2000, he and William Cook are committed to the design and development of the ORC[2] script language for composite services over the Web. This team is therefore the premier player in this area, combining both a strong theoretical research and a professional tool development. Since his launching in 2004, the DistribCom [3] Inria team, with Albert Benveniste, Claude Jard, and Loïc Hélouët, is involved in the study of Quality of Service (QoS) issues in service orchestrations as well as document based workflows. FOSSA was started with the overall objective of enhancing ORC with the advances performed by DistribCom on the above two subjects.

FOSSA has lived from 2010 to 2012. QoS weaving was the main topic developed in 2012. John Thywissen (Austin side), Ajay Kattepur and Claude Jard (Inria side) were the principal contributors. The strategy was to first focus on causality tracking. This has been implemented in ORC using transformations in the OIL intermediate form. Causality has then been extended with QoS and implemented. A joint paper is under finalization. This year, we have also worked on a joint general paper on the overall approach. On the topic of Active XML and ORC integration, the team has decided to put energy on the development of the AXML REST platform developed by Loïc Hélouët and Benoît Masson (post-doctorate). This platform is a natural candidate for integrating AXML+ORC, as we think. But the cooperative work has not really started, due to overload of the corresponding teams.

8.4.2. Inria International Partners

Distribcom has lively collaboration with the National University of Singapore, where Blaise Genest spent the last 3 years. We also have long lasting collaboration with the Chennai Mathematical Institute.

8.4.3. Participation In International Programs

8.4.3.1. Danish-French collaboration

Program: Action des ambassades de France

Title: Modular design and verification of stochastic systems

Inria principal investigator: Axel LEGAY

International Partner (Institution - Laboratory - Researcher):

University of Aalborg (Denmark)

Duration: Jan 2010 - Dec 2012

8.4.3.2. Tournesol (Belgium)

Program: PHC

Title: Vérification de lignes de produits logiciels

Inria principal investigator: Axel LEGAY

---

[1] http://www.cs.utexas.edu/~misra/
[2] http://orc.csres.utexas.edu
[3] http://www.irisa.fr/distribcom/

International Partner (Institution - Laboratory - Researcher):

University of Namur (Belgium)

Duration: Jan 2011 - Dec 2012

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Narayan K. Kumar and Madhavan Mukund from the Chennai mathematical institute visited Dostribcom in april (1 week each) to continue working on session models in web services, and to launch new research on robustness in distributed systems.

Danilo Ardagna visited Distribcom in October 2012

Prof. Michele Pinna (niv. Cagliari) visited DistribCom from Sept. 1 to Sept. 30.

Andrzej Wasowski visited Distribcom in February 2012 Jan Kretiensky visited Distribcom in September 2012

8.5.1.1. Internships

Guillaume Aucher supervised the internship of Himani Rajora (IIT, Delhi, India) entitled "Distances between Kripke models".

Axel Legay supervised the internship of Alessio Colombu (Trento), Hoa Lee (Trento), and Fabrizio Biondi (ITU Copenhagen).

8.5.2. Visits to International Teams

Guillaume Aucher has visited Thomas Bolander (DTU, Copenhagen) the last week of August 2012. The collaboration was very fruitful and has resulted in significant results related to epistemic planning (DEL) (to be submitted).

Guillaume Aucher visited Leon van der Torre at the university of Luxembourg in November 2012. This visit was scheduled at the same time Samir Chopra and Guido Boella were in Luxembourg. Guido Boella is specialist of law and computer science and Samir Chopra is a logician who recently published a book on law and autonomous agents together with the jurist Laurence White. The visit was very instructive and profitable.

Guillaume Aucher was invited (his travel and accommodation expenses have been reimbursed) by Sonja Smets and Alexandru Baltag at the University of Amsterdam the last week of September 2012 to give two seminars at the ILLC and to work in collaboration with them.

Guillaume Aucher was an invited speaker of the workshop "dynamics in logic II" (Lille, March 2012).

Loïc Hélouët spent 10 days in march 2012 at the Chennai Mathematical Institute to pursue collaboration on verification of session models.

Axel Legay was invited researcher at Namur University multiple times. He was also an invited researcher at ITU Copenhagen.

Eric Fabre visited MIT (LIDS) from June 16 to June 20.

<p style="text-align:center">**FOCUS Project-Team**</p>

7. Partnerships and Cooperations

7.1. National Initiatives

- AEOLUS (Mastering the Cloud Complexity) is an ANR-ARPEGE project started on 1st December 2010 and with a 40-month duration. 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 distribution and the dependencies of packages, in such a way that *modification plans* can be (semi)automatically synthesized when packages should be updated or the system should be reconfigured. Main persons involved: Gabbrielli, Mauro, Sangiorgi, Zavattaro.

- ETERNAL (Interactive Resource Analysis) is an Inria-ARC project which started on January 1st, 2011 and will end on December 31st, 2012. ETERNAL aims at putting together ideas from Implicit Computational Complexity and Interactive Theorem Proving, in order to develop new methodologies for handling quantitative properties related to program resource consumption, like execution time and space. People involved: Dal Lago, Gaboardi, Martini, Petit.

- 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.

- The ANR project PACE (Processus non-standard: Analyse, Coinduction, et Expressivité) has been recently accepted but will start only 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.

7.2. European Initiatives

7.2.1. FP7 Projects

- Hats (Highly Adaptable and Trustworthy Software using Formal Models) is an EU Integrated Project from FP7, started March 2009 and with a 4 year duration. Hats studies formal methods for obtaining high adaptability combined with trustworthiness in the setting of object-oriented languages and software product lines. Most Focus members are involved.

- PLATFORM (Practical Light Types for Resource Consumption) is a Marie Curie IOF project from FP7, started July 2011 with a three-year span. It involves one Focus member (Gaboardi) in research work at University of Pennsylvania and in Bologna. Project aim is the development of a practical programming language with information, in the form of dependent types, about the resources needed by programs during their execution, and where type checking a program will naturally corresponds to exhibit a certification of its resource consumption.

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, will use 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, Lanese, Laneve, Sangiorgi, Zavattaro.

- The EIT activity "Intelligent Services for Digital Cities" in the context of the Digital Cities Action Line, has been approved, with funding to be spent in 2013. Main persons involved: Gabbrielli.

7.2.3. Collaborations with Major European Organizations

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, Gaboardi, Martini, Sangiorgi. Several visit exchanges during the year, in both directions. One joint PhD supervision (J.-M. Madiot).

- Inria EPI Sardes (on models and languages for components, reversibility). Contact person(s) in Focus: Lanese, Sangiorgi. A number of visits in both directions. One joint PhD supervision (C. Mezzina).

- Laboratoire d'Informatique, Université Paris Nord, Villetaneuse (on implicit computational complexity). Contact person(s) in Focus: Dal Lago, Gaboardi, 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, Gaboardi, Martini, Sangiorgi. Various 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: Zavattaro. Various short visits in both directions during the year.

- University of Innsbruck (on resource control and termination). Contact person(s) in Focus: Dal Lago. A few short visits during 2012.

- Inria EPI Indes, (on orchestration and programming languages). A common meeting was organised in Bologna, January 2012, where 4 people from Indes and almost everybody from Focus participated.

- EPI Carte, Inria-Nancy Grand Est and LORIA (on implicit computational complexity). Contact person(s) in Focus: Dal Lago,Gaboardi. A few short visits during 2012.

- 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.

- Facultad de Informatica, Universidad Complutense de Madrid (on web services). Contact person(s) in Focus: Bravetti. Bravetti is an external collaborator in the Spanish Ministry of Science and Education project TESIS (advanced methodologies and tools for TESTing and web servIceS).

7.3. International Initiatives

7.3.1. Inria International Partners

- Department of Computer and Information Science, University of Pennsylvania. There has been several collaborations in the past. Presently M. Gaboardi is a long-term visiting researcher in the programming language group, working on resource control and programming languages.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Among the visits below, we note 2 long-term visits: the 6-month visit of Matias Lee (paid by a EADIC II - Erasmus Mundus scholarship); and the sabbatical year of Xian Xu, from East China University of Science and Technology, Shanghai (paid a scholarship from the Chinese Science Foundation).

- Peter Hofner, Nicta, Sydney, Australia. 1 week end of January. Topic: Formal Methods for Wireless Networks.
- Martin Avanzini, Institute of Compute Science, University of Innsbruck, Austria. 23 to 27 April, 2012. Topic: order-theoretic approaches to complexity analysis of functional programs.
- Marco Carbone, IT University of Copenhagen. A week in May/June 2012. Topic: faults and compensations in choreography languages.
- Raju Halder, Macquarie University, Australia. 2 days in May 2012. Topic: Abstract Interpretation and concurrency.
- Luca Fossati, Imperial College London. A week in May 2012. Topic: Liveness properties by means of types in the π-calculus.
- Xian Xu has began in May a year sabbatical in Focus. He is lecturer at the East China University of Science and Technology in Shanghai.
- Matias David Lee. Currently PhD student at Universidad Nacional de Córdoba, Argentina, has spent 5 months during 2012, from January to May (having arrived in November 2011), for a long-term visit.
- Bertrand Meyer, ETH Zurich. One day in September 2012. Topic: Concurrent Object-Oriented Programming.
- Mariangiola Dezani, Univ. Turin, Italy. 4 days October 2012. Topic: Session Types.
- Clement Aubert, LIPN Université Paris 13. From 5 to 16 November 2012. Topic: implicit complexity and the geometry of interaction.
- Matthieu Perrinel, LIP ENS Lyon. From 17 to 21 December 2012. Topic: context semantic and decideable criteria for complexity analysis.

<p align="center" style="color:red">FUN Team</p>

7. Partnerships and Cooperations

7.1. International Initiatives

Tahiry Razafindralambo is researcher on leave at Inria Chile from Sept. 2012 to Aug. 2013 investigating *Integration of wireless sensor network deployed in mines into the Internet.*

7.2. Regional Initiatives

7.2.1. DECARTE

Participants: Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: Developpement de Carton électronique

Type: FUI

Duration: November 2008 - Avril 2013

Coordinator: Cartonneries de Gondardennes

Others partners: Inria FUN IEMN CTP Cascades IER TagSys

Abstract: DECARTE studies the printing of an UHF RFID tag on packaging in order to reduce manufacturing costs.

7.2.2. Tracaverre

Participant: Nathalie Mitton [correspondant].

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.___

7.2.3. IDC

Participants: Roudy Dagher, Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: Intelligent Data Center

Type: IPER

Duration: November 2010 - June 2012

Coordinator: NooliTic

Others partners: Inria FUN CIV

Abstract: ___IDC studies wireless sensor network based solution to optimize the server monitoring in data centers. ___

7.3. National Initiatives

7.3.1. ANR

7.3.1.1. RESCUE

Participants: Milan Erdelj, Nathalie Mitton, Kalypso Magklara, Karen Miranda, Tahiry Razafindralambo [correspondant].

Title: Reseau Coordonne de substitution mobile
Type: VERSO
Duration: December 2010 - December 2013
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 scientic 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.

7.3.1.2. WINGS

Participants: Nathalie Mitton [correspondant], Roberto Quilez, David Simplot-Ryl.

Title: Widening Interoperability for Networking Global Supply Chains
Type: VERSO
Duration: November 2009 - March 2012
Coordinator: GS1
Other partners: Inria FUN UPMC France Telecom AFNIC GREYC
See also: __http://www.wings-project.fr/___

Abstract: ___This 2-year project focus on a proof-of-concept platform demonstrating the federated ONS model and the interaction with a prototype of Discovery Service. ___

7.3.1.3. F-Lab

Participants: Nathalie Mitton [correspondant], Priyanka Rawat, Tahiry Razafindralambo.

Title: Federating Computing Resources
Type: VERSO
Duration: November 2010 - November 2013
Coordinator: UPMC
Other partners: Inria DNet, Planete, FUN Thales ALU
See also: ___http://f-lab.fr/___

Abstract: ___The F-Lab project works towards enabling an open, general-purpose and sustainable large-scale shared experimental facility that fosters the emergence of the Future Internet. F-Lab builds on a leading prototype for such a facility: the OneLab federation of testbeds. F-Lab will enhance the OneLab federation model with the addition of SensLAB's unique sensor network and LTE-based cellular systems, and develop tools to conduct experiments on these enriched facilities. Project partners include some of France's top academic and industrial research institutions, working together to develop experimental facilities on the Future Internet. F-Lab presents an unique opportunity for the French community to play a stronger role in the design of federation systems; for the SensLAB testbed to reach an international visibility and use; and for the pioneering of testbeds based on LTE technology. ___

7.3.1.4. BinThatThinks

Participants: Tony Ducrocq, Nathalie Mitton [correspondant].

Title: BinThatThinks

Type: ECOTECH

Duration: November 2010 - November 2013

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. ___

7.3.2. ADT

7.3.2.1. SenSas

Participants: Nathalie Mitton [correspondant], Lucie Jacquelin, Tahiry Razafindralambo, Julien Vandaele.

Title: Sensor Network Applications (SensAS)

Type: ADT

Duration: November 2010 - November 2014

Coordinator: Inria D-NET

Others partners: Inria Non-A Inria Planete Inria NECS Inria DEMAR Inria MADYNES Inria AMAZONE Inria SED

See also: ___http://sensas.gforge.inria.fr/___

Abstract: ___Sensas aims to propose mainly control science application based on wireless sensor and actuator network nodes provided from the work done around senslab and senstools projects.___

7.3.2.2. SensLille

Participants: Victor Corblin, Khalil Hammami, Nathalie Mitton [correspondant], Loic Schmidt, Julien Vandaele.

Title: SensLille

Type: ADT

Duration: November 2011 - November 2013

Coordinator: Inria FUN

Abstract: ___SensLille is an ADT that aims to improve SensLab Lille platform by offering new functionalities as the use of electric trains to experiment mobile nodes.___

7.3.2.3. 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.___

7.3.3. Equipements d'Excellence

7.3.3.1. FIT

Participants: Nathalie Mitton [correspondant], Anne-Sophie Tonneau, Tahiry Razafindralambo, Loic Schmidt, David Simplot-Ryl, Julien Vandaele.

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.___

7.4. European Initiatives

7.4.1. Collaborations in European Programs, except FP7

Program: ICT Labs

Project acronym: FiTTING

Project title: FiTTING

Duration: January 2012 - December 2012

Coordinator: UPMC

Other partners: Inria, IBBT, Fraunhoffer, University of Budapest

Abstract: The FITTING facility is about developing the tools needed to create the Future Internet of Things. The experimenters (both academic and industrial) who are developing this new technology require access to experimental platforms (testbeds) whey they can try out their ideas before releasing them to the general public. FITTING facilitates their innovation by federating Europe's next-generation testbeds.

7.5. International Initiatives

7.5.1. Participation In International Programs

Program: CoperLink

Project acronym: Palmares

Project title: Palmares

Duration: January 2012 - April 2013

Coordinator: Universita degli Studi Mediterranea, Italy

Other partners: Inria, Stellebosch University (South Africa)

Abstract: Internet of things, VANET and substitution networks.

7.6. International Research Visitors

7.6.1. Visits of International Scientists

Oswald Jumira (from June 2012 until July 2012)

Institution: Stellenbosch University (South Africa)

Essia Hamouda (from June 2012 until July 2012)

Institution: University of Riverside (USA)

Danping He (from August 2012 until October 2012)

Subject: Range and frequency adaptation in neighbor discovery in mobile wireless networks.

Institution: Universidad de Madrid (Spain)

Pr Ian Akyiliz (July 2012)

Institution: GeorgiaTech (USA)

7.6.1.1. Internships

Natale GUZZO (from May 2012 until Oct 2012)

Subject: Quality of Service and Energy Efficiency in Wireless Networks

Institution: Universita di Roma La Sapienza (Italy)

Kalypso Magklara (from Apr 2012 until Sep 2012)

Subject: Pickup and delivery problems in wireless sensor and actuator networks

Institution: University of Piraeus (Greece)

Jaco Du Toit (from Sept 2012 to Jan 2013)

Subject: Application of the Principles of Erasure Resilient Channel Coding Strategies in Distributed Wireless Network Environments

Institution: Stellenbosch University (South Africa)

Johan Pieterse (from Sept 2012 to Jan 2013)

Subject: Investigation of Handover Techniques in a IPv6 Mobile Wireless Network

Institution: Stellenbosch University (South Africa)

Rim Driss (from Apr 2012 to Sept 2012)

Subject: Analysis of the impact of error on geographic positions in neighbor discovery in wireless networks.

Institution: Université de Sfax (Tunisia)

7.6.2. Visits to International Teams

- Tahiry Razafindralambo is made available from Sept 1st 2012 to Aug 21 2013 at Universidad de Santiago, Chili.
- Nathalie Mitton visited for 2 weeks Stellebosch University (Aug-Sept 2012) in South Africa.

GANG Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. PEFICAMO

Participants: Carole Delporte-Gallet, Hugues Fauconnier, Julien Clément.

Managed by University Paris Diderot, H. Fauconnier is leading this project granting J. Clément from Région Ile de France.

6.2. National Initiatives

6.2.1. ANR SONGS

Participant: Fabien Mathieu.

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.

6.2.2. ANR Prose

Participants: Pierre Fraigniaud, Amos Korman, Laurent Viennot.

Managed by University Paris Diderot, P. Fraigniaud.

Online social networks are among the most popular sites on the Web and continue to grow rapidly. They provide mechanisms to establish identities, share content and information, and create relationships. With the emergence of a new generation of powerful mobile devices that enable wireless ad hoc communication, it is time to extend social networking to the mobile world. Such an ad hoc social networking environment is full of opportunities. As opposed to the use of personal computers, a mobile phone is a strictly personal device, always on, with several wireless interfaces that include a short range communication with nearby nodes. Applications such as notification of status updates, sharing of user generated content, documents tagging, rating/recommendation and bookkeeping can be deployed "on the move" on top of contacts established through short range communication. It requires to deploy social networking applications in a delay tolerant manner using opportunistic social contacts as in a peer to peer network, as well as new advanced content recommendation engines.

The Prose project is a collective and multi-disciplinary effort to design opportunistic contact sharing schemes, and characterizes the environmental conditions, the usage constraint, as well as the algorithmic and architecture principles that let them operate. The partners of the Prose project will engage in this exploration through various expertise: network measurement, traffic monitoring from a real application, system design, behavioral study, analysis of distributed algorithms, theory of dynamic graph, networking modeling, and performance evaluation. As part of this project, the partners will be involved in the analysis of the content received and accessed by users of a real commercial application (PlayAdz), and will participate to the design of a new promotion advertisement service.

6.2.3. ANR Shaman

Participants: Carole Delporte-Gallet, Hugues Fauconnier, Hung Tran-The.

SHAMAN (Self-organizing and Healing Architectures for Malicious and Adversarial Networks) is an ANR VERSO Project (2009-2012).

Managed by University Paris Diderot, H. Fauconnier leads this project that grants Ph. D. H. Tran-The.

SHAMAN focuses on the algorithmic foundations of resource-constrained autonomous large scale systems, dedicated to enabling the sustainability of network functions in spite of abrupt system evolutions, component failures, and attacks. We foresee original solutions in the general frameworks of self-stabilization, failure detection, and robust protocols. Our first objective is the design of obligate but realistic models encompassing anonymity, dynamism, and/or malicious behavior. Our second objective is to evaluate both the theoretical power, and the practical functionality, of these models, by confronting them to their ability of designing efficient algorithms and protocols for dynamic and malicious environments. This evaluation will be tackled in two complementary application domains: wireless sensor networks, and peer-to-peer systems. The primary outcome of SHAMAN should be the demonstration of reliable middleware bricks that could be integrated in real distributed platforms.

6.2.4. ANR Displexity

Participants: Carole Delporte-Gallet, Hugues Fauconnier, Pierre Fraigniaud, Arfoui Heger, Amos Korman, Hung Tran-The, 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.

6.3. European Initiatives

6.3.1. FP7 Projects

6.3.1.1. EULER

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 - September 2013

Coordinator: ALCATEL-LUCENT (Belgium)

Others partners:

Alcatel-Lucent Bell, Antwerpen, Belgium

3 projects from Inria: CEPAGE, GANG and MASCOTTE, France

Interdisciplinary Institute for Broadband Technology (IBBT),Belgium

Laboratoire d'Informatique de Paris 6 (LIP6), Université Pierre Marie Curie (UPMC), France

Department of Mathematical Engineering (INMA) Université Catholique de Louvain, Belgium

RACTI, Research Academic Computer Technology Institute University of Patras, Greece

CAT, Catalan Consortium: Universitat Politècnica de Catalunya, Barcelona and University of Girona, Spain

See also: http://www-sop.inria.fr/mascotte/EULER/wiki/

Abstract: The title of this study is "Dynamic Compact Routing Scheme". The aim of this projet is to develop new routing schemes achieving better performances than current BGP protocols. The problems faced by the inter-domain routing protocol of the Internet are numerous:

The underlying network is dynamic: many observations of bad configurations show the instability of BGP;

BGP does not scale well: the convergence time toward a legal configuration is too long, the size of routing tables is proportional to the number of nodes of network (the network size is multiplied by 1.25 each year);

The impact of the policies is so important that the many packets can oscillated between two Autonomous Systems.

Description: In this collaboration, we mainly investigate new routing paradigms so as to design, develop, and validate experimentally a distributed and dynamic routing scheme suitable for the future Internet and its evolution. The resulting routing scheme(s) is/are intended to address the fundamental limits of current stretch-1 shortest-path routing in terms of routing table scalability but also topology and policy dynamics (perform efficiently under dynamic network conditions). Therefore, this project will investigate trade-offs between routing table size (to enhance scalability), routing scheme stretch (to ensure routing quality) and communication cost (to efficiently and timely react to various failures). The driving idea of this research project is to make use of the structural and statistical properties of the Internet topology (some of which are hidden) as well as the stability and convergence properties of the Internet policy in order to specialize the design of a distributed routing scheme known to perform efficiently under dynamic network and policy conditions when these properties are met. The project will develop new models and tools to exhaustively analyse the Internet topology, to accurately and reliably measure its properties, and to precisely characterize its evolution. These models, that will better reflect the network and its policy dynamics, will be used to derive useful properties and metrics for the routing schemes and provide relevant experimental scenarios. The project will develop appropriate tools to evaluate the performance of the proposed routing schemes on large-scale topologies (order of 10k nodes). Prototype of the routing protocols as well as their functional validation and performance benchmarking on the iLAB experimental facility and/or virtual experimental facilities such as PlanetLab/OneLab will allow validating under realistic conditions the overall behaviour of the proposed routing schemes.

6.4. International Initiatives

6.4.1. *Internet Technologies and Architectures*
Participant: Fabien Mathieu.

The aim of this project is to build a community of researchers focusing on fundamental theoretical issues of future networking, including such topics as communication theory, network information theory, distributed algorithms, self-organization and game theory, modeling of large random and complex networks and structures. Partners Inria, VTT, Aalto University, Eindhoven University are gathered under EIT ICT Labs Project Fundamentals of Networking (FUN). http://eit.ictlabs.eu/ict-labs/all-events/article/fundamentals-of-future-networking-workshop/.

<p style="text-align:center;color:red">GRAND-LARGE Project-Team</p>

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. Activities starting in 2009

- Franck Cappello, Co-Director of the **Inria - Illinois Joint Laboratory** on PetaScale Computing, since 2009

6.1.2. Other activities

- **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).

- **ANR SPADES** Coordinated by LIP-ENS Lyon. (Sylvain Peyronnet, Franck Cappello, Ala Rezmerita)

- **Défi ANR SECSI** Participant to this challenge. From September 2008 to August 2010. Managed by the SAIC. (Thomas Hérault, Sylvain Peyronnet, Sébastien Tixeuil)

- **ANR Cosinus project MIDAS - MIcrowave Data Analysis for petaScale computers** December 2009 - December 2012 (http://www.apc.univ-paris7.fr/APC_CS/Recherche/Adamis/MIDAS09/index.html). Collaboration with APC, University Paris 7 and Lawrence Berkeley Laboratory. This is an interdisciplinary project devised to bring together cosmologists, computational physicists, computer scientists and applied mathematiciancs to face the challenge of the tremendous volume of data as anticipated from current and forthcoming Cosmic Microwave Background (CMB) experiments. (Laura Grigori, Coordinator for Inria Saclay, F. Cappello, J. Falcou, T. Hérault, S. Peyronnet)

- **ANR Cosinus project PETALh - PETascale ALgorithms for preconditioning for scientific applications** January 2011- December 2012. Collaboration with Laboratoire Lions - Universite 6, IFP, Inria Bordeaux and CEA, UC Berkeley and Argonne. The goal is to investigate preconditioning techniques on multicore architectures and apply them on real world applications from IFP, CEA and Argonne. (Laura Grigori, Principal Investigator)

- **ANR Cosinus project PetaQCD - Towards PetaFlops for Lattice Quantum ChromoDynamics** (2009-2012) Collaboration with Lal (Orsay), Irisa Rennes (Caps/Alf), IRFU (CEA Saclay), LPT (Orsay), Caps Entreprise (Rennes), Kerlabs (Rennes), LPSC (Grenoble). About the design of architecture, software tools and algorithms for Lattice Quantum Chromodynamics. (Cédric Bastoul, Christine Eisenbeis, Michael Kruse)

  PI L. Grigori

- Inria Associated Team **"F-J Grid"** with University of Tsukuba, head: Franck Cappello

- Inria funding, **MPI-V**, collaboration with UTK, LALN and ANL, head: Franck Cappello

- ANR CIS Project **FF2A3**, 3 years (2007 - 2010), PI F. Hecht, subproject head L. Grigori

- **HipCal**, ANR CIS, 3 years (2006-2009), http://hipcal.lri.fr/wakka.php?wiki=PagePrincipale, Franck Cappello

6.2. International Initiatives

6.2.1. Inria Associate Teams

- **Inria associated team COALA with Prof. J. Demmel, UC Berkeley, 2010-2013**. This project is proposed in the context of developing Communication Optimal Algorithms for Linear Algebra. The funding covers visits in both directions. The following visits of PhD students and postdoctoral researcher took place in the context of this associated team:
  - Visit of M. Jacquelin to UC Berkeley (August 2011, for 1 month).
  - Visit of S. Moufawad (November 2012, for 1 month).

6.3. European Initiatives

6.3.1. Collaborations in European Programs, except FP7

Program: ITEA2

Project acronym: MANY

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

Duration: 01/09/2011 - 31/08/2014

Coordinator: XDIN AB (formerly ENEA)

Other partners: Universitat Auto`noma de Barcelona (UAB), CEPHIS group (Spain), CAPS-Entreprise, (France), Inria, Grand Large (France), Institut Mines-Te´le´com/Te´le´com Sud Paris (IMT/TSP), Computer Science Department (France), THALES Communications & Security, (France), XDIN AB, (Sweden), ETRI, (Korea), Seven Core Co, Ltd, (Korea), TestMidas Co, Ltd, (Korea), ST-Ericsson BV, (Netherlands), Vector Fabrics BV, (Netherlands), Technische Universiteit Eindhoven, (Netherlands), University of Mons (UMONS), POLE-TI (Belgium)

Abstract: The ability to reuse existing software code has grown in importance as software applications become more complex. With the arrival of many-core semiconductor architectures, application developers face an additional problem: how to rewrite software applications to exploit the increased parallel processing available. The MANY project is developing an improved programming environment for the embedded-systems realm; one which will facilitate faster development of applications for a variety of hardware platforms. (Cédric Bastoul, Léna"ic Bagnères, Taj Khan)

6.4. International Research Visitors

6.4.1. Internships

German SCHINCA (*Date_begin_end ???*)

    Subject: Minimizing communication in scientific computing

    Institution: University of Buenos Aires (Argentina)

German SCHINCA (*Date_begin_end ???*)

Alessandro Ferreira Leite (October 2012-December 2012)

    Subject: Energy issues in Cloud Computing

    Institution: University of Brasilia (Brasil)

<p style="text-align:center; color:red;">**HIEPACS Project-Team**</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. OPTIDIS: OPTImisation d'un code de dynamique des DISlocations

Participants: Olivier Coulaud, Aurélien Esnard, Luc Giraud, Jean Roman.

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 behaviour of a single dislocation segment is perfectly understood since 1960 and analytical formulations are available in the literature. However, to understand the behaviour 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 in to develop and validate the algorithms in order to optimise the numerical and performance efficiencies 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 plastical deformation after irradiation. These kinds of studies where "local mechanisms" are correlated with macroscopic behaviour is a key issue for nuclear industry in order to understand material ageing under irradiation, and hence predict power plant secured service life. To carry out such studies, massive numerical optimisations 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 thesis 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.

8.1.1.2. RESCUE: RÉsilience des applications SCientifiqUEs

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Mawussi Zounon.

Grant: ANR-Blanc (computer science theme)
Dates: 2010 – 2014
Partners: Inria EPI GRAAL (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.

8.1.1.3. BOOST: Building the future Of numerical methOdS for iTer

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Xavier Vasseur.

Grant: ANR-Blanc (applied math theme)
Dates: 2010 – 2014
Partners: Institut de Mathématiques de Toulouse (coordinator); Laboratoire d'Analyse, Topologie, Probabilités in Marseilles; Institut de Recherche sur la Fusion Magnétique, CEAr/IRFM and Inria-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 in 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. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. MYPLANET

      Title: MYPLANET
      Type: PEOPLE ()

Instrument: Initial Training Network (ITN)

Duration: October 2008 - September 2012

Coordinator: CERFACS (France)

Others partners: Allinea software, Alstom Power Switzerland, Czestochowa University of Technology, Genias Graphics, Rolls Royce PLC UK, Technical Univ. Munich, Turbomeca, University of Cambridge, University Carlos III Madrid and University of Cyprus.

See also: http://www.cerfacs.fr/myplanet/

Abstract: The present MYPLANET project responds to the first FP7-call "PEOPLE-INITIAL-TRAINING-ITN-2007-1" published by the European Commission. This collaborative initial training network represents a European initiative to train a new generation of engineers in the field of high performance computing applied to the numerical combustion simulation, energy conversion processes and related atmospheric pollution issues. Indeed, the project is based on the recognised lack on the European level of highly skilled engineers who are equally well-trained in both combustion technologies and high-performance computing (HPC) techniques. Thus the MYPLANET project will clearly contribute to the structuring of existing high-quality initial research training capacities in fluid mechanics and the HPC field through combining both public and private (industrial) sectors. The participation of industrial partners in the training of the researchers will directly expose these industries to high performance computing, which will have a very favourable impact on the quality and efficiency of their activities. Reciprocally, the research community will learn more about the mid and long term industrial challenges which will enable the research partners to initiate new activities in order to anticipate and address these industrial requirements.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. FASTLA

Title: Fast and Scalable Hierarchical Algorithms for Computational Linear Algebra

Inria principal investigator: Olivier Coulaud

International Partners (Institution - Laboratory - Researcher):

> Stanford University (United States) - Institute for Computational and Mathematical Engineering - Eric Darve

> Lawrence Berkeley National Laboratory (United States) - Scientific Computing Group - Esmond Ng

Duration: 2012 - 2014

See also: http://people.bordeaux.inria.fr/coulaud/projets/FastLA_Website/index.html.

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 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 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.

8.3.1.2. MORSE

Title: Matrices Over Runtime Systems at Exascale

Inria principal investigator: Emmanuel Agullo

International Partner:

Institution: University of Tennessee Knoxville (United States)

Laboratory: Innovative Computing Lab

Researcher: George Bosilca

International Partner:

Institution: University of Colorado Denver (United States)

Laboratory: Department of Mathematics and Statistical Sciences

Researcher: Julien Langou

Duration: 2011 - 2013

See also: http://www.inria.fr/en/teams/morse.

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 and runtime systems 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.

8.3.2. Participation In International Programs

8.3.2.1. ECS : Enabling Climate Simulation at extreme scale

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Mawussi Zounon.

Grant: G8

Dates: 2011 – 2014

Partners: Univ. Illinois at Urbanna Champaign, Inria, Univ. Tennessee at Knoxville, German Research School for Simulation Sciences, Univ. Victoria, Titech, Univ. Tsukuba, NCAR, Barcelona Supercomputing Center.

Overview: 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).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

The following researchers have visited `HiePACS` in 2012

- George Bosilca, University of Tennessee at Knoxville visited from June 15 to December 31st.
- Yousef Saad, University of Minnesota from June 4 to June 15th.

8.4.1.1. Internships

Both Vincent Cohen and Homar Zenati share their internship time between Inria and UTK in the framework of the MORSE associate team. Pierre Ramet (BACCHUS team) contributed to the advisory of Homar Zenati's work.

<div align="center">

HIPERCOM Project-Team

</div>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR: GETRF

Participants: Paul Mühlethaler, Pascale Minet, Cédric Adjih, Emmanuel Baccelli, Salman Malik.

Period: 2012 - 2014.

Partners: DGA/MI, Inria.

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 will focus 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.

7.1.2. Competitivity Clusters

7.1.2.1. SAHARA
Participants: Pascale Minet, Cédric Adjih, Ridha Soua, Erwan Livolant.

Period: 2011 - 2014.

Partners: EADS, Astrium, BeanAir, Eurocopter, Inria, Oktal SE, Reflex CES, Safran Engineering Systems, CNES, ECE, EPMI,LIMOS.

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. Inria is in charge of coordinating the academic partners. During year 2012, we took part to the specification of application requirements. We also defined the functional architecture and made measurements within the plane of SAFRAN.

7.1.2.2. CONNEXION
Participants: Pascale Minet, Cédric Adjih, Saoucene Mahfoudh Ridene, Ines Khoufi.

Period: 2012 - 2016.

Partners: All4Tec, ALSTOM, AREVA, Atos WorldGrid, CEA, CNRS / CRAN, Corys TESS, EDF, ENS Cachan, Esterel Technologies, Inria, LIG, Predict, Rolls-Royce Civil Nuclear, Telecom ParisTech.

The Cluster CONNECTION (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 HIPERCOM project-team is involved in wireless sensor networks coping with node mobility. We focused on deployment and redeployment algorithms for mobile wireless sensor networks after a disaster. We began with a state of the art. Many works in the literatures deal with this issue. We can classify these works in several ways:

- First classification:
    - Centralized Algorithms as Practical swarm optimization (PSO), Centralized virtual forces...These algorithms minimize the moves done by nodes since each sensor moves only to its final position computed by the specific node. However, they rely on assumption that may be unrealistic (e.g. network connectivity). Furthermore, they are not scalable.
    - Distributed Algorithms as Distributed Self Spreading algorithm (DSSA), Force-based Genetic Algorithm (FGA), Mass-Sprig -Relaxation Algorithm... These algorithms are more relistic: they adapt to the knowledge progressively acquired during the redeployment. However, there are still pending issues such as nodes oscillation, coverage computation, point of interest...
- Second classification:
    - Grid based approach: sensors will redeploy according to a predetermined grid.
    - The computational geometry based approach uses the Voronoi diagram and the Delaunay triangulation.
    - The virtual force based approach is based on virtual forces to move sensors.

The latter (virtual force based approach) presents many advantages such as simplicity and fast coverage. That is why we adopt this appraoch.

7.1.2.3. SensLab and FIT
Participants: Cédric Adjih, Emmanuel Baccelli, Ala Eddin Weslati.

Period: 2011 - 2021

Partners: Inria (Lille, Sophia-Antipolis, Grenoble), INSA, UPMC, Institut Télécom Paris, Institut Télécom Evry, LSIIT Strasbourg.

The HIPERCOM team started the development of a testbed for SensLab in 2010. This testbed located in building 21 at Rocqquencourt Inria center consists now of 128 wireless SensLab nodes.

A location has been found for the new testbed of the EQUIPEX FIT: the basement of building 1 at Rocquencourt. An engineer has been recruited for this project.

7.1.2.4. ACRON

Participant: Cédric Adjih.

Period: 2011 - 2014

Partners: Supélec (Télécommunications), Inria, ENS TREC, Inria HIPERCOM, Université Paris-Sud, IEF.

ACRON is a DIMLSC DIGITEO project. It deals with analysis and design of self-organized wireless networks. The HIPERCOM team project will study the theoretical limits of wireless networking.

7.1.2.5. SWAN

Participants: Cédric Adjih, Salman Malik.

Period: 2011 - 2014

Partners: CNRS, Supélec, Université Paris-Sud (L2S), LTCI, LRI, Inria Hipercom and IEF.

SWAN, Source-aWAre Network coding, is a DIMLSC DIGITEO project. It deals with network coding for multimedia.

7.1.2.6. MOBSIM

Participants: Cédric Adjih, Paul Mühlethaler, Hana Baccouch.

Period: 2011 - 2013

Partners: Inria Sophia, Inria Genoble.

MOBSIM is an ADT, Action of Technology Development. It aims at developing the NS3 simulation tool. The HIPERCOM team focuses on routing protocols and MAC protocol (namely the EY-NPMA protocol Elimination Yield Non-Preemptive Multiple Access). An engineer has been recruited for this project.

7.1.3. OCARI2

Participants: Ichrak Amdouni, Pascale Minet, Cédric Adjih, Ridha Soua.

Partners: EDF, LIMOS, TELIT.

At the end of the OCARI (Optimization of Ad hoc Communications in Industrial networks) project, funded by ANR, started in February 2007 and ended in 2010, EDF the coordinator decided to continue the project with a restricted number of partners: TELIT, LIMOS (Clermont Ferrand university) and Inria. The goal was to prove the feasibility on commercially available cards of the OCARI stack designed during the ANR project and to make a public demonstration of this product. During the year 2011, the OCARI stack has been improved and implemented on the ZE51 module of TELIT based on the Texas Instrument CC2530 Chipset. During 2012, we made several demonstrations of the energy-efficient routing protocol EOLSR and the node coloring algorithm OSERENA to save energy.

The OCARI project deals with wireless sensor networks in an industrial environment. It aims at responding to the following requirements which are particularly important in power generation industry and in warship construction and maintenance:

- Support of deterministic MAC layer for time-constrained communication,
- Support of optimized energy consumption routing strategy in order to maximize the network lifetime,
- Support of human walking speed mobility for some particular network nodes, (e.g. sinks).

The development of OCARI targets the following industrial applications:

- Real time centralized supervision of personal dose in electrical power plants,
- Condition Based Maintenance of mechanical and electrical components in power plants as well as in warships,
- Environmental monitoring in and around power plants,
- Structure monitoring of hydroelectric dams.

To meet the requirements of supported applications (remote command of actuators, tele-diagnostic...), new solutions will be brought to manage several communication modes, ranging from deterministic data transfers to delay tolerant transfers. A key issue is how to adapt routing algorithms to the industrial environment, taking into account more particularly limited network resources (e.g.; bandwidth), node mobility and hostile environment reducing radio range.

The OCARI project aims at developing a wireless sensor communication module, based on IEEE 802.15.4 PHY layer and supporting EDDL and HART application layer. The Inria contribution concerns more particularly energy efficient routing and node activity scheduling.

- The energy efficient extension of OLSR, called EOLSR, is implemented on top of the MAC protocol defined by LATTIS and LIMOS. The MAC protocol is a variant of ZigBee ensuring some determinism and quality of service and allowing leave nodes (e.g. sensor, actuator) as well as router nodes to sleep. The EOLSR protocol avoids nodes with low residual energy and selects the routes minimizing the energy consumed by an end-to-end transmission.

- SERENA, the protocol used to schedule router node activity, is based on three-hop coloring. It allows any node to sleep during the slots that are attributed neither to its color nor to its one-hop neighbors. SERENA contributes to a more efficient use of energy: less energy is spent in the idle and interference states. Hence, network lifetime is considerably increased. SERENA has been optimized for the specific context of OCARI (i.e.; very limited bandwidth 250kbps, small size messages 127 bytes, limited memory and limited processing power) have been delivered.

These protocols have been implemented in the OCARI stack, operating on a ZE51 module of TELIT.

7.2. European Initiatives

7.2.1. Collaborations in European Programs, except FP7

Program: CSOSG

Project acronym: SAFEST

Project title:

Duration: May 2012-April 2015

Coordinator: Emmanuel Baccelli

Other partners: Freie Universitat Berlin, Hamburg University, Sagem, Daviko, FOS, Fraunhofer

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.

7.3. International Initiatives

7.3.1. IT-SG-WN

Title: Information Theory, Stochastic Geometry, Wireless Networks

Inria principal investigator: Paul Muhlethaler

International Partner (Institution - Laboratory - Researcher):

Stanford University (United States) - Information Systems Laboratory, Department of Electrical Engineering - Abbas El Gamal

Duration: 2011 - 2013

See also: http://www.di.ens.fr/~baccelli/IT_SG_WN_web_site.htm

The activity of this proposal is centered on the inter-play between stochastic geometry and network information theory, whith a particular emphasis on wireless networks. In terms of research, three main lines of thought will be pursued:1. Error exponents and stochastic geometry2. Stochastic geometry and network Information Theory3. Cognitive radio and stochastic geometry

7.3.2. Participation In International Programs

7.3.2.1. AWSN2012

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 also: 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 will 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.

After a kick-off meeting in Paris in February, we organized three workshops where each team presented its works:

- a workshop in Rabat in October 2012, where each team presented its works,
- a workshop in Tunis in November 2012. This workshop was open to non-members and was preceded by a call for paper. It was held in conjunction with the IEEE NoF 2012 conference (Network of the Future).
- a workshop in Catania in December 2012, where new results have been presented.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- **Mauro Fonseca**, Pontifical Catholic University of Paraná, Curitiba, Brazil, July 2012-June 2013 (Saclay),
- **Anelise Munaretto**, Federal Technological University of Paraná, Curitiba, Brazil, July 2012-June 2013 (Saclay),
- **Leila Saidane**, ENSI, Tunis, Tunisia, February and July 2012 (Rocquencourt),
- **Lucia Lo Bello**, UniCT, Catania, Italy, February 2012 (Rocquencourt),
- **Mohammed Erradi**, ENSIAS, Rabat, Morocco, February 2012 (Rocquencourt),
- **Bernard Mans**, Macquarie University, March-August 2012 (Rocquencourt).

7.4.1.1. Internships

Kanchana Thilakarathna, NICTA/University of New South Wales, Sydney, Australia, March-September 2012 (Saclay)

INDES Project-Team

8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. ANR DEFIS ParTout

The PARTOUT project (PARTOUT = PARallélisme parTOUT) is funded by the ANR Défis programme for 4 years, starting January 2009. The partners of this project are the teams INDES (coordinator), CNAM/CÉDRIC, and LRI, Université d'Orsay.

8.1.2. ANR DEFIS PWD

The PWD project (for "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.

8.1.3. MEALS

The MEALS project (Mobility between Europe and Argentina applying Logics to Systems), IRSES program, started October 1st (2011), and will end September 30th, 2015. The project 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 Cordoba, Inria (together with Catuscia Palamidessi, Kostas Chatzikokolakis, Miguel Andrés) and University of Twente.

8.1.4. CIRIC

Indes participated in the proposal of the CIRIC project, a joint lab between Inria and Chile, that will start in 2012. Indes members are involved in the line: Internet Research and Development.

8.2. European initiatives

8.2.1. Collaborations in European Programs, except FP7

Program: ICT Cost Action IC1201

Program 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 17 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.

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 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. 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 an everyday basis.

8.2. European Initiatives

8.2.1. FP7 Projects

The SCALUS FP7 Marie Curie Initial Training Network (2009–2013). Partners: Universidad Politécnica de Madrid (UPM), Barcelona Supercomputing Center, University of Paderborn, Ruprecht-Karls-Universität Heidelberg, Durham University, FORTH, École des Mines de Nantes, XLAB, CERN, NEC, Microsoft Research, Fujitsu, Sun Microsystems. Topic: scalable distributed storage. We mainly collaborate with UPM (2 co-advised PhD theses).

8.2.2. Collaborations in European Programs, except FP7

CoreGRID ERCIM Working Group, since 2009. The CoreGRID Symposium held in Las Palmas de Gran Canaria, Spain, 25-26 August 2008 marked the end of the ERCIM-managed CoreGRID Network of Excellence funded by the European Commission. There, it was decided to re-launch CoreGRID as a self-sustained ERCIM Working Group covering research activities on both Grid and Service Computing while maintaining the momentum of the European collaboration on Grid research.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. DATACLOUD

Title: Distributed data management for cloud services

Inria principal investigator: Gabriel Antoniu

International Partner (Institution - Laboratory - Researcher):

Politechnica University of Bucharest (Romania) - NCIT - Valentin Cristea

Duration: 2010 - 2012

See also: http://www.irisa.fr/kerdata/doku.php?id=cloud_at_work:start

Our research topics address the area of distributed data management for cloud services. We aim at investigating several open issues related to autonomic storage in the context of cloud services. The goal is explore how to build an efficient, secure and reliable storage IaaS for data-intensive distributed applications running in cloud environments by enabling an autonomic behavior, while leveraging the advantages of the grid operating system approach.

Our research activities involve the design and implementation of experimental prototypes based on the following software platforms:

> The BlobSeer data-sharing platform (designed by the KerData Team)
>
> The XtreemOS grid operation system (designed under the leadership of the Myriads Team)
>
> The MonALISA monitoring framework (using the expertise of the PUB Team).

The main results obtained in 2012 are described in Section 6.4 .

8.3.2. Inria International Partners

Politehnica University of Bucharest

8.3.3. Participation In International Programs

Joint Inria-UIUC Lab for Petascale Computing (JLPC), since 2009. Collaboration on concurrency-optimized I/O for post-Petascale platforms (see details inw Section 4.1). A joint project proposal with the team of Rob Ross (Argonne National Lab) has been accepted in 2012 at the FACCTS call for projects. It served to prepare the preparation of a project for an Associate Team with ANL and UIUC. The project, called Data@Exascale has been accepted for 2013-2015.

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.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Robert Ross and Dried Kimpe (Argonne National Lab) visited the KerData team for a week (June 2012) within the framework of our FACCTS project.
- Florin Pop and Ciprian Dobre (Politehnica University of Bucharest) visited the KerData team for a week (June 2012) within the framework of our DataCloud@work Associate Team.

8.4.2. Internships

Elena Burceanu (from February 2012 until June 2012)

> Subject: Distributed data storage for context-aware applications
>
> Institution: Politehnica University of Bucharest (Romania)

Vlad Nicolae Serbanescu (from February 2012 until June 2012)

> Subject: Distributed data aggregation using the BlobSeer cloud storage service
>
> Institution: Politehnica University of Bucharest (Romania)

Bharath Vissapragada (from February 2012 until June 2012)

> Subject: MapReduce data processing on hybrid (cloud/desktop grid) infrastructures
>
> Institution: University of Hyderabad (India)

Mauricio De Oliveira de Diana (June 2012)

Subject: Performance modeling for the BlobSeer storage system

Institution: Master student from Brazil

Sergiu Vicol (June–August 2012)

Subject: Optimizing memory management in Damaris

Institution: Bachelor student from Oxford University. Former awardee of the ENS-Inria Excellence Award for the Laureates of the Romanian Olympiad in Informatics.

Alexandru Farcasanu(June–August 2012)

Subject: Optimizing the DStore in-memory storage system

Institution: Bachelor students from Politehnica University of Bucharest. Former awardee of the ENS-Inria Excellence Award for the Laureates of the Romanian Olympiad in Informatics.

8.4.3. Visits to International Teams

- Viet-Trung Tran visited Microsoft Research Cambridge (Dushyanth Narayanan) for a 3-month internship, funded by MSR.

- Houssem-Eddine Chihoub visited the Polytechnical University of Madrid (Maria Perez) for 3 months, funded by the FP7 SCALUS MCITN project.

- Radu Tudoran visited the ATL Lab at European Microsoft Innovation Center (Aaachen Germany) for 3 months, funded by Microsoft.

- Matthieu Dorier visited ANL (Rob Ross, Tom Peterka, Phil Carns) and UIUC (Franck Cappello) for one month, funded by our FACCTS grant.

<p align="center" style="color:red">LOGNET Team</p>

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. Collaborations in European Programs, except FP7

Program: INTERREG ALCOTRA

Project acronym: myMed

Project title: " a peer-to-peer programmable social network and cloud platform"

Duration: January 2010-march2014

Coordinator: Luigi Liquori

Other partners: Uni, Turin, POlitech Turin, Univ. Piemonte Orientale, UNIVE

Founded 1.3Meur on 3 year.

Abstract: see above

7.2. International Initiatives

7.2.1. Inria International Partners

University of Udine, collaboration, common paper and visits since 1990.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- Mariangiola Dezani, fullprof. Univ Turin,
- Luca Paolini, Assistant professor, Univ. Turin,
- Claudio Casetti, Assistant professor, Univ. Piemonte Orientale,
- Massimo Canonico, Assistant professor, Univ. Piemonte Orientale,
- Luigi Alfredo Grieco, Assistant professor, Politech Bari,
- Erol Gelembe, Full professor, Imperial College.

7.3.1.1. Internships

- David Da Silva, "Développement d'une application mobile d'aide aux personnes atteinte d'Alzheimer sur la plate-forme MyMed", Projet de stage de fin d'année: Licence Info Miage, UNICE, 2012.
- Romain Fritz, "Surveillance des réseaux pair à pair par la réputation", Projet de stage de fin d'étude: M2 IFI CSSR, UNICE, 2012.
- Romain Fritz, "Security mechanism applicable on Distributed Hash Table", Projet de stage de fin d'études: M2 IFI CSSR, UNICE, 2012.
- Francesca Guglielmino, "Aide à la constitution d'un bassin d'usagers potentiels du réseau social myMed", Projet de stage de fin d'études: Master Langues et Affaires Internationales Relations franco-italienne, UNICE, 2012.
- Sarah Breda, "Mise en place d'une application Smartphone dans le cadre du projet Interreg Alcotra myMed", Projet de stage de fin d'études: Master Langues et Affaires Internationales Relations franco-italienne, UNICE, 2012.
- Elisa Pellicciari, "Assistance et aide à la conception des services myMed, premier réseau informatique transfrontalier", Projet de stage de fin d'études: Master Langues et Affaires Internationales Relations franco-italienne, UNICE, 2012.
- Guillaume Villena, "A primer on PhP", Projet de Stage, étudiant Collège.

MADYNES Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

In 2012, the team was involved in the following initiative:

- CPER-SSS: in this initiative, the team did work on Scada networks security and P2P monitoring.

8.2. National Initiatives

8.2.1. ANR

The team did coordinate the VAMPIRE ANR Project which ended in october 2012. VAMPIRE is a research project funded by the French Research Agency (ANR, VERSO ANR-08-VERS-017) coordinated by the team. The goal of the project to investigate new thread security issues induced by Voice Over IP (VoIP) protocols and web2.0. Madynes has the lead on this project.

8.2.2. Actions d'Envergure Nationale

The Inria Large-scale initiative action AEN 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 and thanks to the associated ADT PERCEE project, we extended MPIGate (http://mpigate.loria.fr), a multi-protocol interface and gateway, by integrating a publisher-subscriber data distribution model of standard middleware (DDS and ROS). The first experimentations showed its good performance and its easy-to-use interface for transparent heterogenous data access (through either programmer API or end-user web interface) [12]. The development and tests are conducted using LORIA's smart apartment platform developed within CPER MISN Informatique située project (http://infositu.loria.fr). The adoption of ROS (Robotic Operating System) 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 Projects

8.3.1.1. Univerself

Title: Univerself

Type: COOPERATION (ICT)

Defi: The Network of the Future

Instrument: Integrated Project (IP)

Duration: September 2010 - August 2013

Coordinator: Alcatel Lucent (France)

Others partners:

Universiteit Twente,

Alcatel Lucent Ireland,

Alcatel Lucent Deutschland,

Valtion Teknillinen Tutkimuskeskus (Finland),

University of Piraeus,

France Telecom,

Telecom Italia,

National University of Athens,

Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung,

Interdisciplinary Institute for Broadband Technology,

Telefonica Investigacion y Desarrollo,

Thales Communications,

Inria,

Nec Europe,

University of Surrey,

University College London

IBBT (Belgium).

See also: http://www.univerself-project.eu/

Abstract: UniverSelf unites 17 partners with the aim of overcoming the growing management complexity of future networking systems, and to reduce the barriers that complexity and ossification pose to further growth. Univerself has been launched in October 2010 and is scheduled for four years.

8.3.1.2. FI-WARE

Type: COOPERATION (ICT)

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

Instrument: Integrated Project (IP)

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Others partners:Thales, SAP, Inria

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 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 in earlier research projects. We will demonstrate how this infrastructure supports 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.

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. More specifically, the tool uses the Scapy library for packet manipulation, allows users to define interaction scenarios in XML and provides multiple mutation algorithms;

- 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;

- coordination between the Security Work Package and the Inria teams involved in it. This included attending to weekly audio conferences, face to face meetings, and making sure deliverables and tasks were addressed in a timely manner.

8.3.2. Collaborations with Major European Organizations

Partner 1: Univeristy of Luxembourg (Luxembourg)

We have two ongoing PhD candidates with the SnT at Univeristy of Luxembourg. We do collaborate on Large Scale Monitoring for Security Management. Target services are: P2P Networks, Virtual Coordinates Systems and DNS Services.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Maroua BOUMESSOUER (from Mar 2012 until Aug 2012)

Subject: Etude des vulnérabilités et des attaques dans le protocole de routage RPL

Institution: Sup'Com Tunis (Tunisia)

Ayoub SOURY (from Mar 2012 until Aug 2012)

Subject: Vulnerabilities Prevention in Industrial Control Systems

Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

Bernardo LAMAS (from Mar 2012 until Aug 2012)

Subject: Offensive Security for Industrial Control Systems

Institution: National University of Rosario (Argentina)

Tarang CHUGH (from Mar 2012 until Aug 2012)

Subject: Fairness Incentives for Multi-Protocol Cooperation in P2P Networks

Institution: Indraprastha Institute of Information Technology (India)

MAESTRO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *ANR Verso ECOSCELLS (11/2009–10/2012)*

Participants: Eitan Altman, Konstantin Avrachenkov, Philippe Nain.

ANRVERSOECOSCELLS (Efficient Cooperating Small Cells) aims at developing algorithms and solutions which will be required for the deployment of small cell networks. The theoretical studies will define and solve the models needed to understand the behavior of radio channels, and will design the algorithms which will allow the exploitation of the diversity (user, spatial, interference, etc.) in these networks. The consortium gathers two main industrial groups in the telecommunication domain (ALCATEL-LUCENT BELL LABS (leader) and Orange Labs), together with three leading SMEs (3ROAM, SEQUANS and SIRADEL) and six academic partners (Univ. of Avignon, INRIA through its project-teams MAESTRO, MASCOTTE and SWING, INSTITUT EURECOM, LAAS-CNRS and Laboratoire des Signaux et Systèmes/SUPELEC).

http://perso.citi.insa-lyon.fr/hrivano/contrats/ecoscells.php

7.1.2. *Inria Cooperative Research Initiative (ARC) OCOQS (2011-2012)*

Participant: Alain Jean-Marie.

The finishing ARCOCOQS (Optimal threshold policies in COntrolled Queuing Systems) was devoted to the structural analysis of Markov Decision Processes, with the objective to improve the set of formal techniques available to prove that optimal control policies have a particular structure (typically, threshold-type). One of the benchmarks for this project was the extension of the model solved in [27]. This project also involved A. Busic (INRIA project-team TREC), E. Hyon (LIP6 and Univ. Paris 10) and I. Vliegen (Univ. Twente).

http://www.di.ens.fr/~busic/OCOQS/

7.2. European Initiatives

7.2.1. *FP7 Projects*

7.2.1.1. *CONGAS*

Participants: Eitan Altman, Konstantin Avrachenkov, Alexandre Reiffers.

Title: Dynamics and coevolution in multi level strategic interaction games
Type: Collaborative project
Subprogramme Area: FET Proactive: Dynamics of Multi-Level Complex Systems
Instrument: Specific Targeted Research Project (STREP)
Duration: October 1, 2012 – September 30, 2015
Coordinator: Center for Research and Telecommunication Experimentation for Network Communities (CREATE-NET) (Italy)
Other partners:
- Université D'Avignon et des Pays de Vaucluse (UAPV) (France)
- Technische Universiteit Delft (TUDelft) (The Netherlands)
- Imperial College of Science, Technology and Medicine (IMPERIAL) (United Kingdom)
- Universityá di Pisa (UNIPI) (Italy)
- Technion - Israel Institute of Techonology (TECH) (Israel)

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 (b) the competition of information in social networks.

K. Avrachenkov is the coordinator for INRIA. E. Altman is a scientific coordinator of the project.

7.2.1.2. TREND

Participants: Sara Alouf, Delia Ciullo.

> Title: Towards Real Energy-efficient Network Design
>
> Subprogramme Area: ICT-2009.1.1 The Network of the Future
>
> Instrument: Network of Excellence (NoE)
>
> Duration: September 1, 2010 – August 31, 2013
>
> Coordinator: Politecnico di Torino (PoliTO) (Italy)
>
> Other partners:
>
> - Alcatel-Lucent Bell Labs (France)
> - Huawei Technologies Dusseldorf GmbH (HWDU) (Germany)
> - Telefonica Investigacion y Desarrollo (TID) (Spain)
> - France Telecom - Orange (FT) (France)
> - Fastweb (FW) (Italy)
> - Universidad Carlos III (UC3M) (Spain)
> - iMinds (Belgium)
> - Technical University of Berlin (TUB) (Germany)
> - Ecole Polytechnique Fédérale de Lausanne (EPFL) (Switzerland)
> - Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT) (Italy)
> - Panepistimio Thessalias - University of Thessaly (UTH) (Greece)
>
> Collaborating institutions:
>
> - Fondazione Ugo Bordoni (Italy)
> - Technische Universitat Dresden (Germany)
> - Deutsche Telekom Laboratories (Germany)
> - Institute IMDEA Networks (Spain)
> - CNR Institute for High Performance Computing and Networking (ICAR-CNR) (Italy)
> - International Hellenic University (Greece)
> - Institut National de Recherche en Informatique et en Automatique (Inria) (France)
> - Boston University (United States)
>
> See also: http://www.fp7-trend.eu/
>
> Abstract: TREND aims at integrating the activities of major European players in networking, including manufacturers, operators, research centers, to quantitatively assess the energy demand of current and future telecom infrastructures, and to design energy-efficient, scalable and sustainable future networks.

MAESTRO's task is to propose and analyze energy-aware network cellular network design and management, in collaboration with the other partners.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. GANESH

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 - D. Manjunath

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 contributionis to the foundations of the theory of networks, in game theory, team theory, optimization and analysis. Three areas in networkiing will be used to apply these: (i) economy of networks and network neutrality, (2) schedulling in wireless networks, and (3) distributed optimization issues in ad-hoc networks.

7.3.2. Inria International Partners

7.3.2.1. St. Petersburg State Univ.
Participant: Konstantin Avrachenkov.

MAESTRO has a continuing collaboration with St. Petersburg State Univ.. St. Petersburg State Univ. is a partner in INRIA Internship International programme. In particular, MAESTRO hosts every year several intern students from St. Petersburg State Univ.. The collaboration with L. Petrosyan and A. Garnaev is on the application of game theory to resource allocation in networks. The collaboration with V. Dobrynin is on data clustering.

7.3.3. Participation In International Programs

7.3.3.1. STIC Tunisie
Participants: Eitan Altman, Majed Haddad.

E. Altman and M. Haddad have been collaborating with I. Mabrouki (Institut Supérieur d'Informatique et des Techniques de Communication, Tunisia) on intelligent jamming in wireless networks, i.e. jamming in which the jammer is aware of the protocol used by the network.

7.3.3.2. Indo-French Centre for the Promotion of Advanced Research (IFCPAR)
Participants: Eitan Altman, Konstantin Avrachenkov, Manjesh Kumar Hanawal.

Within project 4000-IT on "Emerging Strategies for Wireless Communication Networks," K. Avrachenkov, E. Altman and M. K. Hanawal (also with Univ. Avignon/LIA) have been collaborating with V. Borkar and V. Kavitha (IIT Mumbai, India), A. Kumar, R. Sundaresan and C. Singh (Indian Institute of Science, India) on evaluating and optimization issues in wireless networks. They also worked on network neutrality issues.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Professors / Researchers

        Abdelfettah Belghith (from October 15, 2012 until October 20, 2012)

            Institution: ENSI, Univ. of Manouba (Tunisia)

        Amel Ben Slimane (from October 15, 2012 until October 20, 2012)

            Institution: ENSI, Univ. of Manouba (Tunisia)

        Vivek Borkar (from June 3, 2012 until June 23, 2012)

            Institution: Indian Institute of Technology Bombay (India)

        Ananthanarayanan Chockalingam (from June 11, 2012 until June 22, 2012)

            Institution: Indian Institute of Science (India)

        Jerzy Filar (from June 21 2012 until July 7 2012)

            Institution: Flinders Univ. (Australia)

        David Hay (from June 25, 2012 until June 26, 2012)

            Institution: Hebrew Univ. of Jerusalem (Israel)

        Nelly Litvak (from November 4, 2012 until November 8, 2012)

            Institution: Univ. of Twente (Netherlands)

        Issam Mabrouki (from October 15, 2012 until October 20, 2012)

            Institution: Univ. of Manouba (Tunisia)

        Evsey Morozov (from September 18, 2012 until September 23, 2012)

            Institution: Petrozavodsk State Univ. (Russian Federation)

        Balakrishna Prabhu (from November 21, 2012 until November 23, 2012)

            Institution: LAAS-CNRS (France)

        Rajesh Sundaresan (from May 24 until June 14, 2012)

            Institution: Indian Institute of Science (India)

        Uri Yechiali (from April 10, 2012 until April 25, 2012)

            Institution: Tel Aviv Univ. (Israel)

7.4.1.2. Post-doctoral fellows

        Andrey Lukyanenko (from November 16, 2012 until December 15, 2012)

            Institution: Aalto Univ. (Finland)

        Ali Jahromi (from June 24, 2012 until June 30, 2012)

            Institution: Univ. of Adelaide (Australia)

        Bruno Ribeiro (from February 4, 2012 until March 7, 2012)

            Institution: BBN Technologies (USA)

7.4.1.3. Ph.D. students

        Mohammad Abdel Rahman (from June 27, 2012 until August 14, 2012)

            Subject: Elaborating new mobility models for ad hoc networks

            Institution: Univ. of Arizona (USA)

        Nicolas Accettura (from February 2012 until August 2012)

            Subject: Population size estimation

            Institution: Politecnico di Bari (Italy)

Rodrigo Vaca Ramirez (from November 23, 2012 until February 20, 2013)

Subject: Vertical handover framework towards energy efficiency

Institution: Univ. of Edinburgh

7.4.1.4. Graduate students

Imen Mahjri (from October 1, 2012 until December 31, 2012)

Subject: Road Traffic Mobility Models in Complex Systems

Institution: ENSI, Univ. of Manouba (Tunisia)

Yonathan Portilla (From April 23, 2012 until July 6, 2012)

Subject: Analyzing the evolution of written language in Twitter

Institution: Univ. of Avignon

7.4.1.5. Internships

Sushma Hanawal (from August 2012 until February 2013)

Subject: Creation, Simulation and Multidiscipline Evaluation of Dynamic Mobility Models in Complex Systems

Institution: SJCE Mysore (India)

Vasily Medyanikov (from June 20, 2012 until September 29, 2012)

Subject: Monte Carlo Methods for Centrality Measures in Online Social Networks

Institution: St. Petersburg State Univ. (Russian Federation)

7.4.2. Visits to International Teams

MAESTRO members have visited (the)

- Basque Center for Applied Mathematics (BCAM), Bilbao, Spain in the period June 19–20, 2012 (**S. Alouf**);

- BBN Technologies, Cambridge, MA, USA in the periods November 12–13 and 15–16, 2012 (**G. Neglia**);

- École polytechnique fédérale de Lausanne (EPFL), Switzerland in the period November 5–9, 2012 (**D. Ciullo**);

- Fordham Univ. at Rose Hill campus, Bronx, NY, USA in the period November 19–21, 2012 (**G. Neglia**);

- GERAD, Univ. Montreal, Canada in the period April 16–May 11, 2012 (**A. Jean-Marie**);

- Indian Institute of Science (IISc), Bangalore, India in the periods January 10–20, 2012 and July 12–19, 2012 (**E. Altman**);

- Politecnico di Torino, Italy in the period July 23–27, 2012 (**D. Ciullo**);

- Univ. of Liverpool, UK in the period May 14–18 (**K. Avrachenkov**);

- Univ. of Massachusetts at Amherst, USA in the periods February 13–15 and November 20–28, 2012 (**P. Nain**) and on November 14, 2012 (**G. Neglia**);

- Univ. of Palermo, Italy in the period December 17–21, 2012 (**G. Neglia**);

- Univ. of Twente, Enschede, The Netherlands in the period March 26–30 (**K. Avrachenkov**).

MASCOTTE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Jeunes Chercheurs DIMAGREEN, 09/2009-08/2012

Participants: David Coudert, Frédéric Giroire, Alvinice Kodjo, Joanna Moulierac, Nicolas Nisse, Truong Khoa Phan, Issam Tahiri.

The objectives of the project DIMAGREEN (DesIgn and MAnagement of GREEN networks with low power consumption) are to introduce and analyze energy-aware network designs and managements in order to increase the life-span of telecommunication hardware and to reduce the energy consumption together with the electricity bill.

(http://www-sop.inria.fr/teams/mascotte/Contrats/DIMAGREEN/index.php)

8.1.2. ANR Blanc AGAPE, 10/2009-09/2013

Participants: David Coudert, Frédéric Havet, František Kardoš, Ana Karolinna Maia, Grégory Morel, Nicolas Nisse, Stéphane Pérennes, Michel Syska.

The project AGAPE (Parameterized and exact graph algorithms) is led by MASCOTTE and implies also LIRMM (Montpellier) and LIFO (Orléans). The aim of AGAPE is to develop new techniques to solve exactly NP- hard problems on graphs. To do so, we envisage two approaches which are closely related ways to reduce the combinatorial explosion of NP-hard problems: moderately exponential exact algorithms and fixed-parameter tractability.

(http://www-sop.inria.fr/mascotte/Contrats/Agape.php)

8.1.3. ANR VERSO ECOSCells, 11/2009-12/2012

Participants: David Coudert, Issam Tahiri.

The ECOSCells (Efficient Cooperating Small Cells) project aims at developing the algorithms and solutions required to allow Small Cells Network (SCN) deployment. The consortium gathers industrial groups, together with 3 SMEs and 6 research institutes: ALCATEL-LUCENT BELL LABS (leader), ORANGE LABS, 3-ROAM, SEQUANS, SIRADEL, Inria teams MAESTRO, MASCOTTE and SWING, Université d'Avignon et des Pays de Vaucluse, Laboratoire des Signaux et Systèmes / Supelec, LAAS and Eurecom.

(http://perso.citi.insa-lyon.fr/hrivano/contrats/ecoscells.php)

8.1.4. Action ResCom, ongoing (since 2006)

Réseaux de communications, working group of GDR ASR, CNRS.

(http://citi.insa-lyon.fr/rescom/)

8.1.5. Action Graphes, ongoing (since 2006)

Action Graphes, working group of GDR IM, CNRS.

(http://www.labri.fr/perso/raspaud/pmwiki/pmwiki.php)

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. EULER

Participants: David Coudert, Luc Hogie, Aurélien Lancin, Bi Li, Nicolas Nisse, Stéphane Pérennes, Issam Tahiri.

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 - September 2013

Coordinator: ALCATEL-LUCENT (Belgium)

Others partners:

Alcatel-Lucent Bell, Antwerpen, Belgium

3 projects from Inria: CEPAGE, GANG and MASCOTTE, France

Interdisciplinary Institute for Broadband Technology (IBBT),Belgium

Laboratoire d'Informatique de Paris 6 (LIP6), Université Pierre Marie Curie (UPMC), France

Department of Mathematical Engineering (INMA) Université Catholique de Louvain, Belgium

RACTI, Research Academic Computer Technology Institute University of Patras, Greece

CAT, Catalan Consortium: Universitat Politecnica de Catalunya, Barcelona and University of Girona, Spain

See also: http://www-sop.inria.fr/mascotte/EULER/wiki/

Abstract: 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. The STREP EULER gathers 7 partners: Alcatel-Lucent Bell (leader) (Antwerp, Belgique), IBBT (Ghent, Belgium), UCL (Louvain, Belgium), RACTI (Patras, Grece), UPC (Barcelona, Spain), UPMC (ComplexNetworks, Paris 6), Inria (MASCOTTE, GANG, CEPAGE). MASCOTTE is the leader of WP3 on Topology Modelling and Routing scheme experimental analysis.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. PICS CNRS (with Charles University, Prague), 01/2009-12/2012

Participants: Frédéric Havet, František Kardoš, Leonardo Sampaio.

Bilateral collaboration funded by the french CNRS. The funding covers scientific visits and workshops.

On Graph coloring: theoretical and algorithmic aspects.

8.2.2.2. PHC PROCOPE (with Discrete Optimization group of RWTH Aachen University), 01/2011-12/2012

Participants: Christelle Caillouet, David Coudert, Alvinice Kodjo, Issam Tahiri.

Bilateral collaboration funded by the french ministry of foreign affairs (MAE), the french ministry of research and education (MESR), and the Deutscher Akademischer Austauschdienst (DAAD). The funding covers scientific visits.

"Défis algorithmiques dans les réseaux de communication". The purpose of the project is to exchange expertise between the discrete optimization group of RWTH Aachen University and the MASCOTTE team at Inria Sophia-Antipolis and to address algorithmic problems in communication networks.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. ANR International Taiwan GRATEL, 01/2010 – 12/2013
Participants: Jean-Claude Bermond, Frédéric Havet, František Kardoš, Leonardo Sampaio.

GRATEL (Graphs and Telecomunications) has been started in collaboration with LABRI Bordeaux, UJF Grenoble and three partners in Taiwan: Sun Yat-sen University, the National Taiwan University and Academia Sinica.

(https://gratel.labri.fr/pmwiki.php?n=Main.HomePage)

8.3.2. Participation In International Programs

Inria FUNCAP (Inria-FAP): ALERTE (ALgorithmes Efficaces pour les Réseaux de TÉlécommunications), with Pargo Team, Universidade Federal do Ceará, Brazil, accepted in June 2011.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Jørgen Bang-Jensen: University of Southern Denmark, Odensee, Denmark, May 1-31, 2012 (1 month);

Tom Bouvier: Université Bordeaux 1, Bordeaux, France, May 21-25, 2012 (1 week);

Xavier Defago: JAIST, School of Information Science, Ishikawa, Japan, March 5-23, last week of June, September 12 - 30, 2012 (2 months);

Michele Flammini: University of L'Aquila, Italy, June 18 - July 13 (3 weeks);

Ararat Harutyunyan: Simon Fraser University, Vancouver, Canada, May 19-27, 2012 (1 week);

Brigitte Jaumard: Concordia University, Montréal, Canada, April 23 - May 5, 2012 (3 weeks);

Mejdi Kaddour: University of Oran, Algeria, April 22 - 28, November 21-28, 2012 (2 weeks);

Takako Kodate: Tokyo Woman's Christian University, Suginami-ku, Tokyo, Japan, March 19-29 (2 weeks);

Uéverton Souza Dos Santos: Fluminense Federal University, Brazil, July 13-30, 2012 (3 weeks);

Amel Tandjaoui: University of Oran, Algeria, October 16 - November 16, 2012 (1 month);

Martin Tieves: RWTH Aachen University, Germany, December 16-21, 2012 (1 week);

Joseph Yu: Abbotsford and SFU, Vancouver, Canada, March 1 - April 20, 2012 (1 month 1/2).

8.4.2. Visits to International Teams

J.-C. Bermond: Orsay (March 23, 2012); Athens (May 20-29, 2012);

C. Caillouet: FUN Team, Inria Lille Nord Europe (July 1-6, 2012); Mathematics departement of RWTH Aachen, Germany (July 29-August 5, 2012);

D. Coudert: Alcatel-Lucent Bell labs, Antwerpeen, Belgium (January 10-12, 2012); Mathematics departement of RWTH Aachen, Germany (July 24-27, 2012);

F. Giroire: LIP, ENS Lyon (January 23-27, 2012);

F. Havet: LIP, ENS Lyon (January 23-27, 2012); Federal University of Ceara, Brasil (April 21-28, 2012); LABRI, University of Bordeaux 1 (July 9-11 2012);

A. Lancin: LABRI, University of Bordeaux 1 (March 5-7, 2012);

N. Nisse: LIP, ENS Lyon (January 23-27, 2012); LIF, Univ. Marseille (February 20-22, 2012); LRI, Univ. Paris-Sud 11 (March 19-20, 2012); Adolfo Ibanez University, Santiago, Chile (August 4-20, 2012);

T. K. Phan: Mathematics departement of RWTH Aachen, Aachen, Germany (August 26 -September 01, October 14 - December 06, 2012);

R. Soares: LABRI, University of Bordeaux 1 (March 5-10, 2012).

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, https://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.

8.1.2. High Performance Computing Center

- The ICluster2, the IDPot and the new Digitalis Platforms

The MESCAL project-team manages a cluster computing center on the Grenoble campus. The center manages different architectures: a 48 bi-processors PC (ID-POT), and the center is involved with a cluster based on 110 bi-processors Itanium2 (ICluster-2) and another based on 34 bi-processor quad-core XEON (Digitalis) located at Inria. The three of them are integrated in the Grid'5000 grid platform.

More than 60 research projects in France have used the architectures, especially the 204 processors Icluster-2. Half of them have run typical numerical applications on this machine, the remainder has worked on middleware and new technology for cluster and grid computing. The Digitalis cluster is also meant to replace the Grimage platform in which the MOAIS project-team is very involved.

- The Bull Machine

In the context of our collaboration with Bull the MESCAL project-team exploits a Novascale NUMA machine. The configuration is based on 8 Itanium II processors at 1.5 Ghz and 16 GB of RAM. This platform is mainly used by the Bull PhD students. This machine is also connected to the CIMENT Grid.

- GRID 5000 and CIMENT

The MESCAL project-team is involved in development and management of Grid'5000 platform. The Digitalis and IDPot clusters are integrated in Grid'5000. Moreover, these two clusters take part in CIMENT Grid. More precisely, their unused resources may be exploited to execute jobs from partners of CIMENT project.

8.2. National Initiatives

8.2.1. "Action d'envergure"

- *HEMERA, 2010-2012*

Leading action "Completing challenging experiments on Grid'5000 (Methodology)"

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 con- trolled 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. This encompasses several aspects.

8.2.2. ARC Inria

- *Meneur 2011-2013*:

Partners: EPI Dionysos, EPI Maestro, EPI MESCAL, EPI Comore, GET/Telecom Bretagne, FTW, Vienna (Forschungszentrum Telekommunikation Wien), Columbia University, USA, Pennsylvania State University, USA, Alcatel-Lucent Bell Labs France, Orange Labs.

The goal of this project is to study the interest of network neutrality, a topic that has recently gained a lot of attention. The project aims at elaborating mathematical models that will be analyzed to investigate its impact on users, on social welfare and on providers' investment incentives, among others, and eventually propose how (and if) network neutrality should be implemented. It brings together experts from different scientific fields, telecommunications, applied mathematics, economics, mixing academy and industry, to discuss those issues. It is a first step towards the elaboration of a European project.

8.2.3. ANR

- *Clouds@home, 2009-2013*

The overall objective of this project is to design and develop a cloud computing platform that enables the execution of complex services and applications over unreliable volunteered resources over the Internet. In terms of reliability, these resources are often unavailable 40% of the time, and exhibit frequent churn (several times a day). In terms of "real, complex services and applications", we refer to large-scale service deployments, such as Amazon's EC2, the TeraGrid, and the EGEE, and also applications with complex dependencies among tasks. These commercial and scientific services and applications need guaranteed availability levels of 99.999% for computational, network, and storage resources in order to have efficient and timely execution.

- *SPADES, 2009-2012*

Partners: Inria GRAAL, Inria GRAND-LARGE, CERFACS, CNRS, Inria PARIS, LORIA

Petascale systems consisting of thousands to millions of resources have emerged. At the same, existing infrastructure are not capable of fully harnessing the computational power of such systems. The SPADES project will address several challenges in such large systems. First, the members are investigating methods for service discovery in volatile and dynamic platforms. Second, the members creating novel models of reliability in PetaScale systems. Third, the members will develop stochastic scheduling methods that leverage these models. This will be done with emphasis on applications with task dependencies structured as graph.

- *ANR SONGS, 2012-2015*

Partners: Inria Nancy (Algorille), Inria Sophia (MASCOTTE), Inria Bordeaux (CEPAGE, HiePACS, Run-Time), 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 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 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.

8.3. European Initiatives

8.3.1. FP7 EDGI (European Desktop Grid Initiative)

Partners: SZTAKI insitute (Hungary), CIEMAT (Spain), Univ. Coimbra (Portugal), Univ Cardi (UK), Univ Westminster (UK), AlmereGrid (NL), IN2P3 (FR), Inria (GRAAL, MESCAL)

Years: 2010-2012

EDGI is an FP7 European project whose goal is to build a Grid infrastructure composed of "Desktop Grids", such as BOINC or XtremWeb, where computing resources are provided by Internet volunteers, and "Service Grids", where computing resources are provided by institutional Grid such as EGEE, gLite, Unicore and "Clouds systems" such asOpenNebula and Eucalyptus, where resources are provided on-demand. The EDGI infrastructure will consist of Service Grids that are extended with public and institutional Desktop Grids and Clouds.

8.3.2. FP7 Mont-Blanc project: European scalable and power efficient HPC platform based on low-power embedded technology

FP7 Programme: ICT-2011.9.13 Exa-scale computing, software and simulation

Mont-Blanc Partners: BSC (Barcelone), Bull, ARM (UK), Julich (Germany), Genci, CINECA (Italy), CNRS (LIRMM, LIG)

Duration: 3 Years from 1/10/2011

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.

8.3.3. Collaborations in European Programs, except FP7

- ESPON :

The MESCAL project-team participates to the ESPON (European Spatial Planning Observation Network) http://www.espon.lu/ It is involved in the action 3.1 on tools for analysis of socio-economical data. This work is done in the consortium hypercarte including the laboratories LIG, Géographie-cité (UMR 8504) and RIATE (UMS 2414). The Hyperatlas tools have been applied to the European context in order to study spatial deviation indexes on demographic and sociological data at nuts 3 level.

8.4. International Initiatives

8.4.1. Inria Associated Teams

8.4.1.1. Cloud Computing at Home

Title: Cloud Computing over Internet Volunteer Resources

Inria principal investigator: Derrick Kondo

International Partner:

Institution: University of California Berkeley (United States)

Laboratory: Space Sciences Laboratory

Researcher: David P.

Duration: 2012 - 2013

See also: http://mescal.imag.fr/membres/derrick.kondo/ea/ea.html

Recently, a new vision of cloud computing has emerged where the complexity of an IT infrastructure is completely hidden from its users. At the same time, cloud computing platforms provide massive scalability, 99.999% reliability, and speedy performance at relatively low costs for complex applications and services. In this proposed collaboration, we investigate the use of cloud computing for large-scale and demanding applications and services over the most unreliable but also most powerful resources in the world, namely volunteered resources over the Internet. The motivation is the immense collective power of volunteer resources (evident by FOLDING@home's 3.9 PetaFLOPS system), and the relatively low cost of using such resources. We will address these challenges drawing on the experience of the BOINC team which designed and implemented BOINC (a middleware for volunteer computing that is the underlying infrastructure for SETI@home), and the MESCAL team which designed and implemented OAR (an industrial-strength resource management system that runs across France's main 5000-node Grid called Grid'5000).

8.4.2. Inria International Partners

- MESCAL has strong connections with both UFRGS (Porto Alegre, Brazil) and USP (Sao Paulo, Brazil). This year, Jean-François Méhaut visited both laboratories in July. The creation of the LICIA common laboratory (see next section) will make this collaboration even tighter.

- MESCAL has strong bounds with the University of Illinois Urbana Champaign, within the (Joint Laboratory on Petascale Computing (see next section). Slim Bouguerra is visiting JLPC for an extended period (one year).

- MESCAL also has long lasting collaborations with University of California in Berkeley and a new one with Google. Bruno Gaujal, Derrick Kondo and Arnaud Legrand visited Berkeley in 2012.

8.4.3. Participation In International Programs

8.4.3.1. Africa

- SARIMA and IDASCO / LIRIMA (Cameroon)

MESCAL takes part in the SARIMA (Soutien aux Activités de Recherche Informatique et Mathématiques en Afrique http://www-direction.inria.fr/international/AFRIQUE/sarima.html) project and more precisely with the University of Yaoundé 1. Cameroon student Blaise Yenké completed his PhD under the joint supervision of Professor Maurice Tchuenté. SARIMA also funded Adamou Hamza to prepare his Master Thesis during three months in the MESCAL project-team. SARIMA proposed J-F Méhaut to give a course on Operating System and Networks at Master Research Students. In addition, MESCAL participates in the IDASCO joint project with the University of Yaoundé 1. This is part of the international LIRIMA laboratory, whose goal to develop novel methods and tools for collecting and analyzing massive data sets from biological or environmental domains.

8.4.3.2. North America

- Google Derick Kondo has received a Google Research Award for 2011-2012 for his proposal on predicting idleness in data centers. The technical goal of the proposed work is to give probabilistic guarantees on when data centers are idle. The implication of such predictions is improved data center utilization, while reducing and amortizing monetary costs. The general goal of this award is to facilitate collaboration between Google Inc. and academic researchers. Google Inc. provides the award as an unrestricted gift without constraints on intellectual property.

- JLPC (Joint Laboratory on Petascale Computing) (with University of University of Illinois Urbana Champaign. Several members of MESCAL are partners of this laboratory, and have paid several visits to Urbana-Champaign. Slim Bougherra (Mescal Postdoc) is visiting JLPC for one year, starting Jan. 2012.

8.4.3.3. 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*). On the French side, the laboratory is co-directed by Yves Denneulin and Jean-Marc Vincent.

  The main themes are artificial intelligence, high performance computing, information representation, interfaces and visualization as well as distributed systems.

  More information can be found on http://www.inf.ufrgs.br/licia/.

MOAIS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- **ANR grant REPDYN (2010-2012).** High performance computing for structure and fluid computing. Partners: Inria Rhône-Alpes, CEA, ONERA, EDF, LaMSID lab from CNRS and LaMCoS lab from INSA Lyon.
- **ANR/JST grant PETAFLOW (2010-2012).** France/Japan international program. Peta-scale data intensive computing with transnational high-speed networking: application to upper airway flow. Inria Rhône-Alpes, Gipsa-lab from UJF, NITC (Japan), Cyber Center of Osaka, DITS (Osaka) and the Visualization Lab of Kyoto.
- **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.

8.1.2. Competitivity Clusters

- CILOE, 2008-2012, Minalogic: This project is to develop tools and high level interfaces for compute-intensive applications for nano and micro-electronic design and optimizations. The partners are: two large companies CS-SI (leader), Bull; three small size companies EDXACT, INFINISCALE, PROBAYES; and four research units Inria, CEA-LETI, GIPSA-LAB, TIMA. For Moais, the contract funds the phD thesis of Jean-Noel Quintin.
- SHIVA, Minalogic 2009-2012 contract. This project aims at the development of a high throughput backbone ciphering that ensures a high level of security for intranet and extranet communications over internet. The partners are: CS-SI (leader); 1 small size companies: Easii-IC (support for Xilinx FPGA) IWall-Mataru (key management), Netheos (customizable FPGA for ciphering); INRIA; CEA-LETI (security certification); Grenoble-INP (TIMA lab, integration of cryptography on FPGA); UJF (LJK and Institut Fourier: open cryptographic protocols and handshake; VERIMAG: provable security). Within Inria, the MOAIS and the PLANET teams provide the parallel implementation on a multicore pltaform of IP-Sec and coordination with hardware accelerators (Frog?s and GPUs). The contract funds the phD thesis of Ludovic Jacquin, coadvised by PLANET and MOAIS and a 1 year engineer (Fabrice Schuler, from 11/2010).
- 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 and 1 year engineer.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. VISIONAIR

Title: VISIONAIR

Type: CAPACITIES (Infrastructures)

Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUP-PORT ACTIONS (CPCSA)

Duration: February 2011 - January 2015

Coordinator: Grenoble-INP, France

Others partners: http://www.infra-visionair.eu/members.html

See also: http://www.infra-visionair.eu/

VISIONAIR European platform. With the Grimage platform, we participate to the European project Visionair which objective is to provide an infrastructure that gathers advanced visualization and interaction infrastructures. Visionair is leaded by Grenoble-INP (Frédéric Noel, G-Scop lab) and gathers 25 international partners from 12 countries; it has been funded in 2010 and start in Q1 2011.

8.2.2. Collaborations with Major European Organizations

- **ADT Vcore (2011-2013)**. Partners: Fraunhofer IGD (Darmstad), Inria IMAGINE and MOAIS (Grenoble), SHAMAN and MINT (Lille), VR4i (Rennes), IN SITU (Saclay), SED Sophia Antipolis. This project is currently an ADT Inria (funds IJD). Software infrastructure for advanced applications in augnmented and virtual reality.

8.3. International Initiatives

8.3.1. Inria International Partners

MOAIS has a long term collaboration with several universities in Brazil, and in particular with UFRGS, Porto Alegre and USP, Sao Paulo. Several mobility grants support these collaborations:

- Inria Diode-A associated team (2006-2011),
- CNRS/Cnpq (2011-2013).
- Inria/Cnpq (2008-2010),
- Capes/Cofecub (2006-2007, 2008-2009, 2010-2012),
- Associated International Laboratory LICIA (http://www.inf.ufrgs.br/licia) funded by CNRS (since 2011).

This collaboration is important to get access to high quality students. Classically students pursue their PhD in our team full or half time in "co-tutelle" (double graduation). These PhDs are almost all funded by Brazil. Over the 2008-2012 period, 5 PhD students (3 from UFRGS, 2 from USP) were advised at Moais. Initially based on experimented researcher exchanges, the increase of fundings enabled to involve Master students that usually stay 2-4 months in our team and often come back later for a PhD.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Wieslaw Kubiak (memorial Univiersity, New Foundland, Canada), invited prof UJF (2 months)
- Joseph Peters (SFU Vancouver, Canada, contract INP VOLVIC (3 months)

8.4.1.1. Internships

Julio TOSS (from Apr 2012 until Sep 2012)

> Subject: A new programming paradigm for GPU
>
> Institution: Universidade Federal do Rio Grande do Sul (Brazil)

Nikhil BANSAL (from Jun 2012 until Sep 2012)

> Subject: Multi-objective optimization strategies for parallel multi-users applications
>
> Institution: IIT Delhi (India)

MYRIADS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. HOCL4WS (2010-2012)

Participants: Thierry Priol, Cédric Tedeschi, Marko Obrovac.

The objective of the HOCL4WS project is to develop a prototype of a middleware system for the distributed execution of chemical programs (targeted for large scale platforms). It partially funds Marko Obrovac's PhD grant.

8.1.2. ASYST (2010-2013)

Participants: Djawida Dib, Christine Morin, Nikos Parlavantzas.

The objective of the ASYST project (*Adaptation dynamique des fonctionnalités d'un SYSTème d'exploitation large échelle*) funded by the Brittany council is to provide the view of an Operating System as an "Infrastructure as a Service" (IaaS) and even more as a set of adaptable services. The main functionalities of an Operating System such as memory allocation or job scheduling have to be dynamically adapted to cope with the ever changing environment. This project funds 50% of a PhD grant (Djawida Dib).

In 2012, we have worked on the design and implementation of a PaaS framework for scaling up and down virtual clusters under SLA constraints (price and completion time).

8.2. National Initiatives

8.2.1. ECO-GRAPPE ANR ARPEGE Project (2008-2012)

Participants: Eugen Feller, Christine Morin.

The goal of the ECO-GRAPPE project (http://ecograppe.inria.fr/) funded under the ANR ARPEGE program is to design, implement and validate energy saving policies in clusters.This project funds a PhD grant (Eugen Feller). Partners involved in the ECO-GRAPPE project are EDF R&D and Kerlabs.

In 2012, we completed the implementation of the energy saving algorithms and mechanisms in Snooze and evaluated them experimentally with an elastic web service [39], [26], [48], [24], [8]. We also studied a fully decentralize approach to VM consolidation [47], [23]

8.2.2. COOP ANR COSINUS Project (2009-2013)

Participants: Yvon Jégou, Christine Morin, Yann Radenac.

The COOP project (http://coop.gforge.inria.fr/) funded under the ANR COSINUS program relates to multi level cooperative resource management. The two main goals of this project are to set up a cooperation as general as possible with respect to programming models and resource management systems (RMS) and to develop algorithms for efficient resource selection. Experimentations will be conducted in particular with the SALOME platform and TLSE as examples of programming environments and Marcel, DIET and XtreemOS as examples of RMS. Partners involved in the COOP project are the GRAAL and RUNTIME INRIA EPI, IRIT and EDF R&D. This project funds a research engineer (Yann Radenac).

In 2012, we completed the design and implementation of the modifications needed in XtreemOS Grid distributed operating system in order to integrate the CooRM architecture defined by the Avalon Inria team to support dynamic applications.

8.2.3. CLOUD ANR project (October 2011 - September 2012)

Participants: Sajith Kalathingal, Christine Morin.

The CLOUD project aims at extending an XtreemOS Grid with resources dynamically provisioned from IaaS clouds. An algorithm to select resources in a multi-cloud environment will be defined. A prototype based on XtreemOS Grid and OpenNebula and Nimbus clouds will be built. This project is related to the EIT ICT labs activity 10239 on cloud computing. It funds a research engineer.

In 2012, we augmented XtreemOS Grid distributed system with the capability to acquire virtual resources from cloud service providers. To this end, we enable XtreemOS to provision and configure cloud resources both on behalf of a user and of a virtual organization. We implemented our approach as a set of extension modules for XtreemOS and we evaluated the prototype on Grid'5000 experimentation platform using cloud resources provisioned from a private OpenNebula cloud [58], [60].

8.2.4. MIHMES ANR Investissements d'Avenir (January 2012 - December 2018)

Participants: Christine Morin, Yvon Jégou.

The MIHMES 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 2012, we collected the requirements from the bio-informatics applications and defined a workplan to experiment them on top of the cloud technologies developed by Myriads project-team.

8.2.5. HEMERA Inria AEN (2010-2013)

Participants: Christine Morin, Yvon Jégou.

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.

In 2012, several members of Myriads project-team performed large scale experiments to evaluate the systems and services they proposed. The results obtained are described in our publications.

8.2.6. Inria ADT Aladdin (2008-2012)

Participants: Ghislain Charrier, Yvon Jégou, David Margery, Pascal Morillon.

The Aladdin technological development action funded by INRIA aims at the construction of a scientific instrument for experiments on large-scale parallel and distributed systems, building on the Grid'5000 platform (http://www.grid5000.fr). It structures INRIA's leadership role as the institute is present in 8 of the 9 Grid'5000 sites distributed across France.

An executive committee, where each of the 10 project-teams supporting Grid'5000 in the 8 research centers is represented, meets every month. It gives recommendations to the directors on scientific animation, access policy to the instrument as well as for the hardware and software development according to the resources devoted to this ADT. Yvon Jégou represents INRIA Rennes in this executive committee.

The technical team is now composed of 12 engineers, of which 3 are hosted in the Myriads team (David Margery, technical director, (SED [2] member), Pascal Morillon (SED member), Ghislain Charrier).This technical team is structured in a sysadmin team, managing the instrument, and a development team building the tools to build, execute and analyze experiments.

---

[2]The SED is the INRIA Experimentation and Development Service.

8.2.7. Inria ADT XtreemOS Easy (2010-2012)

Participants: Amine Belhaj, Rémy Garrigue, Yvon Jégou, David Margery, Christine Morin.

The XtreemOS EASY technological development action funded by INRIA aims at developing a set of tools and environments to ease the installation, configuration, deployment, experimentation and use of the XtreemOS Grid operating system and at providing support to the XtreemOS open source community. Two associate engineers are involved in this project: Amine Belhaj and Rémy Garrigue. David Margery (SED) is tutoring them in software development.

In 2012, we completed a major release of XtreemOS system for the OpenSuse Linux distribution. We operated the open testbed and built ready-to-use virtual machine images to ease the use of the system. We also provided support to the user community.

8.2.8. Inria ADT DAUM (2011-2012)

Participants: Erwan Daubert, Jean-Louis Pazat.

We participate to the ADT DAUM which is coordinated by the Triskell project-team. DAUM is a a Technology Development Action (ADT) by INRIA aiming at providing an integrated platform for distributed dynamically adaptable component based applications. DAUM unites and integrates results and software from the Triskell EPI and the Myriads team. More precisely, DAUM extends the Kevoree component framework designed by Triskell with adaptation mechanisms from the SAFDIS framework designed by Myriads.

DAUM will evaluate this integration by designing a full scale system for a tactical assistant for firefighter officers, in collaboration with the firefighters organization of Ille et Vilaine department (2800 firefighters).

Project duration: October 2011 - September 2012

Triskell budget share: One associated engineer shared with the Triskell EPI

Project Coordinator: Noël Plouzeau, Triskell INRIA Project.

Participants: Myriads, Triskell.

8.2.9. Inria ADT Snooze (2012-2014)

Participants: 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 wider community.

In 2012, we validated Snooze on top of Xen hypervisor. We also started re-implementing Snooze based on the Akka library providing asynchronous data communication. We studied how to re-use in Snooze some OpenStack components such as the image repository storage. We deployed Snooze on multiple sites of the Grid'5000 platform. We implemented the libcloud driver for Snooze.

8.2.10. 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 practicies in order to improve the energy efficiency of printers, servers, datacenters, and any ICT equipment in use in public research organizations.

8.2.11. Competitivity Clusters

The COOP ANR project is recognized by the Images & Réseaux cluster.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. S-CUBE

Participants: Erwan Daubert, Guillaume Gauvrit, André Lage, Jean-Louis Pazat, Chen Wang.

Title: S-CUBE

Type: COOPERATION (ICT)

Defi: Service & SW architectures, infrastructures and engineering

Instrument: Network of Excellence (NoE)

Duration: March 2008 - February 2012

Coordinator: Universität Duisburg-Essen (Germany)

Others partners: Tilburg University (The Netherlands), City University London (UK), Consiglio Nazionale delle Ricerche (Italy), Center for Scientific and Technological Research, The French National Institute for Research in Computer Science and Control, Lero - The Irish Software Engineering Research Centre (Ireland), Politecnico di Milano (Italy), MTA SZTAKI - Computer and Automation Research Institute, Vienna University of Technology (Austria), Université Claude Bernard Lyon (France), University of Crete,Universidad Politécnica de Madrid (Spain), University of Stuttgart(Germany)

See also: http://www.s-cube-network.eu/

Abstract: S-Cube, the Software Services and Systems Network, will establish an integrated, multidisciplinary, vibrant research community which will enable Europe to lead the software-services revolution, thereby helping shape the software-service based Internet which is the backbone of our future interactive society. An integration of research expertise and an intense collaboration of researchers in the field of software services and systems are needed to address the following key problems:

Research fragmentation: Current research activities are fragmented and each research community (e.g., grid computing or software engineering) concentrates mostly on its own specific techniques, mechanisms and methodologies. As a result the proposed solutions are not aligned with or influenced by activities in r

8.3.1.2. CONTRAIL

Participants: Roberto-Gioacchino Cascella, Florian Dudouet, Filippo Gaudenzi, Piyush Harsh, Yvon Jégou, Christine Morin.

Title: Contrail

Type: COOPERATION (ICT)

Defi: Internet of Services, Software & Virtualisation

Instrument: Integrated Project (IP)

Duration: October 2010 - September 2013

Coordinator: INRIA (France)

Others partners: 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; EBM WebSourcing, France.

See also: http://contrail-project.eu/

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 will provide a complete Cloud platform which integrates Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) offerings [44], [55].

In 2012, we led the revision of Contrail overall architecture [42]. We also progressed on the design and implementation of VEP advanced features such as the reservation manager and scheduler [43]. We defined a revised version of the API. We worked on the integration of VEP with the other Contrail components. We set up an open permanent testbed for VEP and a testbed running Contrail software stack for internal use by consortium members to allow extensive tests with applications. Christine Morin is the coordinator of Contrail project and Roberto Cascella is the technical manager. She leads WP 10. Yvon Jégou leads WP 5 on VEP and WP 13 on testbeds.

8.3.1.3. HARNESS

Participant: Guillaume Pierre.

Title: Hardware- and Network-Enhanced Software Systems for Cloud Computing

Type: COOPERATION (ICT)

Defi: Pervasive and Trusted Network and Service Infrastructures

Instrument: STREP

Duration: October 2012 - September 2015

Coordinator: Imperial College (United Kingdom)

Others partners: École Polytechnique Fédérale de Lausanne, Konrad-Zuse-Zentrum für Informationstechnik Berlin, Maxeler Technologies and SAP AG.

See also: http://www.harness-project.eu/

Abstract: Cloud computing systems are currently composed of large numbers of relatively inexpensive computers, interconnected by standard IP routers and supported by stock disk drives. However, many demanding applications have now reached a fundamental limit in their ability to scale out using traditional machines. Future performance improvements will derive from the use of high-end specialized equipment in addition to standard hardware: GPUs of course, but also FPGAs, programmable routers, and advanced storage technologies. In this context the European project HARNESS investigates: (i) how cloud providers may offer such extremely heterogeneous hardware to its users; and (ii) how cloud customers may make use of these heterogeneous resources to run their applications such that they exhibit the best possible price-performance tradeoff.

8.3.1.4. PaaSage

Participants: Christine Morin, Nikos Parlavantzas.

Title: PaaSage - Model-Based Cloud Platform Upperware

Type: ICT

Instrument: Large Scale Integrated Project

Duration: October 2012 - September 2016

Coordinator: ERCIM

Other partners: SINTEF, STFC, University of Stuttgart, CETIC, FORTH, BE.Wan, EVRY Solutions, SysFera, Flexiant, Lufthansa Systems AG, GWDG, Automotive Simulation Center Stuttgart

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

Abstract: Software developers targeting the Cloud want an easy way to develop their software in a fashion that exploits the full potential of the clouds, and still is able to run on any of the available offerings. Current platforms are heterogeneous and tend to impose a specific architecture on deployed applications. Accordingly, there is a significant dependency between client applications and the services provided by the platform. It is generally up to the developer to specify and exploit platform services to her best knowledge. However, the typical developer will neither know how to use these characteristics, nor how they impact on the overall behaviour and, what is more, how they relate to a given Cloud infrastructure. To address this complexity, PaaSage will deliver an open and integrated platform to support model-based lifecycle management of Cloud applications. The platform and the accompanying methodology will allow model-based development, configuration, optimisation, and deployment of existing and new applications independently of the existing Cloud infrastructures.

In 2012, we studied the state of the art and worked on the system requirements and specifications.

8.3.1.5. Eco2Clouds

Participants: David Margery, Christine Morin, Anne-Cécile Orgerie, Nicolas Lebreton.

Title: Experimental Awareness of CO2 in Federated Cloud Sourcing

Type: ICT

Instrument: STREP

Duration: October 2012 - September 2014

Coordinator: ATOS

Other partners: The University of Manchester, EPCC, HLRS, Politecnico Di Milano, Inria.

See also: http://eco2clouds.eu

Abstract: The ECO2CLOUD project tackles CO_2 emission awarness in virtualized infrastructures, applying its results to the BonFIRE facility. We specifically tackle the question of predicatable costs for the user despite the varying load on the infrastructure and tractable cost models and APIs to enable application deployment optimization and adaptation.

8.3.1.6. BonFire

Participants: Maxence Dunnewind, Eric Poupart, Nicolas Lebreton, David Margery, Cyril Rohr.

Title: BonFIRE, Building service testbeds on FIRE

Type: COOPERATION (ICT)

Defi: Future Internet experimental facility and experimentally-driven research

Instrument: Integrated Project (IP)

Duration: June 2010 - November 2013

Coordinator: ATOS SPAIN SA (Spain)

Others partners: The university of Edinburgh (U.K.); SAP AG (Germany); Universitaet Stuttgart (Germany); Fraunhofer-Gesellschaft zur Foaerung der Angewandten Forshung E.V (Germany); Interdisciplinary Institute for Broadband Technology (Belgium); Universidad Complutense De Madrid (Spain) ; Fundacio Privada I2CAT, Internet I Innovacio Digital A Catalunya (Spain); Hewlett-Packard Limited (U.K.); The 451 Group Limited (U.K.) Techniche Universitat Berlin (Germany); University of Southampton (U.K.); Inria (France); Instytut Chemii Bioorganicznej Pan (Poland); Nextworks (Italy); Redzinc Services Limited (Ireland); Cloudium systems Limited (Ireland); Fundacio Centro Technologico De Supercomputacion De Galicia (Spain); Centre d'Excellence en technologies de l'Information et de la communication (Belgium); University of Manchester (U.K.);

See also: http://www.bonfire-project.eu/

Abstract:he BonFIRE (Building service testbeds for Future Internet Research and Experimentation) project will design, build and operate a multi-site cloud facility to support applications, services and systems research targeting the Internet of Services community within the Future Internet (http://www.bonfire-project.eu/). The MYRIADS team is involved in this project as it hosts the Aladdin ADT.

In the context of BonFIRE, we operate one of the five cloud sites integrated into the BonFIRE cloud federation. This cloud site is based on OpenNebula and can be extended on-request to all the machines of the local Grid'5000 site. We have also contributed to the cloud federation layer and host the integration infrastructure for the project, generated from configuration management tools using puppet.

8.3.1.7. FED4FIRE
Participants: Nicolas Lebreton, David Margery.

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.

8.3.1.8. SCALUS Marie Curie Initial Training Networks (MCITN) (2009-2013)
Participant: Christine Morin.

Title: SCALUS - SCALing by means of Ubiquitous Storage

Type: PEOPLE (ICT)

Defi: elevating education, research, and development inside the area of storage architectures with a focus on cluster, grid, and cloud storage

Instrument: Marie Curie Initial Training Networks (MCITN)

Duration: 4 years

Coordinator: Padeborn University, Germany

Others partners: Paderborn Center for Parallel Computing (PC2), Germany ; BSC, Spain ; Durham University, UK ; Goethe Universität Frankfurt, Germany ; FORTH-ICS, Greece ; Universidad Politecnica De Madrid, Spain ; Ecole des Mines de Nantes, France ; XLAB, Slovenia ; Universität Hamburg, Germany ; Xyratex, UK ; Fujitsu Technology Solutions GmbH, Germany (associated partner) ; CERN, Switzerland (associated partner) ; Microsoft Research, UK (associated partner) ; NEC, Germany (associated partner) ; ORACLE, Germany (associated partner).

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

Abstract: The consortium of this Marie Curie Initial Training Network (MCITN) SCALing by means of Ubiquitous Storage (SCALUS) aims at elevating education, research, and development inside the area of storage architectures with a focus on cluster, grid, and cloud storage. The vision of the SCALUS MCITN is to deliver the foundation for ubiquitous storage systems, which can be scaled in arbitrary directions (capacity, performance, distance, security, . . .). The consortium involves 8 full academic partners, 2 full industrial partners and 5 additional associated industrial partners. Christine Morin participates in this project by co-advising with Professor Ludwig from the University of Hamburg a PhD student (Amandine Pignier) working on Load Balancing and Scheduling in Parallel and Cluster File Systems.

8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. ICT COST

Participants: Eugen Feller, Christine Morin, Anne-Cécile Orgerie.

- Program: ICT COST
- Project acronym: IC0804
- Project title: Energy efficiency in large scale distributed systems
- Duration: 23/01/2009 - 04/05/2013
- Coordinator: Professor Jean-Marc PIERSON, IRIT, France, http://www.irit.fr/cost804/
- Other partners: 22 COST countries and 7 non-COST institutions
- Abstract: The COST Action IC0804 proposes realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and Storage resources, their energy consumption is exponentially increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, network and applications. The Action characterizes the energy consumption and energy efficiencies of distributed applications. Then based on the current hardware adaptation possibilities and innovative algorithms it proposes adaptive and alternative approaches taking into account the energy saving dimension of the problem. The Action characterizes the trade-off between energy savings and functional and non-functional parameters, including the economic dimension.

In March 2012, Eugen Feller organized a meeting for the participants in the focus group on "Energy and QoS-Aware Workload Management in Clouds" in Rennes.

8.3.2.2. RMAC

Participants: Ancuta Iordache, Yvon Jégou, Christine Morin, Nikos Parlavantzas.

Program: EIT ICT Labs

Project acronym: RMAC

Project title: Resource Management Across Clouds

Duration: January-December 2012

Coordinator: Dick Epema, TU Delft and TU Eindhoven

Other partners: Institut Telecom, KTH, TU Delft and TU Eindhoven

See also: http://www.pds.ewi.tudelft.nl/ghit/projects/rmac/

Abstract: The main goal of this activity is to provide solutions for effective, efficient, elastic resource management across multiple clouds at the IaaS level for a wide range of application types (e.g., applications that fit the MapReduce paradigm and data-intensive applications) in federated public and private cloud infrastructures as extensions of the current systems of the partners.

In 2012, we implemented a new version of Resilin, a software which provides the Amazon Elastic MapReduce API and allows users to leverage resources from one or multiple public and/or private clouds. Resilin is now implemented as a distributed and loosely-coupled system whose business logic is separated into distinct services that can be distributed over the network, combined and reused. We also performed an extensive experimental evaluation conducted on multiple clusters of the Grid'5000 experimentation testbed [59], [31].

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. DataCloud@Work

Participants: Alexandra Carpen-Amarie, Christine Morin.

Title: DataCloud@Work

INRIA principal investigator: Gabriel Antoniu, Kerdata

International Partner: Valentin Cristea

Institution: University Polytechnical Bucharest (UPB)

Laboratory: Team of Prof. Valentin Cristea

Duration: 2010 - 2012

See also: http://www.irisa.fr/kerdata/doku.php?id=cloud_at_work:start

The goal of the Associated team is to study massive data management in cloud based service infrastructures. In this context, the Myriads team is involved in a study aiming at the integration of the BlogSeer large scale storage system in XtreemOS distributed system in a vision where XtreemOS is used for the management of IaaS clouds.

8.4.2. Participation In International Programs

Since September 2011, Christine Morin has been an affiliate at Lawrence Berkeley National Laboratory working in the Advanced Computing for Science (ACS) department of the Computational Research Division (CRD) headed by Deb Agarwal. She is actively engaged in three research collaborations with ACS personnel including data management frameworks for scientific applications in cloud environments (with Lavanya Ramakrishnan), use of data-mining and machine-learning techniques to improve resource and failure management in large-scale infrastructures (with Taghrid Samak), and providing community access to MODIS Satellite Reprojection and Reduction Pipeline and Data Sets [30](with Valerie Hendrix and Lavanya Ramakrishnan). During her 2-year sabbatical visit at the Lawrence Berkeley National Laboratory, Christine Morin is the scientific manager of the Inria@SiliconValley program [54]. Deb Agarwal visited Myriads team in May 2012. The Dalhis associate team proposal was submitted in September 2012.

8.5. International Research Visitors

8.5.1. Visits to International Teams

Eugen Feller did a 3-month internship at the Lawrence Berkeley National Laboratory from July to Septmeber 2012. This internship was partially funded by a fellowship from Ecole Doctorale Matisse. E. Feller has worked with L. Ramakrishnan and C. Morin on the evaluation of Hadoop MapReduce jobs in a virtualized environment.

Héctor Fernández did a 1-month internship at Vrije University in November 2011. This internship was funded by the S-Cube network of Excellence. H. Fernández worked with P. Lago on the simulation through the use of the chemical programming model of Agile Software engineering.

OASIS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR OMD2

Title: MultiDisciplinary Distributed Optimization

Program: Conception and Simulation 2008

Duration: July 2009 - September 2012

Coordinator: Renault

Others partners: SMEs: CD-adapco, SIREHNA, ACTIVEEON, academics: Inria, ENSM-SE, UTC, ECP, IRCCyN, ENS CACHAN, and consortium DIGITEO.

See also: http://omd2.scilab.org/

Abstract: OMD2 (MultiDisciplinary Distributed Optimization) is a national research project led by Renault and gathering several academics and industrial partners which aims at developing methods and tools to generalize the use of optimization on large scale engineering problems. Scilab is the chosen generic programming tool to gather the different developments in a unique optimization environment. ProActive Parallel Suite is used to execute the Workflows in parallel, and to manage the Grid and Cloud resources

7.1.2. ANR MCorePhP

Title: Multi-Core Parallel Heterogeneous Programming

Program: Blanc international

Duration: January 2010 - December 2012

Coordinator: Inria Oasis

Others partners: Tsinghua University Beijing (China)

See also: http://www-sop.inria.fr/oasis/mcorephp_home.htm

Abstract: McorePhP is dedicated to programming models and middleware for large-scale, multilevel infrastructures including multi-core, clusters, and large scale grid/cloud resources. We will ensure the compatibility of the new programming model with the China Grid specifications, and will assess the viability and efficiency of the approach on a large example from the area of bioinformatics.

7.1.3. ANR Soceda

Title: SOCial Event Driven Architecture

Program: Platform

Duration: July 2009 - September 2012

Coordinator: Linagora (ex EBM Web Sourcing)

Others partners: SMEs: ACTIVEEON, industry: Thales, OrangeLabs, academics: Inria, CNRS IMAG, LIRIS, ARMINES

See also: http://www.soceda.org/display/soceda/

Abstract: SocEDA is an ANR project of type Platform, also labelled by two competitiveness clusters, PEGASE and SCS. The aim is to provide a "Cloud based platform for large scale social aware Event-Driven Architecture (EDA)". OASIS is in charge of managing the storage and publication/subscription of events on the cloud.

7.1.4. 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.

7.1.5. CPER PacaGrid

Duration: January 2010 - December 2012

See also: http://www-sop.inria.fr/oasis/pacagrid/

Abstract: ProActive PacaGrid is a set of machines deployed at Inria Sophia Antipolis (1400 cores, 150 TB storage) accessible via Graphical Interactive interfaces based on ProActive Parallel Suite. This Grid is available for Inria, UNS, and PACA (regional) labs, as well as for SMEs for R&D purpose, and international partners in R&D projects. It has been funded by EU FEDER, PACA and Alpes Maritimes Landers, and EIT ICT Labs (about 1.7 MEuros in total). Users include for instance INRA (Institut de recherche en Agronomie), IPMC INSERM (Institut de Pharmacologie Moléculaire et Cellulaire), LCMBA (Laboratoire de Chimie des Molécules Bioactives et des Arômes), IGS (Laboratoire Information Génomique et Structurale, Marseille), LIFM (Laboratoire d'Informatique Fondamentale de Marseille), K-Epsilon SME, Renault, Sirehna DCNS, Poznań Supercomputing and Networking Center (Poland), National University of Singapore.

7.1.6. FUI CompatibleOne

Title: The Open Source Cloud Broker

Program: Conception and Simulation 2008

Duration: July 2009 - September 2012

Coordinator: OW2

Others partners: industry: ActiveEon, Bull, CityPassenger, eNovance, Eureva, Mandriva, Nexedi, Nuxeo, XWiki, Prologue; academic: Inria, Institut Telecom

See also: http://www.compatibleone.org

Abstract: CompatibleOne is an open source project which provides a model, CORDS (CompatibleOne Resource Description System), and a platform, ACCORDS (Advanced Capabilities for CORDS), for the description and federation of different clouds comprising resources provisioned by heterogeneous cloud service providers. CompatibleOne's flexible service architecture makes it independent from any Cloud Service Provider (from OpenStack to OpenNebula, from Azure to Vcloud) and can address all types of cloud services (IaaS, PaaS, SaaS , XaaS, BpaaS, . . .) and any type of cloud service deployment (public, private, community and hybrid).

7.1.7. FUI CloudForce (now OpenCloudWare)

Program: FSN, labelled by Minalogic, Systematic and SCS.

Duration: January 2012 - December 2014

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.

7.1.8. *Oseo-Isis Spinnaker*

Duration: June 2011 - May 2014

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.

7.2. European Initiatives

7.2.1. *FP7 Projects*

7.2.1.1. TEFIS

Title: TEstbed for Future Internet Services

Type: COOPERATION (ICT)

Defi: Future Internet Experimental Facility and Experimentally-driven Research

Instrument: Integrated Project (IP)

Duration: June 2010 - November 2012

Coordinator: THALES (France)

Others partners: Engineering Ingegneria Informatica S.p.A. (It); IT Innovation (UK); Fundação de Apoio à Universidade de São Paulo (Br); Thales Communications (Fr); ActiveEon (Fr); Lulea University of Technology (Se); Software Quality System S.A. (Es); Fraunhofer Institute FOKUS (De)

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

Abstract: TEFIS will support Future Internet of Services Research by offering a single access point to different testing and experimental facilities for communities of software and business developers to test, experiment, and collaboratively elaborate knowledge.

The project develops an open platform to access heterogeneous and complementary experimental facilities addressing the full development lifecycle of innovative services with the appropriate tools and testing methodologies. Through the TEFIS platform users will be supported throughout the whole experiment lifecycle by access to different testing tools covering most of the software development-cycle activities such as software build and packaging, compliance tests, system integration, SLA dimensioning, large-scale deployment, and user evaluation of run-time services. The platform will provide the necessary services that will allow the management of underlying testbeds resources. In particular, it will handle generic resource management, resource access scheduling, software deployment, matching and identification of resources that can be activated, and measurement services for a variety of testbeds.

7.2.1.2. PLAY

Title: Pushing dynamic and ubiquitous interaction between services Leveraged in the Future Internet by ApplYing complex event processing

Type: COOPERATION (ICT)

Defi: Internet of Services, Software & Virtualisation

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - September 2013

Coordinator: FZI (Germany)

Others partners: EBM WebSourcing (Fr), Inria (OASIS and SARDES) (Fr), France Telecom (Fr), ICCS (Gr), Ecole des Mines Albi (Fr), CIM (Serbia).

See also: http://www.play-project.eu/

Abstract: The PLAY project will develop and validate an elastic and reliable architecture for dynamic and complex, event-driven interaction in large highly distributed and heterogeneous service systems. Such an architecture will enable ubiquitous exchange of information between heterogeneous services, providing the possibilities to adapt and personalize their execution, resulting in the so-called situational-driven process adaptivity. The OASIS Team is in charge of designing the key element of the PLAY Platform: the event cloud that is a publish/subscribe P2P based system, developed using the GCM technology.

7.2.1.3. FI-WARE

Title: Morphus

Type: COOPERATION (ICT)

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

Instrument: Integrated Project (IP)

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Others partners:Thales, SAP, Inria

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.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. 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 - Mario Leyton

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 (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 projects, 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.

7.3.1.2. 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 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.

7.3.1.3. Dissiminet

Title: Web-Service approaches for simulation

Inria principal investigator: Olivier Dalle

International Partner (Institution - Laboratory - Researcher):

Carleton University (Ottawa, Canada) - Advanced Real-Time Simulation Laboratory - Gabriel Wainer

Duration: 2011 - 2013

See also: http://www.inria.fr/en/teams/dissiminet

This Franco-Canadian team will advance research on the definition of new algorithms and techniques for component-based simulation using a web-services based approach. On one hand, the use of web-services is expected to solve the critical issues that pave the way toward the simulation of systems of unprecedented complexity, especially (but not exclusively) in the studies involving large networks such as Peer-to-peer networks. Web-Service oriented approaches have numerous advantages, such as allowing the reuse of existing simulators, allowing non-computer experts to merge their respective knowledge, or seamless integration of complementary services (eg. on-line storage and repositories, weather forecast, traffic, etc.). One important expected outcome of this approach is to significantly enhance the simulation methodology in network studies, especially by enforcing the seamless reproducibility and traceability of simulation results. On the other hand, a net-centric approach of simulation based on web-services comes at the cost of added complexity and incurs new practices, both at the technical and methodological levels. The results of this common research will be integrated into both teams' discrete-event distributed simulators: the CD++ simulator at Carleton University and the simulation middle-ware developed in the MASCOTTE EPI, called OSA, whose developments are supported by an Inria ADT starting in December 2011.

7.3.2. Inria International Partners

Fit4Green (http://fit4green.eu) is a FP7 project that aimed at creating an energy-aware layer of plug-in on top of the current data centres' management tools to orchestrate the placement of VMs with regards to energy-efficiency concerns. In 2012, the consortium decided to rely on Btrplace to compute the VM placement. Accordingly, Fabien Hermenier collaborated with them to integrate their work with BtrPlace.

7.3.3. Participation In International Programs

7.3.3.1. CIRIC Chili

Ciric research line: Telecommunications

Inria principal investigator: Eric Madelaine

Duration: 2012 - 2021

Our activities with CIRIC have slowly been starting during this year, while CIRIC and Inria-Chile set-up their local organisations. We took the opportunity of our visit in July in Santiago de Chile (workshop if the SCADA associated Team), to discuss with Ciric, and to setup our plans. Later in November Tomas Barrós (PI on the Ciric side) visited us in Siophia-Antipolis, and we were able to pursue our plans.

The current state is that we have listed two chilean software companies, one in the area of telecommunications, the other in the area of banks, that have an interest in method for the development of safe large and complex applications. The role of Ciric in a first step is to set-up a first technical contact with these companies, discuss the use-cases, the common interests, and a preliminar workplan. The next step (in 2013) will involve the work of Ciric engineers on the case-study definition, and a longer visit of E. Madelaine (and possibly other Inria people) in Santiago to start concrete work on this line.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Visiting Scientists

Min Zhang Sep. 15th to Dec. 15th. This visit is in the framework of out "DAESD" Associated Team with ECNU Shanghai. The subject is on contextual/parametric bisimulations for the pNets (Parameterized Networks of Synchronized automata).

Gabriel Wainer Jun. 15th - July 7th. This visit is in the context of the DISSIMINET Associate Team between Inria and Carleton University. The subject is on simulation in the Cloud and Handheld devices.

7.4.1.2. Internships

Yanwen CHEN: Cotutelle with ECNU Shanghai, visits in Inria planned 6 to 9 month each year.

> Subject: Programmation d'applications hétérogènes embarquées et distribuées

> Institution: UNS & East China Normal University (China)

Quirino ZAGARESE (from Jan 2012 until Aug 2012)

> Subject: Lazy loading of data in service oriented and event oriented interaction software architecture models

> Institution: University Sannio (Italy)

Michel Jackson DE SOUZA (from Jul 2012 until Aug 2013)

> Subject: Distributed coherent snapshot solution for the P2P CAN-based Event Cloud

> Institution: UFBA Federal University of Bahia (Brasil), Science sans Frontière brazilian mobility program

7.4.2. Visits to International Teams

- Fabien Hermenier visited the Flux Team at the University of Utah from September to December 2012. This visit allowed us to enhance our collaboration on the study of the Utah' Emulab in order to improve testbed designs. [22]

- Ludovic Henrio, Eric Madelaine, and Cristian Ruz visited NIC-Labs and CIRIC center in Santiago de Chile in July 2012 (1 week visit); a workshop was also held during the week.

<div align="center">**PHOENIX Project-Team**</div>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Assistive Technologies for Elderly

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 will include a need analysis, the development of new assistive applications and their experimental validation.

This work is funded by CARSAT Aquitaine ("Caisse d'Assurance Retraite et de la Santé au Travail").

8.1.2. 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" reserach 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's Syndrom). 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.

8.1.3. 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 the Aquitaine region.

8.2. National Initiatives

8.2.1. 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.

8.2.2. SERUS: Software Engineering for Resilient Ubiquitous Systems

The objectives of this project is to propose a design-driven development methodology for resilient systems that takes into account dependability concerns in the early stages, ensures the traceability of these requirements throughout the system life-cycle, even during runtime evolution. To provide a high level of support, this methodology will rely on a design paradigm dedicated to sense/compute/control applications. This design will be enriched with dependability requirements and used to provide support throughout the system life-cycle. This project is in collaboration with the TSF-LAAS research group (CNRS, Toulouse) and the ADAM research project-team (Inria Lille Nord Europe).

This work is funded by the Inria collaboration program (in French, "actions de recherches collaboratives").

8.2.3. *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.

8.3. European Initiatives

8.3.1. *Collaborations in European Programs, except FP7*

Program: SUDOE territorial cooperation program (Interreg IV B)

Project acronym: Biomasud

Project title: Mechanisms for sustainability and enhancement of solid biomass market in the space of SUDOE

Duration: July 2011 - June 2013

Coordinator: AVEBIOM

Other partners: UCE (Consumers Union of Spain), CIEMAT (Public Research Agency for excellence in energy and environment, Spain), CBE (Centro da Biomassa para a Energia, Portugal), CVR (Centro para la Valorización de Residuos, Portugal) and UCFF (Union Française de la Coopération Forestière, France)

Abstract: The goal of the Biomasud european project is to show the viability of the biomass-based energy model. The project aims to propose a certification and traceability process throughout the value chain of biofuel. Our objective is to design and implement a prototype of traceability system that will extract automatically traceability information based on sensors such as RFID tags, simplifying the certification process. This work will leverage our DIASUITE development methodology and will be evaluated by the Biomasud partners.

8.4. International Initiatives

8.4.1. *Inria International Partners*

- University of McGill, Montréal, Canada
- University of Québec, Trois-Rivières, Canada

8.5. International Research Visitors

8.5.1. *Visits of International Scientists*

The Phoenix group has been visited by Tim Sheard for 3 months (January-March).

8.5.2. *Visits to International Teams*

Charles Consel is on sabbatical for the academic year of 2012-2013 at the University of Mc Gill in Montreal.

<p align="center" style="color:red">PLANETE Project-Team</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

PFT (2011-2014) : DGCIS funded project, in the context of the competitivity cluster SCS, whose aim is to provide 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.

8.2. National Initiatives

ANR FIT (2011-2108): 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 "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 ARESA2 (2009-2012): The Planète team is involved in the ARESA2 project which aims at advancing the state of the art in Secure, Self-Organizing, Internet?Connected, Wireless Sensor and Actuator Networks (WSANs). These challenges are to be addressed in an energy-efficient way while sticking to memory-usage constraints. The partners are Inria, CEA-LETI, France Telecom R&D, Coronis Systems, LIG/Drakkar, Verimag and TELECOM Bretagne.

ANR pFlower (2010-2013): Parallel Flow Recognition with Multi-Core Processor. 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. The project involves Inria (planete), Université de Savoie, and ICT/CAS (China).

Inria Mobilitics (2011-2012): as a joint national project with CNIL (the French national committee of Information freedom). 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.

Collaborative Action CAPRIS (2011-2014): the Collaborative Action on the Protection of Privacy Rights in the Information Society (CAPRIS), is an Inria national project, which goal is to tackle privacy-related challenges and provide solutions to enhance the privacy protection in the Information Society. His main tasks are the identification of existing and future threats to privacy, and the design of appropriate measures to assess and quantify privacy.

ANR CMON   (2009-2012) : This project involves, in addition to Inria, Technicolor Paris Lab, LIP6, ENS and the Grenouille.com association. CMON stands for collaborative monitoring. It is an industrial research project that develops the technology needed to allow end-users to collaborate in order to identify the origin and cause of Internet service degradation. The main differentiating assumptions made in this project are that *(i)* ISPs do not cooperate together, and *(ii)* one cannot rely on any information they provide in order to diagnose service problems. Even more, CMON considers that these ISP will try to masquerade the user observations in order to make their service look better. The software designed in this project will be added to the toolbox currently provided by the Grenouille architecture. The hope is that such a project will encourage ISPs to improve their quality of service and will contribute to improve customer satisfaction.

See also http://wiki.grenouille.com/index.php/CMON.

ANR F-Lab   (2011-2013): ANR funded project on the federation of computation, storage and network resources, belonging to autonomous organizations operating heterogeneous testbeds (e.g. PlanetLab testbeds and Sensors testbeds). This includes defining terminology, establishing universal design principles, and identifying candidate federation strategies. Other partners : UPMC, A-LBLF and Thales.

ANR Connect   (2011-2012): ANR funded project on content centric Networking architecture. The aim is to propose adequate naming, routing, cache management and transmission control schemes for CCN based networks. Our contribution is centered on network traffic characterization video streaming and on the integration of the CCNx code in the ns-3 simulator. Other partners: UPMC, Alcatel Lucent, Orange R&D, IT.

ANR SCATTER   (2011-2012): ANR funded project on Scalable Naming in Information Centric Networks. The goal of this activity is to evaluate the scalability of state of the art naming schemes both from the name resolution and routing points of view. The four main approaches that will be considered are: Content Centric Networking (CCN), Publish-Subscribe Internet Routing Paradigm (PSIRP), Network of Information (NetInf) and Data-Oriented Network Architecture (DONA). Other French partners: UPMC. International KIC partner: SICS.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. NOVI

Title: Networking innovations Over Virtualized Infrastructures

Type: COOPERATION (ICT)

Defi: CAPACITIES programme.

Instrument: Specific Targeted Research Project (STREP)

Duration: September 2010 - February 2013

Coordinator: NTUA (Greece)

Others partners: 13 european partners including GARR, ELTE, Cisco, etc.

See also: http://www.fp7-novi.eu/

Abstract: NOVI (Networking innovations Over Virtualized Infrastructures) research concentrates on efficient approaches to compose virtualized e-Infrastructures towards a holistic Future Internet (FI) cloud service. Resources belonging to various levels, i.e. networking, storage and processing are in principle managed by separate yet interworking providers. NOVI will concentrate on methods, information systems and algorithms that will enable users with composite isolated slices, baskets of resources and services provided by federated infrastructures.

8.3.1.2. Fed4Fire

Title: Federation for Future Internet Research and Experimentation

Type: COOPERATION (ICT)

Defi: FIRE programme.

Instrument: Integrating Project (IP)

Duration: October 2012 - October 2016

Coordinator: iMinds (Belgium)

Others partners: 17 european partners including iMinds, IT Innovation, UPMC, Fraunhofer, TUB, UEDIN, NICTA, etc.

See also: 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.

8.3.1.3. OPENLAB

Title: OpenLab: extending FIRE testbeds and tools

Type: COOPERATION (ICT)

Defi: ICT 2011.1.6 Future Internet Research and Experimentation (FIRE)

Instrument: Integrated Project (IP)

Duration: September 2011 - January 2014

Coordinator: Université Pierre et Marie Curie (France)

Others partners: 18 European partners (including ETH Zurich, Fraunhofer, IBBT, TUB, UAM, etc.) and Nicta from Australia.

See also: http://www.ict-openlab.eu/

Abstract: OpenLab brings together the essential ingredients for an open, general purpose and sustainable large scale shared experimental facility, providing advances to the early and successful prototypes serving the demands of Future Internet Research and Experimentation.OpenLad partners are deploying the software and tools that allow these advanced testbeds to support a diverse set of applications and protocols in more efficient and flexible ways. OpenLab's contribution to a portfolio that includes: PlanetLab Europe (PLE), with its over 200 partner/user institutions across Europe; the NITOS and w-iLab.t wireless testbeds; two IMS telco testbeds that can connect to the public PSTN, to IP phone services, and can explore merged media distribution; an LTE cellular wireless testbed; the ETOMIC high precision network measurement testbed; the HEN emulation testbed; and the ns-3 simulation environment. Potential experiments that can be performed over the available infrastructure go beyond what can be tested on the current internet. OpenLab extends the facilities

with advanced capabilities in the area of mobility, wireless, monitoring, domain interconnections and introduces new technologies such as OpenFlow. These enhancements are transparent to existing users of each facility. Finally, OpenLab will finance and work with users who propose innovative experiments using its technologies and testbeds, via the open call mechanism developed for FIRE facilities.

8.3.1.4. 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), 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.

8.3.2. EIT KIC funded activities

Our project team was involved in 2012 in **six activities** funded by the EIT ICT Labs KIC:

Title: **Fitting**, Future InterneT (of ThINGs) facility

Activity Number: 12340

Duration: 2011-2013

Coordinator: UPMC (France)

Others partners: Alcatel Lucent, Fraunhofer FOKUS, BME, IT, U. Paris XI.

Abstract: FITTING develops a testbed federation architecture that combines wireless and wired networks. Through FITTING, components and solutions developed in the projects OneLab2, PII and SensLAB are brought together to facilitate access. These components and devices complement each other – for instance SensLAB enhances the testbed federation by adding wireless sensors. FITTING addresses issues related to usability and accessibility of federated experimentation resources from multiple autonomous organizations. FITTING is a process of federating elements from various European and national initiatives into a global shared resource pool with a standardized interface to access them. Further, FITTING will adopt a user-driven (researchers, developers, students) approach with its running testbeds allowing experimentation with different technologies to meet the variety of

needs of a broad customer base. The FITTING activity is mentioned as a "success story" by the EIT ICT Labs KIC [1]. In fact, after an initial funding in 2010, the french partners succeeded to get the FIT Equipment of Excellence project accepted with a total budget of 5.8 MEuros to develop a testbed federation in France.

Mobile Privacy

This activity deals with privacy issues in mobile and geo-based systems.

Smart-Space Privacy

This activity deals with privacy issues in smart environments, with a particular issue on smart metering systems.

Software-Defined Networking (SDN)

The objective of this activity is to explore software-defined networking at different positions on the axis between basic flow-level processing (using OpenFlow for end-to-end flows) in controlled fixed networks and cooperation between mobile end nodes in the open wireless Internet (using opportunistic networking for resources communicated hop-by-hop).

I**nformation-centric networking (ICN) experimentation**

The goal of this activity is to define and implement an early validation environment for ICN proposals.

Seamless P2P video streaming for the web

In this activity, we will extend the current capabilities of the P2P network to distribute content to collaborators. We will analyze privacy concerns in this domain and propose design guidelines to mitigate them.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. COMMUNITY

Title: Message delivery in heterogeneous networks

Inria principal investigator: Thierry Turletti

International Partner (Institution - Laboratory - Researcher):

University of California Santa Cruz (United States) - School of Engineering - Katia Obraczka

Duration: 2009 - 2014

See also: http://inrg.cse.ucsc.edu/community/

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. We have 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.

---

[1]See http://eit.europa.eu/kics1/stories-archiv/stories-single-view/article/fitting-from-eit-ict-labs-the-next-generation-testbeds.html

8.4.1.2. SIMULBED

Title: SIMULBED: Large-Scale Simulation Testbed for Realistic Evaluation of Network Protocols and Architectures

Inria principal investigator: Walid DABBOUS

International Partner (Institution - Laboratory - Researcher):

Keio University (Japan) - Shonan-Fujisawa Campus - Osamu Nakamura

Duration: 2012 - 2014

See also: http://planete.inria.fr/Simulbed

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 to provide 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.

8.4.1.3. CLOUDY

Title: Secure and Private Distributed Data Storage and Publication in the Future Internet

Inria principal investigator: ClaudeCastelluccia

International Partners (Institution - Laboratory - Researcher):

University of California Berkeley (United States) - Electrical Engineering and Computer Science Department - Edward Lee

University of California Irvine (United States) - Donald Bren School of Information and Computer Sciences - Gene Tsudik

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.

8.4.2. Participation In International Programs

- CIRIC: Our project-team was involved in the definition of the topics for the Network and Telecom R&D line of the (the Communication and Information Research and Innovation Center - CIRIC), the Inria research and innovation centre in Chili. In this context, we will extend our collaboration with Universidad Diego Portales, Chile.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Mostafa Ammar, Visiting Professor (one month in June 2012)

> Subject: Investigating fundamenal properties of wireless and mobile networks

> Institution: Georgia Institure of Technology (United States)

Paul de Hert, Visiting Professor (one month in June 2012)

> Subject: Benefits and limitations of the legal notion of "reasonable expection of privacy"

> Institution: Free University of Brussels (Belgium)

Katia Obraczka, Visiting Professor (one week in June 2012)

> Subject: Communication in Heterogeneous Networks Prone to Episodic Connectivity

> Institution: University of California at Santa Cruz (United States)

Marc Mendonca, Visiting PhD student (from Sep 2012 until Dec 2012)

> Subject: Software-Defined Networking in Heterogeneous Networked Environments

> Institution: University of California at Santa Cruz (United States)

Ilaria Cianci, Visiting PhD student (from Nov 2012 until Aug 2013)

> Subject: Content Centric Networking

> Institution: Politecnico di Bari, Italy

8.5.2. Visits to International teams

Mohamed Ali Kaafar, spending a sabbatical at NICTA Australia in Sydney (since February 2012)

> Subject: Online Privacy Enhancing Technologies: measuring the risks and designing countermeasures

Thierry Turletti, Visiting researcher to University of California at Santa Cruz (one week in February 2012)

> Subject: Community Associated team

Thierry Turletti, Alina Quereilhac and Frederic Urbani, Visitors to NICT, Japan (one week in December 2012)

> Subject: Simulbed Associated team

8.5.2.1. Internships

Riccardo Ravaioli (from Mar 2012 until Aug 2012)

Subject: Is the Internet neutral or content-aware? Handling the question by measurements

Institution: Master Ubinet - Sophia Antipolis

Tessema Mindaye (from Mar 2012 until Aug 2012)

Subject: Increasing the space of applications for statistical traffic classification methods

Institution: Master Ubinet - Sophia Antipolis

Francisco Santos (from Mar 2012 until Aug 2012)

Subject: Content management in mobile wireless networks

Institution: EPFL - Lausanne

Lucia Guevgeozian Odizzio (from May 2012 until Oct 2012)

Subject: Automatic IP address and routing table assignment for heterogeneous network topologies

Institution: Universitad de la Republica Oriental del Uruguay

Xuan-Nam Nguyen (from March 2012 until Aug 2012)

Subject: Software Defined Networking in Hybrid Networks

Institution: Université de Nice Sophia Antipolis (France)

Sumit BANSAL (from Feb 2012 until Jul 2012)

Subject: Attacks and Defenses for Secure Virtual Coordinate Systems

Institution: IIT Ropar (India)

RAP Project-Team

6. Partnerships and Cooperations

6.1. International Research Visitors

RAP team has received the following people:

- Louigi Addario-Berry (McGill)
- Vida Dujmovic (Carleton)
- Matthieu Jonckheere (CONICET, Buenos Aires, Argentina)
- Liudmila Rozanova (CNR — IIT, University of Pisa)
- Iraj Saniée (Alcatel-Lucent Bell Labs)
- Hamed Amini (EPFL)
- Christina Goldschmidt (Oxford)
- Ross Kang (CWI)
- Stefan Langerman (UL Bruxelles)
- Henning Sulzbach (Frankfurt)

6.2. National Research Visitors

RAP team has received the following people:

- Bernard Arzur (Orange Labs)
- Thomas Bonald (Telecom ParisTech, Paris)
- Emilie Coupechoux (Inria, TREC)
- Davide Cuda (Orange Labs)
- Fabrice Guillemin (Orange Labs)
- Raluca Indre (Orange Labs)
- Esther le Rouzic (Orange Labs)
- Patrick Loiseau (Eurecom)

<p style="text-align:center">**REGAL Project-Team**</p>

7. Partnerships and Cooperations

7.1. National initiatives

7.1.1. InfraJVM - (2012–2015)

Members: LIP6 (Regal), Ecole des Mines de Nanes (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. Infra-JVM brings a grant of 202 000 euros from the ANR to UPMC over three years.

7.1.2. ODISEA2 - (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 big 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.

7.1.3. 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. The principal investigators for Regal are Luciana Arantes, Pierre Sens, and Julien Sopena. It involves a grant of 155 000 euros from ANR to LIP6 over three years.

7.1.4. ConcoRDanT - (2010–2013)

Members: Inria Regal, project leader; LORIA, Universdide 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. The project leader and principal investigator for Regal is Marc Shapiro. ConcoRDanT involves a grant of 192 637 euros from ANR to Inria over three years.

7.1.5. SPADES - (2009–2012)

Members:　LIP, MIS (and LIP6/REGAL), Inria Rennes, Inria Saclay, LIG, LUG, CERFACS, IN2P3

Funding:　ANR CONTINT

Objectives:　The main goal of SPADES is to propose a non-intrusive but highly dynamic environment, able to take advantages to available resources over very large scale grids. Another challenge of SPADES is to provide a software solution for a service discovery system able to face a highly dynamic platform. This system will be deployed over volatile nodes and thus must tolerate "failures".

　　　　　　The principal investigator for Regal is Franck Petit. The project was initiated while he was with MIS (UPJV/Amiens) and a non-permanent researcher during 2008-2009 with Inria, within Graal Team (LIP, Lyon). The amount of the grant from ANR to MIS is 125 000 euros.

7.1.6. STREAMS - (2010–2013)

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. The principal investigators for Regal is Marc Shapiro. It involves a grant of 57 000 euros from ANR to Inria over three years.

7.1.7. PROSE - (2009–2012)

Members:　Technicolor, Inria (Regal), EURECOM, PlayAdz, LIAFA.

Funding: PROSE project is funded by ANR VERSO.

Objectives: Content Shared Through Peer-to-Peer Recommendation & Opportunistic Social Environment.

The Prose project is a collective effort to design opportunistic contact sharing schemes, and characterizes the environmental conditions as well as algorithmic and architecture principles that let them operate. The partners of the Prose project will engage in this exploration through various expertise: network measurement, system design, behavioral study, analysis of distributed algorithms, theory of dynamic graph, networking modeling, and performance evaluation.

The principal investigators for Regal are Sébastien Monnet and Marc Shapiro. It involves a grant of 152 000 euros from ANR to Inria over three years.

7.1.8. ABL - (2009–2012)

Members: Gilles Muller, Julia Lawall, Gaël Thomas, Saha Suman.

Funding: ANR Blanc.

Objectives: The goal of the "A Bug's Life" (ABL) project is to develop a comprehensive solution to the problem of finding bugs in API usage in open source infrastructure software. The ABL project has grown out of our experience in using the Coccinelle code matching and transformation tool, which we have developed as part of the former ANR project Blanc Coccinelle, and our interactions with the Linux community. Coccinelle targets the problem of documenting and automating collateral evolutions in C code, specifically Linux code. A collateral evolution is a change that is needed in the clients of an API when the API changes in some way that affects its interface. Coccinelle provides a language for expressing collateral evolutions by means of Semantic Patches, and a transformation tool for performing them automatically.

The main achievements of the ABL project in 2012 include the design of an approach to automatically generating a robust interface to the Linux kernel, which received a best paper award at ASE 2012, and the design of an approach to finding resource-release omission faults in systems software. The latter has led to over 60 patches for various systems software projects, including Linux and Python.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.2. Collaborations in European Programs, except FP7

7.2.2.1. Google European Doctoral Fellowship "A principled approach to eventual consistency based on CRDTs

Cloud computing systems 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 Commutative Replicated Data Type (CRDT) approach, based on commutativity, is a simple and principled solution to this conundrum; however, only a handful of CRDTs are known, and CRDTs are not a universal solution. This PhD research aims to expand our knowledge of CRDTs, to design and implement a re-usable library of composable CRDTs, to maintain study techniques for maintaining strong invariants above CRDTs, and to experiment with CRDTs in applications. We are hopeful that significant distributed applications can be designed using our techniques, which would radically simplify the design of cloud software, reconciling scalability and consistency. This Google European Doctoral Fellowship is awarded to Marek Zawirski, advised by Marc Shapiro. This award includes a grant of 41 000 euros yearly over three years starting September 2010.

7.3. International Initiatives

7.3.1. Participation In International Programs

7.3.1.1. Dependability of dynamic distributed systems for ad-hoc networks and desktop grid (ONDINA) (2011-2013)

Members: Inria Paris Rocquencourt (REGAL), Inria Rhone-Alpes (GRAAL), UFBA (Bahia, Brazil))

Funding: Inria

Objectives: Modern distributed systems deployed over ad-hoc networks, such as MANETs (wireless mobile ad-hoc networks), WSNs (wireless sensor networks) or Desktop Grid are inherently dynamic and the issue of designing reliable services which can cope with the high dynamics of these systems is a challenge. This project studies the necessary conditions, models and algorithms able to implement reliable services in these dynamic environments.

7.3.1.2. Enabling Collaborative Applications For Desktop Grids (ECADeG) (2011–2013)

Members: Inria Paris Rocquencourt (REGAL), USP (Sao Paulo, Brazil))

Funding: Inria

Objectives: The overall objective of the ECADeG research project is the design and implementation of a desktop grid middleware infrastructure for supporting the development of collaborative applications and its evaluation through a case study of a particular application in the health care domain.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Kenji Kono, Professor, University Keio, Japan, 1 year, 2012
- Nuno Preguia, Associate Professor, Universidade Nova de Lisboa; 6-month visit
- Valter Balegas, PhD Student, Universidade Nova de Lisboa; 3-month visit

7.4.2. Internships

- David Navalho, PhD Student, Universidade Nova de Lisboa; 3-month visit
- Valter Balegas, PhD Student, Universidade Nova de Lisboa; 3-month visit

<p style="text-align:center; color:red">**RMOD Project-Team**</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

We have signed a convention with the CAR team led by Noury Bouraqadi of École des Mines de Douai. In such context we co-supervized two PhD students (Mariano Martinez-Peck and Nick Papoylias). The team is also an important contributor and supporting organization of the Pharo project.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. Cutter

Participants: Stéphane Ducasse [Correspondant], Nicolas Anquetil, Damien Pollet, Muhammad Bhatti, Andre Hora.

This parternship is done with the following members from the LIRMM-D'OC-APR: Marianne Huchard, Roland Ducournau, Jean-Claude König, Rodokphe Giroudeau, Abdelhak-Djamel Seriai, and Rémi Watrigant.

CUTTER is a Basic Research project that addresses the problems of object-oriented system (re-)modularization 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).

7.3. European Initiatives

Participants: Stéphane Ducasse [correspondant], Veronica Uquillas-Gomez, Marcus Denker.

7.3.1. IAP MoVES

Participant: Stéphane Ducasse [correspondant].

The Belgium IAP (Interuniversity Attraction Poles) MoVES (Fundamental Issues in Software Engineering: Modeling, Verification and Evolution of Software) is a project whose partners are the Belgium universities (VUB, KUL, UA, UCB, ULB, FUNDP, ULg, UMH) and three European institutes (Inria, IC and TUD) respectively from France, Great Britain and Netherlands. This consortium combines the leading Belgian research teams and their neighbors in software engineering, with recognized scientific excellence in MDE, software evolution, formal modeling and verification, and AOSD. The project focusses on the development, integration and extension of state-of-the-art languages, formalisms and techniques for modeling and verifying dependable software systems and supporting the evolution of Software-intensive systems. The project has started in January 2007 and is scheduled for a 60-months period. Read more at http://moves.vub.ac.be.

7.3.2. 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.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. PLOMO

Title: Customizable Tools and Infrastructure for Software Development and Maintenance

Inria principal investigator: Stéphane Ducasse

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - PLEIAD

Duration: 2011–2013

See also: http://pleiad.dcc.uchile.cl/research/plomo

Project Description

Software maintenance is the process of maintaining a software system by removing bugs, fixing performance issues and adapting it to keep it useful and competitive in an ever-changing environment [32]. Performing effective software maintenance and development is 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 [34]. The goal of PLOMO is 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 software maintenance).

PLOMO will (1) enhance the Opal open compiler infrastructure to support plugin definition, (2) offer an infrastructure for change and event tracking as well as model to compose and manipulate them, (3) work on a layered library of algorithms for the Mondrian visualization engine of Moose, (4) work on new ways of profiling applications. All the efforts will be performed on Pharo and Moose, two platforms heavily used by the RMoD and PLEIAD team.

The outcomes of PLOMO will include new research advances in the field of (i) bytecode generation for dynamic language; (ii) change and event tracking; (iii) software visualization engine; (iv) agile profiling framework. These four topics are recurrently considered by the most prestigious and competitive conferences (e.g., ECOOP, OOPSLA, FSE, ESEC, ICSE, TOOLS) and journals (e.g., TSE, TOPLAS, ASE), to which the participants of the PLOMO project are used to publish.

A strong focus on publishing our results in relevant scientific forum will remain a top priority. The artifacts produced by PLOMO will strongly reinforce the Pharo programming language and the Moose software analysis platform. The development and progress of Pharo is structured by RMoD, which has successfully created a strong and dynamic community. Moose is being used to realize consulting activities and it is used as a research platform in about 10 Universities, worldwide. We expect PLOMO to have a strong impact in both the software products and the communities structured around them.

Research Visits to Chile

- Benjamin van Ryseghem from May 28th until June 16th, 2012.
- Damien Pollet from November 1st until November 30th, 2012.
- Marcus Denker from November 5th until November 22nd, 2012

Recent Results

In the second year of execution of Plomo, work has focused on:

- Rizel: a performance evolution monitor.
- A book chapter on Roassal in the book Pharo By Example 2
- Roassal also won the third place award in the ESUG 2012 innovation technology awards.
- Athens, the graphic rendering engine developed by RMoD, is used by Roassal.
- Starting of the founding process of Synectique, a company based in Lille that offers solutions based on the Moose platform. ObjectProfile offers to Synectique a dedicated support of Roassal.

- Integration of profiling techniques into Jenkins, the continuous integration server used for Pharo. We expect to have a massive amount of profiling information.

- Opal debugging and development continued. The bytecode backend is ready for integration in Pharo 2.0.

- Gradualtalk: a gradually typed Smalltalk, built on Opal, has been implemented. It allows code in Pharo to be gradually and optionally typed.

- The Announcements framework to enable change and event tracking.

- Spec: a Framework for the Specification and Reuse of UIs and their Models. It uses the Announcements framework to enable fine-grained UI refreshes. Roassal makes use of Spec for its component

- Work on the DIE domain-specific language and the definition of IDE plugins using it, as well as work on change prediction models are still ongoing.

Supervised PhD students

- Vanessa Peña, PhD student Universidad de Chile. She is working on test coverage and domain specific analyses

- Juan Pablo Sandoval, PhD student Universidad de Chile.

Companies Using our Results

- Synectique is a company delivering dedicated software analysis. Synectique uses Roassal to visually report the analysis of customer source code. The founding process started in 2012, and is expected to be finished in 2013.

- ObjectProfile was founded in 2011 in Chile. Its business plan is essentially focused on Pharo and Roassal. Object Profile offers support of its products to RMoD and Synectique. A number of features of Roassal have been designed to meet Synectique's requirements (e.g., the navigation and scrolling options).

Publications

- Benjamin Van Ryseghem, Stéphane Ducasse, Johan Fabry, Spec: a Framework for the Specification and Reuse of UIs and their Models, in Proceedings of the 4th International Workshop on Smalltalk Technologies (IWST'12), Collocated with ESUG, August 2012. ACM Digital Library (To Appear). [20]

- Juan Pablo Sandoval, Tracking Down Software Changes Responsible for Performance Loss, in Proceedings of the 4th International Workshop on Smalltalk Technologies (IWST'12), Collocated with ESUG, August 2012. ACM Digital Library (To Appear)

7.4.2. Participation In International Programs

7.4.2.1. Project Pequi – Inria/CNPq Brésil

The Pequi project is a collaboration between Professor Marco T. Valente's team at the Federal University of Minas Gerais in Brazil and the RMoD team. It focuses in producing Metrics, Techniques, and Tools for Software Remodularization.

It is recognized that software systems must be continuously maintained and evolved to remain useful. However, ongoing maintenance over the years contributes to degrade the quality of a system. Thus reengineering activities, including remodularization activities, are necessary to restore or enhance the maintainability of the systems. To help in the remodularization of software systems, the project will be structured in two main research lines in which both teams have experience and participation: (i) Evaluation and Characterization of Metrics for Software Remodularization; and (ii) Tools and Techniques for Removal of Architectural Violations.

The project started in July 2011 with a visit of Dr. Nicolas Anquetil to the brazilian team. The project will last 24 months.

Research Visits

- Nicolas Anquetil, from August 6th to 11th.
- Andre Hora, from November 26th to January 4th.

7.4.3. Others

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.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

In the context of the PLOMO associated Team with the University of Chile:

- Johan Fabry from March 19th until March 23rd, 2012
- Johan Fabry from August 17th until Sept 2nd, 2012.
- Juan Pablo Sandoval from 9 November until 2 December 2012. The topic of the research visit is monitoring of performance evolution.

In the context of the Pequi project associated Team with the Federal University of Minas Gerais:

- Professor Marco Tulio Valente visited from February 7th to 13th.
- Ricardo Terra PhD student visited us for one week in begining of April 2012.

Other visits of international scientists:

- Fernando Olivero, PhD Student from the University of Lugano, Switzerland, visited RMoD in March 2012.
- Jurgen VinJu, group leader of SEN1 - Software Analysis & Transformation at CWI, visited us on May 10th and 11th.

7.5.1.1. Internships

Ezequiel La Mónica (from Apr 2012 until Jun 2012)

Subject: Rule checking for pharo

Institution: University of Buenos Aires (Argentina)

Cesar Couto (from December 2011 until February 2012)

Subject: Uncovering Causal Relationships between Software Metrics and Bugs

Institution: Federal University of Minas Gerais, Brazil

7.5.2. Visits to International Teams

In the context of the PLOMO associated Team with the University of Chile:

- Marcus Denker from January 17th to February 1st.
- Benjamin van Ryseghem from May 28th to June 16th.
- Damien Pollet from October 31st to November 13th.
- Marcus Denker from November 5th to November 22nd.

In the context of the Pequi project associated Team with the Federal University of Minas Gerais:

- Nicolas Anquetil, from August 4th to 19th.
- Andre Hora, from November 26th to January 4th.

Many RMoDmembers did various visits at many occasions to, *e.g.,*, Bruxelles in Belgium, Cologne in Germany, Gand in Belgium, Bern in Switzerland, Riva del Garda, Italy, and Belo Horizonte in Brazil.

ROMA Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

ANR White Project RESCUE (2010-2014), 4 years. The ANR White Project RESCUE was launched in November 2010, for a duration of 48 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.

6.2. International Initiatives

6.2.1. 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

6.3. International Research Visitors

6.3.1. Visits of International Scientists

Oliver Sinnen, senior lecturer at the Department of Electrical and Computer Engineering (ECE) of the University of Auckland, New Zealand, visited the ROMA team for three months (April-June, 2012). He worked with Loris Marchal and Frédéric Vivien on scheduling tree-shaped task graphs to minimize both the peak memory usage and the makespan (see Section 5.5).

6.3.2. 7th Scheduling for large scale systems workshop

The University of Pittsburgh (Rami Melhem), the ROMA team (Yves Robert and Frédéric Vivien) and the University of Hawai'i at Manoa (Henri Casanova) have organized a workshop in Pittsburgh, on June 28-30, 2012. The workshop focused on scheduling and algorithms for large-scale systems. This was the seventh edition of this workshop series, after Aussois in August 2004, San Diego in November 2005, Aussois in May 2008, Knoxville in May 2009, Aussois in May 2010, and Aussois in May 2011. The next workshop will be held in Schloss Dagstuhl in September 2013.

RUNTIME Project-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.

8.2. National Initiatives

8.2.1. ANR

ANR COOP   Multi-level Cooperative Resource Management (http://coop.gforge.inria.fr/).

> ANR COSINUS 2009 Program, 12/2009 - 06/2013 (42 months)
>
> Identification: ANR-09-COSI-001
>
> Coordinator: Christian Pérez (Inria Rhône-Alpes)
>
> Other partners: Inria Bordeaux, Inria Rennes, IRIT, EDF R&D.
>
> Abstract: COOP aims at establishing generic cooperation mechanisms between resource management, runtime systems, and application programming frameworks to simplify programming models, and improve performance through adaptation to the resources.

ANR ProHMPT   Programming Heterogeneous Multiprocessing Technologies (http://runtime.bordeaux.inria.fr/prohmpt/).

> ANR COSINUS 2008 Program, 01/2009 - 06/2012 (42 months)
>
> Identification: ANR-08-COSI-013
>
> Coordinator: Olivier Aumage (Inria Bordeaux)
>
> Other partners: CEA INAC, CEA CESTA, CAPS entreprise, Bull, UVSQ PRiSM, Inria Grenoble.
>
> Abstract: ProHMPT aims at focusing the joint research work of several teams about compilers, runtimes and libraries as well as scientific application programmers on designing methods and tools for programming heterogeneous platforms such as GPU and accelerators.
>
> Nomination: The project ProHMPT has been nominated for the first round of selection for the best ANR projects recently completed.

ANR MediaGPU   Massive multimedia GPU-Based Processing (http://picoforge.int-evry.fr/projects/mediagpu/).

> ANR CORD 2009 Program, 01/2010 - 12/2012 (36 months)
>
> Identification: 2009-CORD-25-01
>
> Coordinator: Pierre Pleven (Institut TELECOM)
>
> Other partners: PLAY ALL, ATEME, HPC-Project, Inria Bordeaux
>
> Abstract: The MediaGPU project will develop a software architecture and will review and adapt a number of classical multimedia algorithms, considering the latest advances offered by the new hardware architectures, such as Hybrid CPU+GPU and GPGPU. Initial key target applications are very large still images processing, high definition video encoding, video post-production, real-time geometry 3D synthesis.

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.

8.3. European Initiatives

8.3.1. FP7 Projects

PEPPHER FP7 Strep   "Performance Portability and Programmability for Heterogeneous Many-core Architectures"

Specific Targeted Research Project (STREP), October 2010 - December 2012

Coordinator: Universität Wien (Austria)

Others partners: Chalmers Tekniska Högskola AB (Sweden), Codeplay Software Limited (United Kingdom), Intel GmbH (Germany), Linköpings Universitet (Sweden), Movidia Ltd. (Ireland), Universität Karlsruhe (Germany)

Abstract: PEPPHER aims at providing a unified framework for programming architecturally diverse, heterogeneous many-core processors to ensure performance portability. PEPPHER will advance state-of-the-art in its five technical work areas:

1. Methods and tools for component based software
2. Portable compilation techniques
3. Data structures and adaptive, autotuned algorithms
4. Efficient, flexible run-time systems
5. Hardware support for autotuning, synchronization and scheduling

8.3.2. Collaborations in European Programs, except FP7

COST ComplexHPC   complexhpc.org

Program: COST

Project acronym: ComplexHPC

Project title: ComplexHPC

Duration: may 2009 – june 2013

Coordinator: Emmanuel Jeannot

Abstract: The goal of the Action is to establish a European research network focused on high performance heterogeneous computing in order to address the whole range of challenges posed by these new platforms including models, algorithms, programming tools and applications. This Action gathers more than 26 countries and 50 partners in Europe. The budget for the whole action and the four years is 380 000 euros.

8.4. International Initiatives

8.4.1. Inria Associate Teams

MORSE   Matrices Over Runtime Systems at Exascale

Inria Associate-Teams program: 2011-2013

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.

8.4.2. Participation In International Programs

ANR-JST FP3C   Framework and Programming for Post Petascale Computing.

ANR-JST 2010 Program, 03/2010 - 02/2013 (36 months)

Identification: ANR-10-JST-002

Coordinator: Serge Petiton (Inria Saclay)

Other partners: CNRS IRIT, CEA DEN Saclay, Inria Bordeaux, CNRSPrism, 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.

HPC-GA   High Performance Computing for Geophysics Applications (http://project.inria.fr/HPC-GA/)

European FP7 Programme, "Marie Curie" Action, PIRSES Scheme, 01/2012 - 12/2014 (36 months)

Identification: PIRSES-GA-2011-295217

Coordinator: Jean-François Méhaut (UJF)

Other Partners: Inria Grenoble, Inria Bordeaux, Basque Center for Applied Mathematics (BCAM, Bilbao, Spain), Federal University of Rio Grande do Sul (UFRGS, Porto Alegre, Brazil), Universidad Nacional Autónoma de México (UNAM, Mexico, Mexico), Bureau de Recherche Géologique et Minière (BRGM, Orléans, France), Grand Équipement National de Calcul Intensif (GENCI, France).

Abstract: 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: 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.

SEHLOC   Scheduling evaluation in heterogeneous systems with hwloc

STIC-AmSud 2012 Program, 01/2013 - 12/2013 (12 months, renewable)

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.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

Satoshi OHSHIMA visited us in September and October 2012, and accelerated the FEM application of the University of Tokyo execution by using STARPU.

SARDES Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *Automatique pour l'informatique autonomique (CNRS PEPS)*
Participant: Eric Rutten.

This project is lead by Eric Rutten and funded by CNRS in the *programme Projet Exploratoire-Premier(s) Soutien(s) PEPS Rupture de l'INS2I 2011*. It concerns Control Techniques for Autonomic Computing, and intends to group researchers of different backgrounds (Architectures and FPGA, distributed systems and adaptative software, programming languages for reconfiguration, and control theory) to gather experiences and points of view on this multi-disciplinary topic.

http://sardes.inrialpes.fr/~rutten/peps-api/

7.1.2. *SocEDA (ANR Arpege project)*
Participants: Vivien Quéma, Baptiste Lepers.

The goal of SocEDA is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex eventdriven interaction in large highly distributed and heterogeneous service systems. Such architecture will enable exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize the execution of them, according to social network information.

The main outcome of the SocEDA project will be a platform for event--driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements.

The project partners are Inria (ADAM in Lilles), EBM WebSourcing (FR), ActiveEon (FR), ARMINES (FR), France Telecom R&D (FR), CNRS (I3S and LIG), INSA Lyon, Thales Communications.

The project runs from October 2010 to September 2013.

7.1.3. *PiCoq (ANR project)*
Participants: Damien Pous, 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 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 (Sardes), LIP (Plume team), and Université de Savoie. the project runs from November 2010 to October 2014.

The ANR PiCoq is in the programme ANR 2010 BLAN 0305 01: http://sardes.inrialpes.fr/collaborations/PiCoq/.

7.1.4. Project MyCloud (ANR project)

Participants: Amit Sangroya, Sara Bouchenak, Damian Serrano-Garcia.

The objective of the MyCloud project is to define and implement a novel cloud model: *SLAaaS* (*SLAa*ware *Se*rvice). The SLAaaS model enriches the general paradigm of Cloud Computing, and enables systematic and transparent integration of service levels and SLA to the cloud. SLAaaS is orthogonal to IaaS, PaaS and SaaS clouds and may apply to any of them. The MyCloud project takes into account both the cloud provider and cloud customer points of view. From cloud provider's point of view, MyCloud proposes autonomic SLA management to handle performance, availability, energy and cost issues in the cloud. An innovative approach combines control theory techniques with distributed algorithms and language support in order to build autonomic elastic clouds. 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. On the other hand from cloud customer's point of view, the MyCloud project provides SLA governance. It allows 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 former provides more transparecy about SLA guaranties, and the latter aims to raise customers' awareness about cloud's energy footprint.

The project partners are Inria (Sardes is the project coordinator), Grenoble; LIP6, Paris; EMN, Nantes; We Are Cloud, Montpellier; Elastic Grid LLC, USA.

The project runs from November 2010 to October 2013.

7.1.5. Famous (ANR project)

Participants: Eric Rutten, Xin An.

The FAMOUS project (FAst Modeling and Design FlOw for Dynamically ReconfigUrable Systems) intends to make reconfigurable hardware systems design easier and faster, by introducing a complete methodology that takes the reconfigurability of the hardware as an essential design concept and proposes the necessary mechanisms to fully exploit those capabilities at runtime. The tool under development in this project is expected to be used by both industrial designers and academic researchers, especially for modern application system specific design such as smart cameras, image and video processing, etc.

The project partners are Inria (Sardes in Grenoble and DaRT in Lille), Université de Bretagne Sud, Université de Bourgogne, Sodius.

The project runs from December 2009 to November 2013.

7.1.6. REVER (ANR project)

Participants: Barbara Petit, 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 workprogramme 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 (Sardes in Grenoble and Focus in Bologna), Université de Paris VII (PPS laboratory), and CEA (List laboratory).

The project runs from December 2011 to November 2015.

7.1.7. CtrlGreen (ANR project)

Participants: Fabienne Boyer, Noël De Palma, Eric Rutten, Soguy Mak-Kare Gueye.

The goal of the CtrlGreen project is to develop the control techniques and software infrastructure required to build energy-efficient data centers. Because resource management must meet performance, dependability and scalability objectives and as well as service level agreements, energy-efficiency must be considered as a multi-criteria control problem. CtrlGreen aims to develop an autonomic system approach, where multiple control loops may coexist and coordinate. Specifically, the work will proceed along four directions:

- The study of reactive control techniques including synchronous languages and discrete controller synthesis to program, verify and synthetize coordinating controllers.

- The development of a controllable platform that can provide system level support for the deployment and integration of the requuired controllers.

- The study of several green data center scenarios that involve the coordination between several controllers at different levels (hardware, operating system and middleware) and targetting different objectives (performance, availability, energy efficiency, etc).

- Experiments with an industrial data center to evaluate CtrlGreen techniques in a real world environment, with multiple running applications.

The project partners include Eolas, Inria Rennes, INPT/IRIT Toulouse, LIG (Sardes) and ScalAgent. The project runs from January 2012 to December 2014.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. PLAY

> Title: Pushing dynamic and ubiquitous interaction between services Leveraged in the Future Internet by ApplYing complex event processing
>
> Type: COOPERATION (ICT)
>
> Defi: Internet of Services, Software & Virtualisation
>
> Instrument: Specific Targeted Research Project (STREP)
>
> Duration: October 2010 - September 2013
>
> Coordinator: FZI (Germany)
>
> Others partners: EBM WebSourcing (Fr), Inria (OASIS and SARDES) (Fr), France Telecom (Fr), ICCS (Gr), Ecole des Mines Albi (Fr), CIM (Serbia).
>
> See also: http://www.play-project.eu/
>
> Abstract: The goal of PLAY is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex, event-driven interaction in large highly distributed and heterogeneous service systems. Such architecture should enable the exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize the execution of them, resulting in the so called situational-driven adaptivity.
>
> The main outcome will be a FOT (federated open trusted) Platform for event-driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements. The platform will comprise in particular:

- A federated middleware layer: a peer-to-peer overlay network combined with a publish/subscribe mechanism, that has the task to collect events coming from the heterogeneous and distributed services.

- A distributed complex event processor: an elastic, distributed computing cloud based engine for complex processing/combining of events coming from different services in order to detect interesting situations a service should react on.

,

SCORE 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 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.

7.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2013)

Participants: Gérald Oster [coordinator], Luc André, Claudia-Lavinia Ignat, Pascal Urso, Hien Thi Thu Truong.

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 – oct. 2013) 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 technics. 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 experimentations.

7.1.3. Wiki 3.0 (2009–2012)

Participants: Claudia-Lavinia Ignat [contact], Luc André, Gérald Oster, Gérôme Canals, Bogdan Flueras.

Partners: XWiki SAS, SCORE team and Mandriva.

Website: http://wiki30.xwikisas.com/

The Wiki 3.0 project (december 2009 - june 2012) was sponsored by the call for projects "Innovative Web" launched by the French Ministry of Economy. The objective of this project was the development of an open-source platform based on XWiki (http://www.xwiki.org) that addressed the three major evolution axes of collaborative Web: real-time collaboration, social interaction integrated into the production (chat, micro-blogging, etc) and on demand scalability (cloud computing). This platform should be competitive with major editors of collaborative Web developed by Google such as Google Wave, IBM and Microsoft. SCORE team was responsible with the design and integration of real-time editing features into the XWiki system. We designed solutions for a raw text editor as well as for a WYSIWYG editor for XWiki pages. The real-time wiki editor has been released as an extension of XWiki (http://extensions.xwiki.org/xwiki/bin/view/Extension/RealTime+Wiki+Editor).

7.1.4. 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/mediawiki/index.php

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.

7.1.5. 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 allow to design and deploy applications based on proven technologies provided by partners such as collaborative messaging system, integration and workflow technologies that will be extended in order to address Cloud Computing requirements. Available as an open-source Enterprise Social Netwotk, 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. International Initiatives

7.2.1. GIS Interop Grande Région

Participants: Nacer Boudjlida [responsible], Khalid Benali, François Charoy, Olivier Perrin, Claude Godart.

Follow-up the INTEROP Network of Excellence, the INTEROP V-Lab (International Virtual Laboratory on interoperability, http://www.interop-vlab.eu/) has been officially created in Brussels on March 2007 as an international non-profit making association (serving the international interest). In this context, Nancy played also a leading role in the definition of the V-Lab and in the settlement of the so-called INTEROP V-Lab pole (a partner of the INTEROP V-Lab): the Grande Region pole. The institutions that compose the Grande Region pole are University of Namur, University of Paris I La Sorbonne, University Lyon II, INSA Lyon, INSA Strasbourg, the former University Henri Poincaré Nancy 1 and the former University Nancy 2. The pole is legally defined as a Scientific (International) Interest Group (Groupement d'Intérèt Scientifique or GIS). Its attachment to the INTEROP V-Lab has been achieved in may 2009. The role of the GIS is to animate regional scientific cooperation amongg the French GIS partners and Luxembourg (Henri Tudor Public Research center) and Belgium (University of Namur) as well as international cooperation since the INTEROP V-Lab encompasses lot of partners coming from the European Union and from China. Nacer Boudjlida is the head of the management committee of the INTEROP Grande Region and he is also a member of its scientific committee.

7.2.2. *Associate Team Inria VanaWeb*

SCORE is involved in the Associate Team Inria VanaWeb (with UTFSM Valparaìso, Chili) which is interested in autonomous constraint solving concepts and their application to composition problems for Web services. The coordinators of this project are Carlos Castro (UTFSM Valparaìso, Chili) and Christophe Ringeissen (CASSIS).

7.3. International Research Visitors

7.3.1. *Visits of International Scientists*

Valerie Shalin is an associate Professor in the Department of Psychology of Wright State University. She is a leading researcher in the domain of Human factors and she has a comprehensive expertise on empirical and analytic methods to support the design and evaluation of coordinated work. We are collaborating with her on an ongoing project that tries to understand the actual implications of real time collaboration.

SOCRATE Team (section vide)

<p style="text-align:center; color:red;">**TREC Project-Team**</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. LINCS

TREC participates in the Laboratory of Information, Networking and Communication Sciences (LINCS); http://www.lincs.fr/ created on October 28th, 2010, by three French institutions of higher education and research: Inria, Institut Télécom and UPMC. Alcatel-Lucent joined the LINCS in February 2011 as a strategic partner.

8.1.2. Digiteo ACRON

Participant: Bartłomiej Błaszczyszyn.

Project *Analyse et Conception de Réseaux Sans Fil Auto-Organisés* (ACRON) started in 2011. Coordinator: Supélec (Télécommunications), Partners: Inria HIPERCOM, Université Paris-Sud, IEF. Trec is associated partner.

The objective of this project is to work on characterization of the fundamental performance limits of large self-organizing wireless networks and develop distributed and self-organizing communication techniques that will approach the theoretical limits.

8.2. National Initiatives

8.2.1. ANR CMON

Participants: François Baccelli, Florence Bénézit, Darryl Veitch.

The ANR project CMON, jointly with Technicolor, LIP6, the Inria project-team Planète and the community http://wiki.grenouille.com/index.php/CMON was continued for 6 months. This project is focused on the development of end-to-end measurement for Internet that can be deployed by end-users, without any support from ISP. Our work over this period focused on wireless network tomography.

8.2.2. ANR PEGASE

Participants: Abir Benabid, Anne Bouillard.

TREC is a partner of the 3-year ANR project called PEGASE, jointly with ENS Lyon, the Inria project-team MESCAL, ONERA, Real-Time-at-Work (start-up) and Thalès. This project is focused on the analysis of critical embedded networks using algebraic tools. The aim is to apply these techniques to AFDX and Spacewire architectures. Abir Benabid was hired until January 2012.

8.2.3. ANR GAP

Participants: Marc Lelarge, Emilie Coupechoux, Mathieu Leconte.

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 (2012-2016) is to develop mathematical tools in order to contribute to a rigorous formalization of the cavity method. We intend to launch two new research lines:

- 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.

8.2.4. *ANR MAGNUM*
Participant: Ana Bušić.

Ana Bušić is participating (pôle de rattachement: LIP6, UPMC) in the 4-year ANR project MAGNUM (Méthodes Algorithmiques pour la Génération aléatoire Non Uniforme: Modèles et applications), 2010–2014; http://www.lix.polytechnique.fr/~rossin/ANR/Magnum/www/. The central theme of the MAGNUM project is the elaboration of complex discrete models that are of broad applicability in several areas of computer science. A major motivation for the development of such models is the design and analysis of efficient algorithms dedicated to simulation of large discrete systems and random generation of large combinatorial structures.

8.2.5. *GdR Stochastic Geometry*
Participants: François Baccelli, Bartłomiej Błaszczyszyn.

TREC is a member of the 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. The kickoff meeting was organized this year in March at the University of Rouen; http://gdr-geostoch.math.cnrs.fr/workshop_Rouen. It brought together more than 80 researchers from France and Europe.

8.2.6. *ARC OCOQS*
Participant: Ana Bušić.

Two-year Inria Collaborative action *Action de recherche collaborative (ARC)* OCOQS "Optimal threshold policies in COntrolled Queuing Systems" OCOQS started in 2011. Coordinator: Ana Bušić, Participants: Alain Jean-Marie (MAESTRO, Inria Sophia-Antipolis), Emmanuel Hyon (University of Paris Ouest and LIP6), Ingrid Vliegen (University of Twente); http://www.di.ens.fr/~busic/OCOQS. The research subject is the optimal control of stochastic processes, with applications to the control of networks and manufacturing systems. The principal aim is to widen the set of mathematical techniques that can be used to prove that optimal policies are of threshold type, thereby widening the set of classes of models that can be effectively solved exactly or numerically handled in practice. A one-day workshop on Structural Properties in Markov Decision Processes was organized this year in January at Inria, Paris; http://www.di.ens.fr/~busic/OCOQS/workshop.html.

8.3. European Initiatives

8.3.1. Collaborations in European Programs FP7

Participant: All Trec.

- European Network of Excellence (NoE), http://euronf.enst.fr/en_accueil.html;
- Project acronym: Euro-NF;
- Duration: January 2008 - June 2012;
- Coordinator: D. Kofman (Intitut Télécom);
- Partners: about 30 partners;
- Abstract: This NoE is focused on the next generation Internet. Its main target is to integrate the research effort of the partners to be a source of innovation and a think tank on possible scientific, technological and socio-economic trajectories towards the network of the future. Euro-NF is supported by the theme "Information and Communication Technologies (ICT)" under the 7th Framework Programme of the European Community for RTD. Euro-NF is a continuation of Euro-NGI

8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. EIT ICT Labs

Participants: François Baccelli, Fabien Mathieu, Mir Omid Mirsadeghi, Rémi Varloot.

This grant in collaboration with Fabien Mathieu (GANG) was focused on the analysis of P2P systems, primarily in the context of wireless. Our partner Ilkka Norros (VTT) visited several times to work on the matter. We hired an Intern from ENS (Rémi Varloot). Our efforts led to a joint paper accepted at Infocom'13. In spite of the success of this collaboration, the grant will not be continued (due to the lack of proper 'Catalyst' with EIT ICT Labs).

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. IT-SG-WN

- Title: Information Theory, Stochastic Geometry, Wireless Networks
- Inria principal investigator: François Baccelli
- International Partner:

  Institution: University of California Berkeley (United States)

  Laboratory: EECS Department

  Researcher: Venkat Anantharam, Anant Sahai, David Tse.
- International Partner:

  Institution: Stanford University (United States)

  Laboratory: EE

  Researcher: Abbas El Gamal.
- Duration: 2011 - 2013
- See also: http://www.di.ens.fr/~baccelli/IT_SG_WN_web_site.htm
- The activity of this proposal is centered on the inter-play between stochastic geometry and network information theory, whith a particular emphasis on wireless networks. In terms of research, three main lines of thought will be pursued:1. Error exponents and stochastic geometry2. Stochastic geometry and network Information Theory3. Cognitive radio and stochastic geometry

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Venkat Anantharam (University of Berkeley),
- Daryl Daley (University of Melbourne),
- Christian Hirsch (University of Ulm),
- Guenter Last (KIT Germany),
- Ravi Mazumdar (University of Waterloo, Inria visiting professor),
- Naoto Miyoshi (Tokyo Institute of Technology),
- Ilkka Norros (VTT, Finland).

8.5.2. Internships

- Julieta BOLLATI (from Apr 2012 until Jun 2012)

  Subject: Optimal threshold computation in controlled queueing systems

  Institution: National University of Rosario (Argentina)

8.5.3. Visits to International Teams

- François Baccelli is one of the two recipients of the Simons Math+X Chair (https://simonsfoundation.org/funding/funding-opportunities/mathematics-physical-sciences/mathx/mathx-encouraging-interactions-2011-chair-recipients/ and is now on the faculty at UT Austin. He keeps a part time position in TREC.

TRISKELL Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR GEMOC

Participants: Benoit Combemale, Didier Vojtisek, Olivier Barais, Arnaud Blouin, Benoit Baudry.

Heterogeneous modeling, model driven engineering, executable metamodeling, models of computation, simulation.

The ANR project **GEMOC** (French Agency for Research, Program INS 2012) 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.

Project duration: 2012-2016

Triskell budget share: 253 keuros

Number of person/years: 2.2

Project Coordinator: Inria (Triskell)

Participants: ENSTA Bretagne, Inria, IRIT, I3S, Obeo, Thales

8.1.2. ANR INFRA-JVM

Participants: Johann Bourcier, Olivier Barais, Inti Gonzalez.

JVM, Kevoree, Models@Runtime

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. The project focuses on the three following parts:

- Defining new mechanisms to provide component-based support for provisionning I/O and memory guarantee
- Defining languages and runtime support for efficient process scheduling on multi-core platform
- Optimizing the memory allocation on multi-core platforms.

Triskell mainly works this year on VMkit (the integration platform of the project) and Kevoree (our Component Based platform) to run Kevoree on top of VMkit.

Project duration: 2012-2015

Triskell budget share: 193 keuros

Number of person/years: 2

Project Coordinator: Université Paris 6

Participants: Université Paris 6, Université Bordeaux 1, Université Rennes 1 (Triskell), Ecole des Mines de Nantes

8.1.3. BGLE2 CONNEXION

Participants: Benoit Baudry, Arnaud Blouin, Valéria Lelli, Nicolas Sannier.

requirement, software testing, critical system, HCI, MDE

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.

Project duration: 2012-2016

Triskell budget share: 515 keuros

Number of person/years: 3

Project Coordinator: EDF

Participants: Atos WorldGrid, Rolls-Royce Civil Nuclear, Corys TESS, Esterel Technologies, All4Tec, Predict, CEA, Inria, CNRS / CRAN, ENS Cachan, LIG, Telecom ParisTech

8.2. European Initiatives

8.2.1. FP7 S-CUBE

Title: S-CUBE

Type: COOPERATION (ICT)

Defi: Service & SW architectures, infrastructures and engineering

Instrument: Network of Excellence (NoE)

Duration: October 2008 - March 2012

Coordinator: University of Duisburg-Essen (Germany), Tilburg University (The Netherlands)

Others partners: Tilburg University (The Netherlands), City University London (UK), Consiglio Nazionale delle Ricerche (Italy), Center for Scientific and Technological Research, The French National Institute for Research in Computer Science and Control, Lero - The Irish Software Engineering Research Centre (Ireland), Politecnico di Milano (Italy), MTA SZTAKI - Computer and Automation Research Institute, Vienna University of Technology (Austria), Université Claude Bernard Lyon (France), University of Crete,Universidad Politécnica de Madrid (Spain), University of Stuttgart(Germany)

See also: http://www.s-cube-network.eu/

Abstract: S-Cube, the Software Services and Systems Network, will establish an integrated, multidisciplinary, vibrant research community which will enable Europe to lead the software-services revolution, thereby helping shape the software-service based Internet which is the backbone of our future interactive society.

An integration of research expertise and an intense collaboration of researchers in the field of software services and systems are needed to address the following key problems:

- Research fragmentation: Current research activities are fragmented and each research community (e.g., grid computing or software engineering) concentrates mostly on its own specific techniques, mechanisms and methodologies. As a result the proposed solutions are not aligned with or influenced by activities in related research fields.

- Future Challenges: One challenge, as an example, is to build service-based systems in such a way that they can self-adapt while guaranteeing the expected level of service quality. Such an adaptation can be required due to changes in a system's environment or in response to predicted and unpredicted problems.

Triskell budget share: 150 keuros

8.2.2. FP7 NESSoS

Title: NESSoS

Type: COOPERATION (ICT)

Defi: Service & SW architectures, infrastructures and engineering

Instrument: Network of Excellence (NoE)

Duration: October 2010 - October 2014

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)

See also: http://www.nessos-project.eu/

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.

Triskell budget share: 100 keuros

8.2.3. CESAR

Title: CESAR

Duration: February 2009 - January 2012

Coordinator: AVL - GmbH (Austria)

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

Abstract: In the context of CESAR, we have participated to the sub-project 3 demonstrator in order to demonstrate the usability of Polychrony as a co-simulation tool within the reference technology platform of the project, to which its open-source release has been integrated. The case-study, implemented in collaborateion with Airbus and IRIT, consists of co-modeling the doors management system of an Airbus A350 by merging its architecture description, specified with AADL, with its behavioral description, specified with Simulink.

Triskell brings its model-driven engineering expertise to compositionally assemble, compile and verify heterogeneous specifications (AADL and Simulink). Our case study will cover code generation for real-time simulation and test as well as formal verification both at system-level and in a GALS framework. Based on that case study, we aim at developing further modular code-generation services, real-time simulation, test and performance evaluation, formal verification as well as the validation of the generated concurrent and distributed code.

8.2.4. Artemis CHESS

Participants: Noël Plouzeau, Jean-Marc Jézéquel, Jacques Falcou, Viet-Hoa Nguyen.

Real-Time Embedded systems, Component-based Development, Model Driven Engineering

CHESS is an Artemis project that seeks industrial-quality research solutions to problems of property-preserving component assembly in real-time and dependable embedded systems, and supports the description, verification, and preservation of non-functional properties of software components at the abstract level of component design as well as at the execution level. CHESS develops model-driven solutions, integrates them in component-based execution frameworks, assesses their applicability from the perspective of multiple domains (such as space, railways, telecommunications and automotive), and verifies their performance through the elaboration of industrial use cases.

In 2012 Triskell contributed to final phase of development of the model editor specially built for CHESS on top of Papyrus. Using its Kermeta platform, Triskell contributed to the design and implementation of a set of constraint checkers, which ensure that designers define models compliant with the CHESS metamodel.

Project duration: 2/2009-4/2012

Triskell budget share: 400 keuros

Project budget: 6 M euros

Project Coordinator: INTECS

Participants: AICAS, Aonix, Atego ENEA, Ericsonn, Fraunhofer, FZI, GMV, Inria (Triskell), INTECS, Thales Alenia Space, THALES Communications, UPM, University of Padua, X/Open

8.2.5. ITEA2 OPEES

Program: ITEA2

Project acronym: OPEES

Project title: Open Platform for the Engineering of Embedded Systems

Duration: 2010-2012

Triskell budget share: 150 keuros

Coordinator: OBEO (Gaël Blondelle)

Other partners: AIRBUS, ADACORE, Anyware Technologies, Astrium Satellites, Atos Origin, CEA LIST, CNES, C-S, Dassault, EADS Astrium ST, ENAC, INPT-IRIT, Inria (Atlan-Mod/EXPRESSO/TRISKELL), MBDA, OBEO, ONERA, Schneider Electric, Thales, Xipp

Abstract: OPEES is an ITEA2 project which goal is to build a community able to ensure long-term availability of innovative engineering technologies in the domain of software-intensive embedded systems. Its main benefits should be to perpetuate the methods and tools for software development, minimize ownership costs, ensure independence of development platform, integrate, as soon as possible, methodological changes and advances made in academic world, be able to adapt tools to the process instead of the opposite, take into account qualification constraints. In this purpose, OPEES relies on the Eclipse Modeling Project platform (EMF, GEF, GMF, OCL, UML2, ...) and on many available tools such as Kermeta. The participation of Triskell into the OPEES project aims at industrializing both ModMap and Pramana. ModMap is a method and the associated tool to specify and use alignment rules between both homogeneous and heterogeneous languages. Current use is the creation of adapters between aligned languages. Pramana is a model transformation testing framework that makes it possible to synthesize input data (i.e. test models) for model transformations and check that the transformation behaves "correctly" on them.

8.2.6. Marie-Curie Relate

Program: Marie Curie

Project acronym: Relate

Project title:Trans-European Research Training Network on Engineering and Provisioning of Service-Based Cloud Applications

Duration: February 2011 - January 2015

Triskell budget share: 730 keuros

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)

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.

8.2.7. MERGE

Program: ITEA2

Project acronym: Merge

Project title:Trans-European Research Training Network on Engineering and Provisioning of Service-Based Cloud Applications

Duration: December 2012 - December 2015

Triskell budget share: 250 keuros

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, POHTO nSense Oy, University of Oulu, University of Jyvaskyla, Space Applications Services NV, Melexis, E2S, Katholieke Universiteit Leuven

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. International Initiatives

8.3.1. Inria International Partners

Following the Diva STREP project, we keep an active collaboration with the SINTEF institute. Fran√ßois Fouquet visited SINTEF for 8 weeks. During this visit, we combined the results of Kevoree and the result of the Moderate from SINTEF project to provide a dynamic component model for a micro-controllers based Internet of Things. Indeed, as the Internet of Things promises new ways for humans to interact with computing systems by seamlessly integrating resource constrained devices and traditional computing environment. These new computing environments are highly volatile and force applications to embed self-adaptive behaviors. The contribution of this collaboration is Œº-Kevoree: a plain C implementation of the Kevoree runtime which can be deployed on poor in resources micro-controllers. Evaluation of memory usage, reliability and performance shows that Œº-Kevoree is a viable solution with strong benefits over adaptation through dynamic firmware upgrades.

Following the MoCAA Equipe associée, we keep an active collaboration with Colorado State University. Benoit Baudry and Benoit Combemale visited CSU in April 2012 and Philippa Bennett spent a 4-monhts internship in Triskell. We continue the collaboration with Prof. Sanjay Rajopadhye (from the optimizing compiler domain) to cross-fertilize both HPC and MDE. Results of this collaboration were published in the Journal of Software and Systems in October 2012.

8.3.2. Participation In International Programs

8.3.2.1. TAAS

Program: Foundation Araucaria Inria Brazil

Title: Software testing for cloud computing

Inria principal investigator: Gerson SUNYE

International Partner (Institution - Laboratory - Researcher):

Federal University of Parana (Brazil)

Duration: Jul 2011 - Jun 2013

8.3.2.2. SPLIT

Program: PICS International Project of Scientific Cooperation

Title: Combiner les lignes de produits logicielles et le d$\sqrt{}$©veloppement logiciel orient$\sqrt{}$© aspects

Inria principal investigator: Jean-Marc JEZEQUEL

International Partner (Institution - Laboratory - Researcher):

University of Luxembourg (Luxembourg)

Duration: Jan 2009 - Dec 2012

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Joerg Kienzle (http://www.cs.mcgill.ca/~joerg) - Robert France - Barrett Bryant

8.4.1.1. Internships

Phillipa BENNETT (from Apr 2012 until Sep 2012)

Subject: Model Transformation Testing

Institution: Colorado State University (United States)

Martin FAUNES (from Mar 2012 until May 2012)

Subject: Automated discovery of domain invariants

Institution: Carleton University (Canada)

<h1 style="text-align: center; color: red;">URBANET Team</h1>

8. Partnerships and Cooperations

8.1. Regional Initiatives

- ARC 7 PhD Grant on Urban mobility measurement for citizen-oriented services cartography. Participants: Trista Lin (PhD), Marco Fiore, Hervé Rivano, Fabrice Valois. In collaboration with Frédéric Le Mouel (CITI) and Lyon Urbanism Agency.

- ARC 7 animation grant for organizing the "Digital Cities days".

- BQR INSA 3 years project on "Network architecture for Buildings and Energy" (ARBRE). Participants: Hervé Rivano, Fabrice Valois. In collaboration with CETHIL (energetic modeling), LIRIS (database management) and EVS (social science).

8.2. National Initiatives

8.2.1. ANR

- ANR Verso ECOScells 10/2009-12/2012
  Participants: Anis Ouni, Hervé Rivano, Fabrice Valois
  The objective of ECOScells is to study energy efficient microcells networks. Hervé Rivano is leader for Inria side and of the work package focusing on energy efficient wireless backhauling.

- ANR ARESA2 03/2010-08/2013.
  Participants: Alexandre Mouradian, Isabelle Augé-Blum, Fabrice Valois
  The partners in the ANR ARESA2 project are: Orange Labs, Coronis, Inria, LIG, Télécom Bretagne, VERIMAG. Our contributions focus on: resiliency of routing protocols in WSN; how to exploit the heterogeneity in wireless multi-hop network; real-time and QoS support in routing protocols for WSN. This project will end in August 2013. Alexandre Mouradian (Ph.D student) is funded by ARESA2.

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.

8.3. International Initiatives

8.3.1. Inria International Partners

- Universidade Federal do Ceara (Brazil): Joint publication [6] with Claudia Linhares Sales on proportional coloring for wireless mesh networks.

- University of Waterloo (Canada): Collaboration with Catherine Rosenberg on optimization of wireless mesh networks.

- Politecnico di Torino (Italy): Multiple publications [4], [5], [7], [18] co-authored with members of the Telecommunication Networks Group.

- Universidade Federal de Minas Gerais (Brazil): Collaboration with Pedro Vaz de Melo on mobility analysis [26].

- Ecole Polytechnique Fédérale de Lausanne (Switzerland): Collaboration with Florian Huc on proportional coloring for wireless mesh networks [6].

- A new collaboration started with Université of Yaoundé 1 into the LIRIMA framework. Fabrice Valois works with Prof. Maurice Tchuente and a joint Ph.D. thesis started: the research topics of M. Rodrigue Domga Komguem focus on the use of wireless sensor networks for intelligent transport systems (ITS).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Delia Ciullo (04/2012)

> Subject: Sleep Mode Effectiveness in Cellular Networks

> Institution: Politecnico di Torino (Italy)

Catherine Rosenberg (06/2012)

> Subject: Resource Allocation, Transmission Coordination and User Association in Heterogeneous Cellular Networks

> Institution: University of Waterloo (Canada)

Prasan Kumar Sahoo (11/2012)

> Subject: Wireless Sensor Networks: Applications and Research Issues

> Institution: University Chang Gung (Taiwan)

8.4.2. Visits to International Teams

- Marco Fiore visited with monthly frequency the Telecommunication Networks Group of the Politecnico di Torino, Italy. The cooperation focused on the topics of content download in vehicular environments and mobile user position verification.

- Marco Fiore visited the Hamilton Institute, Ireland, on October 2012. He gave an invited talk and discussed possible cooperation between UrbaNet and the Hamilton Institute.

- In last August, in the frame of the "Saisons Croisées France-Afrique du Sud", with the collaboration of the French Foreign Office and with the support of the Inria foreign office, Fabrice Valois participated to a common workshop on the use of wireless sensor networks for South-African applications. This workshop was held in Stellenbosch University, and was organized jointly by the communications group of Stellenboch University and the Inria project FUN (Dr. Nathalie Mitton). In this context, Fabrice Valois gave lectures and participated to a tutorial on Senslab. In September, a project proposal was submitted with these collaborators. Last November, a new research meeting was held in Inria Lille, hosted by the FUN team.

- In November, Hervé Rivano, Fabrice Valois, Razvan Stanica and Quentin Lampin participated to the Wireless Days conference in Dublin, Ireland. As Dublin academic institutions are very active in the area of urban networking and applications, we extended our stay and met with research teams from the Hamilton Institute and Dublin City University, as well as with French Embassy staff, to discuss possible collaborative activities.

ALICE Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

Our collaborative project "Meshing and PDEs" (cooperation with CORIDA team) aims at developing new techniques for discretizing and solving PDEs, by combining the expertise of the CORIDA team in mathematical modeling with the expertise of the ALICE team in geometry processing.

6.2. National Initiatives

Samuel Hornus has a continued cooperation with the Scientific Foundation Fourmentin-Guilbert on the Graphite-LifeExplorer software.

6.2.1. ANR

Sylvain Lefebvre has a continued collaboration with our industrial partners Allegorithmic and the CSTB through the ANR SIMILAR-CITIES.

Dmitry Sokolov is involved in the ANR COSINUS ModItère (ANR-09-COSI-014) which goal is to design a new geometric modeller based on fractal geometry. The aim of this work is to specify and develop a geometric modeler, based on the formalism of iterated function systems with the following objectives: access to a new universe of original, various, aesthetic shapes, modeling of conventional shapes (smooth surfaces, solids) and unconventional shapes (rough surfaces, porous solids) by defining and controlling the relief (surface state) and lacunarity (size and distribution of holes).

Rhaleb Zayer has continued the investigations on the ANR Physigrafix which aim is to bridge the gap between acquisition and modeling in the context of deformable objects.

6.3. European Initiatives

6.3.1. FP7 Projects

6.3.1.1. GoodShape

Title: Numerical Geometric Abstractions: from bits to equations

Type: IDEAS ()

Instrument: ERC Starting Grant (Starting)

Duration: August 2008 - July 2013

Coordinator: Inria (France)

Abstract: GOODSHAPE involves several fundamental aspects of 3D modelling and computer graphics. GOODSHAPE is taking a new approach to the classic, essential problem of sampling, or the digital representation of objects in a computer. This new approach proposes to simultaneously consider the problem of approximating the solution of a partial differential equation and the optimal sampling problem. The proposed approach, based on the theory of numerical optimization, is likely to lead to new algorithms, more efficient than existing methods. Possible applications are envisioned in inverse engineering and oil exploration.

6.3.1.2. ShapeForge

Title: ShapeForge: By-Example Synthesis for Fabrication

Type: IDEAS ()

Instrument: ERC Starting Grant (Starting)

Duration: December 2012 - November 2017

Coordinator: Inria (France)

Abstract: Despite the advances in fabrication technologies such as 3D printing, we still lack the software allowing for anyone to easily manipulate and create useful objects. Not many people possess the required skills and time to create elegant designs that conform to precise technical specifications. 'By–example' shape synthesis methods are promising to address this problem: New shapes are automatically synthesized by assembling parts cutout of examples. The underlying assumption is that if parts are stitched along similar areas, the result will be similar in terms of its low–level representation: Any small spatial neighbourhood in the output matches a neighbourhood in the input. However, these approaches offer little control over the global organization of the synthesized shapes, which is randomized. The ShapeForge challenge is to automatically produce new objects visually similar to a set of examples, while ensuring that the generated objects can enforce a specific purpose, such as supporting weight distributed in space, affording for seating space or allowing for light to go through. This properties are crucial for someone designing furniture, lamps, containers, stairs and many of the common objects surrounding us. The originality of my approach is to cast a new view on the problem of 'by–example' shape synthesis, formulating it as the joint optimization of 'by–example' objectives, semantic descriptions of the content, as well as structural and fabrication objectives. Throughout the project, we will consider the full creation pipeline, from modelling to the actual fabrication of objects on a 3D printer. We will test our results on printed parts, verifying that they can be fabricated and exhibit the requested structural properties in terms of stability and resistance.

6.4. International Initiatives

6.4.1. Participation In International Programs

Sylvain Lefebvre continues his collaborations with Microsoft Research Asia (Xin Tong), the Hong Kong University (Li-Yi Wei), KIT (Carsten Dachsbacher), and started a new collaboration with ETH Zurik (Olga Sorkine). He was invited for seminars within the teams of Carsten Dachsbacher (KIT) and Rüdiger Westerman (TU Munich).

Bruno Lévy continues his collaborations with Hong-Kong University (Wenping Wang).

6.5. International Research Visitors

6.5.1. Visits of International Scientists

During this last year, our team has been visited by Carsten Dachsbacher, Mathäus Chajdas, Li-Yi Wei and Ivo Ihrke (MPII Sarrbruecken).

6.5.1.1. Internships

Samuel Hornus supervised Pulkit Bansal (Indian master student) as an Inria internship, on the modeling of RNA molecules.

ALPAGE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

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

Participants: Laurence Danlos, Benoît Sagot, Chloé Braud, Marie Candito, Benoît Crabbé, Pascal Denis, Charlotte Roze, Pierre Magistry, Djamé Seddah, Juliette Thuilier, 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 should provide Alpage with opportunities for collaborating with new teams, e.g., on language resource development with descriptive linguists (INALCO, for example).

Benoît Sagot is in charge of one of the 7 scientific "strands" of the LabEx EFL, namely the strand on Language Resources. Several other project members are in charge of research operations within 3 of these 7 strands ("Experimental grammar from a cross-linguistic perspective", "Computational semantic analysis", "Language Resources").

8.2. National Initiatives

8.2.1. *ANR*

8.2.1.1. *ANR project ASFALDA (2012 – 2015)*

Participants: Marie Candito, Benoît Sagot, Éric Villemonte de La Clergerie, Laurence Danlos, Marianne Djemaa.

Alpage is principal investigator team for the ANR project ASFALDA, lead by Marie 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 [56] 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.

8.2.1.2. ANR project EDyLex (2010 – 2013)

Participants: Benoît Sagot [principal investigator], Rosa Stern, Damien Nouvel, Virginie Mouilleron, Marion Baranes, Marion Richard, Sarah Beniamine, Laurence Danlos.

EDyLex is an ANR project (STIC/CONTINT) headed by Benoît Sagot. The focus of the project is the dynamic acquisition of new entries in existing lexical resources that are used in syntactic and semantic parsing systems: how to detect and qualify an unknown word or a new named entity in a text? How to associate it with phonetic, morphosyntactic, syntactic, semantic properties and information? Various complementary techniques will be explored and crossed (probabilistic and symbolic, corpus-based and rule-based...). Their application to the contents produced by the AFP news agency (Agence France-Presse) constitutes a context that is representative for the problems of incompleteness and lexical creativity: indexing, creation and maintenance of ontologies (location and person names, topics), both necessary for handling and organizing a massive information flow (over 4,000 news wires per day).

The participants of the project, besides Alpage, are the LIF (Université de Méditerranée), the LIMSI (CNRS team), two small companies, Syllabs and Vecsys Research, and the AFP.

In 2012, several important developments have been achieved:

- Large-scale improvements within the WOLF (Free French WordNet)
- Corpus-based studies targeted at qualitatively understanding and quantitatively modeling French morphological construction mechanisms (derivation, composition, borrowing and others)
- Development of modules for automatic detection, classification and morphological analysis of unknown words in French corpora [45];
- Adaptation and extension of the NewsProcess architecture, previously developed at Alpage, for meeting the expectations of the EDyLex project in terms of lexicon extension from dynamic corpora, here AFP news wires.

8.2.1.3. ANR project Polymnie (2012-2015)
Participants: Laurence Danlos, Éric Villemonte de la Clergerie.

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. 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 define two languages: an abstract language for the abstract forms, and an object language for the surface forms.

The role of Alpage in this project is to develop sentential or discursive grammars written in TAG so as to study their conversion in ACG.

8.2.1.4. "Investissements d'Avenir" project PACTE (2012 – 2014)
Participants: Benoît Sagot, Éric Villemonte de La Clergerie, Laurence Danlos.

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 early 2012.

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 (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.

In 2012, the results obtained within PACTE are mostly related to SxPipe and to DeLex, the new Alexina lexicon for German (as well as the German instance of MElt trained among other on DeLex). These results are described in more details in the corresponding "software" sections.

8.3. International Initiatives

8.3.1. Participation In International Programs

8.3.1.1. ISO subcommittee TC37 SC4 on "Language Resources Management"
Participant: Éric Villemonte de La Clergerie.

The participation of ALPAGE to French Technolangue action Normalangue has resulted in a strong implication in ISO subcommittee TC37 SC4 on "Language Resources Management" Éric de La Clergerie has participated to an ISO meeting in Madrid (June 2012) and has played a role of expert (in particular on morpho-syntactic annotations [MAF], feature structures [FSR & new FSD], and syntactic annotations [SynAF]). MAF has finally reached the level of an ISO standard (ISO/FDIS 24611, oct. 2012). A paper [21] promoting both SynAF and MAF was presented at TLT'11 (Lisbon, Dec. 2012).

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

Roser Sauri, research scientist at Media-Lab in Barcelonea (Spain), has been "professeur invitée" at Alpage between the 1st of april and the 15th of May 2012. Roser Sauri is well known for her work on event factuality for which she developed a formal model and an annotated corpus. During her stay in Paris, she has been working with Alpage members to extend her model to discourse. Moreover, she helped Alpage in launching the FDTB (French Discourse Tree Bank), a project to annotate the French Tree Bank for discourse. Her experience in annotating similar copora for Catalan and Spanish was very fruitful and collaboration with her is going on.

8.4.1.1. Internships

Thomas Roberts (from Jun 2012 until Aug 2012)

Subject: Lefff-like English syntactic lexicon

Institution: Massachusetts Institute of Technology (United States)

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 (see 6.1).

8.1.2. ANR EASEA-Cloud

Participants: Evelyne Lutton [correspondant], Waldo Cancino.

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://lsiit.u-strasbg.fr/easea) 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), ISC-PIR/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 will develop new visualisation tools adapted to the monitoring of the optimization process.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. DREAM

Program: FP7

Project acronym: **DREAM**

Project title: Design and development of REAlistic food Models with well-characterised micro- and macro-structure and composition

Duration: 2009–2013

Coordinator: INRA - CEPIA department, Monique Axelos

Other partners: Technical Research Centre of Finland, Actilait France, ADRIA Développement France, CNRS, INRA Transfert, Société de Recherche et Développement Alimentaire Bongrain, Campden BRI Magyarország Nonprofit Kft. Hungary, Central Food Research Institute Hungary, Teagasc - Agriculture and Food Development Authority Ireland, Consiglio Nazionale delle Ricerche - Istituto di Scienze delle Produzioni Alimentari Italy, Top Institute Food and Nutrition The Netherlands, Wageningen University (WUR) The Netherlands, University of Ljubljana, Biotechnical Faculty Slovenia, Institute for Food and Agricultural Research and Technology Spain, Campden BRI UK, Institute of Food Research UK, United Biscuits (UK) Limited.

Abstract:

The overall goal of DREAM (Design and development of REAlistic food Models with well-characterised micro- and macro-structure and composition) is to develop realistic, physical and mathematical models to be used as standards that can be exploited across all major food categories to facilitate development of common approaches to risk assessment and nutritional quality for food research and industry.

The partnership involves 18 partners from 9 european countries, among which two multinationals. The project is lead by INRA, CEPIA department, and Inria participation is managed by delegation by the ISC-PIF (CNRS-CREA, UMR 7656).

See more at http://dream.aaeuropae.org/.

The role of AVIZ has been to develop evolutionary techniques adapted to the modeling of agrifood process. In 2012, the work was focussed on the development:

- of robust evolutionary methods to learn the structure of Bayesian Networks when experimental data are rare (in collaboration with Alberto Tonda, Cédric Baudrit and Nathalie Perrot of INRA/GMPA and Pierre-Henri Wuillemin od LIP6/DESIR), applied to cheese making and biscuit baking process,

- of a model of milk gel based on partial differential equations, where numerical parameters were learn by artificial evolution (in collaboration with Julie Foucquier, Sébastien Gaucel Alberto Tonda, and Nathalie Perrot of INRA/GMPA).

8.2.1.2. 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 Desden, (DE)

We have been collaborating with Raimund Dachselt on stackable tangible devices for faceted browsing [35], [33].

8.3. International Initiatives

8.3.1. Inria International Partners

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

- Google, Mountain View, USA
- Microsoft Research, Redmond, USA
- Purdue University, USA
- New York University, USA
- University of Toronto, Canada
- University of Calgary, Canada
- University of British Columbia, Canada
- City University London, UK,
- University of Kent, UK
- University of Konstanz, Germany
- University of Magdeburg, Germany
- University of Groningen, the Netherlands
- University of Granada, Spain

8.3.2. Collaboration with Google

AVIZ collaborates with Google on several projects, related to the Google Research Grant (see sec 7.1) and to evaluation methodology in information visualization [20]. Heidi Lam from Google spent 3 months at AVIZ to collaborate more closely.

8.3.3. Collaboration with Microsoft Research

AVIZ collaborates with several researchers from Microsoft Research Redmond, in particular on the topic of new interactions for information visualization [21] and brain connectivity visualization.

8.3.4. 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 not porting the Obvious Toolkit [53] in this environment to integrate all its components [26].

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Heidi Lam (Google, USA)
- Nathaly Henry-Riche (Microsoft Research, USA)
- Ronald Rensink (University of British Columbia, Canada)

AVIZ organized hosted the following international visitors for a one-day visit:

- Marian Dörk (University of Calgary, Canada)
- Shengdong Zhao (National University of Singapore)
- Oliver Deussen and Hendrik Strobelt (University of Konstanz, Germany)

8.4.1.1. Internships

Basak ALPER (from May 2012 until Sep 2012)

Subject: Visualization of Brain Data Connectivity

Institution: University of California San Diego (United States)

Stefanie Klum (from September 2011 until April 2012)

Subject: Stackable Widgets for Faceted Information Seeking

Institution: University of Magdeburg (Germany)

<p style="text-align:center;color:red;">**AXIS Project-Team**</p>

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. PREDIT (ADEME) TIC TAC (2010 - 2012)

Participants: Carole Goffart, Guillaume Pilot, Bernard Senach, Brigitte Trousse, Florian Bonacina.

> Title: TIC TAC
>
> Type: PREDIT groupe 3, Mobilité dans les régions urbaines
>
> Challenge: Information and Communication Technologies – Transportation
>
> Instrument: Mobilité dans les régions urbaines
>
> Duration: 2010 - March 2012
>
> Coordinator: VuLOG
>
> Others partners: MHC Conseils
>
> Abstract: TICTAC project aims at providing an advanced travellers' information system in which real time information about waiting time at bus stop will be avalaible: users define their "favourite" and can call a vocal server which give them immediately the requested information.

This year, we conducted a second experimentation with an improved version of real-time information system. Main modification were : a lighter interaction with the vocal server, simpler registration procedure, on-line memo . . . The experiment started in January 2012 and lasted till end of February and 62 people registrated to the experiment [57]. The quantitative log analysis was articulated with two appreciation questionnaires. Results show that there was few access to the vocal server and a small rise of web server consultation in comparison with the first experimentation. The error rate and the response time were rather high and the users didn't have a very good experience with the service. The service was acknowledged as very useful and the user interface was perceived as easy to use but TICTAC didn't met its users expectations: very few of them used it on a daily basis [52], [51].

The second experimentation was also a good opportunity to test our new approach of co-creation and we conducted a workshop with users to identify functionalities of a real-time traveler information system and to test a first mock-up.

6.1.2. PACALABS HOTEL-REF-PACA (2010 - 2012)

Participants: Florian Bonacina, Bernard Senach, Brigitte Trousse, Yves Lechevallier, Nicolas Béchet, Ehab Hassan.

> Title: HOTEL-REF-PACA
>
> Type: PACALABS
>
> Challenge: Referencing Accomodation Web Sitesi in PACA Region
>
> Instrument: PACALABS (Paca Region and FEDER fundings)
>
> Duration: October 2010 - May 2012
>
> Coordinator: Full performance
>
> Others partners : General Council of Maritim Alps
>
> This project is conducted with Full Performance, a SME specialized in Web site referencing. It aims at improving hinterland tourism and hotel-keepers as well as tourists are involved in the experimentation. Experiments of different new referencing rules are conducted with Web site visitors in order to study their effect on behavioral changes and on touristic choices. The experimentation consists in three stages: current referencing rules are first studied and their efficiency estimated through eye-tracking experiments. Then new rules are explored and tested with users. When the convenient new rules are selected, their efficiency is evaluated through data mining analysis and qualitative studies.

Due to some delay in the experiment (mainly tag installation, data access), our task related to data analysis was postponed until May 2012. This year we conducted several eye tracking studies on different sites (general council 06 in Nice, Draguignan citizen space, Inria) in order to understand the visual search behavior when looking for ill-defined or well defined targets on a Google results page. The results show that commercial ads are rarely looked at and that for the intended users (touristic hosts) a good natural referencing is more efficient than commercial ads. The impact of ergonomic recommendations about web site users interface provided to hotel and restaurant owners participating in the project was evaluated. The pool showed that the participant had a deeper understanding of on line referencing and awareness of the weight of usability quality [54], [44], [42], [43], [45].

6.1.3. PACALABS ECOFFICES (2010 - 2012)

Participants: Guillaume Pilot, Yves Lechevallier, Bernard Senach, Brigitte Trousse [correspondant].

> Title: ECOFFICES
>
> Type: PACALABS
>
> Challenge: Energy Challenge within Offices
>
> Instrument: PACALABS (Paca Region and FEDER fundings)
>
> Duration: august 2010 - november 2011
>
> Coordinator: Osmose
>
> Others partners: CASA, CSTB
>
> See also: http://www.ecoffices.com/
>
> Abstract: ECOFFICES is an eco-challenge within an enterprise: offices are equipped with sensors and actuators. Actions of employees on actuators are registered and consumption behaviors are tracked. The experimentation consists in three successive stages: data are first recorded during the usual work of the challengers, then feed-back is provided through user interface and in the challenge phase, 3 teams are competing to reach the best economy level. After the challenge, registered data are analysed to study the change of practices, if any. The goal of the project is to provoke behavioral changes and our team is in charge of the evaluation.

The ECOFFICES project based on the concept of **energy challenge** in tertiary sector ended officially in november 2011, but due to the complexity of cleaning data before data analysis, we analysed usage data and IoT data up to February 2012. The final assessment showed that the participation rate was higher than expected. The most notable behavior change at the office concerns a declared increase of switching off of aircon and electrical devices when leaving the office for a long time. At the end of the challenge, participants were not convinced about effective savings and the sustainability of emergent eco-behaviour is questioned. Our main contribution is described in Section 5.5.3 and reported in three main deliverables related to the qualitative and quantitative analysis of experimental data, which are summarised in [64] and the final report [62].

6.1.4. PACALABS ECOFAMILIES (2011- 2012)

Participants: Xavier Augros, Florian Bonacina, Brigitte Trousse [correspondant].

> Title: ECOFAMILIES
>
> Type: PACALABS
>
> Challenge: Design by end users of an user interface for energy savings
>
> Instrument: PACALABS (Paca Region and FEDER fundings)
>
> Duration: October 2011 - October 2012
>
> Coordinator: CSTB
>
> Others partners : University of Nice Sophia Antipolis (I3M), NCA

See also: http://www.ictusagelab.fr/projet/ecofamilies fro a summary of the mainoutcomes of the project.

The ECOFAMILIES project has proposed to prototype and experiment an innovative technological solution to promote energy-aware behaviors at home, through a participatory design approach. A web-based user interface has been developed by SME Ekenos (Italy). It provides a set of customized contents, ranging from basic information to proposal of actions aiming at reducing energy consumption.

ICT Usage Lab (cf. section 6.1.8) was a sponsor partner and was represented in this project by AxIS team for advices on the experimentation and co-design protocol (through the supervising committee) and various supports to partners related to the dissemination via the Web site, to the workshop animation and Focuslab tools (Sphinx tool, Eye-tracker,) and to the redaction of some deliverables (D2,D3, D3.2 and the final report [61]).

For some pictures of such workshops: http://www.flickr.com/photos/ecofamilies/ ECOFAMILIES Was presented during a report at TV during the 19-20 journal France 3 on October 17. See also a summary of the project ECOFAMILIES on the Web site [69].

6.1.5. CPER Telius - FocusLab (2008 - 2013)

Participants: Xavier Augros, Guillaume Pilot, Brigitte Trousse [correspondant].

This grant, funded by Regional and European support, covers 3 areas: an experimental platform for research on telecomnumication networks, a software and informatics platform (including a virtual reality environment, a medical imaging platform, and a peer-to-peer computing grid), and an experimental platform on the usage of information systems. AxIS is being funded through the experimental platform on the usage of information systems called Focus (and renamed FocusLab) (cf. section 5.6).

Projects using elements of the FocusLab platform are reported in [70]. The following list identifies AxIS projects where our platform was used: TIC TAC, ECOFFICES, ECOFAMILIES. In addition to others Inria teams (WIMMICS, REVES), we can cite external organisations/teams: I3M laboratory from university of Nice Sophia Antipolis, CSTB (Sophia Antipolis), the Ergonauts Association, Elliot partners such as BIBA (Germany) and HSR (Italy).

6.1.6. IMREDD

Participant: Brigitte Trousse [correspondant].

Our activities on Internet of things (IoT), Environment and Health&Well Being, mainly leaded in the context of the european ELLIOT Project (cf. section 6.3.1.1) are related to "Environment and health", one of the three topics of the Mediterannean Institute of Risks, Environment and Sustainable development (IMREDD [7] in French). This institute is in relation to the EcoCampus of the OIN (*Opération d'intérêt National de la Plaine du var* (University of Nice Sophia Antipolis and Nice Côte d'Azur Metropole).

URL: htmladdnormallinkhttp://unice.fr/universite/imreddhttp://unice.fr/universite/imredd.

6.1.7. Labex UCN@Sophia

Participant: Brigitte Trousse.

Title: User-Centered Network

URL: http://www.ucnlab.eu/

Instrument: Labex

Coordinator: University of Nice - Sophia Antipolis

Others partners: I3S (UNS / CNRS), LEAT (UNS / CNRS), Inria, EURECOM

---

[7]IMREDD: Institut Méditerranéen des Risques,de l'Environnement et du Développement Durable

Abstract: The Labex UCN@Sophia proposes a research program for researchers of the ICT Campus at Sophia Antipolis, program motivated by a vision which positions the user at the centre of the network. Five scientific and strategic directions are proposed: a) Data Centric Networking, b) Distributed and Ubiquitous Computing, c) Security, privacy and network neutrality, d) Infrastructures: Heterogeneity and Efficiency and e) Energy Efficiency. Two application domains have been selected: e-Health to allow persons with reduced autonomy to retain at home and Intelligent Transport Systems.

AxIS is mainly concerned by Intelligent Transport Systems (mainly by co-creating ITS applications with users and stakeholders) and potentially all the research directions involving users. AxIS experience in ITS domain is based on various projects (c. section 3.2).

6.1.8. *ICT Usage Lab*

Participants: Brigitte Trousse [correspondant], Bernard Senach.

This year was rich in concrete projects with experiments with citizens or professionals for various members of ICT Usage Lab: CSTB, I3M (UNiversity of Nice Sophia Antipolis) and AxIS (Inria).
The FocusLab platform (CPER Telius 6.1.5) has been avalaible to ICT Usage Lab projects and toother expriments by academics or association of PACA region: EPI Reves (Inria), CSTB, I3M 5university of Nice) and the association Ergonautes.
ICT Usage Lab was partner of the Innovatice City Convention event organised in June 2012 (Nice Côte d'Azur): http://www.innovative-city.fr/partenaires/partners/. In this context we invited two speakers for ICC 2012: Michael Nilsson (CDT, Lulea, Finland) and Khaldoun El Agha (ICT Labs - EIT, Paris).
ICT Usage Lab have several dissemination activities related to ECOFAMILIES, ECOFFICES and ELLIOT projects at the europena level.
ICT Usage Lab was co-founder of the Association France Living Labs (cf. section 6.2.4).
Let us note the visit of Noel Conryut from the living lab for Teaching and Learning (Island of the Reunion) at the end of december in order to identify collaboration topics with our living lab.

6.1.9. *Involvement in Regions*

PACA Region

- B. Trousse as Inria representative is a member of the expert committee of the PACALABS and of the strategic committee of the PACALABS orientation of the Regional Council.

- B. Trousse and B. Senach are members of the coordination committee of the ICT Usage Lab (Inria, CSTB, Orange Labs and UNS).

- B. Senach and B. Trousse pursued the reactivation started in 2008 of the living lab ICT Usage Lab by increasing our contacts with territories and academics disseminating the living lab approach and/or involving them as supporters or partners of experiments. This year, in addition to previous contacts (NCA, CASA, CG06) we had fruitful meetings with PAP (Pôle Azur Provence, a cluster of hinterland territorial communities) to set up collaboration about ecological behaviour changes and with CG06 about eco-tourism. Inside ICT Usage Lab, we had contcats with I3M (University of Sophia Antipolis) involved in the ECOFAMILIES project. See the activities of ICT usage lab (cf. section 6.1.8).

- B. Senach, G. Pilot and B. Trousse had contact with ADEME and CASA in order to promote the real-time traveler information system MOBILTIC which capitalized on the TicTac Project.

- B. Trousse (Inria and ICT Usage Lab representative) was member of the program committee of Innovative City Convention (ICC) 2012 (Nice).

- AxIS as responsible of Elliot experiments has established relations with the Environment department of the urban community of Nice Côte d'Azur (NCA) and CHU Nice in order to organize co-creation workshops.

- B. Trousse gave a talk about ECOFFICES project at the smart grid group (Cap Energies and SCS clusters).

- B. Trousse met in january Stéphane Delalaye from Arsenic association (PACA). Following this contact, we have the opportunity to organise one experiment for HOTEL-REF-PACA in a citizen space at Draguignan (ERIC) and another one for the ELLIOT project in the Hublot (ERIC, Nice).

- AXIS organised two Elliot workshops for professionnels (Health & Environment) in the Environment department of Nice Côte d'Azur (cf. section 6.3.1.1).

Midi Pyrénées Region

- AxIS (C. Detraux and D. L. Scapin) are involved in ANR-PIMI project (cf. section 6.2.1) where the Midi-Pyrénées region and IUT Tarbes are pilot-partners.

6.2. National Initiatives

6.2.1. *ANR PIMI (2010 - 2013)*

Participants: Claudia Detraux, Dominique Scapin [correspondant].

Title: PIMI

Type: ANR

Defi: Personal Information Space

Instrument: Verso 2010

Duration: 2010 - 2013

Coordinator: Genigraph

Others partners: LRI, IRIT, Institut Telecom, Montimage, The Grand Duchy of Luxembourg

Abstract: PIMI Project aims at the definition of a design environment and a deployment platform for Personal Information Management system (PIM). The future PIM must provide the end-user personal data access with services that are relevant to his needs. In order to take mobility into account, the PIM will be accessed both by mobile devices (smartphone) and personal computers.

The main contributions this year are described in Section 5.4.1 .

6.2.2. *FIU FIORA (2012-2015)*

Participants: Yves Lechevallier [correspondant], Thierry Despeyroux.

Program: FIU (14th call)

Project acronym: FIORA

Project title: Moteur d'inférences pour la personnalisation

Duration: 2012-2015

Coordinator: Michel Manago (SME KIOLIS)

Other partners: Editions SOLAR, Mondeca, Inria (AxIS), ISEP, UNiversity of Paris XIII

Abstract: This project aims the design and the development of FIORA an engine offering personnalised content. Perosnnalisation will be based on context parameters related to the user and avalaible semantic information.The main result will be to develop an engine merging case-based reasoning technics, recommandation technics based on collaborative filtering and data mining.The proof concept will be experimented in two domains: a) Nutrition and Health (use of the cohort Nutrinet with more than 200 users) and b) e-tourism.

This project starts at the end of 2012.

6.2.3. Competitivity Clusters

Cap Digital: B. Trousse was reviewer for the selection of proposals for Cap Digital competitively cluster related to the call for Projects "Expérimentation in situ et in vivo de projets" (deadline : September 19th) of Paris Region.

SCS and Cap Energies: B. Trousse was invited for a talk on *Ecoffices: the usages aspect* during a meeeting (April 19th, Brignoles) of the working group Smart grid in PACA (common to two clusters, SCS and Cap Energies clusters).

6.2.4. France Living Labs

The French Network of Living Labs has created the association named "France Living Labs" (F2L) in order to promote the French Living and to facilitate user-driven open innovation on a national level. From the first ENoLL wave in 2006, the French network of living labs has grown from one ENoLL accredited living lab to 47 living labs up to this date after the ENoLL 6th Wave of Call for Membership applications.

The French Network of Living Labs have had annual meetings since 2008. Due the growing number of the French network of living labs, a majority of living labs (25 among 36) has decided to create an association on March 2012 in order to support operations of its members, mainly for common international/European projects, b) to animate the network, promoting the concept of living lab, supporting the sharing of methods and tools and c) to promote the ENoLL label and the Living lab approach by organizing various events and to finally contributing to the maturity of Living Labs European initiative by capitalizing knowledge and experiences and to support the defining KPI indicators for impact assessment of a Living Lab.

ENoLL and France Living Labs are looking into opportunities of closer communication and cooperation in their activities and initiatives through meetings, exchanging of information, knowledge, experiences and best practice. This will be done through signing a formal cooperation agreement (MoU).

B. Trousse (Inria) and A. Zarli (CSTB) are the official representatives of the ICT Usage Living Lab which is a founding member of France Living Labs and member of the administration council. Brigitte Trousse was elected President of the Association in the adminsitration council of april 2012. The association wrote a press communication on June 18.

Three Council Meetings: august (Universcience, Paris), may and october (Inria, Paris).

URL: http://www.france-livinglabs.fr/

6.3. European Initiatives

6.3.1. FP7 Projects

6.3.1.1. STREP ELLIOT (2010 - 2013)

Participants: Anne-Laure Negri, Mylène Leitzelman, Bernard Senach, Caroline Tiffon, Brigitte Trousse [correspondant].

> Title: Experiential Living Lab for the Internet of Things
> Type: COOPERATION (ICT)
> Defi: Internet of Things and enterprise environments
> Instrument: Specific Targeted Research Project (STREP)
> Duration: September 2010 - February 2013
> Coordinator: TXT Polylemia (Italy)
> Others partners:
> See also: http://www.elliot-project.eu/
> Abstract: The ELLIOT project (Experiential Living Labs for the Internet of Things) aims at developing an Internet Of Things (IOT) experiential platform where users/citizen are directly involved in co-creating, exploring and experimenting new ideas, concepts and technological artifacts related to IOT applications and services. Based on a three levels experiential model issued from previous European projects, the study will capitalize on existing practices of co-creation in IoT contexts. It will allow the exploration of the potential impact of IOT and of the Future Internet in the context of the Open User Centered Innovation paradigm followed in the Living Lab approach.

This year we conducted the following activities:

- 3 co-conception workshops (1 group of health and/or air professionals) were held in order to identify the ideas and positions of professionals related to potential internet of things services based on air and noise measurements. These workshops took place in Nice during spring 2012; both Aloha! and GenIoT co-creation methods were used and an evaluation of these methods is reported in Section 5.5.2 and [56].

- An experiment with IoT probe (a fake green watch) was run in order to test the online diary and data analysis.

- Specification of the methodology for user experience measurement for Green Services Use case and application for delivrables [50], [63].

- Implementation of MyGreenServices application which collects IoT data from electric cars and citizens sensors and provides some services such as alerts. Usage data are stored in order to be sent to the ELLIOT platform.

- Development of Focuslab V1.3 (cf. section 5.6) in relation to the ELLIOT platform..

- Contribution to a lot of deliverables, five public [47], [46], [55], [50], [63] and three others.

- Co-organisation of two workshops on user experience measurement (KSB model, use cases, data analysis) at Inria Sophia Antipolis and one general meeting dedicated to ELLIOT partners.

6.3.1.2. ICT CSA FIREBALL (2010 - 2012)
Participants: Marc Pallot, Brigitte Trousse [correspondant], Caroline Tiffon, Bernard Senach.

Title: FIREBALL

Type: CAPACITIES (ICT)

Defi: Future Internet Experimental Facility and Experimentally-driven Research

Instrument: Coordination and Support Action (CSA)

Duration: May 2010 - April 2012

Coordinator: Luleå University of Technology (Sweden)

Others partners: AALTO (Finland), AENESCEN (Italy), MCC (United Kingdom), SAIM (Netherlands), ESADE (Spain), ALFAMICRO (Portugal), ISA (Portugal), E-NOVA (Portugal) HK (Finland), Inria (France), DIMES (Finland), IBBT (Belgium), AUTH (Greece), OY (Finland), IMAGES & RESEAUX (France), BCN (Spain)

URL: http://www.fireball4smartcities.eu/

Abstract: FIREBALL (Future Internet Research and Experimentation By Adopting Living Labs - towards Smart Cities) is a coordination action which establishes a coordination mechanism through which a network of Smart Cities across Europe engages in long term collaboration for adopting User Driven Open Innovation to explore the opportunities of the Future Internet.

We mainly have collaborations with Prof. Dr Nicos Komninos (Faculty of Engineering, Aristotle University of Thessaloni, Greece) and Hans Schaffers (Expert at ESoCE Net, Director of Adventure research, Nederlands) for the two scientific publications [26], the white paper [59] and the delivrables D1.2 [58] and D2.1 [60].

This year we finalize a contribution (about 25 pages) on Paca Region - Sophia Antipolis - Nice Côte d'Azur Assets Case Study for a Fireball deliverable [58].

6.3.1.3. SSH CSA IDEAS (2010 - 2012)

Participants: Yves Lechevallier [correspondant], Marc Csernel, Ehab Assan.

Title: IDEAS

Instrument: Coordination and Support Action (CSA)

Type: CAPACITIES (SSH)

Duration: January 2010 - June 2012

Coordinator: École française d'Extrême Orient (EFEO)

Others partners: Institute of Ethnology of the University of Turku, Hungarian Academy of Sciences, British Academy, Asien-Afrika-Institut of the University of Hamburg, Istituto italiano per l'Africa e l'Oriente (IsIAO).

Abstract: The overall objective of IDEAS is to make progress in coordinating and bringing together academic research, researchers and policy-makers. IDEAS will make use of the expertise and resources of a recently created network, the European Consortium for Asian Field Study (ECAF), which comprises 44 research institutions from ten EU countries and nine Asian countries and Russia, which specialize in Asian studies, and a network of 22 field research centers run by ECAF members across Asia. The task attributed to Inria was to provide the pilot of a website devoted to the presentation of Asian manuscripts (France)

The contribution of Axis was not only a pilot, as requested within the contract, but also a methodology leading to the construction of a smart search engine dedicated to the pilot. As a prototype website we took the IsIAO website according to our partner's wishes and because it was an opportunity to get together, at the same place, a set of manuscripts and large collection of photographs: the Tucci's collection. The Tucci's collection was a good opportunity to test our methodology and our search engine. The main goal of our search engine is to provide a "reasonable" amount of answers whatever the question is.

The reason of the construction of this search engine was the observation of a lot of orientalist websites, included the most famous one the such IDP (International Dunhuang Project). We find that after a query done by a naive user (one of us) most of the time we obtained either no answer, either a lot too much of them. This was a strong motivation and our pilot tested on the Tucci's collection provide now a "reasonable" amount of answers either according to one of our queries.

6.3.2. Collaborations in European Programs, except FP7

6.3.2.1. COST TwinTide (2010-2013)

Participant: Dominique Scapin [correspondant].

Program: COST IC0904

Project acronym: TwinTide

Project title: Towards the Integration of Transectorial IT De- sign and Evaluation

Duration: 2010 - 2013

Coordinator: Effie Lai-Chong Law - Swiss Federal Institute of Technology (ETH Zürich), Switzer- land (CH) / University of Leicester, UK

Other partners: see http://www.irit.fr/recherches/ICS/projects/twintide

Abstract: Towards the Integration of Transectorial IT De- sign and Evaluation is a usability and user experience research community running under the auspices of COST (http://www.cost.esf.org/). The main objective is to harmonize research and practice on design and evaluation methodologies for computing artifacts, across sectors and disciplines, bringing together researchers and D&E professionals.

6.3.2.2. EIT ICT Labs

B. Trousse managed several actions related to EIT ICT Labs:

- Participation at the Living Lab Business Models Coaching and Best-practice Sharing workshop (Telecom italia lab, Turin, April 2-3) organised by the Experience & Living Labs (E&LL) catalyst of the Research component of the european institute EIT ICT Labs http://www.eitictlabs.eu/
- Interaction with Khaldoun El Agha, Valerie Issarny, Olivier Festor and Bruno le Dantec related to the action line called "Digital Cities of the Future" and Proposition of an invited talk at ICC 2012 http://www.innovative-city.fr.
- Participation at the submission at the ICT Labs call (2013) related to E&LL catalyst (which was accepted).

6.4. International Initiatives

6.4.1. Participation in International Programs

6.4.1.1. FACEPE CM2ID, Brazil 2003-2013

Participants: Yves Lechevallier, Marc Csernel.

During 2012 we start a new collaboration on social network data analysis with F.A.T. De Carvalho from Federal University of Pernambuco (Recife) and two Inria Teams AxIS (Inria Rocquencourt) and Orpailleur (Inria Nancy Grand Es -LORIA).

A scientific project **Combining Numerical and Symbolical Methods for the Classification of Multi-valued and Interval Data (CM2ID)** submitted by F. De Carvalho and A. Napoli has been accepted by FACEPE and Inria. The project started on january and will end on 12/2013. Researchers and students are concerned by this project from Orpailleu, AxIS and CIn-UFPE side. It aims at developing Numerical and Symbolical methods of clustering on Multi-valued and Interval Data.

This project aims at developing and comparing clustering algorithms for 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, in order to push the complexity barrier farther in the mining of complex data. Biological data, namely gene expression data, are used for test and evaluation of the combination of algorithms. The project involves three teams, one Brazilian team and two French Inria teams, including specialists of clustering and classification methods. Thus the complementarity of the teams is ensured and, in addition, close contacts exist with experts of the domain of data for carrying on a complete evaluation of the results obtained by the combined algorithms expected to be designed during the project.

6.4.2. Participation to Standards in Ergonomics

Participant: Dominique Scapin [correspondant].

Standardization in ergonomics is increasingly important due to the application of the European directives about the introduction of measures to encourage improvements in the safety and health of workers (e.g., 2006/42CE on security of machinery); as well as taking into consideration national and international legislation, including accessibility. Standardization in ergonomics covers many issues. The contributions from AxIS (D. L. Scapin)at Inria concern mainly software ergonomics, in the context of AFNOR X35A, X35E, as well as ISO mirror groups:

- National: AFNOR X35A (Ergonomie) (expert); AFNOR X35E (Ergonomie des Logiciels Interactifs), AFNOR groupe de travail "Normes de processus ergonomiques" (chair) [41].
- International: ISO/TC 159/SC4/WG5 (Software ergonomics and human-computer dialogues) (expert); ISO/TC 159/SC4/WG6 (Human-centred design processes for interactive systems) (expert); ISO/TC 159/SC4/WG9 (Tactile and Haptic Interactions) (expert); ISO/TC 159/SC4/WG28 (System and software product Quality Requirements and Evaluation - Common industry Format) (expert); ISO/TC 159/SC1/WG1 (Ergonomic principles) (expert).

6.5. International Research Visitors

6.5.1. Visits of International Scientists

AxIS Rocquencourt welcomed various international scientists from Brazil:

- Francisco de Carvalho (UFPE, Brazil) [17], [34], [27], [23],
- Sergio Queiroz (UFPE, Brazil) [27],
- Cleber Zanchettin (UFPE, Brazil).

B. Trousse visited in October Hicham Behja which is involved in a new position at the National High School of Electrical and Mechanical engineering (ENSEM) at Casablanca in Morocco in October.

6.5.2. Internships

Bruno ALMEIDA PIMENTEL (from Feb 2012 until Jul 2012)

Subject: Social Network Aggregation

Institution: Federal University of Pernambuco (Brazil)

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Paula Craciun and Josiane Zerubia met Antoine Mangin, Scientific Director at ACRI-ST (http://www.acri-st.fr/English/index.html), in Sophia Antipolis to discuss about Paula Craciun's Master research work on boats detection and counting in Mediterranean harbors using marked point processes.

8.2. European Initiatives

8.2.1. 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

8.3. International Initiatives

8.3.1. Participation In International Programs

- In July, during the visit of Prof. Qiyin Fang from Mc Master University (http://www.mcmaster.ca/), Hamilton, Canada, we identified a research project of mutual interests related to new optical sensors for skin imaging and their biomedical applications. the visit of Prof. Fang was supported by the French Embassy in Canada and in November we jointly applied to the France-Canada Research Fund to be able to collaborate during the next 2 years.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Siddharth Buddhiraju (from May 2012 until July 2012)

Subject: Satellite image classification using Bootstrap EM

Institution: IIT Bombay (India)

Paula Craciun (from March 2012 until August 2012)

Subject: Boats detection and counting in Mediterranean harbors

Institution: West University of Timisoara, Romania

8.4.1.2. Visiting professors

Qiyin Fang (One week in September 2012)

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

Institution: McMaster University (Canada)

Joseph Francos (One week in March and one week in July 2012)

Subject: Manifold embedding for geometric deformations estimation. Application to both remote sensing and skin imaging

Institution: Ben-Gurion University (Israel)

Ian Jermyn (One week in July 2012)

Subject: Object shape detection in images using prior shape information and higher order active contours

Institution: Durham University (UK)

Zoltan Kato (One week in July 2012)

Subject: Markov random fields for image segmentation

Institution: Sveged University (Hungary)

Nataliya Zagorodna (One month in July 2012)

Subject: Use of periodic or cyclic random processes for image processing, with application to both remote sensing and skin imaging

Institution: Ternopil Ivan Pul'uj Technical University (Ukraine)

8.4.2. Visits to International Teams

- Ikhlef Bechar was visiting Dr. Ian Jermyn at Durham University, UK from October 21, 2012 until November 19, 2012.

- Yannick Verdie visited National Institute of Informatics (Nii) in Tokyo, Japan from February 15, 2012 to June 15, 2012, funded by Nii internship exchange program. He worked there on the topic of exact sub graph matching by mixed-integer linear problem.

<div align="center">

COPRIN Project-Team

</div>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. ID4CS project
Participant: Yves Papegay.

The ID4CS project, supported by French National Research Agency (ANR) through COSINUS program has the ambition to propose a modeling and simulation environment for designing complex systems such as aircrafts, based on a self-adaptive, distributed and open multi-agent architecture distributing the optimization process inside the agents.

As a partner of the project we are mainly involved in the definition of the use case on preliminary aircraft design, in collaboration with Airbus (6.3.1), in development of uncertainty analysis algorithms, and in automatic generation of agents based on models.

8.1.1.2. COGIRO project
Participants: Julien Alexandre Dit Sandretto, David Daney [correspondant], Jean-Pierre Merlet.

We are collaborating with LIRMM, LASMEA and TECNALIA for the development of large scale wire-driven parallel robots [5]. We are especially involved in the calibration of a prototype developed by LIRMM and TECNALIA, see section 6.2.1.2 .

8.2. European Initiatives

8.2.1. FP7 Projects
Participants: Laurent Blanchet, David Daney, Jean-Pierre Merlet [correspondant], Odile Pourtallier, Yves Papegay.

Program: FP7-2011-NMP-ICT-FoF, Factory of the Future

Project acronym: CableBot

Project title:Parallel Cable Robotics for Improving Maintenance and Logistics of Large-Scale Products

Duration: December 2011- December 2014

Coordinator: Tecnalia

Other partners: LIRMM (France), FRAUNHOFER-IPA (Germany), Duisburg-Essen University (Germany), EADS (France), ACCIONA (Spain), VICINAY (Spain)

Abstract: The CableBOT project 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.

---

[5]http://www2.lirmm.fr/cogiro/

6. Partnerships and Cooperations

6.1. European Initiatives

6.1.1. FP7 Projects

6.1.1.1. FOX

Title: FOX

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: May 2009 - September 2012

Coordinator: Inria (France)

Others partners: Thomas Schwentick at the university of Dortmund, Mikołaj Bojańczyk at the university of Warsaw, Leonid Libkin at the university of Edinburgh, Georg Gottlob at the university of Oxford, Frank Neven at the university of Hasselt and Maarten Marx at the university of Amsterdam.

See also: http://fox7.eu

Abstract: The objective of FoX is to study the fundamental issues necessary in order to make the data management over the internet more efficient and more reliable.

6.1.2. ERC grant Webdam

6.1.2.1. Webdam

Title: WebDam

Type: IDEAS

Instrument: ERC Advanced Grant (Advanced)

Duration: December 2008 - November 2013

Coordinator: Serge Abiteboul, Inria (France)

Others partners: Pierre Senellart, Telecom Paristech.

See also: http://webdam.inria.fr

Abstract: The goal is to develop a formal model for Web data management. This model will open new horizons for the development of the Web in a well-principled way, enhancing its functionality, performance, and reliability. Specifically, the goal is to develop a universally accepted formal framework for describing complex and flexible interacting Web applications featuring notably data exchange, sharing, integration, querying and updating. We also propose to develop formal foundations that will enable peers to concurrently reason about global data management activities, cooperate in solving specific tasks and support services with desired quality of service.

6.2. International Initiatives

6.2.1. Inria International Partners

- Victor Vianu, UC San Diego, USA.

6.3. International Research Visitors

6.3.1. Visits of International Scientists

Victor Vianu (from June 2012 until September 2012)

    Subject: WebDaM

    Institution: UC San Diego (USA)

Gerome Miklau (from September 2012 to June 2012)

    Subject: WebDaM

    Institution: Univesity of Massachusetts at Amherst (USA)

6.3.2. Internships

- David Montoya, Webdam, 04/2012 to 09/2012
- Jules Testard, Webdam, 09/2012 to 12/2012

DREAM Project-Team (section vide)

E-MOTION Project-Team (section vide)

EXMO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Datalift

Program: ANT-ContInt

Project acronym: Datalift

Project title: Datalift

Instrument: platform

Duration: September 2010 - March 2014

Coordinator: Inria Exmo/François Scharffe

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 [17]. EXMO is particularly involved in the generation of links between datasets (see §6.2).

7.2. European Initiatives

7.2.1. FP7 SEALS

Title: Semantic Evaluation At Large Scale

Type: CAPACITIES (Infrastructures)

Defi: Scientific Data Infrastructure

Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUP-PORT ACTIONS (CPCSA)

Duration: June 2009 - June 2012

Coordinator: Universidad Politecnica de Madrid (ES)

See also: http://seals-project.eu

Abstract:

EXMO is a partner of the SEALS European commission infrastructure project whose goal is to provide the infrastructure for evaluating semantic technologies. Jérôme Euzenat has been vice-coordinator in charge of the research area.

More particularly, EXMO has been in charge of providing an infrastructure for evaluating ontology matching systems and algorithms, to be aggregated in the SEALS platform. This task involves:

- designing evaluation campaigns, including identifying criteria, metrics, datasets, and tools to be used in each campaign,
- designing and implementing services for automatic evaluation of systems and algorithms,
- analysing the results of evaluation campaigns and using them to produce detailed reports on both the effectiveness of the testing methodologies, and the systems that have been tested.

This year we have prepared the second SEALS evaluation campaign and designed a fully automated evaluation process (see §6.1.1).

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Riccardo Albertoni (Universidad Politecnica de Madrid) visited EXMO from October 15th to October 22nd, 2012 working on similarity measures and their application to linked data.

Alexander Borgida (Rutgers University) visited EXMO from April 29th to May 11th, 2012 mostly working on weighted alignment semantics.

Jorge Gracia (Universidad Politecnica de Madrid) visited EXMO from June 4th to July 3rd, 2012, working more particularly on multilingual ontology/instance matching;

Daniel Vila (Universidad Politecnica de Madrid) visited EXMO from April 23rd to July 23rd, 2012 working on data interlinking and multilingual instance matching.

7.3.2. Internships

Thinh Dong (2nd year master «Master Informatique: Fondements et Ingénierie» option «Knowledge Information System», U. Nice Sophia-Antipolis, 2012) on «Query generation from expressive ontology alignments».

<div style="text-align:center">**FLOWERS Project-Team**</div>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ADT CARRoMan

The ADT project CARRoMan started in november 2012 (recruitement of Antoine Hoarau). Autonomous human-centered robots, for instance robots that assist people with disabilities, must be able to physically manipulate their environment. There is therefore a strong interest within the FLOWERS team to apply the developmental approach to robotics in particular to the acquisition of sophisticated skills for manipulation and perception. ENSTA-ParisTech has recently acquired a Meka humanoid robot dedicated to human-robot interaction, and which is perfectly fitted to this research. The goal of this ADT is to install state-of-the-art software architecture and libraries for perception and control on the Meka robot, so that this robot can be jointly used by FLOWERS and ENSTA. In particular, we want to provide the robot with an initial set of manipulation skills. The engineer will develop a set of demos, which demonstrate the capabilities of the Meka, and provide a basis on which researchers can base their experiments.

8.1.2. CRA ARAUI

A Conseil Régional d'Aquitaine Project (ARAUI, 2011-) began, coordinated by Manuel Lopes entitled *Apprentissage Automatique en Robotique pour l'Adaptation aux Utilisateurs a Travers L'Interaction*. It will fund 50% of a 3 years PhD student and funding of 5500 euros for equipment.
The objective of ARAUI is the creation of robots that initiate autonomously the execution of frequent tasks after learning about the user's preferences through repeated interactions. Particularly these robots will act as personal companions or helpers and will be able to perform shared tasks with humans.

The long-term view of this project is that of a robot that comes out of the box with general purpose motor and sensory skills and then is adapted to each user's preferences and needs to achieve autonomous behavior. The major challenge is how to equip machines with such adaptability and learning capabilities. Until now machines are programmed by skilled engineers to perform a specific task and learning new tasks is not possible. Even in a restricted industrial setting the need for robots that can be more easily re-programmed to new tasks and environments has lead to research programs on flexible manufacturing that consider frequent changes in tasks and close (physical) interactions with human operators.

8.1.3. CRA ACROBATE

The Conseil Régional d'Aquitaine Project (ACROBATE, 2009-) continued, involving Thomas Cederborg and Pierre-Yves Oudeyer. The funding contributes with 50% funding for a 3 years PhD student. The objective of ACROBATE is to study mechanisms and models that can allow a robot to learn in a unified manner context-dependant motor skills and linguistic skills through interactions with humans.

8.1.4. ADT Acrodev

The ADT project (Acrodev, 2010-) continued, involving Paul Fudal, Haylee Fogg, Olivier Ly and Pierre-Yves Oudeyer. The Inria ADT funds two engineers for two years. The objective of Acrodev is on the one hand to build up re-usable software architectures for embedded control of Acroban-like robots, and on the other hand to explore novel morphologies in particular for the feet, hands and head of Acroban-like robots.

8.1.5. Collaboration with Labri/Unvi. Bordeaux I

We continued to collaborate with the Rhoban group at Labri/CNRS/Univ. Bordeaux I, and in particular Olivier Ly and Hugo Gimbert, about the design of bio-inspired compliant robotic morphologies, such as around the Acroban humanoid robot. The goal is to study both how properties of the body can facilitate motor control, and how to experiment and design such bodies with rapid prototyping methods.

8.1.6. Collaboration with Labri/Univ. Bordeaux I and Institut de Neurosciences Cognitives et Integratives d'Aquitaine

The collaboration with Olivier Ly, from Labri and Univ. Bordeaux I, as well as with Jean-René Cazalets, Christophe Halgand and Etienne Guillaud from Institut de Neurosciences Cognitives et Integratives d'Aquitaine, Bordeaux continued. The goal is to compare properties of the postural balance, and its relation to morphology and distributed control, in humans and in the humanoid Acroban (developed in collaboration with Labri), which vertebral column and postural control shares several fundamental features with the human vertebral column, and using the "Plateforme d'analyse de la motricité" available at the Institut de Neurosciences Cognitives et Integratives d'Aquitaine. This collaboration involves Matthieu Lapeyre and Pierre-Yves Oudeyer.

8.2. National Initiatives

8.2.1. ANR MACSi

An ANR Project (MACSi, ANR Blanc 0216 02), coordinated by ISIR/Univesity Paris VI (Olivier Sigaud), on developmental robotics (motor learning, visual learning, and exploration algorithms on the ICub robot) continued. The MACSi project is a developmental robotics project based on the iCub humanoid robot and the Urbi open source software platform. It is funded an as ANR Blanc project from 2010 to 2012. The project addresses four fundamental challenges, led by four partners:

- How can a robot learn efficient perceptual representations of its body and of external objects given initially only low-level perceptual capabilities? Challenge leader : Inria-ENSTA-ParisTech FLOWERS (Paris).
- How can a robot learn motor representations and use them to build basic affordant reaching and manipulation skills? Challenge leader : ISIR-UPMC-Paris 6 (Paris). ISIR hosts the iCub humanoid robot on which the achievements will be evaluated.
- What guidance heuristics should be used to explore vast sensorimotor spaces in unknown changing bodies and environments? Challenge leader : Inria-ENSTA-ParisTech FLOWERS (Bordeaux).
- How can mechanisms for building efficient representations/abstractions, mechanisms for learning manipulation skills, and guidance mechanisms be integrated in the same experimental robotic architecture and reused for different robots? Challenge leader : GOSTAI company (Paris).

Web site: http://macsi.isir.upmc.fr/

8.2.2. Quasimetric approach to probabilistic optimal control (LPPA)

- Jean-Luc Schwartz[1], Julien Diard[2], Pierre Bessire[3], Raphael Laurent[4], **1: GIPSA-Lab, Grenoble University, CNRS. 2: LPNC, Grenoble University, CNRS. 3: LPPA, Collège de France, CNRS. 4: GIPSA-Lab, Grenoble University.** Clément Moulin-Frier is continuing his collaborative work with people he worked with during his PhD thesis at GIPSA-Lab. See the section entitled "COSMO ("Communicating about Objects using Sensory-Motor Operations"): a Bayesian modeling framework for studying speech communication and the emergence of phonological systems" for more information.
- Jacques Droulez, Steve N'Guyen, **Laboratoire de Physiologie de Perception et de l'Action (LPPA), College de France, Paris**. Clément Moulin-Frier is continuing his collaborative work with people he worked with during his post-doc in 2011 at LPPA, College de France. See the section entitled "Probabilistic optimal control: a quasimetric approach" for more information.

8.2.3. Collaboration and technological transfer with Laboratoire de Physiologie de la Perception et de l'Action (LPPA)

A collaboration is in progress with Jacques Droulez and Steve Nguyen from Laboratoire de Physiologie de la Perception et de l'Action (LPPA), Paris. Poppy represents for them a humanoid platform very interesting because it is relatively flexible and versatile, with more similar proportions to that of humans, which facilitate comparison with the experimental results obtained in humans. The laboratory will evaluate this platform probabilistic methods of control of balance and locomotion.

In the short term the first experimental project with Poppy will test methods of management support, in the case of restoration of balance, in the case of walking to correct or prepare a change of direction. This project will be initiated in the framework of a long internship of master 2 that starts in January. In the future, we would also like to evaluate motor controllers compliant, and learning algorithms. This collaboration involves Matthieu Lapeyre and Pierre-Yves Oudeyer.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. EXPLORERS

Program: ERC Starting Grant

Project acronym: EXPLORERS

Project title: Exploring Epigenetic Robotics: Raising Intelligence in Machines

Duration: 12/2009-11/2014

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. The ERC EXPLORERS is a central scientific driver of the FLOWERS team.

8.4. International Initiatives

8.4.1. Inria International Partners

- Luis Montesano, **University of Zaragoza, Spain**. Manuel Lopes collaborated with Luis Montesano on several topics. Recently on active learning approaches for grasping point learning [103] and clustering activities.

- Francisco Melo **Instituto Superior Técnico, Portugal**. Manuel Lopes collaborated with Francisco Melo on the development of active learning for inverse reinforcement learning. Recent developments consider the extension to more cues available to the learner and sampling complexity on the algorithm.

- José Santos-Victor, **Instituto Superior Técnico, Portugal**. Manuel Lopes collaborated with José Santos-Victor on the extension of affordances models to higher levels of representations, e.g. relational models.

- Maya Cakmak, Andrea Thomaz, **Georgia Tech, USA**. Manuel Lopes collaborated with Maya Cakmak on the development of optimal teaching algorithms for sequential decision problems (modeled as markov decision processes). The algorithm provides optimal demonstrations for systems that learn using inverse reinforcement learning. The joint work considers not only the algorithmic aspects but also a comparison with human behavior and the possibility of using insights from the algorithm to elicit better teaching behavior on humans [32].

- Marc Toussaint, Tobias Lang, **Free University of Berlin, Germany**. Manuel Lopes and Pierre-Yves Oudeyer are collaborating with FUB in the unification of exploration algorithms based on intrinsic motivation with methods for exploration in reinforcement learning such as R_{max}. We intend to develop a general framework for exploration in non-stationary domains [46]. Another project consider how to learn efficient representation for robotic hierarchical planning [44].

- Todd Hester and Peter Stone, **University of Texas, USA** (2012 -)
  Peter Stone is a leading expert on reinforcement learning applied to real robots (he won the RobotCup competition several times) and to multi-agent problems. We started this collaboration by introducing a new method to automatically select the best exploration strategy to use in a particular problem [42]. Future directions of the collaboration will include ad-hoc teams, exploration in continuous space and human-guided machine learning.

- Jacqueline Gottlieb and Adrien Baranes, **Columbia University, New-York, US**. Pierre-Yves Oudeyer and Manuel Lopes continued a collaboration with Jacqueline Gottlied, neuroscientist at Columbia University and specialist of visual attention and exploration in monkeys, and Adrien Baranes, postdoc in Gottlieb's lab and previously working in Flowers team. An experimental set-up with brain imaging and behavioural observations of monkeys, and made to evaluate new families of computational models of visual attention and exploration (some of which developped in the team around the concept of intrinsic motivation) is being elaborated.

- Louis ten Bosch, **Radboud University, The Netherlands**. Pierre-Yves Oudeyer and David Filliat continued to work with Louis ten Bosch on the modelling of multimodal language acquisition using techniques based on Non-Negative Matrix Factorization. We showed that these techniques can allow a robot to discover audio-video invariants starting from a continuous unlabelled and unsegmented flow of low-level auditory and visual stimuli. A journal article is in preparation.

- Britta Wrede, Katharina Rohlfing, Jochen Steil and Sebastian Wrede, **Bielefeld University, Germany**, Jun Tani **KAIST, South Korea**. Pierre-Yves Oudeyer collaborated with Wrede, Rohlfing, Steil, Wrede and Tani on the elaboration of a novel conceptual vision of teleoogical language and action development in robots. This led to the publication of a joint workshop article [64].

- Michael A. Arbib, **University of Southern California (Los Angeles, USA)**. Clément Moulin-Frier is continuing his collaborative work with Michael Arbib since his 6-month visit at USC in 2009. See the section entitled "Recognizing speech in a novel accent: the Motor Theory of Speech Perception reframed" for more information.

- Paul Vogt (**Tillburg University, The Netherlands**), Linda Smith (**Indiana University, Blooming-ton, US**), Aslo Ozyurek (**Max Planck Institute for Psycholinguistics, Nijmegen, The Nether-lands**), Tony Belpaeme (**University of Plymouth, UK**). Pierre-Yves Oudeyer began collaboration with partners of the NWO SCMSC project to set up a research network on modeling of social cognition and symbolic communication.

- Michael Gienger from **Honda Research Institute Europe**. Alexander Gepperth collaborated with Principal Scientist Dr.Michael Gienger from Honda Research Institute Europe GmbH about robotic grasping: this activity will result in a jointly supervised internship ("stage de fine d'études") and a publication.

- Ursula Korner from **Honda Research Institute Europe**. Alexander Gepperth collaborated with Dr. Usula Körner of Honda Research Institute Europe GmbH, Offenbach (Germany), on the topic of biologically inspired learning architectures for visual categorization of behaviorally relevant entities. This work is intended to be summitted to the International Conference on Development and Learning, as well as the journal "Frontiers in Cognitive Systems".

- Michael Garcia Ortiz, **Laboratory for Cognitive Robotics (CoR-Lab) in Bielefeld, Germany**. Alexander Gepperth collaborated with Michael Garcia Ortiz, a PhD student from the Laboratory for Cognitive Robotics (CoR-Lab) in Bielefeld, Germany, on the exploitation of scene context for object detection in intelligent vehicles. This collaboration resulted in the submission of a journal publication to the journal "Neurocomputing".

- Martha White and Richard Sutton from the **University of Alberta, Canada**. Thomas Degris collaborated with Martha White and Richard Sutton on the paper "Off-Policy Actor–Critic" [38].

- Patrick Pilarski and Richard Sutton from the University of Alberta (Canada). Thomas Degris collaborated with Patrick Pilarski on the following papers: "Model-Free Reinforcement Learning with Continuous Action in Practice" [37], "Apprentissage par Renforcement sans Modèle et avec Action Continue" [65], "Dynamic Switching and Real-time Machine Learning for Improved Human Control of Assistive Biomedical Robots" [57], "Towards Prediction-Based Prosthetic Control" [58], and "Prediction and Anticipation for Adaptive Artificial Limbs" [27].

- Joseph Modayil from the **University of Alberta, Canada**. Thomas Degris collaborated with Joseph Modayil on the following paper: "Scaling-up Knowledge for a Cognizant Robot" [35].

- Ashique Rupam Mahmood from the **University of Alberta, Canada**. Thomas Degris collaborated with Ashique Rupam Mahmood on the following paper: "Tuning-Free Step-Size Adaptation" [50].

8.5. International Research Visitors

8.5.1. *Visits of International Scientists*

- Andrew Barto, Reinforcement learning and intrinsic motivation, University of Massachusetts Amherst, USA (oct 2012)

- Adam White, Reinforcement Learning and Artificial Intelligent group, Computing Science department of the University of Alberta, Canada (September 2012)

- Joseph Modayil, Reinforcement Learning and Artificial Intelligent group, Computing Science department of the University of Alberta, Canada (September 2012)

- Akihiko Yamaguchi, Robotics Lab of Prof. Ogasawara at NAIST in Japan (march 2012)

- Todd Hester, RL and Robotics Lab, Univ. Texas, US (may, june, july 2012)

- Louis ten Bosh, Speech processing, Univ. Radboud, The Netherlands (june 2012)

- Robert Saunders, Design Lab, Faculty of Architecture, University of Sydney, Australia (september 2012)

- Adrien Baranes, Columbia University, NY, USA (october 2012)

- Joshka Boedecker, Asada Lab, Osaka University, Japan (october 2012)

- Olivier Georgeon, Univ. Lyon, France (november 2012)

8.5.2. *Internships*

- Gennaro Raiola, MSc. Student from Università degli Studi di Napoli Federico II. Parameterized skills are able to map parameters of the task (for instance the 2D position of an object on a table) to the appropriate parameters of a policy for achieving this task. In this project, we use imitation learning to train a Dynamic Movement Primitive (DMP) with several observed trajectories. To achieve generalization, the basis functions in the DMP are expanded so that they span the space of the task relevant parameters. The resulting algorithm is applied to human reaching data, and to generalizing skills on the Nao robot.

- Laura Vogelaar, visiting student from GeorgiaTech and Carnegie Mellon University. Within a stochastic optimization context, we use clustering algorithms to determine features that are relevant to minimizing the cost of executing a skill. Our objective is to enable a robot to autonomously expand its libraries of skills, whilst simultaneously learning which skills can be successfully executed in which contexts.

8.5.3. *Visits to International Teams*

- Manuel Lopes (December 2012), Willow Garage, Palo Alto, USA: visit to Maya Cakmak to discuss tutoring systems and human-robot internaction.

- Manuel Lopes (December 2012), Bosch Research, Palo Alto, USA: visit to Dejan Pangercic to discuss active learning and human-robot interaction.

- Manuel Lopes (December 2012), Berkely University, USA: visit to Pieter Abbeel to discuss safe exploration methods and inverse reinforcement learning.

- Manuel Lopes (December 2012),

- Clément Moulin-Frier (November 2012), UC Merced, USA: visit to Anne Warlaumont's lab at UC Merced, to discuss about the role and the computational modeling of infraphonology in infant language development. The aim is to initiate a collaboration with Anne Warlaumont and D. Kimbrough Oller (University of Memphis, USA) to computationally study the possible role of intrinsic motivations in infraphonological exploration.

- Olivier Mangin (17/10/2012), Instituto Superior Técnico, Lisbone, Portugal

- Thomas Degris (June 2012), Reinforcement Learning and Artificial Intelligent group, Computing Science department of the University of Alberta, Canada (June 2012)

8.5.4. *Participation to Summer/Winter School*

- Jonathan Grizou participated to e'NTERFACE 2012, July, 2nd - July, 27th 2012, SUPELEC, Metz, France The 8th International Summer Workshop on Multimodal Interfaces took place on the SUPELEC campus of Metz, France. This one month summer school brought together more than 70 students and experts to work together and foster the development of tomorrow's multimodal research community. Jonathan Grizou enrolled in the Project P1 : "Speech, gaze and gesturing – multimodal conversational interaction with Nao robot", supervised by Graham Wilcock and Kristiina Jokinen (University of Helsinki). This summer school lead to a join publication by the members of the project P1 at the CogInfoCom 2012 conference [34].

- Jonathan Grizou and Fabien Bénureau participated to the IM-CLeVeR/FIAS Winter School on "Intrinsic Motivation: From Brains to Robots", December 3-8, 2012, Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany. The school brought together 25 students in the field of intrinsic motivation as well as leaders in the field (among which, Andrew Barto, Minoru Asada, Peter Redgrave, Giorgio Metta and others). Students' time was divided between keynotes in the morning and project work in the afternoon, supervised by the speakers and the school organizers. The school was an opportunity to meet and discuss with researchers and PhD students. It also allowed us to explain and disseminate our work; Pierre-Yves Oudeyer, notably, was an invited speaker. Jonathan

Grizou took part in the project "Intrinsic Motivation in Active Perception" while Fabien Benureau participated in "Playful Acquisition of Basic Behavioral skills Machine". The results of the school are highly positive, and some scientific collaborations may directly stem from this event in the future.

GRAPHIK Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. ASPIQ
Participants: Jean-François Baget, Jérôme Fortin, Marie-Laure Mugnier, Michel Leclère.

ASPIQ (ASP technologIes for Querying large scale multisource heterogeneous web information), is an ANR white program that started in Oct. 2012. The project coordinator is Odile Papini (LSIS), and it involves partners from CRIL and LERIA.

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.

8.1.1.2. Pagoda
Participants: Jean-François Baget, Marie-Laure Mugnier, Mélanie König, Michaël Thomazo.

Pagoda is an ANR JCJC (young researchers) that will begin in Jan. 2013. The project coordinator is Meghyn Bienvenu (LRI), and it involves partners from the EPI LEO, the LIG, and the Anatomy Laboratory of Grenoble.

The primary aim of this project is to help address challenges brought by scalability and the handling of data inconsistencies by developing novel OBDA query answering algorithms and practical methods for handling inconsistent data.

8.1.1.3. Qualinca
Participants: Michel Leclère, Michel Chein, Madalina Croitoru, Léa Guizol, Akila Ghersedine, Rallou Thomopoulos, Marie-Laure Mugnier.

Qualinca is an ANR Contint project that started in Apr. 2012 and will end in Sept. 2015. The project coordinator is Michel Leclère (GraphIK), and it involves partners from LRI, LIG, ABES and INA.

The main objective is to elaborate mechanisms allowing to:

- evaluate the quality of an existing documents 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).

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 Projects

8.2.1.1. EcoBioCap
Participants: Patrice Buche, Madalina Croitoru, Jérôme Fortin, Patricio Mosse.

FP7-KBEE, March 2011–March2015. Led by INRA (and scientifically managed by Montpellier IATE laboratory). 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". GraphIK is involved in this project via its common members with IATE-KRR team. The budget is managed by IATE team. This project will feed Axis 2.

- *See Sect. 6.2 (argumentation for decision making in agronomy) for the results obtained this year.*

8.2.2. Collaborations with Major European Organizations

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-supervise a PhD student (Tjitze Rienstra).

Sebastian Rudolph: University of Karlsruhe, AIFB (Germany)

Jean-François Baget, Marie-Laure Mugnier and Michaël Thomazo collaborate with Sebastian Rudolph on the study of complexity classes for fragments of existential rules. This successful work has already led to major publications (see Sect. 6.1).

Srdjan Vesic: University of Luxmbourg, Individual and Collective Reasoning research group (Luxembourg)

Madalina Croitoru collaborates with Srdjan Vesic on the link between inconsistency tolerant reasoning and argumentation.

Nir Oren: University of Aberdeen, Department of Computing Science (United Kingdom)

Madalina Croitoru and Jérôme Fortin collaborate with Nir Oren on argumentation and preference logics.

Ioannis A. Vetsikas: University of Athens, IIT (Greece)

Madalina Croitoru collaborates with Ioannis A. Vetsikas on mechanism design aspects of multi-agent knowledge allocation.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Feb. 2012: Leon van der Torre (Pr., University of Luxembourg), collaboration on argumentation systems (2 days)
- Mar. 2012: Meghyn Bienvenu (CR CNRS, IASI/LEO), collaboration on Ontology-Based Data Access (5 days)
- Apr. 2012: Karima Sedki (MdC AgroCampus-Rennes, IRISA), Seminar on "Reasoning with preferences and deciding under uncertainty"
- May. 2012: Safa Yahi (MdC University of Marseille, LSIS), Seminar on "Management of inconsistency with justified argumentative inference"
- Sept. 2012: Bernard Moulin (Université Laval, Canada), collaboration on argumentation and dynamic systems (1 month)

- Oct. 2012: Jean-François Condotta (CRIL), collaboration on representation and treatment of inconsistencies (2 days)
- Nov. 2012: Frank van Harmelen (Freie Univ. Amsterdam), seminar on "Reasoning over very, VERY large knowledge bases: towards a web-scale knowledge base of a 100 million facts and beyond"

8.3.1.1. Internships

Patricio Mosse (6 months)

Subject: Argumentation based preference aggregation (cf Ecobiocap in Sect. 8.2)

Institution: University of Buenos Aires (Argentina)

Awa Diattara (6 months)

Subject: Default rules for an agronomy application (cf CTFC in Sect. 7.2)

Institution: University Gaston Berger of Saint-Louis, Sénégal

8.3.2. Visits to International Teams

- Madalina Croitoru and Jérôme Fortin. Visit to the Department of Computer Science (University of Aberdeen). 5 days in January 2012.
- Souhila Kaci. Visit to Leon van der Torre (University of Luxembourg). January 2012.
- Michaël Thomazo. Visit to KIT (Karlsruhe Institute of Technology). 6 weeks in June/July 2012. Collaboration with Sebastian Rudolph on Ontology-Based Data Access. Funded by DAAD http:// paris.daad.de/bourses_de_recherche_de_courte_duree.html.
- Madalina Croitoru. Visit to Srdjan Vesic (University of Luxembourg). 1 week in November 2012. Collaboration on the link between maximal repairs and argumentation extensions
- Jean-François Baget, Marie-Laure Mugnier and Michaël Thomazo. Visit to the Information Systems Group (University of Oxford). 3 days in December 2012. Scientific Exchanges on Existential Rules and Datalog+/-.

<div align="center">**IMAGINE Team**</div>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. BQR Intuactive 06/2011-12/2012

Participants: Rémi Brouet, Marie-Paule Cani, Jean-Claude Léon.

The Intuactive project is a collaboration between our research group, the conception group of G-scop lab, and the HCI group of LIG lab. The goial is to develop and compare 2D vs 3D interaction for selecting, placing and editing 3D shapes. The project is funded by Grenoble-INP and provides the grant for Rémi Brouet's PhD.

8.1.2. BQR INP IDEAL (04/2009 - 03/2012)

Participant: Jean-Claude Léon.

3D models, coming for instance from engineering fields, are often 'idealized', or 'simplified' (topologically speaking), in order to be used for simulation. The goal of this project IDEAL, funded by Grenoble-INP, is to study these models, in particular the most general ones which are called 'non-manifolds' and which are not handled by current software. We collaborate in this project with the University of Genova in Italy (Leila De Floriani).

8.1.3. BQR INP "Modèles multirésolutions de fissures" (04/2009 - 09/2012)

Participants: Marie Durand, François Faure.

A project on the simulation of fracture propagation in concrete structures has started, funded by INP Grenoble. The puropose is to develop a mixed, dynamic model of structures, using finite elements everywhere excepted near crak fronts, where a discrete model is applied. This goes beyond the ANR Vulcain project because we want to dynamically switch between finite element and discrete models. Bui Huu Phoc has started a Ph.D. in October, co-tutored by Frederic Dufour and Vincent Richefeu, from the L3S-R CNRS laboratory, and François Faure from EVASION.

8.1.4. LIMA 2 "Loisirs et Images" (2007 - 2013)

Participants: Marie-Paule Cani, François Faure, Damien Rohmer.

LIMA 2 (Loisirs et Images) is a Rhône-Alpes project in the ISLE cluster (Informatique, Signal, Logiciel Embarqué) focussed on classification and computer graphics. This project founded the PhD for Lucian Stanculescu with Raphaelle Chaine (LIRIS) and Marie-Paule Cani. A research seminar is planed in January 2013 in Lyon. Thibaut Weise from EPFL will be invited as an international speaker.

8.1.5. 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.

8.1.6. PERSYVAL

Participant: Rémi Ronfard.

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).

8.2. National Initiatives

8.2.1. ANR RepDyn (01/2010-12/2012)

Participants: Marie Durand, François Faure.

We will participate to the ANR RepDyn project, starting at the beginning of 2010, in collaboration with CEA, EDF, Laboratoire de Mécanique des Structures Industrielles Durables (LaMSID), and ONERA. The purpose of this project is to enhance the performance of discrete elements and fluid computations, for the simulation of cracks in nuclear reactors or planes. Our task is to propose GPU implementations of particle models, as well as load balancing strategies in the context of multi-core, multi-GPU hardware. Marie Durand has started a PhD thesis on this task.

8.2.2. ANR ROMMA (01/2010-12/2013)

Participants: François Faure, Jean-Claude Léon, Stefanie Hahmann.

The ANR project ROMMA has been accepted in 2009 and started in January 2010. The partners of this project are academic and industry experts in mechanical engineering, numerical simulation, geometric modeling and computer graphics. There are three academic members in the consortium: the LMT in Cachan, G-SCOP and LJK (EVASION and MGMI teams) in Grenoble. There are four industrial members: EADS, which coordinates the project, SAMTECH, DISTENE and ANTECIM. The aim of the project is to efficiently and robustly model very complex mechanical assemblies. We are working on the interactive computation of contacts between mechanical parts using GPU techniques. We will also investigate the Visualization of data with uncertainty, applied in the context of the project.

8.2.3. 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.

Dicko Ali Hamadi is a Ph.D. student within EVASION team. His works turns around the problems in SOHUSIM project. He is co-tutored Olivier Palombi in IMAGINE.

8.2.4. 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 [31], [30] to practical animation tools. This contract provides us with the funding of two engineers and one graphical artist during two 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 *Investissements d'avenir* research program entitled *Technologies de numérisation et de valorisation des contenus culturels, scientifiques et éducatifs*.
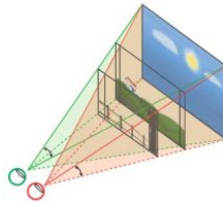

Figure 18. Illustration of the stereoscopic camera system.

The project is coordinated by Thales Angénieux (Patrick Defay). Partners are Inria (Rémi Ronfard), Lutin Userlab (Chrles 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 PhD student Inigo Rodriguez who is working on learning-based camera control for stereoscopic 3D cinematography. His advisor is 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.

8.2.9. *MSTIC Adamo (03/2012 - 12/2013)*

Participant: Olivier Palombi.

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. *PhD grant from USM (University Sains Malaysia) (11/2011 - 10/2014)*

Seou Ling NG: PhD supervisor: Stéfanie Hahmann: geometric modelling.

8.3.3. *PhD grant from USM (University Sains Malaysia) (08/2012 - 07/2015)*

Chen Kim Lim: PhD supervisor: Marie-Paule Cani: croud modelling, animation.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Nicolas Szilas (University of Geneva): Interactive Storytelling: Models, Architecture and Approach (26/04/2012).

- Karan Singh (University of Toronto): Artist and Perception driven Interactive Graphics (10/05/2012).

- Alla Sheffer (University of British Columbia): Geometry in action (24/05/2012).

- Jarek Rossignac (Georgia Tech): The Beauty of a Motion: Mathematical Definition, Robust Implementation and Applications to Design and Animation (07/06/2012).

- Michael Gleicher (University of Wisconsin-Madison): From Art and Perception to Visualization, Video, and Virtual Reality (12/06/2012).

- Michael Wand (Max-Planck-Institut): Shape Analysis with Correspondences (06/07/2012).

- Ladislav Kavan (ETH Zurick): 3D Virtual Characters: Skinning, Clothing, and Weird Math (12/07/2012).

- Niloy J. Mitra (University of College London): Smart Geometry: In Search of Geometric Simplicity (25/10/2012).

- Mathieu Desbrun (California Institute of Technology): The Power of Duals: from Poisson to Blue Noise (20/12/2012).

IMARA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. LINK&GO

Title: LINK&GO

Duration: 12 months

Coordinator: AKKA Group

Others partners: AKKA Technologies, Inria, ControlSys Engineering, DBT

See also: http://automobile.yvelines.fr/fr/lappel-a-projets-2011/laureats-du-2nd-appel-a-projets/linkandgo-le-vehicule-autonome-dakka-technologies/

Abstract: LINK&GO in a regional project financed by the CG78 (Yvelines Region). Link & Go is presented as the solution for next-generation mobility. It is the first dual-mode electric vehicle: the driver can choose between manual and automatic modes. The vehicle will move independently from the specific infrastructure such as car parks or roads. Safe and secure, Link & Go vehicle is intelligent establishing contact with the users through their personal devices and with the infrastructure via touch screen controls, voice and gestures. In addition, the system Sarveca allow the vehicle to automatically connect to the charging station can intelligently optimize the grid and facilitate the identification, payment, maintenance, etc..

8.1.2. TRANSY'VES

Title: TRANSY'VES

Duration: 12 months

Coordinator: ADM Concept

Others partners: Inria

See also: http://automobile.yvelines.fr/fr/lappel-a-projets-2011/laureats-du-2nd-appel-a-projets/transyves-la-borne-automatique-dadm-concept/

Abstract: The proposed project, called Transy'Ves, is based on two technological components. The first brick aims to optimize routes with electric vehicles, developing an indispensable tool for the appropriation of its use: the EVCO (Electric Vehicle Cruise Optimizer). This is a system for real-time assistance and course management for users of electric vehicles. The second brick aims to facilitate intermodal transport by developing a fully automatic guidance system in order to democratize the parking valet system in new generation parking lots.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ABV

Title: Automatisation basse vitesse

Instrument: ANR

Duration: 2009-2012

Coordinator: IFFSTAR

Others partners: Continental, IBISC, IEF, Induct, LAMIH, Vismetris, UHA-MIPS, Veolia Environnement

See also: http://www.projet-abv.fr/

Abstract: This ambitious project aims at demonstrating automated driving at low speed in urban areas and on peri-urban roads. The aim is to demonstrate the technical feasibility of automating driving at low speeds, typically in situations of congestion or heavy traffic.

8.2.1.2. PUMAS

Title: Plate-forme Urbaine de Mobilité Avancée et Soutenable

Instrument: FUI

Duration: February 2010 - October 2012

Coordinator: Egis Mobilité

Others partners: Induct, Intempora, Armines, Insa-Rouen, Esigelec

See also: http://www.projet-pumas.fr/

Abstract: The purpose of the project PUMAS is to create a platform for travel time information for cities and towns.

8.2.1.3. SCORE@F

Title: Système COopératif Routier Expérimental Français

Instrument: FUI

Duration: 2010-2013

Coordinator: Renault-REGIENOV

Others partners: UTAC, LAB, EURECOM, IFSTTAR, Inria, Telecom Ecole de Management

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

Abstract: SCORE@F (French Experimental Road Cooperative System) is a collaborative research project, experimental road cooperative systems as part of a European framework for experimentation. The SCORE@F is intended to prepare the deployment of "road cooperative systems" on motorways and other road environments through the implementation of operational tests in an open environment. Road cooperative systems are based on wireless local communication between vehicles and road infrastructure (V2I - I2V) and between vehicles (V2V). The deployment of cooperative systems will be strongly influenced by road Framework Directive of the European Commission ITS.

8.2.1.4. Travesti

Title: Traffic Volume Estimation via Space-Time Inference

Instrument: ANR SYSCOMM

Duration: January 2009 - June 2012

Coordinator: Inria (TAO)

Others partners: Armines

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

Abstract: This project addresses the problem of modelling large scale complex systems to provide predictions of their macroscopic behaviour. For application purpose, we focus here on the particular problem of the real-time prediction of traffic conditions on a road network.

8.2.2. Competitivity Clusters

IMARA 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. IMARA is also the main Inria contributor in the VeDeCoM institute (IEED). Vedecom is financing a new PhD thesis student supervised by IMARA research; his scientific research topic is on the fusion of perception and communication for pedestrian assistance, monitoring and tracking.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. DRIVE C2X

Title: DRIVE C2X – Accelerate cooperative mobility

Type: COOPERATION (ICT)

Defi: Driving implementation of car 2 x communication technology

Instrument: Integrated Project (IP)

Duration: January 2011 - December 2013

Coordinator: DAIMLER AG (Germany)

Others partners: 31 partners from automotive industry, electronic and supplier industry, software development, traffic engineering, research institutes and road operators.

See also: http://www.drive-c2x.eu/project

Abstract: With 31 partners, 15 support partners and 18.8 million Euro budget, DRIVE C2X will lay the foundation for rolling out cooperative systems in Europe. Hence, lead to a safer, more economical and more ecological driving.

8.3.1.2. ITSSV6

Title: IPv6 ITS Station Stack for Cooperative ITS FOTs

Type: COOPERATION (ICT)

Defi: IPV6 ITS Station Stack for Cooperative Systems FOTs

Instrument: Specific Targeted Research Project (STREP)

Duration: February 2011 - January 2014

Coordinator: Inria (France)

Others partners: Universidad de Murcia, Institut Telecom, lesswire, SZTAKI, IPTE and BlueTechnix.

See also: http://itssv6.inria.fr/

Abstract: ITSSv6 builds on the base of existing standards from ETSI, ISO and IETF and IPv6 software available from CVIS and GeoNet projects. Its main objectif is to deliver an optimized IPv6.

8.3.1.3. SANDRA

Title: Seamless Aeronautical Networking through integration of Data links, Radios and Antennas.

Type: COOPERATION (TRANSPORTS)

Instrument: Integrated Project (IP)

Duration: October 2009 - September 2013

Coordinator: Selex Communications (Italy)

Others partners: 30 partners.

See also: http://www.sandra-project.eu/2012/

Abstract: The SANDRA concept consists of the integration of complex and disparate communication media into a lean and coherent architecture for aeronautical networking.

8.3.1.4. PICAV

Title: Personal Intelligent City Accessible Vehicle System (PICAV)

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: August 2009 - July 2012

Coordinator: Univ. Gènes (Italy)

Others partners:University College London (UK), Universite di Pisa (Italy), TCB (Portugal), ZTS (Slovakia), Mazel (Spain)

See also: http://www.dimec.unige.it/pmar/picav/

Abstract: The proposal presents a new mobility concept for passengers ensuring accessibility for all in urban pedestrian environments. The concept addresses a new Personal Intelligent City Accessible Vehicle (PICAV) and a new transport system that integrates a fleet of PICAV units.

8.3.1.5. CATS

Title: City Alternative Transport System

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: January 2010 - December 2013

Coordinator: Lohr Industrie (France)

Others partners: CTL (I), EPFL (CH), TECHNION (IL), GEA (CH), ERT (F), and the cities of Formello (I), Strasbourg (F), Ploiesti (R)

See also: http://www.cats-project.org

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 utilisation 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.

8.3.1.6. FURBOT

Title:Architectures of Light Duty Vehicles for urban freight transport

Type: COOPERATION (TRANSPORTS)

Instrument: Specific Targeted Research Project (STREP)

Duration: November 2011 - October 2014

Coordinator: Univ. Gênes (Italy)

Others partners: Bremach (Italy), ZTS (Slovakia), Universite di Pisa (Italy), Persico (Italy), Mazel (Spain), TCB (Portugal)

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

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.

8.3.1.7. DESERVE

Title: DEvelopment platform for Safe and Efficient dRiVE

Duration: September 2012 - August 2015

Coordinator: VTT (Finland)

Others partners: CRF (I), CONTINENTAL (F), FICOSA (I), Inria (F), TRW (GB), AVL (A), BOSCH (D), DAIMLER (D), VOLVO (S),...(26 partners)

See also: http://www.artemis-ia.eu/project/index/view/?project=38

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.

8.3.1.8. CITYMOBIL-2

Title: CityMobil-2

Duration: September 2012 - August 2016

Coordinator: University of Rome La Sapienza, CTL (Italy)

Others partners: Inria (F), DLR (D), GEA Chanard (CH), POLIS (B), ERT (B), EPFL (CH),...(45 partners!)

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.

8.4. International Initiatives

8.4.1. Inria International Partners

- NAIST (Nara Institute of Sciences and Technologies – Nara – Japan): IMARA and NAIST are extending their cooperation on research activities regarding ITS communications. In 2012, IMARA received 2 visiting researchers, 1 PhD student, and 1 internship student, deepening cooperative research activities on service discovery, geo-networking, and medium access control for vehicular communications.

- IMARA and YAMAHA Motors Company (YMC) have signed a NDA for the exchange of information in view of the participation of both parties in the New generation AGV project.

- IMARA and the South-West Research Institute (SwRI) renewed their collaboration agreement on the collaboration in the design and development of innovative Advanced Driver Assistance System.

8.4.2. Participation In International Programs

IMARA is a partner of ict-PAMM, which is an ICT-ASIA project accepted in 2011 for 2 years. It is funded by the French Ministry of Foreign Affairs and Inria. The coordinator of the project is Anne Spalanzani from UPMF University and Inria Co-coordinator is Philippe Martinet from Blaise Pascal Institute. This project aims at conducting common research activities in the areas of robotic mobile service and robotic assistance of human in different contexts of human life. From France the partners are: Inria/e-Motion, Inria/IMARA, Institut Blaise Pascal. From Asia, the partners are: ISRC-SKKU - Suwon, (Korea), ITS Lab - Kumamoto (Japan), IRA-Lab (Taiwan), Mica Institute - Hanoi (Vietnam).

http://emotion.inrialpes.fr/people/spalanzani/HomePAMM.html

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Professor Masatoshi Kakiuchi (Nara Institute of Sciences and Technologies) visited IMARA from November 2011 to October 2012;

- Professor Satoshi Matsuura (Nara Institute of Sciences and Technologies) visited IMARA from April 2012 to March 2013;

- Professor Plamen Petrov (Technical University of Sofia) visited IMARA from July 2012 to September 2012.

IMEDIA2 Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Pl@ntNet project [2009-2013]

It is a joint project with AMAP (CIRAD, INRA, IRD, Montpellier) and Tela Botanica, an international botanical network with 8,500 members and an active collaborative web platform (10,000 visits /day). The project has its financial support from Agropolis International Foundation http://www.agropolis.fr/ and is titled "Plant Computational Identification and Collaborative Information System".

In addition to the results presented in [7], [13], [11], [12], [18], [20], [21], [9], [8], a demo of the Pl@ntNet platform has been done by Vera Bakic at World Wide Web conference (WWW 2012) in Lyon.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. I-SEARCH

Title: I-SEARCH (A unified framework for multimodal content SEARCH)

Type: COOPERATION (ICT)

Defi: Networked Medias & 3D Internet

Instrument: Specific Targeted Research Project (STREP)

Duration: January 2010 - December 2012

Coordinator: CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS (Greece)

Others partners: CERTH (Greece), JCPC (France), ATTC (Greece), ENG (Italy), Google (Germany), UNIGE (Italy), Exalead (France), FHE (Germany), ANSC (Italy), EGR (Germany)

See also: http://www.isearch-project.eu/isearch/

Abstract: The I-SEARCH project aims to provide a novel unified framework for multimodal content indexing, sharing, search and retrieval. The I-SEARCH framework will be able to handle specific types of multimedia and multimodal content (text, 2D image, sketch, video, 3D objects and audio) alongside with real world information, which can be used as queries and retrieve any available relevant content of any of the aforementioned types. IMEDIA2 is workpackage leader of "RUCOD COMPLIANT Descriptor Extraction".

7.2.1.2. Glocal

Title: Glocal (Event-Based Retrieval of Networked Media)

Type: COOPERATION (ICT)

Defi: Networked Medias & 3D Internet

Instrument: Integrated Project (IP)

Duration: December 2009 - November 2012

Coordinator: Univ. Degli Studi di Trento (Italy)

Others partners: UNITN (Italy), ISOCO (Spain), ALINARI (Italy),CERTH (Greece), Yahoo Iberia SL (Spain), AFP (France), DFKI (Germany), Exalead (France), LUH (Germany), BUT (Czech Republic)

See also: http://www.glocal-project.eu/

Abstract: The key idea underlying the project is to use events as the primary means for organizing and indexing media. Within networked communities, common (global) descriptions of the world can be built and continuously enriched by a continuous flow of individual (local) descriptions. With two leading search companies and four content providers, the consortium attempts to realize and evaluate this approach in several application domains, which will involve professional and amateur users dealing with professional and generic contents. IMEDIA2 is responsible of three research tasks related to visual-based event indexing, retrieval and mining, notably in distributed contexts.

7.2.1.3. CHORUS+

Title: CHORUS+ Network of Audio-Visual Media Search

Type: CAPACITIES (ICT)

Defi: Networked Medias & 3D Internet

Instrument: Coordination and Support Action (CSA)

Duration: January 2010 - December 2012

Coordinator: JCP-Consult (France)

Others partners: UNITN (Italy), HES-so (Switzerland), Thomson R&D (France), JCPC (France), CERTH (Greece), TU Wien (Austria), ENG (Italy), IPTS (Belgium)

See also: http://www.ist-chorus.org/

Abstract: CHORUS + has been funded in the continuity of the former CHORUS initiative thanks to its success. Beyond CHORUS coordination objectives, CHORUS+ includes new key issues such as extended cooperation and coordination to Asian countries and US, support to integration and implementation, support to coordinated research evaluations or support to results dissemination of EU projects. Nozha Boujemaa is part of the management board of the project.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Don Geman from John Hopkins University.

7.3.1.1. Internships

OLFA MZOUGHI (from Jan 2012 until Jul 2012)

Subject: Analyse et description de la morphologie foliaire: Application à la classification et l'identification d'espèces de plantes

Institution: Université de Tunis El Manar - Faculté des Sciences (Tunisia)

IN-SITU Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

DigiPods (2012-2015) – The *Distant Collaborative Interaction Between Heterogeneous Visualization Platforms* project is funded by the "Équipement mi-lourd SESAME 2012" program of the Région Île-de-France. 6 academic partners: FCS Paris-Saclay (coordinator), Université Paris-Sud, Inria, CNRS, CEA, Institut Telecom ParisTech with an overall budget of 1.9 Meuros, including 850 keuros public funding from Région Île-de-France. Stéphane Huot: coordinator and principal investigator for the whole project. The goal is to equipe Digiscope platforms (see below) with high-end input and interaction devices/systems. These interaction facilities should be: (i) specific to each kind of platform (e.g., haptic devices for immersive rooms, multitouch devices for high-resolution visualization walls); or (ii) generic for all platforms, in order to allow collaboration between heterogeneous platforms. The latter will be the more innovative, providing users with a personal and configurable interaction space, similar on every platform of the project. Designed for studying distant collaborative interaction, these systems will also serve as a testbed for exploring and addressing the challenges of configurability and adaptability for the end-user.

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 the project 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 will contribute 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). In Situ 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 – Adrian Bosseau (Inria, Sophia Antipolis) submitted a successful ANR grant with members from INSITU Fanis Tsandilas (Inria) and Wendy Mackay, and Prof. Maneesh Agrawala (Berkeley), called DRAO, 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

VCoRE – Visual COmputing Runtime Environment. Inria ADT (Technology Transfer Initiative), two academic partners: Inria (Grenoble, Lille, Rennes, Saclay, Sophia Antipolis) and IGD Fraunhofer Institute (Darmstadt, Germany). Stéphane Huot: coordinator and principal investigator for INSITU / Inria Saclay–Île-de-France, Romain Primet: investigator for INSITU / SED / Inria Saclay–Île-de-France. The VCoRE project aims to share resources and to develop a new software framework for advanced Mixed/Augmented/Virtual Reality and Visualization platforms. The advantages of this shared framework will be (i) to provide engineers and researchers with unified and flexible development tools to support research projects; (ii) to ease the development and porting of applications on heterogeneous immersive and visualization platforms, while still making the most of their capabilities (specific hardware, computing power, interaction devices, etc.). All the partners are conducting research projects on such platforms and have a strong background in computer graphics, human-computer interaction, software engineering, real-time simulation, parallel computing, etc. In VCoRE, INSITU will contribute with its expertise in HCI and software engineering, thanks to the knowledge gained from the WILD project. In concrete terms, several of the software tools and methods for designing and programming interaction developed at INSITU will be improved and integrated into VCoRE as the framework interaction management tools (FlowStates, WILDInputServer).

7.4. International Initiatives

BayScope – Prof. Bjorn Hartman (Berkeley), Michel Beaudouin-Lafon and Wendy Mackay submitted a successful NSF CNIC grant "Architectures and Interaction Paradigms for Multi-surface Environments" to support travel between France and Berkeley in conjunction with the BayScope project, the goal of which is to link our work on DigiScope within France to our partners in the SIRIUS Equipe Associé, in California, specifically at Berkeley and at U.C. San Diego.

7.4.1. *Inria Associate Teams*

SIRIUS – INSITU has an Equipe Associée called *SIRIUS: Situated Interaction Research at Inria, UCSD and Stanford* with U.C. San Diego and Stanford University. The creation of Inria Silicon Valley, and the move of Prof. Bjoern Hartmann to Berkeley, has meant that we've included Berkeley in the research group. The primary area of collaboration has been in the context of our DigiScope project and interaction with wall-sized displays, which led to the creation of BayScope at Berkeley and collabortions on the 75-screen wall at UCSD. We have also collaborated on design process and interactive paper with Stanford.

The SIRIUS Associate Team includes INSITU, (head: W. Mackay), the HCI group at Stanford, (head: Prof. Scott Klemmer), and the DCOG-HCI group at UCSD (head: Prof. Jim Hollan). Arvind Satyanarayan completed his undergraduate degree at UCSD and started a Ph.D. at Stanford in the fall of 2011, with three visits to INSITU in 2012 to work on the Multimedia Interactive Schedule project for CHI'13. Bjorn Hartman completed his Ph.D. at Stanford and joined the UC Berkeley faculty in 2011, and is continuing to collaborate on the HydraScope project. Lora Oehlberg completed her Ph.D. at Berkeley in October, 2011 and began an Inria-Silicon Valley post-doc at INSITU. Daniel Strazzula completed his Masters at Stanford and began a Ph.D. on a CORDI grant at INSITU. Melody Kim, an undergraduate at UCSD, visited INSITU in the fall quarter. Both are working with A. Satyanarayan on the Multimedia Interactive Schedule. W. Mackay worked on Combinatorix [28] with B. Schneider (Stanford Ph.D. student). W. Mackay and F. Tsandilas had several meetings with A. Bosseau as part of the ANR DRAO project, which includes Prof. Maneesh Agrawala from Berkeley). W. Mackay and M. Beaudouin-Lafon visited UCSD (J. Hollan and N. Weibel). W. Mackay, M. Beaudouin-Lafon, A. Satyanarayan and J. Hollan attended the Dagstuhl HCI seminar in Germany. SIRIUS helped sponsor two international workshops, one at Berkeley and one in Orsay, France on interaction in multi-surface environments.

7.4.2. *Participation In International Programs*

CIRIC Chili – Emmanuel Pietriga joined Inria Chile in July 2012 and is now heading the Massive Data project, continuing the close collaboration with ALMA 6.3 and starting new industrial transfer projects related to the visualization of massive datasets and to the engineering of interactive systems.

7.5. International Research Visitors

7.5.1. Internships

Jéronimo Barbosa, Master student, "Linking digital tabletops with physical paper for creative interactions", Universidade Federal de Pernambuco (CIn/UFPE), Recife, Brazil. May 2012 - October 2012, Inria International Internships Program. Supervision: Theophanis Tsandilas, Anastasia Bezerianos.

Melody Kim, "Interaction with large displays", Undergraduate student, University of California, San Diego, USA. UCSD. Supervision: Wendy Mackay.

Arvind Satyanarayan, "Interaction with large displays", PhD student, Stanford University, Computer Science Dpt. (HCI and Visualization group), Stanford, USA. Sirius associate team. Supervision: Wendy Mackay, Michel Beaudouin-Lafon.

7.5.2. Visits to International Teams

Wendy Mackay and Michel Beaudouin-Lafon completed their two-year sabbatical at Stanford University in June, 2012, where they collaborated closely with the Stanford HCI group (Prof.s S. Klemmer and S. Card) and the Berkeley Institute of Design (BID) (Prof. B. Hartmann). D. Strazzula, who completed his Master's degree at Stanford, returned to U. Paris on an Inria Cordi Ph.D. grant and L. Oehlberg, who completed her Ph.D. at Berkeley, joined INSITU as a Post-Doctoral Fellow. Julie Wagner (Ph.D., INSITU) and Emilien Ghomi (Ph.D., INSITU), and Stéphane Huot (MC, INSITU) visited W. Mackay and M. Beaudouin-Lafon at Stanford, in April and in May. W. Mackay visited Prof. Marcelo Wanderley at McGill University in Canada.

<p style="text-align:center">**LAGADIC Project-Team**</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. FUI Rev-TV project

Participants: Céline Teulière, François Chapeau, Eric Marchand.

no. Inria Rennes 4549, duration: 36 months.

This project started in January 2010. It is composed of a consortium managed by Technicolor with Artefacto, Istia, Telecom Bretagne, Soniris, Bilboquet and Inria Lagadic and Metiss groups. The goal of this project is to provide tools to develop new TV programs allowing the final user to interact within an immersive and convivial interface. Within this project, we focused on the development of tracking algorithms (3D localization) and on visual servoing techniques for camera localization.

8.1.2. i-Lab ExtAR

Participants: Clément Samson, Eric Marchand.

duration: 24 months.

ExtAR is an Inria i-Lab with Artefacto that started in March 2011. Its goal is to develop an augmented reality library for smartphones.

8.1.3. Apash project

Participants: Rafik Sekkal, François Pasteau, Marie Babel.

no Insa Rennes 2012-230, duration : 24 months.

Started in September 2012, the Apash project is supported by the Images & Réseaux cluster. It involves three laboratories connected to Insa Rennes, namely Irisa/Inria, IETR and LGCGM. Two industrial partners take part into this project: AdvanSEE and Ergovie. It aims 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 6.3.6 .

8.2. National Initiatives

8.2.1. DGA/DGCIS Rapid Canari

Participants: Patrick Rives, Cyril Joly.

no. Inria Sophia 4979, duration : 36 months.

This project started in July 2010. It aims at developing a full autonomous indoor mobile robot dedicated to survey missions. The partners are Robopec and ECA companies. We are in charge of the development of Slam aspects. The contract supported Cyril Joly's engineer grant (see Section 6.3.3).

8.2.2. ANR Contint Prosit

Participants: Tao Li, Alexandre Krupa.

no. Inria Rennes 3585, duration: 46 months.

This project is led by the Prisme lab in Bourges. It started in December 2008 in collaboration with LIRMM in Montpellier, LMS in Poitiers, CHU of Tours, and the Robosoft company. Its goal is to develop an interactive master-slave robotic platform for medical diagnosis applications (tele-echography) with assistance functionalities. The work that we have realized within this project is described in Section 6.4.2 .

8.2.3. *ANR Contint US-Comp*

Participants: Caroline Nadeau, Alexandre Krupa.

no. Inria Rennes 3560, duration: 42 months.

This project, led by Alexandre Krupa, started in December 2008. It involves a collaboration with the Visages team in Rennes, LSIIT in Strasbourg and Lirmm in Montpellier. Its goal is to provide methodological solutions for real-time compensation of soft tissues motion during ultrasound imaging. The approach consists in synchronizing the displacement of a 2D or 3D ultrasound probe to stabilize the observed image by the use of a robotic arm. The work that we have realized within this project is described in Sections 6.4.1 and 6.4.3 .

8.2.4. *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.

8.2.5. *PEA Decsa*

Participants: Aurélien Yol, Eric Marchand, François Chaumette.

no Inria Rennes 6630, duration: 36 months.

This project started in November 2011. It is composed of a consortium managed by Astrium with the Novadem, Sirehna, Spot Image and Magellium companies, and with the Inria Lagadic and Steep groups. It is devoted to the development of navigation and perception algorithms for small drones in urban environment.

8.2.6. *Equipex Robotex*

Participants: Aurélien Yol, 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 significant equipments in the main robotics labs in France. This year, it allowed us to buy the Viper S650 arm and the Pioneer 3DX described in Sections 5.4 and 5.5 . In a near future, we plan to buy a humanoid robot, Romeo, by Aldebaran Robotics.

8.2.7. *Inria Large Scale Initiative Action Pal*

Participants: Patrick Rives, Marie Babel, François Chaumette, Luca Marchetti, Cyril Joly, Rafik Sekkal, François Pasteau.

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. 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 6.3.6 , 6.2.4 and 6.3.5 .

8.3. European Initiatives

8.3.1. FP7 Regpot Across

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 (Austrtia), Politecnico di Milano (Italy), University of Sevilla (Spain), Eindhoven University of Technology (The Netherlands), University of Athens (Greece), etc.

8.4. International Initiatives

8.4.1. Participation in International Programs

8.4.1.1. Inria/CNPq MuNave

The project MuNave (2010 - 2012) funded through the Inria/CNPq collaboration framework, succeeds to a long time collaboration between Patrick Rives and the CTI in Campinas (Brazil). This project aims at investigating new research themes in perception and control for autonomous mobile robots.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Shogo Arai, Assistant Prof. at the University of Tohoku in Sendai, Japan, spent a two-month visit in our group in Rennes in March and April 2012 to work on visual servoing.
- Nicolas Alt, Ph.D. student at the Technische Universität München, Germany, visited our group in Sophia Antipolis from July 2 to September 26. He worked on the detection and modeling of transparent objects using a Kinect.
- Rogelio Esteller Curto, Assistant Prof. at the University of Jaume-I in Castillon, Spain, has spent a one-month visit in our group in Rennes in November 2012 to work on visual servoing.

8.5.2. Internships

Thanks to the FP7 Regpot project (see Section 8.3.1), we have got three internships from University of Zagreb from March to June 2012:

- Ante Trbojevic
- Petra Bosilj
- Petar Palasek.

Two internships from the University of Guanajuato started in December 2012:

- Raul Orlando Alvarado Lara
- Francisco Javier Rangel Butanda.

LEAR Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. QUAERO Project

Participants: Mohamed Ayari, Matthijs Douze, Dan Oneata, Danila Potapov, Alessandro Prest, Jerome Revaud, Cordelia Schmid, Franck Thollard, Heng Wang.

Quaero is a French-German search engine project supported by OSEO. It runs from 2008 to 2013 and includes many academic and industrial partners, such as Inria, CNRS, the universities of Karlsruhe and Aachen as well as LTU, Exalead and INA. LEAR/Inria is involved in the tasks of automatic image annotation, image clustering as well as large-scale image and video search. See http://www.quaero.org for more details.

8.1.2. 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.

8.1.3. ANR Project Physionomie

Participants: Frédéric Jurie [University of Caen], Jakob Verbeek.

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.

8.2. European Initiatives

8.2.1. FP7 European Project AXES

Participants: Ramazan Cinbis, Matthijs Douze, Zaid Harchaoui, Dan Oneata, Danila Potapov, Cordelia Schmid, Jakob Verbeek.

This 4-year project started in January 2011. 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. FP7 European Network of Excellence PASCAL 2

Participants: Zeynep Akata, Adrien Gaidon, Zaid Harchaoui, Thomas Mensink, Cordelia Schmid, Jakob Verbeek.

PASCAL (Pattern Analysis, Statistical Modeling and Computational Learning) is a 7th framework EU Network of Excellence that started in March 2008 for five years. It has established a distributed institute that brings together researchers and students across Europe, and is now reaching out to countries all over the world. PASCAL is developing the expertise and scientific results that will help create new technologies such as intelligent interfaces and adaptive cognitive systems. To achieve this, it supports and encourages collaboration between experts in machine learning, statistics and optimization. It also promotes the use of machine learning in many relevant application domains such as machine vision.

8.2.3. ERC Advanced grant Allegro

Participant: Cordelia Schmid.

The ERC advanced grant ALLEGRO will start beginning of 2013 for a duration of five year. 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, 2012–2014
  Despite the ever-increasing number of large annotated image and video datasets, designing principled and scalable statistical learning approaches from such big computer vision datasets remains a major scientific challenge. In this associate team we collaborate with two teams of University of California Berkeley, headed respectively by Prof. Jitendra Malik and Prof. Nourredine El Karoui. It will allow the three teams to effectively combine their respective strengths in areas such as large-scale learning theory and algorithms, high-level feature design for computer vision, and high-dimensional statistical learning theory. It will result in significant progress in domains such as large-scale image classification, weakly-supervised learning for classification into attributes, and transfer learning.

8.3.2. Inria International Partners

- **Microsoft Research NY:** Zaid Harchaoui has been collaborating since the fall 2010 with Miro Dudik, formerly from Yahoo! Research (until Spring 2012), and now in the recently setup Microsoft Research New York lab, on lifted coordinate descent algorithms for large-scale learning. This collaboration lead to several published papers, including an oral presentation at CVPR 2012. Zaid Harchaoui has visited Microsoft Research NY for one week in the fall 2012. We intend to pursue this fruitful collaboration in the coming years.

- **UC Berkeley:** This collaboration between Bin Yu, Jack Gallant, Yuval Benjamini (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, involving a student from UC Berkeley working on the extension of the current image model to videos.

- **UC Berkeley, Institut Curie:** In a collaboration between Jean-Philippe Vert, Elsa Bernard (Institut Curie), Laurent Jacob (UC Berkeley) and Julien Mairal (Inria LEAR) we aim to develop novel efficient optimization techniques for identification and quantification of isoforms from RNA-Seq data. Elsa Bernard was a master student between April and August 2012. She was co-advised by Jean-Philippe Vert, Laurent Jacob and Julien Mairal. Elsa Bernard has now started her PhD at Institut Curie and the collaboration is still ongoing.

- **ETH Zürich:** We collaborate with V. Ferrari, junior professor at ETH Zürich, and recently appointed as assistant professor at University of Edinburgh. V. Ferrari and C. Schmid co-supervised a PhD student (A. Prest) on the subject of automatic learning of objects in images and videos [3], [9], [20]. A. Prest was bi-localized between ETH Zürich and Inria Grenoble.

8.3.3. Participation In International Programs

- **France-Berkeley fund:** The LEAR team was awarded a grant from the France-Berkeley fund for the project with Pr. Jitendra Malik (EECS, UC Berkeley) on "Large-scale learning for image and video interpretation". The award amounts to 10,000 USD for a period of one year. The funds are meant to support scientific and scholarly exchanges and collaboration between the two teams.

MAGRIT Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- ANR ARTIS (2009-2013)
  Participants: M.O. Berger, E. Kerrien, M. Loosvelt.
  The main objective of this fundamental research project is to develop inversion tools and to design and implement methods that allow for the production of augmented speech from the speech sound signal alone or with video images of the speaker's face. The Magrit team is especially concerned with the development of procedures allowing for the automatic construction of a speaker's model from various imaging modalities.

- ANR Visac (2009-2012)
  Participants: M.O. Berger, B. Wrobel-Dautcourt.
  The ANR Visac is about acoustic-visual speech synthesis by bimodal concatenation. The major challenge of this project is to perform speech synthesis with its acoustic and visible components simultaneously. Within this project, the role of the Magrit team is to build a stereovision system able to record synchronized audio-visual sequences at a high frame rate [11].

- 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 simulation to exactly superimposes 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.

7.1.2. 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.

7.1.3. Institut Pascal, Université de Clermont-Ferrand

Since June 2012, we are 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.

7.2. European Initiatives

7.2.1. Collaborations with Major European Organizations

Partner 1: Imperial College, London.

Pierre-Frédéric Villard has a Honorary Research Fellow contract with Imperial College. The collaboration has involved 2 research visits in London in summer to mainly discuss about the ongoing work on parameters optimization. There was also a participation as an activity leader in two one-week summer schools on Haptic Technology (to give the basics of computer haptics, including visual and haptics rendering, force feedback, haptic interfaces, collision detection, collision response and deformation modelling).

<div align="center">

MAIA Project-Team

</div>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CPER "Informatique Située" project

Participants: Olivier Simonin, François Charpillet, Olivier Rochel ,, Amandine Dubois, Mihai Andries.

Ye-Qiong Song (Madynes team, LORIA-Inria) is an external collaborator.

The CPER MIS is a Lorraine region and Inria-Feder project. In this context the Informatique Située action aims at studying and experiment AI models for human assistance and intelligent home. We developed an experimental platform called "Smart Appartment", where we define and study the iTile network (6.2.4.2.1) and different multi-sensors systems for tracking functions. See http://infositu.loria.fr.

8.1.2. RNSC project AEGSST

Participant: Vincent Chevrier.

This project "Approche Enactive pour la Gouvernance des Systèmes Socio-Techniques" (AEGSST) is the consequence of the work undertaken within the GEST project funded by the IXXI ("Institut Rhône Alpin des Systèmes Complexes") and PEPS CNRS project GEST. It is labeled and funded by the Réseau National des Systèmes Complexes (RNSC).

This project aims at a fundamental level at proposing an enactive perspective for the governance issue in case of complex socio-technical systems, like public transportation systems or smart grids in energy domain. From a more applicative perspective, we seek at specifying a participatory and reflexive simulation system based on a multi-agent model.

This project gathers researchers coming from different domains (social cognition, decision theory, simulation, serious game, etc) in order to clarify interdisciplinary issues.

Several meetings were organized and a workshop occurred the 29 th November in Paris.

8.1.3. COMAC

Participants: Mauricio Araya, Marie Tonnelier, Vincent Thomas, Olivier Buffet, François Charpillet.

Laurent Bougrain (CORTEX team, LORIA) is an external collaborator.

The COMAC [6] project is part of the Materalia competitive cluster. The main objective of the project is to develop diagnosis tools for the low cost identification of defaults in aeronautic parts made of composite materials.

In the MAIA team, our research effort focuses more precisely on information gathering problems involving active sensors, i.e., an intelligent system which has to select the observations to perform (which sensor, where, at which resolution). Mauricio Araya's undergoing PhD looks precisely at the topic of Active Sensing (Section 6.1.2).

The project has ended in December 2012 and the main contributions of the MAIA and CORTEX teams are (1) the development of the iComac platform that gathers the information concerning the diagnosis procedures results obtained by all the partners (2) the development of Pie Diagnosis System (PDS), a demonstrative application which uses a POMDP approach to compute the optimal active diagnosis strategy, and hypertrees for visualization.

---

[6]COMAC = *contrôle optimisé multi-techniques des aérostructures composites* / optimized multi-technique control of composite aeronautic parts

8.2. National Initiatives

8.2.1. CNRS PEPII project "IMAVO" (2011-2012)

Participant: Alain Dutech.

IMAVO, for "Interactions entre Modules pour l'Apprentissage dans un environnement VOlatile", is a PEPII project of the INSB institute of the CNRS. It involves Alain Marchand and Etienne Coutureau from the INCIA Lab of Bordeaux (Behavioral Neurosciences - INSB), Mehdi Khamassi and Benoît Girard from the ISIR Lab of Paris (Robotics and Neurosciences - INS2I), Alain Dutech and Nicolas Rougier from the Loria Lab of Nancy (Computational Neurosciences and Machine Learning - INS2I).

This project investigates *model-based* and *model-free* reinforcement learning approaches for rats learning in volatile environments (*i.e.* context and reward can change during learning). It aims at designing new concept for modularized decision-making systems, allowing a better understanding of the underlying neuro-biological process involved in rats and humans and applications in the field of autonomous robotics.

8.2.2. Inria AEN PAL Personally Assisted Living

Participants: François Charpillet, Olivier Simonin, Mihai Andries.

The PAL project is a national Inria Large Scale Initiative (Action d'Envergure Nationale) 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), cf. Sec. 6.2.4.2.1 .

In 2012, we organized a Workshop PAL in Nancy, on November (http://pal.inria.fr). The PAL project funded the PhD. thesis of Mihai Andries, who started in october 2012.

8.2.3. PEA-DGA SUSIE 2009-12

Participants: François Charpillet, Olivier Simonin, Romain Mauffray.

This project relies on results and questions arising from the SMAART project (2006-08). During this project we adapted the EVAP algorithm, proposed in the PhD thesis of Arnaud Glad (Maia, 2011) to the patrol with UAVs, while providing a generic digital pheromone based patrolling simulator. Concerning sharing authority, we proposed an original interface to manipulate groups of UAVs.

The SUSIE project allowed to progress on two questions (i) studying and improving parameters of the EVAP algorithm through the SUSIE simulator (ii) defining new ways to manipulate pheromones fields in order to improve the sharing authority.

8.2.4. Inria ADT Percee (2011-13)

Participants: Olivier Simonin, François Charpillet, Olivier Rochel, Nicolas Beaufort.

Percee, for "Perception Distribuée pour Environnements Intelligents", is a project proposed by Maia and Madynes teams and funded by Inria. This ADT (Action de Developpement Technologique) supports our action in the PAL Inria National Scale Initiative (Personally Assisted Living, see 8.2.2).

The project deals with the development and the study of intelligent homes. Since two years we develop an experimental platform, the smart appartment. It allows us to study models and technology for life assistance (walk analysis with iTiles and camera networks, robotic assistants, health diagnostic, domotic functions, wireless communication inside home).

In particular we develop a new tactile floor, which is the iTiles network. Two engineers are funded by the ADT: Moutie Chaider (IJD) and Olivier Rochel (Inria research engineer) for two years.

8.2.5. ANR

8.2.5.1. CART-O-MATIC ANR Carotte
Participants: Olivier Simonin, François Charpillet, Antoine Bautin, Nicolas Beaufort.

This project has been granted by ANR in the Robotics Carotte challenge (CArtographie par ROboT d'un TErritoire) from the *Contenus et Interactions* program (2009-2012). The project is funded with ca. 50000 EUR to purchase the robotics platform. The Maia team was also funded with a PhD fellowship (Antoine Bautin, defending his PhD in the beginning of year 2013). The Cartomatic consortium was formed by LISA/Angers University (leader) and Maia/LORIA team (and until 2011 by Wany robotics, Montpellier).

This project concerned the mapping of indoor structured but unknown environments, and the localization of objects, with one or several robots. We explored a decentralized multi-robot approach to achieve the challenge. We demonstrated the efficiency and robustness of the approach by winning the final edition of the contest (June 2012, Bourges). See Section 6.2.4.1.3 and the Web page Cartomatic project.

8.2.5.2. 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 will allow to define a behavioral model of olfactive processes. This work will also provide several applications, in particular the development of bio-inspired components hightly 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).

8.2.5.3. ANR project BARQ
Participants: Jörg Hoffmann, Olivier Buffet, Bruno Scherrer.

This project has been granted by ANR in the "Chaires d'Excellence" program. The project is funded with ca. 400000 EUR and will hire four non-permanent researchers (Doctorants and/or Postdocs). Jörg Hoffmann is the project leader, Olivier Buffet and Bruno Scherrer collaborate. Other collaborators from LORIA are Stephan Merz, Ammar Oulamara, and Martin Quinson. The project also has several international collaborators, in particular Prof. Blai Bonet (Universidad Simon Bolivar, Caracas, Venezuela), Prof. Carmel Domshlak (Technion Haifa, Israel), Prof. Hector Geffner (Universitat Pompeu Fabra, Barcelona, Spain), Dr. Malte Helmert (University of Freiburg, Germany), and Prof. Stephen Smith (CMU, Pittsburgh, USA).

The project unites research from four different areas, namely classical planning, probabilistic planning, model checking, and scheduling. The underlying common theme is the development of new methods for computing lower bounds via state aggregation. Specifically, the basic technique investigated allows explicit selection of states to aggregate, in exponentially large state spaces, via an incremental process interleaving it with state space re-construction steps. The two main research questions to be addressed are how to choose the states to aggregate, and how to effectively obtain, in practical scenarios, anytime methods providing solutions with increasingly tighter performance guarantees.

So far, we have hired Dr. Michael Katz as a PostDoc (for 2 years) working on classical planning, and Manel Tagorti as a PhD student (for 3 years) working on probabilistic planning. The Conseil Regional de Lorraine has accepted to co-finance, for 2011, 50% of the the position of Michael Katz for a period of 1 year. Chao-Wen Perng was funded from BARQ for an internship of 5 months during which she worked on her MSc report, laying some basis for the research direction to be followed by Manel Tagorti.

The project has stopped when Joerg Hoffmann left Inria.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: InterReg IV B

Project acronym: InTraDE

Project title: Intelligent Transportation for Dynamic Environment

Duration: 2010 - 2014

Coordinator: University of Science and Technology of Lille (Lille 1-LAGIS) (France),

Other partners: South East England Development Agency (United Kingdom), Centre Régional d'Innovation et de Transfert de Technologie – Transport et Logistique (CRITT TL) (France), AG Port of Oostende (AGHO) (Belgium), National Institute for Transport and Logistics, Dublin Institute of Technology (Ireland), Liverpool John Moores University (LOOM) (United Kingdom)

Abstract:

The InTraDE project (Intelligent Transportation for Dynamic Environments, http://www.intrade-nwe.eu/) is funded by the European North West Region. The project is coordinated by Rochdi Merzouki from University of Science and Technology of Lille (LAGIS lab.). Other partners are the Maia team, Liverpool John Moores University (LOOM), the National Institute for Transport and Logistics in Dublin Institute of Technology, the South East England Development Agency, the AGHO Port of Oostende and the CRITT in Le Havre. In the context of seaports and maritime terminals, the InTraDE project aims to improve the traffic management and space optimization inside confined spaces by developing a clean and safe intelligent transportation system. This transportation system will operate in parallel with virtual simulation software of the automated site, allowing a robust and real-time supervision of the goods handling operation.

The Maia team partner focuses on decentralized approaches to deal with the control of automated vehicle platooning and the adaptation of the traffic. Maia is funded with two PhD fellowships and one engineer. Both PhD thesis started in the end of 2010. The PhD of Jano Yazbeck, supervised by F. Charpillet and A. Scheuer, aims at studying a "Secure and robust immaterial hanging for automated vehicles". The PhD of Mohamed Tlig, supervised by O. Simonin and O. Buffet, addresses "Reactive coordination for traffic adaptation in large situated multi-agent systems".

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Dr. Iadine Chadès, Research Scientist at CSIRO, Ecosystem Sciences division (Brisbane, Australia), visited MAIA for 1 week in April 2012.
- Pr. Sukanta Das, Professor at the Department of Information Technology, BESU university (West Bengal, India), visited MaIA for three weeks in March 2012.

MANAO Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. CTP materials (2011-2015):

U. Zaragoza, U. Girona
Leader: P. Barla (*MANAO*)
This collaboration between regions on both French and Spanish sides of Pyrénées aims at studying material properties through their connections between physical and image space. Although the purpose of such a study is general in scope, we also target a particular application: the acquisition of material properties from a single image of an object of unknown shape, under unknown illumination.

6.2. National Initiatives

6.2.1. ANR

6.2.1.1. 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 offline, high-quality simulation or interactive simulations.

6.2.1.2. "Young Researcher" IMandM (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.

6.2.1.3. SeARCH (2009-2013):

PFT3D Archéovision (CNRS), CEAlex (USR CNRS 3134), ESTIA
Leader: P. Reuter
Cultural Heritage (CH) artifacts often come as a set of broken fragments leading to difficult 3D puzzles and sometime impossible to solve in a real world. The project's goal is to propose solutions from on-site acquisition, 3D surface reconstruction and semi-automatic virtual reassembly, taking into account the expertise of CH scientists.

6.2.2. Competitivity Clusters

6.2.2.1. 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 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.

6.3. European Initiatives

6.3.1. FP7 Projects

6.3.1.1. FP7 NoE - V-MusT.net (2011-2015):

partners available at http://www.v-must.net/participants

Leader: S. Pescarin (CNR - Italy)

V-MusT.net is a new 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.

6.3.1.2. FP7 ITN - PRISM "Perceptual Representations for Illumination, Shape and Materials" (2013-2016):

Giessen University, Université Paris-Descartes, Bilkent University, Université de Leuven, Delft University, Birmingham University, Philips and NextLimit

Leader: Roland 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.

<div align="center">**MAVERICK Team**</div>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *ANR BLANC: ALTA*

Participants: Nicolas Holzschuch, 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.

7.1.2. *ANR jeune chercheur: SimOne*

Participants: Fabrice Neyret, Cyril Soler, Manuel Vennier.

We are funded by the ANR research program "jeune chercheur" (grants for young research leaders, obtained by Eric Bruneton) for a joint research project with the EVASION Inria project-team. The goal of this project is to develop "Scalable Interactive Models Of Nature on Earth" (including shape, motion and illumination models for ocean, clouds, and vegetation). The grant started in December 2010, for 36 months.

7.1.3. *ANR CONTINT: RTIGE*

Participants: Eric Bruneton, Jean-Dominique Gascuel, Nicolas Holzschuch, Fabrice Neyret.

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. We aim at integrating our results for digital planetariums. The grant started in December 2010, for 48 months.

7.1.4. *ANR COSINUS: ROMMA*

Participants: Georges-Pierre Bonneau, 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.

7.1.5. *ANR CONTINT: MAPSTYLE*

Participants: Joëlle Thollot, 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.

7.2. International Initiatives

7.2.1. Participation In International Programs

We had an internship funded by the REUSSI program. Pascal Grosset is PhD student at the university of Utah. He stayed in Maverick from May to July 2012.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Professor Charles Hansen has started in November 2011 a visit of six month in the Maverick team. His six-months visit is funded by the University of Grenoble. Charles D. Hansen received a BS in computer science from Memphis State University in 1981 and a PhD in computer science from the University of Utah in 1987. He is a professor of computer science at the University of Utah an associate director of the SCI Institute. From 1989 to 1997, he was a Technical Staff Member in the Advanced Computing Laboratory (ACL) located at Los Alamos National Laboratory, where he formed and directed the visualization efforts in the ACL. He was a Bourse de Chateaubriand PostDoc Fellow at Inria, Rocquencourt France, in 1987 and 1988. His research interests include large-scale scientific visualization and computer graphics.

7.3.1.1. Internships

Pascal Grosset visited from May to July 2012, funded by Inria internship (REUSSI). He worked on a psychometric experiment in order to evaluate the benefit of depth of field to improve depth perception in direct volumetric rendering. His work has been accepted for publication at IEEE Pacific Visualization [15].

7.3.2. Visits to International Teams

Eric Heitz is currently visiting the computer graphics group at the university of Montreal, funded by the explora'doc program from region Rhône-Alpes, from August 2012 to February 2013.

<h1 style="color:red; text-align:center;">METISS Project-Team</h1>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. National Projects

8.1.1.1. QUAERO CTC and Corpus Projects (OSEO)

Participants: Kamil Adiloglu, Frédéric Bimbot, Laurence Catanese, Gabriel Sargent, Emmanuel Vincent.

Main academic partners : IRCAM, IRIT, LIMSI, Telecom ParisTech

Quaero is a European research and development program with the goal of developing multimedia and multilingual indexing and management tools for professional and general public applications (such as search engines).

This program is supported by OSEO. The consortium is led by Thomson. Other companies involved in the consortium are: France Télécom, Exalead, Bertin Technologies, Jouve, Grass Valley GmbH, Vecsys, LTU Technologies, Siemens A.G. and Synapse Développement. Many public research institutes are also involved, including LIMSI-CNRS, Inria, IRCAM, RWTH Aachen, University of Karlsruhe, IRIT, Clips/Imag, Telecom ParisTech, INRA, as well as other public organisations such as INA, BNF, LIPN and DGA.

METISS is involved in two technological domains : audio processing and music information retrieval (WP6). The research activities (CTC project) are focused on improving audio and music analysis, segmentation and description algorithms in terms of efficiency, robustness and scalability. Some effort is also dedicated on corpus design, collection and annotation (Corpus Project).

METISS also takes part to research and corpus activities in multimodal processing (WP10), in close collaboration with the TEXMEX project-team.

8.1.1.2. ANR ECHANGE

Participants: Rémi Gribonval, Emmanuel Vincent, Nancy Bertin.

Duration: 3 years (started January 2009). Partners: A. Cohen, Laboratoire J. Louis Lions (Paris 6); F. Ollivier et J. Marchal, Laboratoire MPIA / Institut Jean Le Rond d'Alembert (Paris 6); L. Daudet, Laboratoire Ondes et Acoustique (Paris 6/7).

The objective of the ECHANGE project (ECHantillonage Acoustique Nouvelle GEnération) was to setup a theoretical and computational framework, based on the principles of compressed sensing, for the measurement and processing of complex acoustic fields through a limited number of acoustic sensors.

8.1.1.3. DGCIS REV-TV

Participants: Guylaine Le Jan, Grégoire Bachman, Nathan Souviraà-Labastie, Frédéric Bimbot.

Duration: 2.5 years (2010-2012). Partners: Technicolor (ex Thomson R&D), Artefacto, Bilboquet, Soniris, ISTIA, Télécom Bretagne, Cap Canal

The Rev-TV project aims at developping new concepts, algorithms and systems in the production of contents for interactive television based on mixed-reality.

In this context, the Metiss research group was focused on audio processing for the animation of an avatar (lip movements, facial expressions) and the control of interactive functionalities by voice and vocal commands.

8.1.2. Action de Développement Technologique

8.1.2.1. FASST

Participants: Nancy Bertin, Emmanuel Vincent, Frédéric Bimbot.

Duration: 2 years (2012–2014). Partners: Inria Teams Parole (Nancy) and Texmex (Rennes)

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.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. SMALL

Participants: Rémi Gribonval, Jules Espiau de Lamaestre, Sangnam Nam, Emmanuel Vincent, Nancy Bertin.

Title: Sparse Models, Algorithms and Learning for Large-scale data

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: February 2009 - January 2012

Coordinator: Inria (France)

Others partners: Univ. Edimburg (UK), Queen Mary Univ. (UK), EPFL (CH), Technion Univ. (ISR)

See also: http://small-project.eu/

Abstract: The project has developed new foundational theoretical framework for dictionary learning, and scalable algorithms for the training of structured dictionaries.

8.2.1.2. PLEASE

Title: Projections, Learning and Sparsity for Efficient data processing.

Type: IDEAS ()

Instrument: ERC Starting Grant (Starting)

Duration: January 2012 - December 2016

Coordinator: Inria (France)

Principal investigator: Rémi Gribonval

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

8.2.2. Collaborations in other European Programs

Program: Eureka - Eurostars

Project acronym: i3DMusic

Project title: Real-time Interative 3D Rendering of Musical Recordings

Duration: October 2010 - September 2013

Other partners: Audionamix (FR), Sonic Emotion (CH), École Polytechnique Fédérale de Lausanne (CH)

Abstract:The i3DMusic project (Real-time Interative 3D Rendering of Musical Recordings) has been setup with the SMEs Audionamix and Sonic Emotion and the academic partner EPFL to provide a system enabling real-time interactive respatialization of mono or stereo music content. This will be achieved through the combination of source separation and 3D audio rendering techniques. Metiss 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 Associate Teams

8.3.1.1. VERSAMUS

Participants: Emmanuel Vincent, Nobutaka Ito, Gabriel Sargent, Frédéric Bimbot, Rémi Gribonval.

Title: Integrated probabilistic music representations for versatile music content processing

Inria principal investigator: Emmanuel Vincent

International Partner (Institution - Laboratory - Researcher):

Tokyo University (Japan) - Department of Physics and Computing

Duration: 2010 - 2012

See also: http://versamus.inria.fr/

Music plays a major role in everyday use of digital media contents. Companies and users are waiting for smart content creation and distribution functionalities, such as music classification, search by similarity, summarization, chord transcription, remixing and automatic accompaniment. So far, research efforts have focused on the development of specific algorithms and corpora for each functionality based on low-level sound features characterizing sound as a whole. Yet, music generally results from the superposition of heterogeneous sound components (e.g. voices, pitched musical instruments, drums, sound samples) carrying interdependent features at several levels (e.g. music genre, singer identity, melody, lyrics, voice signal). Integrated music representations combining all feature levels would make it possible to address all of the above functionalities with increased accuracy as well as to visualize and interact with the content in a musically relevant manner. The aim of this project was to investigate, design and validate such representations in the framework of Bayesian data analysis, which provides a rigorous way of combining separate feature models in a modular fashion. Tasks addressed in the project have included the design of a versatile model structure, of a library of feature models and of efficient algorithms for parameter inference and model selection.

<p align="center">**MIMETIC Team**</p>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Contint: iSpace&Time

Participants: Fabrice Lamarche [contact], Julien Pettré, Marc Christie, Carl Jorgensen.

The iSpace&Time project is founded by the ANR and gathers six partners: IGN, Lamea, University of Rennes 1, LICIT (IFSTAR), 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 will end in 2013.

7.1.2. ANR Contint: Chrome

Participants: Julien Pettré [julien.pettre@inria.fr], Kevin Jordao, Orianne Siret.

Chrome is a national project funded by the French Research Agency (ANR). The project is leaded 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 far 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 a crowded scene visualisation thorugh the scope of virtual camera control (Inria Rennes and Grenoble)

7.1.3. ANR TecSan: RePLiCA

Participant: Armel Crétual [contact].

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.

7.1.4. ANR JCJC: Cinecitta

Participants: Marc Christie [marc.christie@irisa.fr], Cunka Sanokho.

Cinecitta is a 3-year young researcher project funded by the French Research Agency (ANR), lead by Marc Christie and that started in October 2012.

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.

7.2. European Initiatives

7.2.1. FP7 STREP Fet-Open Tango

Participants: Julien Pettré [contact], Jonathan Perrinet, Anne-Hélène Olivier.

The goal of the TANGO project is to take some familiar ideas about affective communication one radical step further by developing a framework to represent and model the essential interactive nature of social communication based on non-verbal communication with facial and bodily expression. Indeed, many everyday actions take place in a social and affective context and presuppose that the agents share this context. But current motion synthesis techniques, e.g. in computer graphics, mainly focus on physical factors. The role of other factors, and specifically psychological variables, is not yet well understood.

In 2012, we focused on interactions between real and virtual humans based on Virtual Reality. During body-based interactions between real and virtual actors, we modulate the emotional expression of the virtual actor. We experimentally observe how the real human react to this modulation.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. SIMS

Title: Toward realistic and efficient simulation of highly complex systems

Inria principal investigator: Julien Pettré

International Partner (Institution - Laboratory - Researcher):

University of North Carolina at Chapel Hill (United States) - GAMMA Research Group - Ming LIN

Duration: 2012 - 2014

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.

7.3.2. Inria International Partners

- Collaboration with Zhejiang University, State Key Lab CAD&CG, China. Lead by Franck Multon and Julien Pettré (France) and Qunsheng Peng and Weidong Geng (China), following the EA BIRD (ended in 2010). The collaboration mainly involves the co-supervision of a PhD student.
- Collaboration with Queen's University Belfast, UK. Lead by Benoit Bideau and Richard Kulpa (France) and Cathy Craig (UK).

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Internships

Hui-Yin WU (from May 2012 until Jul 2012)

Subject: Structured story models for Interactive Storytelling

Institution: National Cheng Chi University (Taiwan)

Funding: Inria Internship

Alexandra COVACI (from Jan 2012 until Jul 2012)

Subject: VR accelerator for learning basketball throws

Institution: University of Brasov (Romania)

Funding: Romanian funding for PhD mobility

7.4.2. Visits to International Teams

- Julien Pettré, Explorateur vist, July 2012, Trinity College Dublin (1 month)
- Edouard Auvinet, joint PhD with University of Montreal, Canada (24 months in Canada on 36 months), Cifre funding
- David Wolinski, (Master student), 3 month visit to Chapel Hill, University of North Carolina, USA

MINT Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

MINT is associated to the CPER (2007-2013), and participates to the PIRVI platform (handled by F. Aubert, co-animated by F. Aubert and D. Marchal), which aims at promoting research achieved by participant research teams (6 research teams, among which MINT), as well as encouraging collaborations with regional economical tissue on the knowledge fields covered within the associated research teams. This dissemination activity has been supported with a regional contract 500 Keuros.

8.2. National Initiatives

8.2.1. InSTInCT (ANR ContInt, 2009-2012)

Participants: Géry Casiez [correspondant], Frédéric Giraud, Laurent Grisoni, Nicolas Roussel.

This project focuses on the design, development and evaluation of new simple and efficient touch-based interfaces, with the goal of bringing widespread visibility to new generations of interactive 3D applications.

Partners: Inria [Mint, Iparla], Immersion, Cap Sciences

Web site: http://anr-instinct.cap-sciences.net/

8.2.2. TOUCHIT (13th FUI, 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, Lille 1 Univ., Inria, Orange Labs, CNRS, EASii IC, MENAPIC and ALPHAUI.

Competitive clusters involved: Minalogic, Cap Digital and MAUD.

8.2.3. 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 start 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)

8.3. European Initiatives

8.3.1. Sm(art)^2

Participants: Laurent Grisoni [correspondant], Betty Lemaire-Semail, Frédéric Giraud, Géry Casiez.

We submitted in april 2012 the IP proposal Sm(art)^2 on the call 9, priority 8.2 "ICT for access to cultural ressources". Laurent Grisoni is the scientific coordinator of this proposal. It includes 25 partners, with a global budget of 10 489 Keuros. This proposal ranks 4th on the call among 40 submissions, three proposals are currently in the negociation phasis. Our proposal is currently ranking first on the additionnal list.

Program: FP7-ICT-2011-9

Project acronym: Sm(art)^2

Project title: Smart art: smart tools for personnalised and engaging experiences in cultural heritage

Duration: 48 months

Coordinator: L. Grisoni

Other partners: organisme, labo (pays): Musee du louvres-lens (france), Fraunhoffer (germany), CNRS (france), University Hasselt (belgium), Softkinetic (Belgium), immersion (france), InescID (portugal), France Telecom (france), ...

Abstract: Sm(art)^2 project is based on the extended model of museum visit concept (pre-, during and post experience) combining physical and online museum and addresses visitors as participants rather than passive consumers.The next generation of museum practitioners will have to think through these challenges carefully, drawing the links more closely between the physical and the virtual so that the museum create more engaging and personalizing experiences and reaches more people meaningfully. The Sm(art)^2 project aims to implement an interoperable platform with a reusable set of tools and compatible equipment for advanced innovative digital technologies that are able to demonstrate enhanced engaging and personalized experiences of cultural heritage in museums. Moreover the development of economic models for the efficient and legal exploitation of high quality content and technologies will permit the implementation of new services related to the cultural heritage and the use of new technologies.

8.3.2. SHIVA (InterReg II-Seas, 2010-2014)

Participants: Fabrice Aubert, Géry Casiez, Samuel Degrande, Laurent Grisoni [correspondant], Damien Marchal, Yosra Rekik, Nicolas Roussel.

Program: Interreg-II seas IV-A

Project acronym: SHIVA

Project title: Sculpture for Haelth-care: Interaction and Virtual Art in 3D

Duration: february 2010-march 2014

Coordinator: L. Grisoni

Other partners: organisme, labo (pays) : University Bournemouht (UK), Victoria education center (Poole, UK), Fondation Hopale (Berck/mer, France)

Abstract: The SHIVA project aims to create a tool that combines virtual reality, advanced geometric modelling, gesture analysis and digital fabrication in a framework for the modelling and physical fabrication of 3-dimensional shapes and objects. The system will be simple to use and disseminate, specifically enabling and improving the quality of life for individuals with impairments, by facilitating and promoting social inclusion and interaction. It will use, provided that patient pathologies allows for it, hands-free interaction, based on currently available hardware systems. Some of the most complex aspects of the system will be transparent to the user or patient. This will enable individuals with or without impairments who use the system to be able to interact with and model 3-dimensional objects that can then be physically manufactured. A set of specific interfaces will also be implemented for children with very low physical abilities (two-states interfaces for example).

Web site: http://www.lifl.fr/mint/pmwiki.php?n=SHIVA.Php

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

Masaya Takasaki (from March 2012 until july 2012)

Subject: Design of transparent tactile displays

Institution: Saitama University (Japan)

8.4.2. *Internships*

Yy Yang (from May 2012 until Aug 2012)

Subject: Design and control of large tactile feedback device

Institution: Beihang University of Aeronautics and Astronautics (China)

8.4.3. *Visits to International Teams*

Frédéric Giraud, Sept 2012–Aug 2013, University of Toronto: Invited professor in the Energy System Group hosted by the department of Electrical and Computer Engineering.

MORPHEO Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. 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 analyses 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 Perception team and the Evasion team, the GIPSA-lab Grenoble and the Inria-Lorraine with the Alice team. Website: http://morpho.inrialpes.fr/.

8.1.2. Competitivity Clusters

8.1.2.1. 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 multi-media 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.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. project RE@CT

Program: FP7 ICT STREP

Project acronym: RE@CT

Project title: IMMERSIVE PRODUCTION AND DELIVERY OF INTERACTIVE 3D CONTENT

Duration: 12/2011 - 12/2013

Coordinator: BBC (UK)

Other partners: Fraunhofer HHI (Germany), University of Surrey (UK), Artefacto (France), OMG (UK).

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.

8.3. International Initiatives

8.3.1. Inria Associate Teams

The Morpheo team from the Inria Grenoble Rhône-Alpes is associated with the Matsuyama lab. at the University of Kyoto. Both entities are working on the capture of evolving shapes using multiple videos and the objective of the collaboration is to make progress on the modeling of dynamic events using visual cues with a particular emphasize on human gesture modeling for analysis purposes. To this aim, the collaboration fosters exchanges between researchers in this domain, in particular young researchers, through visits between the two teams.

8.3.2. Inria International Partners

Simon Courtemanche and Lionel Reveret collaborate with Pr. Kry from University McGill (Montreal) on physical simulation of 3D character. Simon Courtemanche has spent 6 months with Pr Kry at McGill University thanks to an explora'doc regional grant. During this stay, motion capture experiments have been done on specific climbing wall equipped with force and torque sensors.

<p align="center" style="color:red">MOSTRARE Project-Team</p>

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Thèse Inria-Région NPdC (2012-2015)*
Participants: David Chatel, Pascal Denis, Marc Tommasi [correspondent].

Denis and Tommasi supervise the PhD thesis of David Chatel on guided clustering. The PhD is funded by INRIA and the "région Nord - Pas de Calais".

8.2. National Initiatives

8.2.1. *ANR*

8.2.1.1. *ANR Lampada (2009-2014)*
Participants: Marc Tommasi [correspondent], Rémi Gilleron, Aurélien Lemay, Fabien Torre, Gemma Garriga.

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/.

8.2.1.2. *ANR Defis Codex (2009-2012)*
Participants: Joachim Niehren [correspondent], Sławek Staworko, Aurélien Lemay, Sophie Tison, Anne-Cécile Caron, Jérôme Champavère.

The Codex project on "Efficiency, Dynamicity and Composition for XML Models, Algorithms, and Systems" and is coordinated by Manolescu (GEMO, Inria Saclay). The other partners of Mostrare there are Geneves (WAM, Inria Grenoble), COLAZZO (LRI, Orsay), Castagna (PPS, Paris 7), and Halfeld (Blois). Public information on Codex can be found on http://codex.saclay.inria.fr/.

8.2.2. *Competitivity Clusters*

8.2.2.1. *FUI Hermes (2012-2015)*

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.

8.3. European Initiatives

8.3.1. *Collaborations in European Programs, except FP7*

MOSTRARE, in collaboration with SEQUEL and Rouen, is part of the Inria Lille - Nord Europe site for the European Network of Excellence in Pattern Analysis, Statistical Modelling and Computational Learning (PASCAL2).

8.3.2. *Collaborations with Major European Organizations*

Publications [29] and [20] are results of collaborations with the University of Wroclaw and the University of Oxford respectively.

8.4. International Initiatives

8.4.1. Inria International Partners

The ongoing cooperation with our previous international partner at NICTA Sydney has lead to a publication at PODS'2012 [26].

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Jan van den Bussche from the University of Hasselt and Werner Nutt from the University of Bolzano visited Bonifati and Niehren for a recent cooperation.

Fabien Suchanek from the Max-Planck Instutite in Saarbrücken visited Bonifati and Niehren and presented is work in the Mostrare seminar.

Yannis Valegrakis from the University of Trento visited Bonifati and presented his work in the Mostrare seminar.

George Fletcher and Toon Calders from the University of Eindhoven visited Bonifati and Staworko and presented their work in the Mostrare seminar.

8.5.1.1. Internships

Carles Creus from the University of Barcelona visited Boiret, Lemay, and Niehren for 4 months for working on tree transducers and compression.

Pavel Labath from the University of Bratislava visited Debarbieux, Sebastian, and Niehren for working on streaming algorithms for XSLT.

8.5.2. Visits to International Teams

Staworko visited Gabriele Pupis and Cristian Riverson at the Univerity of Oxford [28].

Niehren visited Mikael Benedikt, Georg Gottlob, and Marta Kwiatkowska at the University of Oxford.

Staworko visited Piotr Wieczorek at the University of Warclaw [29].

Groz left for postdoc to the database group of Tova Milo at the University of Haifa in Israel.

OAK Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. DW4RDF

This Digiteo DIM LSC (*Logiciels et Systèmes Complexes*) project has started in October 2011. The aim is to design and implement data warehouse-style models and technologies for RDF data. This project supports the PhD scholarship of A. Roatis.

8.2. National Initiatives

8.2.1. ANR

The ANR Codex project (Coordination, dynamicity and efficiency for XML, 2009-2012) has ended; the final review has taken place in Lyon in January 2012. The project was coordinated by Ioana Manolescu; Nicole Bidoit, Dario Colazzo and François Goasdoué also participated.

The ANR DataBridges project (Data integration for digital cities, 2011-2012) has ended; the final review has taken place in Paris in September 2012. The project was coordinated by Ioana Manolescu; François Goasdoué also participated.

The ANR ConnectedCities project (Clouds for digital cities, 2011-2012) has ended; the final review has taken place in Paris in September 2012. Dario Colazzo, François Goasdoué and Ioana Manolescu have participated to the project.

The ANR DataRing project (Massive data management in peer-to-peer, 2009-2012) has ended; the final review has taken place in Lyon in January 2012. Ioana Manolescu has participated to the project.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: KIC EIT ICT Labs

Project acronym: DataBridges

Project title: Data Integration for Digital Cities

Duration: January 2012 - December 2012

Coordinator: Ioana Manolescu

Other partners: Université Paris Sud (France), Technical University of Delft (The Netherlands), DFKI (Germany), Aalto University (Finland), KTH (Sweden), Alcatel-Lucent Bell Labs (France), DataPublica (France)

Abstract: DataBridges work focuses on two main topics: (i) the interoperability, enrichment and personalization of data, e.g. data on the cultural activities within a city, based on user profiles; (ii) efficient techniques for large-scale RDF data management, to be applied (among others) on digital city data.

Program: KIC EIT ICT Labs

Project acronym: Europa

Project title: Efficient cloud-based data management

Duration: January 2012 - December 2012

Coordinator: Volker Markl (Technical Univ. Berlin)

Other partners: Université Paris Sud (France), Technical University of Delft (The Netherlands), DFKI (Germany), Aalto University (Finland), SICS (Sweden)

Abstract: Europa aims at developing techniques for large-scale efficient data management based on a cloud (massively parallel) processing paradigm. Within Europa, we have finalized the Amada platform, and our ongoing work focuses on an algebraic translation framework from XQuery into PACT programs. PACT is the parallel data processing language proposed by the Berlin partner.

8.3.2. Collaborations with Major European Organizations

Partner 1: organisme 1, labo 1 (pays 1)

Sujet 1 (max. 2 lignes)

Partner 2: organisme 2, labo 2 (pays 2)

Sujet 2 (max. 2 lignes)

8.4. International Research Visitors

8.4.1. Visits of International Scientists

We have been visited by:

- Prof. Paolo Atzeni (Università Roma Tré), in June

- Prof. Alin Deutsch (UCSD, USA) in June-July (Digiteo invited scientist)

- Prof. Evi Pitoura (University of Ioannina, Greece), in October

- Prof. Vassilis Christophides (FORTH, Greece) in December

- Prof. Themis Palpanas (University of Trento, Italy) in December

- Prof. Yanlei Diao (U. Massachussets at Amherst, USA) in December

8.4.1.1. Internships

Three students visited the team within the Inria Internship program: Karan Aggaral, Abishek Choudhary and Kuldeep Reddy.

ORPAILLEUR Project-Team

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Participation In International Programs

8.1.1.1. Facepe Inria Project: CM2ID
Participants: Amedeo Napoli [contact person], Chedy Raïssi.

Combining Numerical and Symbolical Methods for the Classification of Multi-valued and Interval Data (CM2ID)

This research project called "Combining Numerical and Symbolical Methods for the Classification of Multi-valued and Interval Data (CM2ID)" involves the Orpailleur Team at Inria NGE, AxIS at Inria Rocquencourt (Yves Lechevallier) and the computer science laboratory of the University of Recife (Prof. Francisco de A.T. de Carvalho). The project aims at developing and comparing classification and clustering algorithms for 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, in order to push the complexity barrier farther in the mining of complex data. Biological data, namely gene expression data, are used for test and evaluation of the combination of algorithms.

The project involves three teams, one Brazilian team and two French Inria teams, including specialists of clustering and classification methods. Thus the complementarity of the teams is ensured and, in addition, close contacts exist with experts of the domain of data for carrying on a complete evaluation of the results obtained by the combined algorithms expected to be designed during the project.

8.1.1.2. Fapemig Inria Project: IKMSDM
Participants: Amedeo Napoli [contact person], Chedy Raïssi.

This Fapemig – Inria research project, called "Incorporating knowledge models into scalable data mining algorithms" involves 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 are interested in the mining of large amount of data and we target two relevant application scenarios where such issue may be observed. The first one is text mining, i.e. extracting knowledge from texts and document categorization. The second application scenario is graph mining, i.e. determining relationship-based patterns and use these relations to perform classification tasks. In both cases, the computational complexity is large either because the high dimensionality of the data or the complexity of the patterns to be mined.

One strategy to ease the execution of such data mining tasks is to use existing knowledge to restrict the search space and to assess the quality of the patterns found. This existing knowledge may be formalized in ontologies but also in other ways whose study is a research issue in this project. Once we are able to build knowledge models, we need to determine how to use such knowledge models, which is a second major research issue in this project. In particular, we want to design and evaluate mechanisms that allow the exploitation of existing knowledge for sake of improving data mining algorithms.

Finally, the computational complexity of the algorithms remains a major issue and we intend to address it through parallel algorithms. Data mining algorithms, in general, represent a challenge for sake of parallelization because they are irregular and intensive in terms of both computing and communication. Accordingly, in a first joint work, we developed a new parallel algorithm to build skycubes based on the Anthill framework developed at UFMG. The paper was presented in a local Brazilian Conference and an extended journal version will appear in a 2012 special issue of the International Journal of Parallel Programming.

8.1.1.3. International collaborations in Mining complex data
Participants: Mehwish Alam, Aleksey Buzmakov, Victor Codocedo, Adrien Coulet, Elias Egho, Ioanna Lykourentzou, Amedeo Napoli [contact person], Chedy Raïssi.

8.1.1.3.1. PICS CNRS CADOE

A first collaboration involves "Université du Québec à Montréal" (UQAM) in Montréal with Prof. Petko Valtchev and Laboratoire LIRMM in Montpellier with Prof. Marianne Huchard. This collaboration is supported by a CNRS PICS project (2011-2014), which is called "Concept Analysis driving Ontology Engineering" and abbreviated in "CAdOE". The research work within this project is aimed at defining and implementing a semi-automatic methodology supporting ontology engineering based on the joint use of Formal Concept Analysis (FCA) and Relational Concept Analysis (RCA). At the moment, some elements of this methodology are existing and were used in text mining [86], [85], but this methodology should be completed and improved, especially regarding the applicability on complex data and the interoperability with knowledge representation modules.

8.1.1.3.2. Collaboration with HSE Moscow

A second collaboration involves Sergei Kusnetsov at Higher School of Economics in Moscow (HSE). Amedeo Napoli visited HSE laboratory in November 2012 (with the support of HSE) and Sergei Kuznetsov visited Inria NGE in August and in December 2012. These visits were the occasion of preparing a publications (submitted for the next year). This shows that the collaboration is on-going and that there is still a substantial research work to be done.

8.1.1.3.3. AGAUR Project: collaboration with UPC Barcelona

This project mainly involves Amedeo Napoli and Jaume Baixeries who is an Associate Professor at UPC Barcelona (Universitat Politècnica de Catalunya). Amedeo Napoli had a stay of roughly two months in December 2011 and May-June 2012. Both researchers have worked, jointly with Mehdi Kaytoue, on the characterization of functional dependencies in many-valued data with FCA and pattern structures. In this work, functional dependencies are directly taken into account and this shows a different but important capability of pattern structures to deal with complex data [30].

8.1.1.3.4. PHC Zenon (Cyprus)

A third collaboration –a PHC Zenon project– exists with Florent Domenach, associated professor at the University of Nicosia in Cyprus. This project is entitled "Knowledge Discovery for Complex Data in Formal and Relational Concept Analysis" (KD4CD) and is aimed at studying and combining different types of classification process in the framework of FCA. These processes can be based on Galois connections but also on the so-called "overhangings", i.e. a kind of generalization of closure systems. Moreover, another interest is put on consensus theory where the objective is to find the better classification of a set of abjects according to a quality measure (this could be applied to ontologies). This year, there were two visits, one from Cyprus to France in October 2012 and the other from France to Cyprus in December 2012. Publications are currently submitted.

8.2. European Initiatives

8.2.1. FP7 Project DOVSA

DOVSA stands for "Development of Virtual Screening Algorithms: Exploring Multiple Ligand Binding Modes Using Spherical Harmonic Consensus Clustering". It is a European project (Type PEOPLE) funded as a "Marie Curie Intra-European Fellowships for Career Development (IEF)" from July 2010 until July 2012. The coordinator of the project is Inria NGE.

This project is aimed at advancing the state of the art in virtual drug screening by developing novel spherical harmonic-based consensus clustering algorithms. The main disease that will be targeted in this project is the acquired immune deficiency syndrome (AIDS), caused by the human immuno-deficiency virus (HIV). However, the approach will be quite generic and will be broadly applicable to many other diseases. The approach will be tested and validated using 40 well-known drug targets from the DUD dataset. It will then be used to screen the French Chimiothèque Nationale library of some 36000 compounds for novel ligands which will bind the CCR5 co-receptor and hence block HIV infection. A small list of candidate entry-blocking compounds will be sent to Barcelona for experimental testing. By extending the SH-based consensus clustering technique, this project will provide a generic tool to help deal with cases where multiple ligands may be associated with multiple pocket sub-sites or which may bind multiple targets, and it will help to find new HIV entry-blocking compounds.

8.3. National Initiatives

8.3.1. ANR

8.3.1.1. ANR Hybride

Participants: Luis Felipe Melo, Amedeo Napoli, Chedy Raïssi, My Thao Tang, Yannick Toussaint [contact person].

The Hybride research project aims at developing new methods and tools for supporting knowledge discovery from textual data by combining methods from Natural Language Processing (NLP) and Knowledge Discovery in Databases (KDD). 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 analyzing textual documents. NLP methods are mainly based on text analysis, and extraction of general and temporal information, while KDD methods are based on pattern mining, e.g. itemsets and sequences, formal concept analysis and variations, and graph mining. In this way, NLP methods applied to some texts locate "textual information" that can be used by KDD methods as constraints for focusing the mining of textual data. By contrast, KDD methods can extract itemsets or sequences that can be used for guiding information extraction from texts and text analysis. This combination of NLP and KDD methods for common objectives, can be viewed as a continuous process, based on a sequence of complex operations from NLP and KDD that reinforces itself through a feedback loop. 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 fundamental aspects of the Hybride project can be understood through the main steps of the knowledge discovery loop with a NLP/KDD perspective : (i) data preparation, (ii) data mining, (iii) interpretation and validation of the results, (iv) knowledge construction. At each step, new methods have to be designed for achieving this interrelated NLP/KDD loop. One of the outcomes of the project should be a system integrating the operations involved within the whole NLP/KDD loop, in the context of Orphanet for text analysis and production of new documentation on rare diseases. The implementation of such a system combines various interrelated aspects, namely natural language processing, knowledge discovery, data mining, and knowledge engineering. This original combination still remains a challenge in computer science.

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 Inria NGE (FCA, knowledge representation, pattern mining, text mining).

8.3.1.2. ANR Kolflow

Participants: Jean Lieber [contact person], Amedeo Napoli, Emmanuel Nauer, Julien Stévenot, My Thao Tang, Yannick Toussaint.

Kolflow (http://kolflow.univ-nantes.fr/) is a 3-years basic research project taking place from February 2011 to July 2014, funded by French National Agency for Research (ANR), program ANR CONTINT. The aim of the project is investigation on man-machine collaboration in continuous knowledge-construction flows. Kolflow partners are GDD (LINA Nantes), Silex (LIRIS Lyon), Orpailleur, Score (LORIA), and Wimmics (Inria Sophia Antipolis).

8.3.1.3. ANR PEPSI: Polynomial Expansions of Protein Structures and Interactions
Participants: Dave Ritchie, Marie-Dominique Devignes, Malika Smaïl-Tabbone.

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 programme 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).

8.3.1.4. ANR 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 knowledge for other public health domains such as epidemiology or health care planning.

The objective of the Trajcan project is to represent and analyze "patient care trajectories" (patient suffering from cancer limited to breast, colon, rectum, and lung cancers) and the associated healthcares. The data are related to patients receiving hospital cares in the "Bourgogne" region and using data from the PMSI. Such an analysis involves various data, e.g. type of cancer, number of visits, type of stays, hospitalization services and therapies used, and demographic factors, i.e. age, gender, place of residence.

One thesis is currently carried out on this subject whose objective is to design a knowledge discovery system working on multidimensional and sequential data for characterizing Patient Care Trajectories (PCT). This thesis combines knowledge discovery and knowledge representation methods for improving the definition of patient care trajectories as temporal objects (sequential data mining). The overall objective id to provide in decision support for improving healthcare in detecting for example typical or exceptional trajectories for planning with precision healthcare for a given population. In order to discover groups of patients showing similar health condition, treatments or journeys through the healthcare system, PCT are modeled as multilevel and multidimensional sequences of itemsets, using external knowledge on hospitals, medical procedures and diagnoses. Accordingly, a new algorithm [42] has been developed to mine sequential patterns.

8.3.2. Other National Inititives and Collaborations

8.3.2.1. PEPS Cryo-CA
Participant: Dave Ritchie [Inria Nancy].

Cryo-CA is a two-year PEPS project (Projets exploratoires pluridisciplinaires) funded by CNRS, involving a collaboration with cryo-electron microscopy experimentalists at the IGBMC (Institut de Génétique et de Biologie Moléculaire et Cellulaire) in Strasbourg. People involved in the project with Dave Ritchie are Sergei Grudinin (Inria Grenoble), Annick Dejaegere (IGBMC, Strasbourg), and Patrick Schultz (IGBMC Strasbourg). The aim of the project is to encourage collaborations between experimentalists and computer scientists in order to advance the state of the art of computational algorithms in structural biology. In November 2012, a workshop funded by this project attracted some 60 participants (http://ccsb2012.loria.fr).

8.3.2.2. 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. We collaborate on the NRPS toolbox [57]. 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.

8.4. Regional Initiatives

8.4.1. *BioProLor*

The Orpailleur team is member of the BioProLor consortium composed of 5 enterprises and 7 academic research teams. This consortium is funded for 2 years (2010-2012) by the AME ("Agence pour la Mobilisation Economique"). The objective of BioProLor is the design of a production filière for compounds with high added-value which originate from plants in Lorraine. The Orpailleur team and the associated start-up "Harmonic Pharma" are in charge of the computational aspects of this research work.

In addition, a CIFRE contract (2009-2012) was set up with Harmonic Pharma for funding the thesis of Emmanuel Bresso on the following subject: "Organisation et exploitation des connaissances sur les réseaux d'interactions biomoléculaires pour l'identification de gènes candidats et la caractérisation de profils d'effets secondaires de principes actifs".

8.4.2. *Contrat Plan État Région" (CPER)*

The links between the Regional Administration and LORIA are materialized through an administrative contract called "Contrat Plan État Région" (CPER) running from 2007 to 2013. The associated scientific program is called "Modélisations, informations et systèmes numériques" (MISN) and includes two tracks in which the Orpailleur team is involved.

- "Modeling Bio-molecules and their Interactions" (MBI).

  This project is coordinated by Marie-Dominique Devignes (http://bioinfo.loria.fr) and the general objective is to study how domain knowledge can be taken into account for improving modeling of biomolecules and their interactions, and how, in sequence, this guides the modeling of biological systems. Six scientific projects are currently under development and involve collaborations with computer scientists, and people working either in biology or chemistry.

  An Inria experimental research platform is currently developed in the framework of MBI (http://bioinfo.loria.fr/Plateforme%20MBI). This platform is aimed at sharing data and computing resources. Its specific features are relative to biomolecules modeling, classification, and to data integration for data mining. In parallel with the bioinformatics platforms in Strasbourg, Reims, Lille, and Nancy-INIST, it constitutes the North-East node of RENABI ("Réseau National des Plateformes Bioinformatiques").

- "Traitement Automatique des Langues et des Connaissances" (TALC).

  TALC stands for "Automatic Processing of Languages and Knowledge". The general objective is to study the relations existing between knowledge discovery, knowledge representation, reasoning, and natural language processing. In this framework, the Orpailleur team plays an important role as the research themes are closely related to those of the team. Actually, research projects are currently under development on knowledge management and decision support in the large involving in particular the Kasimir and the Taaable systems.

<p style="text-align:center">**PAROLE Project-Team**</p>

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. Collaborations in European Programs, except FP7

8.1.1.1. Allegro

> Program: Interreg
>
> Project acronym: Allegro
>
> Project title: Adaptive Language LEarning technology for the Greater Region
>
> Duration: 01/01/2009 to 31/12/2012
>
> Coordinator: Saarland University
>
> Other partners: Supélec Metz and DFK Kaiserslautern
>
> Abstract: Allegro is an Interreg project (in cooperation with the Department of COmputational LInguistics and Phonetics of the Saarland University and Supélec Metz) which started in April 2010. It is intended to develop software for foreign language learning. Our contribution consists of developing tools to help learners to master the prosody of a foreign language, i.e. the prosody of English by French learners, and then prosody of French by German learners. We started by recording (with the project Intonale) and segmentating of a corpus made up of English sentences uttered by French speakers and we analyzed specific problems encountered by French speakers when speaking English.

In the first part of the project we have investigated the phonetic segmentation of non-native speech and analyzed the precision of the phoneme boundaries as boundaries are critical for making duration-based diagnoses in computer assisted learning of the prosody of a foreign language. The experiments have shown that it is critical to include non-native pronunciation variants in the pronunciation lexicon used for forced alignment. However it is better to avoid introducing unusual variants. The best performance was achieved by introducing variants that were seen at least two times on some development non-native data set. A detailed analysis of the boundary precision was also carried out. It was observed that a good precision was achieved for boundaries between some classes of phonemes (as for example between plosives and vowels, fricatives and vowels, and so on). Hence such information should be taken into account either in choosing the words when designing the exercises, and/or in the diagnosis process.

During this year, a special attention was paid to checking the consistency of the recorded speech signal with the expected text. The goal behind that, is to detect speech utterances that do not match with the expected text because of learner's inattention (not pronouncing the expected words) or acquisition problems (truncation of the speech acquisition - the beginning or the end of the sentence is missing - or background noise troubles). In case of mismatch, no further processing is to be carried on; on the opposite, when the speech utterance matches the expected text, prosodic features will be analyzed in details in order to provide a prosodic diagnosis of the pronunciation and the adequate feedback. In order to detect a possible mismatch, several criteria are computed based on the comparison of the phonetic segmentation resulting from a forced alignment with the phonetic segmentation obtained with a phonetic-loop or with a word-loop grammar; these criteria are then combined by a classifier to decide if the speech utterance and the expected text matches or not (cf. section 6.2.3.2).

The automatic phonetic segmentation has been included in the JSNOORI software (cf. section 5.2), as well as other extensions specific to handling exercises for learning the prosody of a foreign language.

The detection of the fundamental frequency (F0) is a key aspect of tools developed for learning prosody of a foreign language. Errors in F0 detection compromise the diagnosis set about the learner's utterance and the modifications of the prosody as well. Since no method alone can be sufficiently robust we thus investigated the combination of three methods, Yin, the method proposed by de Cheveigné et al., an autocorrelation method and a spectral comb method already developed withinh JSnoori. The three methods were redeveloped in Matlab and combined with a neural network approach.

8.1.1.2. Emospeech

Program: Eurostar

Project acronym: Emospeech

Project title: Interagir naturellement et émotiennellement avec des environnements virtuels

Duration: 01/06/2009 to 01/06/2012

Coordinator: Artefacto

Other partners: Acapela Speech group

Abstract: The Emospeech project is an Eurostar project started on 1st June 2010 in cooperation with SMEs Artefacto (France) and Acapela (Belgium). This project comes within the scope of serious games and virtual worlds. If existing solutions reach a satisfying level of 3D physical immersion, they do not provide satisfactory natural language interactions. The objective is thus to add spoken interactions via automatic speech recognition and speech synthesis. EPI Parole and Talaris take part in this project and the contribution of Parole will be about the interaction between the virtual world, automatic speech recognition and the dialogue management.

With respect to the development of a speech recognition solution, a prototype was developed in the framework of a serious game, in collaboration with the Talaris team. The speech-based prototype, which relies on the Sphinx4 speech recognition engine, has made possible the collection of speech material, that has later been transcribed. Specialized lexicons have been developed by combining the task-specific vocabulary extracted from the documentation of the serious game, from the speech data collected using the prototype, and from the text data collected by the Talaris team using a text-based prototype, with the most frequent words selecting in broadcast new corpus. Acoustic models have also been adapted using collected speech material.

Parallel to this work, a client/server speech recognizer system has been developed. The client was developed to run on an iPad terminal. Its role mainly consists in recording the speech signal, sending it to the server, waiting for the speech recognition answer, and finally displaying the speech recognition results. The server, runs on a PC, and performs the actual speech recognition task.

<div align="center">

PERCEPTION Team

</div>

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. FP7 Projects

8.1.1.1. HUMAVIPS

Title: Humanoids with audiovisual skills in populated spaces

Type: COOPERATION (ICT)

Defi: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project (STREP)

Duration: February 2010 - January 2013

Coordinator: Inria (France)

Others partners: CTU Prague (Czech Republic), University of Bielefeld (Germany), IDIAP (Switzerland), Aldebaran Robotics (France)

See also: http://humavips.inrialpes.fr

Abstract: Humanoids expected to collaborate with people should be able to interact with them in the most natural way. This involves significant perceptual, communication, and motor processes, operating in a coordinated fashion. Consider a social gathering scenario where a humanoid is expected to possess certain social skills. It should be able to explore a populated space, to localize people and to determine their status, to decide to join one or two persons, to synthetize appropriate behavior, and to engage in dialog with them. Humans appear to solve these tasks routinely by integrating the often complementary information provided by multi sensory data processing, from low-level 3D object positioning to high-level gesture recognition and dialog handling. Understanding the world from unrestricted s

8.2. International Research Visitors

8.2.1. Visits of International Scientists

8.2.1.1. Internships

Charlotte CLARK (from Apr 2012 until Jul 2012)

Subject: Piecewise Planar Reconstruction of a Scene from Depth Data

Institution: Massachusetts Institute of Technology (United States)

Siva KUMAR (from May 2012 until Jul 2012)

Subject: Visual Matching Using Kernel Canonical Correlation Analysis

Institution: IIT Delhi (India)

Ravi Kant MITTAL (from May 2012 until Jul 2012)

Subject: Finding Audio Visual Objects (AVO) with the Kinect

Institution: IIT Delhi (India)

Christopher STOCK (from May 2012 until Aug 2012)

Subject: Detection of keypoints on 2D manifolds

Institution: Harvard University (United States)

<p style="text-align: center">**POTIOC Team**</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

- Potioc has strong relationships with Cap Sciences http://www.cap-sciences.net/
- Potioc has started a collaboration with La CUB (Communauté Urbaine de Bordeaux). Joint Master thesis on "visualization of strategic data in 3D cities"

7.2. National Initiatives

ANR Project Instinct:

duration: 2009-2012

partners: MINT (Inria Lille), Immersion, Cap Sciences

website: http://anr-instinct.cap-sciences.net/

FUI SIMCA 2000:

duration: 2011-2013

partners: Oktal, ENAC (Ecole Nationale de l'Aviation Civile), Toulouse-Blagnac airport, Air France, CGx AERO in SYS

website: https://team.inria.fr/potioc/fr/collaborative-projects/simca/

PIA ville numérique "Villes transparentes":

duration: 2012-2014

partners: Pages Jaunes/Mappy, Vectuel/Virtuelcity

Inria ADT OpenViBE-NT:

duration: 2012-2014

partners: Inria teams Hybrid, Neurosys and Athena

website: http://openvibe.inria.fr

7.3. European Initiatives

LIRA Stress and Relaxation project:

Program: Inria - Philips - Fraunhofer partnership

Project acronym: LIRA

Project title: LIfe-style Research Association, Lifestyle Management: Stress and Relaxation

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

7.4. International Initiatives

7.4.1. International Partners

- Institute for Infocomm Research (I2R), Singapore - Wadsworth Center, Albany, USA and Kansas University, USA.
  Topic: Analysis of speech production and perception from ECoG signals
- BIG (Bristol Interaction Group), University of Bristol, UK.
  Topic: 3D User Interfaces and Musical Performance.

7.5. International Research Visitors

7.5.1. Visits to International Teams

- A. Cohé visited the BIG (Bristol Interaction and Graphics), in Bristol, UK, during 1 month
- F. Berthaut visited the Center for Computer Research on Music and Acoustics (CCRMA) of Stanford University, USA, during 2 months
- J. Laviole did a 3 month intership at Microsoft Research Redmond, USA

<p style="text-align:center; color:red;">**PRIMA Project-Team**</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. *EquipEx AmiQual4Home - Ambient Intelligence for Quality of Life*

Participants: Stan Borkowski, Sabine Coquillart, Joelle Coutaz, James Crowley [correspondant], Alexandre Demeure, Thierry Fraichard, Amaury Nègre, Patrick Reignier, Dominique Vaufreydaz.

Ambient Intelligence, Equipment d'Excellence, Investissement d'Avenir

The AmiQual 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 to be 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 core of the AmiQual 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 AmiQual 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 AmiQual 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 AmiQual 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 nased 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 AmiQual 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) [35] as well as the SNRI (Stratégie Nationale de la Recherche et de l'Innovation).

8.1.2. INRETS Intelligent Urban Spaces Platform

Participants: Claudine Combe, James Crowley [correspondant], Lukas Rummelhard.

Visual detection and tracking of pedestrians, Intelligent Urban Space

The project ANR-07-TSFA-009-01 CIPEBUS ("Carrefour Intelligent - Pôle d'Echange - Bus) has been proposed by INRETS-IFSTTAR, in collaboration with Inria, Citilog, Fareco, and the city of Versaille. The Objective of the CIPEBUS project is to develop an experimental platform for observing activity in a network of urban streets in order to experiment with techniques for optimizing circulation by context aware control of traffic lights.

Within CipeBus, Inria jas developed a real time multi-camera computer vision system to detect and track people using a network of surveillance cameras. The CipeBus combines real time pedestrian detection with 2D and 3D Bayesian tracking to record the current position and trajectory of pedestrians in an urban environment under natural view conditions. The system extends the sliding window approach to use a half-octave Gaussian Pyramid to explore hypotheses of pedestrians at different positions and scales. A cascade classifier is used to determine the probability that a pedestrian can be found at a particular position and scale. Detected pedestrians are then tracked using a particle filter.

The resulting software system has been installed and tested at the INRETS CipeBus platform and is currently used for experiments in controlling the traffic lights to optimize the flow of pedertrians and public transportation while minimizing the delay imposed on private automobiles.

8.1.3. FUI 3Dlive

Participants: Frédéric Devernay, Sylvain Duchêne, Matthieu Volat.

3Dlive (http://3dlive-project.com) is a collaborative project, supported by French Ministry of Industry, and involving 3 industry and research clusters: Images & Reseaux (Brittany and Pays-de-la-Loire regions), Imaginove (Rhône-Alpes region), Cap Digital (Paris region). The objectives of this project are to create expertise in France for the live filming and transmission of 3D stereo contents, and to help French industry and universities to be major global 3D actors. 3Dlive won the *Loading the Future* trophy from the Images & Reseaux cluster in 2011. The consortium consists of:

> R&D/industry:
>
>> Orange Labs (project leader), Technicolor (3D R&D), Thomson Video Networks (encoders) and Thales Angenieux (optics).
>
> Small companies:
>
>> AMP (TV shooting) and Binocle (specific 3D HW & SW manufacturer).
>
> University labs:
>
>> Inria/PRIMA and Institut Telecom.

The role of PRIMA within this project is to develop new algorithms for real-time processing of stereoscopic video streams. This includes:

> stereoscopic video rectification and geometric adjustments.
>
> view interpolation, and extraction of stereoscopic metadata for the adaptation of the stereoscopic content to the projection screen.

These algorithms rely on view- and scale- invariant feature extraction, feature matching, dense stereoscopic reconstruction, and computer graphics techniques (matting, and accelerated processing and rendering using the GPU).

8.1.4. FUI PRAMAD

Participants: Wafa Benkaouar, Claudine Combe, 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:

>>Wizarbox (game designer) 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.

8.1.5. *Large-scale initiative action PAL*

Participants: Rémi Barraquand, Thierry Fraichard, Patrick Reignier, Dominique Vaufreydaz.

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:

>Coprin, Demar, E-Motion, Flowers, Lagadic, Lagadic-Sophia, Maia, Phoenix, Prima, Pulsar, Reves and Trio.

The role of PRIMA within this project is to develop new algoritms mainly along two research axes:

>assessing frailty degree of the elderly,

>social interaction.

8.2. European Initiatives

8.2.1. *Collaborations in European Programs*

>Program: CATRENE - Communication and digital lifestyle

>Project acronym: AppsGate

>Project title: Applications Gateway

>Duration: September 2012 to March 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

>Abstract:

AppsGate will develop 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. The AppsGate project is putting together chip suppliers, consumer electronics OEMs and service providers to demonstrate an advanced Set Top Box that provides a home gateway for applications in the areas of entertainment, home automation, energy management and healthcare.

This project aims at developing 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. This device has evolved beyond its historical role as a simple black box sitting on top of a large TV set into a device that supports a variety of functions, notably interactive television applications. Another interesting development is the concept of residential gateway, which is a complex device capable of delivering multiple services to the home, including video, voice and data.

Both the set-top box and the residential gateway can be combined into a unique platform to deliver the same rich experience to multiple users in different rooms. When various devices are connected to this platform and multiple applications are seamlessly integrated together, the concept of application gateway or AppsGate is born. This new platform, which offers the prospect of unprecedented business opportunities, is the focus of the project.

8.2.2. *Collaborations with EIT KIC ICTlabs*

ICTLabs is the KIC for ICT (http://eit.ictlabs.eu/ict-labs/) ICTlabs is set up as a network of 6 "co-location" centers in Helsinki, Stockholm, Berlin, Paris, Eindhoven and Trento. The Paris node is run by Inria with partners Alcatel Lucent, Orange, University Paris Sud Institut Telecom.

PRIMA actively participates in the thematic actions: Smart Spaces, Smart Energy Systems and Health and Well Being.

ICTLabs Action Line Smart Spaces (ASSP) Activity 11547 : PI3 - Pervasive Information interfaces and interaction.

With activity PI3 we have constructed and released an "Attention Recognition Module"

ICTLabs Action Line Smart Spaces (ASSP) Activity 12201 : TIK - The Interaction Toolkit

PRIMA coordinates the Activity TIK. This activity will deliver a standard library of tools for human computer interaction for smart Spaces.

ICTLabs Action Line TSES - Smart Energy Systems Activity 12201 : Activity 11831 Open SES Experience Labs

PRIMA has constructed a testbed that integrates information from multiple environmental sensor to detect and track people and recognize their activity.

ICTLabs Action Line THWB Health and Wellbeing, IActivity 12100 "Affective Computing".

PRIMA has constructed a embedded software system for mobile computing that can detect and track faces, and measure the physiological parameters of Valence, Arousal and Dominance in order to recognize and stimulate human emotion.

8.3. International Initiatives

8.3.1. *Inria International Partners*

Starting with the PERSPOS project (BQR Grenoble INP 2008-2009) PRIMA has a long standing collaboration the MICA center (UMI 2954 CNRS). Our current goal is to develop the concept of "large-scale" perceptive space that is an intelligent environment which will be deployed on a large surface containing several buildings (as a university campus for example). The user is assumed to wear one or many mobile intelligent wireless devices (telephone, Smartphone, PDA, notebook). Using these devices, one can use many different applications (read emails, browse the Internet, file exchange, etc.). By combining the concepts of large-scale perceptive environments and mobile computing, we can create intelligent spaces to propose services adapted to individuals and their activities. Our collaboration is focussing the user location within such a smart space.

Tracking people in smart environments remains a challenging fundamental problem. Whether it is at the scale of a campus, of a building or more simply of a room, we can dynamicaly combine several localization levels (and several technologies) to allow a more accurate and reliable user localization system. This collaboration was concrete with the Ph.D. thesis from Han Yue (started in November 2008). This thesis was co-supervided between Grenoble INP and Hanoi Polytechnical Institute.

8.4. International Research Visitors

8.4.1. Internships

Marco Polo Cruz Ramos (from Dec. 2011 until May 2012)

Subject: Design of Interaction Systems for Mobile Robots Collaboration.

Institution: Technológico de Monterrey (Mexico).

Thomas FISCHER (from Feb. 2012 until Dec 2012).

Subject: Design of a Robot Companion.

Institution: University of Buenos Aires (Argentina).

<p style="text-align:center; color:red;">**REVES Project-Team**</p>

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR ALTA

Participants: Emmanuelle Chapoulie, Adrien David, 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 solutions that can be used in Virtual Reality solutions, for example in the context of the immersive space.

7.1.2. ANR DRAO

Participants: Emmanuel Iarussi, Adrien Bousseau.

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 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.

7.1.3. ADT Interact3D

Participants: Adrien David, George Drettakis.

This ADT involves half time software development for ARC NIEVE, and the other half general support to the new Immersive Space Gouraud-Phong in Sophia-Antipolis (supervised by Jean-Christophe Lombardo of the DREAM service). The main contribution was the complete rewrite of our VR application environment with the development of the Imerse software. This platform will allow first experiments, and the development of a generic Virtual Reality framework addressing neuroscience/psychology applications. This generic platform is based on osgVR which aims at a high-quality context abstraction to be usable in several domains, as well as distributed rendering capacities. These improvements, deployable for a variety of applications to come, are tightly coupled with the current ARC NIEVE, thus contributing to its implementation. Future prospects for the ADT Interact 3D include developing novel multimodal interaction techniques for example for gesture-based interaction etc.

7.1.4. ARC NIEVE: Navigation and Interfaces in Emotional Virtual Environments

Participants: Peter Vangorp, Adrien David, George Drettakis, Gaurav Chaurasia, Emmanuelle Chapoulie.

The goal of this joint research project is to develop and evaluate improved interfaces for navigation in immersive virtual environments (VEs) such as the 4-wall stereoscopic ISpace system in the Immersive Space Gouraud-Phong.

There is evidence of significant overlap in brain structures related to spatial memory and orientation and those related to emotion. We examine the influence of high-quality 3D visual and auditory stimuli on the emotions evoked by the virtual environment. Our study focuses on the phobia of dogs as a way to modulate emotion in audiovisual VEs (see Figure 13).

Navigation in VEs involves the use of different views, i.e., egocentric ("first person") and allocentric ("bird's eye") views during navigation tasks. We study appropriate visual representations for each view (for example, the level of realism ranging from abstract map-like rendering for top-down views to photorealistic rendering for first-person views), and appropriate transitions between the different views.

We develop an appropriate methodology to evaluate such navigation interfaces in stressful environments, based on the insights gained by the emotion modulation study in phobic settings. This novel methodology can be seen as a "stress-test" for navigation interfaces: if the navigation interfaces developed are successful even in stressful setups, they will definitely be successful under "normal conditions".

ARC NIEVE has resulted in several publications this year: [21], [13].

Figure 13. A person immersed in a virtual environment where the behaviors of several dogs will evoke different levels of anxiety.

This is a joint research project with Isabelle Viaud-Delmon (IRCAM, CNRS), Anatole Lécuyer and Maud Marchal (VR4I project team, IRISA-INSA/Inria Rennes - Bretagne Atlantique), and Jean-Christophe Lombardo (DREAM / Inria Sophia Antipolis). Interact3D (Section 7.1.3) is associated with this ARC.

7.1.5. National French Bilateral Collaboration

We have ongoing collaborations with Maud Marchal and Anatole Lécuyer (VR4I project team, IRISA-INSA/Inria Rennes - Bretagne Atlantique) [13], [17], and Bruno Galerne (ENST/ENS Cachan) [15].

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. 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/

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.

For the first year period (October 2011 - September 2012), the consortium focused its effort on the following main actions:

- Designing scenarios for different situations, 3 main scenarios were designed:

  1. DogPhobia scenario (for phobias),

  2. Kitchen scenario (for Alzheimer patients),

  3. MeMoVE (for memory complaints).

- Ethical approvals submission for the different scenarios.

- Conducting different experiments in the context of these different scenarios, especially DogPhobia scenario.

- Development and adaptation of different technologies in order to implement the scenarios:

  – Image based rendering (IBR) for virtual realistic environment modeling,

  – Emotive avatars,

  – Crowds simulation,

  – Realistic human skin rendering.

- Development of different technical tool:

  – Virtual environment for mobile device serious game (Kitchen scenario),

  – Porting the IBR to immersive space for the MeMoVE scenario,

  – Adapting the partner's technologies to the different platforms within the consortium.

The first year review of the VERVE project was hold on October 2nd, 2012, and the project were judged good and follows the defined plan.

7.3. International Initiatives

7.3.1. *Inria Associate Teams*

7.3.1.1. CRISP

> Title: Creating and Rendering Images based on the Study of Perception
>
> Inria principal investigator: Adrien Bousseau
>
> International Partner (Institution - Laboratory - Researcher):
>
> > University of California Berkeley (United States) - Electrical Engineering and Computer Science - Maneesh Agrawala
>
> Duration: 2011 - 2013
>
> See also: http://www-sop.inria.fr/reves/crisp/

The goal of the CRISP associate team between REVES and University of California (UC) Berkeley is to investigate novel ways to create, render and interact with images based on the study of human Perception. This novel and emerging area has been the focus of ongoing collaborations between researchers from the REVES research group at Inria (Adrien Bousseau, George Drettakis) and researchers in Computer Science and Vision Science at UC Berkeley (Maneesh Agrawala, Ravi Ramamoorthi, Martin S. Banks (Human Vision Science)). All of the researchers involved in CRISP share a common interest in creating and manipulating effective synthetic imagery. To achieve this goal we will focus on understanding how people perceive complex material, lighting and shape, on developing new rendering algorithms based on this understanding, and on building interactive tools that enable users to efficiently specify the kind of image they wish to create. More specifically, we will explore the following research directions :

Perception: Images are generated from the interaction of lighting, material, and geometry. We will evaluate how people perceive material, lighting, and geometry in realistic images such as photographs, and non realistic images such as drawings and paintings. This knowledge of human perception is essential for developing efficient rendering algorithms and interaction tools that focus on the most important perceptual features of an image. We have started several projects on the perception of materials in realistic and non realistic images, with promising results.

Rendering: We will develop rendering algorithms that generate images that are plausible with respect to the user's intent and allocate resources on the visual effects that best contribute to perception. Current projects on rendering include work on enhancing material variations in realistic and non realistic rendering.

Interaction: We will facilitate the creation of material, lighting, and geometric effects in synthetic images by developing novel user interfaces for novice and professional users. We are currently working on interfaces to draw object appearance and to relight photographs.

Our contributions have the potential to benefit different applications of image creation such as illustration (archeology, architecture, education), entertainment (video games, movies) and design (sketching, photograph editing). This research naturally falls in Inria's strategic objective of interacting with real and virtual worlds.

7.4. Bilateral Collaborations

7.4.1. *France-USA*

Participants: Gaurav Chaurasia, Pierre-Yves Laffont, Adrien Bousseau, George Drettakis, Christian Richardt, Jorge Lopez-Moreno.

We have an ongoing collaboration with Yale University (Holly Rushmeier and Julie Dorsey), on weathering, resulting in the publication [17]. We continue this collaboration on stone aging.

We have an ongoing collaboration with Adobe Research (Sylvain Paris) and MIT (Fredo Durand) on intrinsic images for mutliple lighting conditions, resulting in the publication [19].

We also collaborate with M. Banks, R. Ramamoorthi and M. Agrawala from the University of California, Berkeley in the context of our CRISP associate team, resulting in the publications [14], [12]. Gaurav Chaurasia spent 6 weeks this summer at UC Berkeley in the context of this collaboration. Adrien Bousseau and George Drettakis also visited UC Berkeley for 3 days in August.

7.4.2. France-Switzerland

Participants: Gaurav Chaurasia, Sylvain Duchêne, George Drettakis.

We collaborate with O. Sorkine at ETH Zurich on image-based rendering, which resulted in a submission to ACM TOG.

7.4.3. France-Germany

Participant: George Drettakis.

We collaborate with the Max-Planck-Institut, Germany, where P. Vangorp is now a PostDoc. We collaborate on perception techniques for rendering and on interactions for virtual environments. This resulted in the following publication [13].

7.4.4. France-Spain

Participants: George Drettakis, Adrien Bousseau.

We collaborate with C. Bosch who is now at the University of Girona (Spain), on weathering.

7.4.5. France-Italy

Participant: Adrien Bousseau.

We collaborate with F. Pellacini from Sapienza Università di Roma on lightfield editing.

7.4.6. 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. This collaboration resulted in the publication [20] and in the 3 weeks visit of Xu Baoxuan (PhD student at U. British Columbia).

7.4.7. France-Belgium

Participant: George Drettakis.

We have continued the collaboration with A. Lagae from the Catholic University of Leuven, resulting in the publication [15].

7.5. International Research Visitors

7.5.1. Visits of International Scientists

We hosted several researchers this year:
- Maneesh Agrawala (Univ. of Berkeley), in May-June
- Brian Curless (Univ. of Washington), in October
- Eugene Fiume (Univ. of Toronto), in June
- Michael Gleicher(Univ. of Wisconsin), in June
- Diego Guttierez (Univ. of Zaragoza), in October
- Ares Lagae, (KU Leuven), in November
- Hendrik Lensch (Univ. of Ulm), in October
- Pierre Poulin (Univ. of Montreal), in May
- Alla Sheffer (Univ. of British Columbia), in May-June
- Karan Singh (Univ. of Toronto), in May-June
- Kartic Subr (Univ. College London), in March
- Peter Vangorp (Univ. Giessen), in September and November
- Romain Vergne (Univ. of Giessen), in March
- Brian Xu (Univ. of British Columbia), in September-October

7.5.1.1. Internships

Emmanuel IARUSSI (from Mar 2012 until Aug 2012), Inria Internship Program

Subject: Computer-assisted drawing lessons

Institution: National University of the Center of the Buenos Aires Province (Argentina)

Felicitas Hetzelt (from Mar 2012 until Aug 2012)

Subject: Computer-assisted drawing lessons

Institution: University of Erlangen (Germany)

<p style="text-align:center; color:red">**SEMAGRAMME Team**</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. SLAM: Schizophrenia and Language, Analysis and Modeling

Participants: Maxime Amblard [coordinator], Sylvain Pogodalla.

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.

Maxime Amblard is coordinating the pre-project which ended at the end of 2012. A new application on this topic is send for a 2013-2015 project to the Maison des Sciences de l'Homme de Lorraine (MSH–Lorraine, USR 3261), with the same leader. 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. 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).

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[3] 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 define 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 it 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.

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 formulation have been proposed. In particular, a formulation based on continuation semantics allow them to be expressed quite naturally in the ACG architecture. Dynamic effects of discourse, in particular those related to anaphora resultion or rhetoretical 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 [4].

---

[3]http://semagramme.loria.fr/doku.php?id=projects:polymnie

It has been shown that the discourse structure of texts play a key role in their understanding. This is the case not only for both for human readers but also for automatic processing systems. For instance, it can enhance text transformation systems such as the ones performing automatic summarization.

POLYMNIEfocuses on studying and implementing the modeling 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 functionnalities 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 Initiatives

7.3.1. Participation In International Programs

7.3.1.1. PHC: Partenariats Hubert Curien

The team collaborates with the Utrecht Institues of Linguistics OTS (Utrecht University) in the framework of a Van Gogh action (Hubert Curien program). This collaborations is concerned with conservative extensions of Montague semantics.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Prof. A. Hadj-Salah (Académie Algérienne de la Langue Arabe) visited Philippe de Groote (January, 10).
- Chris Blom and Yoad Winter (University of Utrecht) visited Philippe de Groote (March, 28-30).

7.4.2. Visits to International Teams

- Philippe de Groote and Sylvain Pogodalla visited Prof. Makoto Kanazawa at the National Institute of Informatics (NII, Tokyo, Japan).
- Philippe de Groote was invited speaker at the workshop 'Properties and Optionality in Syntax and Semantics', Utrecht, February, 13-14.
- Philippe de Groote visited Prof. Yoad Winter at the Utrecht Institute of Linguistics (Utrecht University, the Netherlands), May 23-25.

---

[4]http://www.loria.fr/~pogodall/cauld/

<p align="center" style="color:red">SIROCCO Project-Team</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR-PERSEE

Participants: Josselin Gautier, Christine Guillemot, Laurent Guillo, Olivier Le Meur, Fabien Racapé.

- Title : Perceptual coding for 2D and 3D images.
- Research axis : § 6.2.2 , 6.1.1 .
- Partners : IRCCYN-Polytech Nantes, INSA-Rennes, Telecom Paris Tech.
- Funding : ANR.
- Period : 10/2009-08/2013

The objective of the project is to develop perceptually driven coding solutions for mono-view and multi-view video. The SIROCCO project-team contributes on different problems relevant for mono-view and multi-view video coding: visual attention modeling (see Section 6.1.1), on texture synthesis and inpainting for both 2D and 3D content. Several methods for 2D image inpainting and 2D/3D inpainting to handle disocclusions in virtual view synthesis have been developed (see Sections 6.2.2 . A computational model for 3D content has also been studied (see Section 6.1.1)

8.1.2. ANR-ARSSO

Participants: Mounira Ebdelli, Christine Guillemot, Ronan Le Boulch, Olivier Le Meur, Aline Roumy.

- Title : Adaptable, Robust, Streaming SOlutions.
- Partners : Inria/Planète, TESA-ISAE, CEA-LETI/LNCA, ALCATEL LUCENT BELL LABS, THALES Communications, EUTELSAT SA.
- Funding : ANR.
- Period : 06/2010-11/2013

The ARSSO project focuses on multimedia content communication systems, characterized by more or less strict real-time communication constraints, within highly heterogeneous networks, and toward terminals potentially heterogeneous too. It follows that the transmission quality can largely differ in time and space. The solutions considered by the ARSSO project must therefore integrate robustness and dynamic adaptation mechanisms to cope with these features. The overall goal is to provide new algorithms, develop new streaming solutions and study their performances. The SIROCCO project-team contributes on the development of loss concealment methods based on video inpainting. A first approach using examplar-based inpainting with neighbor embedding techniques has been developed. This method is currently being improved along three directions: 1/- he use of new distance metrics for finding the best matching patches; 2/- using a multi-resolution approach to both reduce the computational time and improve the robustness of the method; 3/- using mosaicking techniques for enhancing steps of stationary background and spatial inpainting. These solutions are studied in the context of a video compression and transmission chain using the emerging HEVC coding standard.

8.2. European Initiatives

8.2.1. 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 Beijing University.
- Funding : EC-FP7 MC-IIF International Incoming Fellowships (IIF).
- Period : 08/2012-07/2014

The proposal SHIVPRO (Saliency-aware High-resolution Video Processing) submitted to the call FP7-PEOPLE-2011-IIF (funding scheme: MC-IIF International Incoming Fellowships (IIF)) has been accepted. Dr. Z. Liu, from Beijing University, has joined the team since August 2012 for two years. The objective of this project is 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.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Mattei Mancas, researcher from the Univ. of Mons, Belgium has visited the team for two months (June-July 2012).

Dr. Zhi Liu, from Beijing University, is visiting the team since August 2012 for two years. His stay is funded by the FP7-PEOPLE-2011-IIF program. The funding scheme is the MC-IIF International Incoming Fellowships (IIF).

SMIS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR DEMOTIS (Feb. 2009 - Feb. 2012)

Partners: SopinSpace (coordinator), Inria (SMIS, SECRET), CECOGI
SMIS funding: 85k€
http://www.demotis.org/
The design and implementation of large-scale infrastructure for sensitive and critical data (e.g., electronic health records) have to face a tangle of legal provisions, technical standards, and societal concerns and expectations. DEMOTIS project aims to understand how the intrication between legal and technical domains constrains the design of such data infrastructures. DEMOTIS consists of two interdependent facets: legal (health law, privacy law, intellectual property law) and computer science (database security, cryptographic techniques). Combining expertise of researchers in Law and computer scientists should help to better assess whether law statements can be actually put in practice, to characterize the related technological challenges when mismatches are detected and, when possible, to suggest preliminary solutions.

8.1.2. 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.

8.1.3. ARC CAPPRIS (Dec. 2011 - Dec. 2015)

Inria Large Scale Initiative
Inria Partners: PRIVATICS (coordinator), SMIS, PLANETE, CIDRe, COMETE
External partners: Univ. of Namur, Eurecom, LAAS
Funding: not associated to individual project-teams
An ARC 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 will be 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 signicance of the research results, they will be confronted to three classes of case studies CAPPRIS partners are involved in, namely Online Social Networks, Location Based Services and Electronic Health Record Systems.

8.2. European Initiatives

8.2.1. 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

Coordinator: Philippe Bonnet (ITU of Copenhagen)

Other 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 [6], and (ii) a database system optimized for bimodal flash devices. The project funding will be managed by the IT University of Copenhagen and will cover the expenses for two co-supervised PhD students (including regular visits to and from Denmark).

8.2.2. Collaborations with Major European Organizations

The SMIS members have developed tight european cooperations with the following persons/teams:

- P. Bonnet (Associate Professor at the University of Copenhagen, Denmark): collaboration on Flash-based data management for high-end servers. The study of flash devices started during a short sabbatical of Luc Bouganim (from April to August 2008) in Copenhagen. The uFLIP study has been conducted in close cooperation with Philippe Bonnet from IT University of Copenhagen and Björn Þór Jónsson from Reykjavík University. The cooperation with Copenhagen is very active and led to new studies on flash devices and on the Trusted Cell architecture Two PhD students are currently co-supervised by Luc Bouganim and Philippe Bonnet. Philippe Bonnet got a Marie-Curie IEF grant and will visit SMIS for one year in 2013-2014.

- 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 Initiatives

8.3.1. Inria International Partners

The SMIS members have developed tight international cooperations with the following persons/teams:

- Dennis Shasha (Professor at the University of New-York, USA): collaboration on tamper-resistant data management issues. Dennis Shasha has done a one year sabbatical stay in SMIS (July 2006 to June 2007).

- I. Ray and I.Ray (Professors at Colorado State University, USA): collaboration on data privacy and usage control (Indrajit and Indrakshi Ray have visited SMIS from September 2009 up to February 2010).

- Cristian Borcea (Associate Professor at New Jersey Institute of Technology, USA): collaboration on spatio-temporal data management issues.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

- Quoc-Cong To (Vietnam): Internship on distributed query processing in the PDS architecture. September 2012 - February 2013.
- Athanasia Katsouraki (Greece): Internship on usage control models. January-September 2012.
- Danae Boutara (Greece): Internship on Minimal exposure. April-August 2012.

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Collaborations

- Stars has a strong collaboration with the CobTek team (CHU Nice).
- G. Charpiat works with Yuliya Tarabalka (AYIN team) and with Bjoern Menze (Computer Vision Laboratory at ETH Zurich, Medical Vision group of CSAIL at MIT, and collaborator of Asclepios team) on the topic of shape growth/shrinkage enforcement for the segmentation of time series.
- G. Charpiat worked with former members from the ARIANA team: Ahmed Gamal Eldin (now LEAR team), Xavier Descombes (MORPHEME team) and Josiane Zerubia (AYIN team) on the topic of multiple object detection.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. VIDEO-ID

Program: ANR Sécurité

Project acronym: VIDEO-ID

Project title: VideoSurveillance and Biometrics

Duration: February 2008-February 2012

Coordinator: Thales Security Systems and Solutions S.A.S

Other partners: Inria; EURECOM; TELECOM and Management Sud Paris; CREDOF ; RATP

See also: http://www-sop.inria.fr/pulsar/projects/videoid/

Abstract: Using video surveillance, the VIDEO-ID project aims at achieving real time human activity detection including the prediction of suspect or abnormal activities. This project also aims at performing identification using face and iris recognition. Thanks to such identification, a detected person will be tracked throughout a network of distant cameras, allowing to draw a person's route and his destination. Without being systematic, a logic set of identification procedures is established: event and abnormal behaviour situation and people face recognition.

7.2.1.2. SWEET-HOME

Program: ANR Tecsan

Project acronym: SWEET-HOME

Project title: Monitoring Alzheimer Patients at Nice Hospital

Duration: November 2009-November 2012

Coordinator: CHU Nice Hospiteal (FR)

Other partners: Inria (FR); LCS (FR); CNRS unit - UMI 2954, MICA Center in Hanoi (VN); SMILE Lab , National Cheng Kung University (TW); National Cheng Kung University Hospital (TW).

Abstract: SWEET-HOME project aims at building an innovative framework for modeling activities of daily living (ADLs) at home. These activities can help assessing elderly disease (e.g. Alzheimer, depression, apathy) evolution or detecting pre-cursors such as unbalanced walking, speed, walked distance, psychomotor slowness, frequent sighing and frowning, social withdrawal with a result of increasing indoor hours.

7.2.2. FUI

7.2.2.1. QUASPER

Program: FUI

Project acronym: QUASPER

Project title: QUAlification et certification des Systèmes de PERception

Duration: June 2010 - May 2012

Coordinator: THALES ThereSIS

Other partners: AFNOR; AKKA; DURAN; INRETS; Sagem Securité; ST Microelectronics; Thales RT; Valeo Vision SAS; CEA; CITILOG; Institut d'Optique; CIVITEC; SOPEMEA; ERTE; HGH.

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

Abstract: QUASPER project gathers 3 objectives to serve companies and laboratories: (1) to encourage R&D and the design of new perception systems; (2) to develop and support the definition of European standards to evaluate the functional results of perception systems; (3) to support the qualification and certification of sensors, software and integrated perception systems. Target domains are Security, Transportation and Automotive.

7.2.3. Investment of future

7.2.3.1. 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, Inria(Stars), CMRR (CHU Nice) and CobTek team.

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.

7.2.4. Large Scale Inria Initiative

7.2.4.1. PAL

Program: Inria

Project acronym: PAL

Project title: Personally Assisted Living

Duration: 2010 -2014

Coordinator: COPRIN team

Other partners: AROBAS, DEMAR, E-MOTION, PULSAR, 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.

7.2.5. Collaborations

- G. Charpiat works with Gabriel Peyré, François-Xavier Vialard and Giacomo Nardi (CNRS, CERE-MADE, Université Paris-Dauphine) on the topic of piecewise rigid movements.

- G. Charpiat works with Yann Ollivier (Computer Science department in Paris-Sud University (Orsay)), on the topic of image compression.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. PANORAMA

Title: PANORAMA

Duration: April 2012 - March 2015

Coordinator: Philips Healthcare (Netherlands)

Other partners :Medisys (France), Grass Valley (Netherlands), Bosch Security Systems (Netherlands), STMicroelectronics (France), Thales Angenieux (France), CapnaDST (UK), CMOSIS (Belgium), CycloMedia (Netherlands), Q-Free (Netherlands), TU Eindhoven (Netherlands) , University of Leeds (UK), University of Catania (Italy), Inria(France), ARMINES (France), IBBT (Belgium).

See also: http://www.panorama-project.eu/

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.

7.3.1.2. VANAHEIM

Title: Autonomous Monitoring of Underground Transportation Environment

Type: COOPERATION (ICT)

Defi: Cognitive Systems and Robotics

Instrument: Integrated Project (IP)

Duration: February 2010 - July 2013

Coordinator: Multitel (Belgium)

Other partners: Inria Sophia-Antipolis (FR); Thales Communications (FR); IDIAP (CH); Torino GTT (Italy); Régie Autonome des Transports Parisiens RATP (France); Ludwig Boltzmann Institute for Urban Ethology (Austria); Thales Communications (Italy).

See also: http://www.vanaheim-project.eu/

Abstract: The aim of this project is to study innovative surveillance components for the autonomous monitoring of multi-Sensory and networked Infrastructure such as underground transportation environment.

7.3.1.3. SUPPORT

Title: Security UPgrade for PORTs

Type: COOPERATION (SECURITE)

Instrument: IP

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).

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.

7.3.1.4. Dem@Care

Title: Dementia Ambient Care: Multi-Sensing Monitoring for Intelligent Remote Management and Decision Support

Type: COOPERATION (ICT)

Defi: Cognitive Systems and Robotics

Instrument: Collaborative Project (CP)

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).

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.

7.3.2. Collaborations in European Programs, except FP7

7.3.2.1. ViCoMo

Program: ITEA 2

Project acronym: ViCoMo

Project title: Visual Context Modeling

Duration: October 2009 - October 2012

Coordinator: International Consortium (Philips, Acciona, Thales, CycloMedia, VDG Security)

Other partners: TU Eindhoven; University of Catalonia; Free University of Brussels; Inria; CEA List;

Abstract: The ViCoMo project is focusing on the construction of realistic context models to improve the decision making of complex vision systems and to produce a faithful and meaningful behavior. ViCoMo goal is to find the context of events that are captured by the cameras or image sensors, and to model this context such that reliable reasoning about an event can be performed.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. 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.

7.4.1.2. Collaboration with U.S.

Stars collaborates with the University of Southern California.

7.4.1.3. Collaboration with Europe

Stars collaborates with Multitel in Belgium and the University of Kingston upon Thames UK.

7.4.2. Participation In International Programs

7.4.2.1. EIT ICT Labs

EIT ICT Labs is one of the first three Knowledge and Innovation Communities (KICs) selected by the European Institute of Innovation & Technology (EIT) to accelerate innovation in Europe. EIT is a new independent community body set up to address Europe's innovation gap. It aims to rapidly emerge as a key driver of EU's sustainable growth and competitiveness through the stimulation of world-leading innovation. Among the partners, there are strong technical universities (U Berlin, 3TU / NIRICT, Aalto University, UPMC - Université Pierre et Marie Curie, Université Paris-Sud 11, Institut Telecom, The Royal Institute of Technology); excellent research centres (DFKI, Inria, Novay , VTT, SICS) and leading companies (Deutsche Telekom Laboratories, SAP, Siemens, Philips, Nokia, Alcatel-Lucent, France Telecom, Ericsson). This project is largely described at http://eit.ictlabs.eu.

Stars is involved in the EIT ICT Labs - Health and Wellbeing .

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

This year Stars has hosted 12 internships:

- Pierre Aittahar, Nice University.
- Guillaume Barbe, Nice University.
- Sorana Capalnean, Cluj-Napoca University.
- Cintia Corti, FCEIA Facultad de Ciencias Exactas Ingenieria y Agrimensura, National University of Rosario.
- Eben Freeman, MIT USA.
- Vaibhav Katiyar, Asian Institute of Technology Khlong Luang Pathumtani, Thailand.
- Vannara Loch, Nice University.
- Qioa Ma, Ecole centrale de Pékin, University of Beihang (China).
- Firat Ozemir, Sabancı Universitesi Orta Mahalle, University Caddesi Istanbul.
- Luis Sanchez, Buenos Aires University.
- Abhineshwar Tomar , Ku Leuven University, Belgium.
- Swaminathan Sankaranarayanan, Delft University of Technology.

TEXMEX Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. *ANR Attelage de systèmes hétérogènes*

Participants: Guillaume Gravier, Bogdan Ludusan.

Duration: 3 years, started in November 2009.
Partners: IRISA, LIA, LIUM

The project ASH (Automatic System Harnessing – ANR-09-BLAN-0161-03) aims at developing new collaborative paradigms for speech recognition. Many current ASR systems rely on an a posteriori combination of the output of several systems (e.g., confusion network combination). In the ASH project, we investigate new approaches in which three ASR systems work in parallel, exchanging information at every step of the recognition process rather than limiting ourselves to an a posteriori combination. What information is to be shared and how to share such information and make use of it are the key questions that the project is addressing. The collaborative paradigm is being extended to landmark-based speech recognition where detection of landmarks and speech transcription can be considered as two (or more) collaborative processes.

8.1.2. *ANR 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.

8.1.3. *ANR Secular*

Participants: Laurent Amsaleg, Teddy Furon, Benjamin Mathon, Ewa Kijak.

Duration: 3 years, started in September 2012.
Partners: Morpho, Univ. Caen GREYC, Telecom ParisTech, Inria Rennes

Since their invention, content based image retrieval systems (CBRS) and biometric systems have evolved separately. This is due to the fact that they originate from different research and industrial communities. This Basic Research project, called SecuLar, groups researchers from both communities who have observed that both type of systems have indeed a lot in common in terms of goals and technological blocks. These techniques are used, however, in quite different settings possibly explaining the gap between the two. The people involved in this SecuLar project believe that what is specific to each family of approach can now benefit the other for the two following fundamental reasons.

Biometrics needs scale. The size of biometric databases quickly increases. It grows in terms of the number of records kept in the database. It also grows in terms of the size of each record as larger biometric templates maintain high quality recognition. The amount of data becomes large enough to require powerful indexing techniques. CBRS are good at this as they allow ultra fast searches of nearest neighbours in huge datasets. But porting these techniques to a biometric context is far from being easy. Biometric databases are typically protected to enforce confidentiality and privacy as security is paramount. Indexing biometric data is thus difficult because the techniques enforcing security in biometrics conflict with the technique bringing efficiency to database searches. No biometric system can today cope with both all the privacy and security constraints and the scale at which they should work in the real world for new applications.

CBRS need security and privacy. We witness a new use of CBRS these days. CBRS become the main multimedia security technology to enforce copyright laws (content monetization) or to spot illegal contents (detection of copies, paedophile images, ...) over the Internet. However, they 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. It 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. Here, we plan to understand how biometrics related techniques can help increasing the security levels of CBIRS while not degrading their performance.

8.2. European Initiatives

8.2.1. *Quaero*

Participants: Laurent Amsaleg, Sébastien Campion, Vincent Claveau, Ali Reza Ebadat, Julien Fayolle, Patrick Gros, Gylfi Gudmundsson, Camille Guinaudeau, Carryn Hayward, Hervé Jégou, Ewa Kijak, Fabienne Moreau, Christian Raymond, Pascale Sébillot.

Duration: 5 years, starting in May 2008. Prime: Technicolor.

Quaero is a large research and applicative program in the field of multimedia description (ranging from text to speech and video) and search engines. It groups 5 application projects, a joint Core Technology Cluster developing and providing advanced technologies to the application projects, and a Corpus project in charge of providing the necessary data to develop and evaluate the technologies. The large scope of QUAERO's ambitious objectives allows it to take full advantage of Texmex's many areas of research, through its tasks on: Indexing Multimedia Objects, Term Acquisition and Recognition, Semantic Annotation, Video Segmentation, Multi-modal Video Structuring, Image and video fingerprinting.

In 2012, a key fact is our strong participation to Mediaeval to evaluate the technologies developed in Quaero.

8.3. International Initiatives

8.3.1. *Participation in International Programs*

Participants: Patrick Gros, Guillaume Gravier.

Duration: 2 years
Collaboration Inria-FAPEMIG with PUC Minas and UFMG – Brazil

The collaboration started this year with a visit of Patrick Gros to Belo Horizonte. The thesis of a brazilian student, Bruno Teixeira, will be co-advised, and he will spend 6 months in France next year. His work focuses on video high level description for video classification.

8.4. International Research Visitors

8.4.1. *Visits of International Scientists*

- **Visit of Fabio Guimaraes, 1 week in March 2012.** This visit was the opportunity to launch our collaboration with Brazil, which will take place in the framework of the Inria-FAPEMIG program. The main topic of the collaboration will be video multimodal description.

- **Visit of Michael Houle, National Institute of Informatics, Tokyo, Japan.** This visit was dedicated to share knowledge and initiate a collaboration for high-dimensional indexing.

8.4.2. *Internships*

- Michele Trevisiol

    Dates: May 2012–July 2013 (3 months)

Subject: Geo-Tagging of Flickr videos, evaluated in the context of the Mediaeval's Placing task.

Institution: Yahoo Research & Universitat Pompeu Fabra (Barcelona)

- Giorgos Tolias

    Dates: October 2012–January 2013 (5 months)

    Subject: Large scale visual search

    Institution: National Technical University of Athens (Greece)

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. FUI SIFORAS

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Thomas Lopez.

SIFORAS (Simulation for training and assistance), based on GVT 5.2 , aims to propose Instructional Systems Design to answer the new objectives of training (Intelligent Tutorial System, mobility, augmented reality, high productivity).

SIFORAS involves Academic partners 4 (INSA Rennes, ENIB, CEA-List, ENISE) and 9 Industrial partners (Nexter Training, Delta CAD, Virtualys, DAF Conseils, Nexter Systems, DCNS, Renault, SNCF, Alstom).

In this project, INSA Rennes-VR4i aims ensuring consistency with respect to CORVETTE project (see section 7.1.3) in particular for the global architecture based on STORM and LORA models.

7.1.2. ANR Collaviz

Participants: Thierry Duval [contact], Valérie Gouranton [contact], Cédric Fleury, Van Viet Pham.

Collaviz is an innovative multi-domain remote collaborative platform (project ANR-08-COSI-003-11 funded by the french national research agency) for the simulation-based design applications.

Collaviz was involving 6 Academic partners (ECP, EGID, INPT, INSA Rennes, LIRIS, Scilab) and 11 Industrial partners (Artenum, BRGM, Distene, EDF, Faurecia, Medit, MCLP Consulting, NECS, Oxalya, TechViz, Teratec). The Collaviz ended at on 30th June 2012.

The major value brought by Collaviz to the scientific and industrial community is to make remote analysis and collaboration easily available and scalable. Web-based technologies, on the top of shared high-performance computing and visualization centers, will permit researchers and engineers handling very large data sets, including 3D data models, by using a single workstation, wherever in the world. Just a "standard" internet connexion will be needed. The classical approach is not adapted anymore: simulation-based design applications tend to generate Terabytes and even Petabytes of data.

We were leading the WP4 about Collaborative Virtual Environments and Techniques, whose aim was to manage the 3D collaborative interactions of the users. During 2012 we contributed to the second Collaviz prototype by building upon it new collaborative interaction metaphors. We also improved the Collaviz software architecture in order to provide interoperability, making it possible to share a virtual universe between heterogeneous 3D viewers. We added a JMonkeyEngine viewer dedicated to deploy Collaviz on mobile devices such as tablets. We also made a link with the VCoRE project by adding a C++ OpenSG viewer to the our Java Collaviz framework.

We have also deployed the Collaviz framework between London (in the immersive room of the University College of London) and Rennes (in our Immersia room). We setup an experiment of collaborative manipulation of a clipping plane inside 3D scientific data within VISIONAIR project. This first real deployment of Collaviz was a success, it has allowed efficient co-manipulation of a shared 3D object between two really distant users, and the experimental results have been presented in [20]. Collaviz has then been deployed in the Inria Sophia-Antipolis immersive system in the context of the VCoRE project.

7.1.3. ANR Corvette

Participants: Bruno Arnaldi [contact], Valérie Gouranton [contact], Florian Nouviale, Andrés Saraos Luna.

Corvette (COllaboRative Virtual Environment Technical Training and Experiment) based on GVT 5.2 , aims to propose a set of scientific innovations in industrial training domain (maintenance, complex procedures, security, diagnostic, ...) exploiting virtual reality technologies. This project has several scientific axes : collaborative work, virtual human, communication and evaluation.

Corvette involves 3 Academic partners (INSA Rennes, ENIB, CEA-List) and 4 Industrial partners (AFPA, Nexter Training, Virtualys, Golaem). We (INSA Rennes) are leading the ANR Corvette.

The project seeks to put in synergy a number of scientific axes:

- Collaborative work that can handle representative complex scenarios of industrial training
- Virtual Human for its ability to embody the user as an avatar and acting as a collaborator during training
- Natural communication between users and virtual humans for task-oriented dialogues
- Methodology in cognitive psychology for the assessment of the effectiveness of the collaboration of users and virtual humans to perform complex cooperative tasks in a virtual environment.

Unit contributions and technologies are demonstrated. Each partner has integrated global constraints of the project to produce the technical elements in relation to their contributions. The next step is to combine the components into a unified environment and have it validated by industrial use cases.

For further information: http://corvette.irisa.fr/

7.1.4. ANR Acoustic

Participant: Maud Marchal [contact].

The main objective of the project ACouStiC is to develop an innovative strategy based on models for helping decision-making process during surgical planning in Deep Brain Stimulation. Models rely on different levels involved in the decision-making process; namely multimodal images, information, and knowledge. The project aims at developing methods for 1) building generic and patient specific models and 2) automatically computing optimal electrodes trajectories from these models taking into account possible simulated deformations occurring during surgery. VR4i is involved in the project with Shaman Inria project-team and aims at providing models of deformations of the cerebral structures and electrodes for the surgical planning. The objective is to propose a biomechanical approach to model the brain and electrode deformations and also their mutual interaction.

7.1.5. ANR Open-ViBE2

Participants: Laurent Bonnet, Laurent George, Anatole Lécuyer [contact], Jozef Legeny.

OpenViBE2 is a 3-year project funded by the French National Agency for Research. The objective of OpenViBE2 is to propose a radical shift of perspective about the use of Brain-Computer Interfaces (BCI). First, in OpenViBE2 we consider the possibility to merge a BCI with traditional peripherals such as joysticks, mice and other devices, all being possibly used simultaneously in a virtual environment. Therefore, BCI is not seen as a replacement but as a complement of classical HCI. Second, we aim at monitoring brain cognitive functions and mental states of the user in order to adapt, in real-time and in an automated fashion, the interaction protocol as well as the content of the remote/virtual environment (VE).

One major strength of OpenViBE2 consortium relies on the fact that four partners were already involved in the previous ANR project OpenViBE1 (2005-2009): Inria, INSERM, GIPSA-LAB, CEA. In addition, six partners have joined OpenViBE2 to bring their complementary expertise required by the scope of our proposal: CHART, CLARTE, UBISOFT, BLACK SHEEP, and KYLOTONN.

In parallel, the OpenViBE2 consortium contributes to the free and open-source software OpenViBE, which is devoted to the design, test and use of Brain-Computer Interfaces (see Section 5.3).

7.1.6. ANR HOMO TEXTILUS

Participants: Anatole Lécuyer [contact], Jozef Legeny, Maud Marchal, Jonathan Mercier.

HOMO TEXTILUS is a 3-year project funded by the French National Agency for Research (2012-2015). 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 VR4i team in the project consists in contributing to 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.

Partbers of the project are : Inria, CHART, LIP6, TOMORROW LAND, RCP and potential end-user is Hussein Chalayan fashion creator.

7.1.7. ANR MANDARIN

Participants: Anatole Lecuyer [contact], Maud Marchal [contact], Merwan Achibet.

MANDARIN is a 3-year project funded by the French National Agency for Research (2012-2015). The objective of MANDARIN is to study the design of truly dexterous haptic peripherals allowing natural and intuitive mono or bi-manual interactions with force feedback in virtual environments. The design of an innovative and comfortable and high performance force feedback glove is planned in the project, based on accurate biomechanical models of the human hand. The involvement of VR4i team in the project consists in contributing to the design of novel multimodal 3D interactions techniques and metaphors allowing to deal with haptic gloves limitations and to assist the user in virtual applications requiring dexterous manipulation. The scientific results will be evaluated with a representative industrial application proposed by Renault, that is not feasible currently with existing technologies (bi-manual manipulation of complex rigid objects and cables bundles).

Partners of the project are : Inria, CEA, UTC, Haption, Renault (potential end-user)

7.2. European Initiatives

7.2.1. INFRA-FP7: VISIONAIR

Participants: Georges Dumont [contact], Bruno Arnaldi, Valérie Gouranton, Thierry Duval, Alain Chauffaut, 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 (see section 6.4) Virtual Reality room is now, 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).

7.2.2. STREP: NIW

Participants: Gabriel Cirio, Anatole Lécuyer [contact], Maud Marchal, Léo Terziman.

The Natural Interactive Walking Project (NIW) is a 3-year project funded by the European Commission under the FET Open STREP call. NIW involves 5 partners: Inria/VR4i (Bunraku), University of Verona (leader), University of Aalborg, University of Paris 6, and McGill University. The Natural Interactive Walking (NIW) project aims at taking advantage of multisensory information about the ground to develop knowledge for designing walking experiences. This will be accomplished through the engineering and perceptual validation of human-computer interfaces conveying virtual cues of everyday ground attributes and events. Such cues may be conveyed by auditory, haptic, pseudo-haptic, and visual augmentation of otherwise neutral grounds. The project is focused on creating efficient and scalable display methods across these modalities that can be easily and cost-effectively reproduced, via augmented floors and footwear.

It is expected that the NIW project will contribute to scientific knowledge in two key areas. First, it will reinforce the understanding of how our feet interact with surfaces on which we walk. Second, it will inform the design of such interactions, by forging links with recent advances in the haptics of direct manipulation and in locomotion in real-world environments. The methods that will be created could impact a wide range of future applications that have become prominent in recently funded research within Europe and North America. Examples include floor-based navigational aids for airports or railway stations, guidance systems for the visually impaired, augmented reality training systems for search and rescue, interactive entertainment, and physical rehabilitation.

More information can be found on Natural Interactive Walking project website : http://www.niwproject.eu/

7.2.3. BRAINVOX

Participants: Anatole Lécuyer [contact], Jozef Legeny [contact].

The BRAINVOX project is a project funded by Brittany region in the frame of the CREATE call. It is a 4 year-project (2008-2012), on the topic of Brain-Computer Interfaces.

The "blue-sky" vision of the BrainVox project is a "mental language", more elaborated, and richer, for BCI applications. We want to study the possibility for a single user to exploit various mental activities, in order to achieve more varied operations in the BCI-based application within novel hybrid BCI schemes. In the end, this novel mental language would enable a practice of BCI richer and more intuitive, with more potential actions in the real world. This should improve the spreading of BCI technologies in numerous applications such as multimedia and video games, but also assistance to disabled people.

7.2.4. ADT-Mixed Reality Technological Development: VCore

Participants: Georges Dumont [contact], Thierry Duval, Valérie Gouranton, Alain Chauffaut [contact], Ronan Gaugne [contact], Rémi Félix.

The Mixed Reality Project is a shared collaboration between Fraunhoffer IGD and five Inria research centers: Rennes, Grenoble, Sophia, Lille and Saclay. On the Inria side, the project started in october 2011, with a four years outlook, as an ADT with two IJDs, one in Rennes and one in Sophia. The goal of the project is to build a modular shared source software framework, fostering the development of new and unique research topics and application areas, which can be used alike by research teams and innovative companies. The goal is to make it a de facto standard, favoring interoperability between various developments in the mixed reality area. Research teams will get a sound software base that helps them focus their efforts on innovative software libraries or applications. Companies will benefit from implementations of state-of-the-art algorithms as well as a full-fledged framework strongly connected with 3D-related emerging standards like Collada, X3D and WebGL.

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: 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 generating interactive evaluation tests

- processes for continuous enhancement of content, e.g.: social annotation, behavior analysis, accessible multi-support publishing (web, PDF, ODT, LaTeX, smartphones, tablets).

7.1.2. ANR

Codex

Title: Efficiency, Dynamicity and Composition for XML: Models, Algorithms, and Systems

Call: Emerging Domains program (DEFIS)

Duration: March 2009 - June 2012

Coordinator: Inria Saclay-Île-de-France

Others partners: Inria Lille-Nord-Europe (MOSTRARE), University Paris Sud, Sorbonne - University Paris 7 (PPS), Centre universitaire de Blois (LI - Université F. Rabelais Tours), Innovimax SARL.

See also: http://codex.saclay.inria.fr/

Abstract: Codex seeks to push the frontier of XML technology innovation in three interconnected directions.

- Languages and algorithms: prototypes are developed for efficient and expressive XML processing, in particular advancing towards massively distributed XML repositories.

- Codex considers models for describing, controlling, and reacting to the dynamic behavior of XML corpora and XML schemas with time.

- The project proposes theories, models and prototypes for composing XML programs for richer interactions, and XML schemas into rich, expressive, yet formally grounded type descriptions.

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 approach
- a data-oriented approach

7.1.3. Competitivity Clusters

Autonomy

Title: High-tech to serve people with disabilities

Call: Global competitiveness cluster Minalogic, 6th call for R&D projects

Duration: March 2010 - June 2012

Coordinator: ST Microelectronics

Others partners: ST-Ericsson, Raisonance, Grenoble University, IVèS

See also: http://autonomie.minalogic.net/

Abstract: The goal of the project is to develop high-tech tools to improve autonomy for people with disabilities. These tools are integrated in mobile devices such as cell phones or special-purpose devices, to improve the quality of life of people with disabilities. These devices access remote dedicated services to help geolocation and guiding. They take advantage of the latest advances in embedded systems: cameras, audio, video, compass, accelerometer, gyroscope. Two major application areas are addressed: software tools on cell phones for sight disabled people, and guiding and information tools for moving around in a city.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. 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.

7.2.2. Collaborations with Major European Organizations

EPFL, MEDIA group (Switzerland)

We have been working jointly for years on XML editing, more specifically on the template-driven approach. This collaboration was recently extended to XML processing [2].

<p style="text-align:center; color:red;">**WILLOW Project-Team**</p>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. *Agence Nationale de la Recherche: DETECT (ENS)*
Participant: Josef Sivic.

The DETECT project aims at providing new statistical approaches for detection problems in computer vision (in particular, detecting and recognizing human actions in videos) and bioinformatics (e.g., simultaneously segmenting CGH profiles). These problems are mainly of two different statistical nature: multiple change-point detection (i.e., partitioning a sequence of observations into homogeneous contiguous segments) and multiple tests (i.e., controlling a priori the number of false positives among a large number of tests run simultaneously).

This is a collaborative effort with A. Celisse (University Lille 1), T. Mary-Huard (AgroParisTech), E. Roquain and F. Villers (Univeristy Paris 6), in addition to S. Arlot and F. Bach from Inria SIERRA team and J. Sivic from Willow.

8.2. European Initiatives

8.2.1. *QUAERO (Inria)*
Participant: Ivan Laptev.

QUAERO (AII) is a European collaborative research and development program with the goal of developing multimedia and multi-lingual indexing and management tools for professional and public applications. Quaero consortium involves 24 academic and industrial partners leaded by Technicolor (previously Thomson). Willow participates in work package 9 "Video Processing" and leads work on motion recognition and event recognition tasks.

8.2.2. *EIT-ICT: Cross-linking Visual Information and Internet Resources using Mobile Networks (Inria)*
Participants: Ivan Laptev, Josef Sivic.

The goal of this project within the European EIT-ICT activity is to perform basic research in the area of semantic image and video understanding as well as efficient and reliable indexing into visual databases with a specific focus on indexing visual information captured by mobile users into Internet resources. The aim is demonstrate future applications and push innovation in the field of mobile visual search.

This is a collaborative effort with C. Schmid (Inria Grenoble) and S. Carlsson (KTH Stockholm).

8.2.3. *European Research Council (ERC) Advanced Grant*
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.

8.3. International Initiatives

8.3.1. IARPA FINDER Visual geo-localization (Inria)
Participants: Josef Sivic, Petr Gronát.

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, 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). The project will be funded during 2012-2014.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Alexei Efros (Carnegie Mellon University) and René Vidal (Johns Hopkins University) have visited WIllow during summer 2012.

8.4.2. Visits to International Teams

Vincent Delaitre has visited the Robotics Institute, Carnegie Mellon University during November 2012 — January 2013, within the scope of Inria associate team VIP.

Armand Joulin has done a 3 months internship at Microsoft Research in Redmond, U.S.A.

8. Partnerships and Cooperations

8.1. Regional Initiatives

Nhan Le Thanh is animator of a multidisciplinary working group (PSP) on personalized eHealth in the Alpes-Maritimes department.

8.2. National Initiatives

8.2.1. 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

8.2.2. ANR Datalift

DataLift is an ANR project (2010-2013). Its goal is to design a platform to publish and interlink datasets on the Web of data. Datalift will both publish datasets coming from a network of partners and data providers and propose a set of tools for easing the datasets publication process. DataLift brings raw structured data coming from various formats (relational databases, CSV, XML, ...) to semantic data interlinked on the Web of Data.

Partners: Inria Exmo & Wimmics, LIRMM, Eurecom, Mondeca, Atos, IGN, INSEE, FING

Web site: http://www.datalift.org

8.2.3. 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

8.2.4. ANR OCKTOPUS

This new ANR project is starting in December 2012. 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.

We believe that this approach will maximize the scientific, economic and social impact of OCKTOPUS by giving high visibility to the research results produced by our academic partners, and by providing a direct route to transfer these results to the internet marketplace through Alcméon's commercial products.

Partners: Alcméon, CRG, Inria Wimmics.

Web site: http://ocktopus.alcmeon.com

8.2.5. *CNRS Mastodons CrEDIBLE*

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 on the distribution of algorithms in the Corese/KGRAM engine [33], [63], [64].

Web site: https://credible.i3s.unice.fr

8.2.6. *Inria Large scale initiative action PAL*

Wimmics entered this year the Inria large scale initiative Personal Assistant Living (PAL), devoted to the assistance to elderly and fragile people. Our contribution in PAL is described in section 6.16.2 .

Web site: http://pal.inria.fr

8.2.7. *Follow up: GDR I3I*

In the continuation of a specific action (AS) *Interopérabilité des Systèmes d'Information et Ingénierie des Modèles*, funded by GDR I3I in 2011, C. Faron-Zucker worked in 2012 on a synthesis work on the contributions of model driven engineering to the interoperability of information systems [45]. She was specially involved on model and data integration issues which can also be found in the CrEDIBLE project.

8.3. International Initiatives

8.3.1. *Participation In International Programs*

LIRIMA, Senegal

The Wimmics team participates to the LIRIMA [25].

We have a collaboration with Moussa Lo, Computer Science department of university Gaston Berger at Saint-Louis in Senegal. We participate to a AUF funded project: *Social Semantic Web Platform for Knowledge Sharing in West-africa Communities*

U. of Annaba, Algeria

Catherine Faron-Zucker is responsible in France of a scientific collaboration project with the LabGed laboratory of university of Annaba funded by CNRS and DPGRF (Algeria). This project aims to study the personalization and socialization of ubiquitous e-learning systems based on Semantic Web models and techniques. In this framework, she co-supervise with Algerian colleague Hassina Seridi two PhD students at LabGed.

---

[25]http://www.lirima.uninet.cm/

In 2012, Khaled Halimi continued the development of a personal learning system with the aim of providing for each user a personal space according to his/her profile, providing intelligent recommendations based on the analysis of the user's interactions, relations and activities, recommending to students the best learning paths according to the recommendation of the best collaborators and the best learning resources, making all users aware of what happens in the system.

Samia Beldjoudi is working on the personalization of resource recommendations based on the analysis of tag-based user profiles; in 2012 she focused on social interactions between the folksonomy's members in order to extract the meaning of terms and overcome the problems of tags' ambiguity and spelling variations [25].

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

> *Eric Toguem* (*October 8th to November 27th*)
>> Subject: *Distributed LOD*
>> Institution: *University Yahoundé* (*Cameroun*)
> *Fatou Kamara* (*November 5th to 15th*)
>> Subject: *Semantic Distance*
>> Institution: *University Gaston Berger* (*Saint-Louis, Senegal*)

ZENITH Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Labex NUMEV, Montpellier*

URL: http://www2.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. Patrick Valduriez heads 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.

8.1.3. *ModSiCS2020 Working Group, Montpellier*

The ModSiCS2020 (Modeling and Simulation of Complex Systems in 2020) working group was set up by UM2 to analyze the local situation (forces and weaknesses, current projects), identify the critical research directions and propose concrete actions in terms of research projects, equipment facilities, human resources and training to be encouraged in Montpellier. The group was headed by Patrick Valduriez and gathered a small number of experts in different disciplines (agronomy, bioinformatics, computer science, environmental science, life science, etc.). The conclusions of the group [57] were presented at the ModSiCS2020 workshop on Data, Models and Theories for Complex Systems: new challenges and opportunities, organized by UM2 in march. Following the work of the group, a "Groupement d'Intérêt Scientifique (GIS)" is being proposed in Montpellier.

8.2. National Initiatives

8.2.1. *ANR*

8.2.1.1. *VERSO DataRing(2008-2012, 300Keuros)*

Participants: Reza Akbarinia, Zohra Bellahsène, Emmanuel Castanier, Duy Hoa Ngo, Esther Pacitti, Didier Parigot, Guillaume Verger, Patrick Valduriez [leader].

URL: http://www-sop.inria.fr/teams/zenith/dataring

The DataRing project, headed by P. Valduriez, involves the Leo project-team (Inria Saclay Ile de France), LIG, LIRMM and Telecom ParisTech. The objective is to address the problem of data sharing for online communities, such as social networks (e.g. sites like MySpace and Facebook) and professional communities (e.g. research communities, online technical support groups) which are becoming a major killer application of the web. The project addresses this problem by organizing community members in a peer-to-peer (P2P) network ring across distributed data source owners where each member can share data with the others through a P2P overlay network. In this project, we study the following problems: schema matching, query processing with data uncertainty, data indexing and caching, data privacy and trust. To validate our approach, we develop services based on our prototypes WebSmatch, SON, P2Prec and ProbDB.

8.2.1.2. OTMedia (2011-2013), 150Keuros
Participants: Alexis Joly, Julien Champ, Pierre Letessier.

The Transmedia Observatory project, launched in November 2010, aims to develop processes, tools and methods to better understand the challenges and changes in the media sphere. Studying and tracking media events on all media (web, press, radio and television) are the two prioritized research areas. OTMedia brings together six partners: Inria (ZENITH), AFP (French Press Agency), INA (French National Audiovisual Institute), Paris 3 Sorbonne Nouvelle (researchers in Information Science and Communication), Syllabs (a SME specialized in semantic analysis and automatic creation of text) and the Computer Science Laboratory of Avignon University. ZENITH addresses more specifically the research challenges related to the trans-media tracking of visual contents (images and videos) and the clustering of heterogeneous information sources.

8.2.2. Others

8.2.2.1. RTRA Pl@ntNet (2009-2013), 1Meuros
Participants: Alexis Joly, Hervé Goëau, Saloua Litayem, Mathias Chouet.

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 [3], IMEDIA project team at Inria, and the French botanical network TelaBotanica [4]), 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 (2011-2013), 100Keuros
Participants: Alexis Joly, Pierre Letessier.

This CIFRE contract with INA funds a 3-years PhD (Pierre Letessier) to address research challenges related to content-based mining of visual objects in large collections.

8.2.2.3. CNRS INS2I Mastodons (2012), 30Keuros
Participants: Florent Masseglia, Patrick Valduriez, Esther Pacitti [leader].

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

> Program: FP7
>
> Project acronym: CHORUS+ (avmediasearch.eu)
>
> Project title: European coordination action on Audio-Visual Media Search
>
> Duration: 2010 - 2012
>
> Coordinator: JCP consulting

---

[3] http://amap.cirad.fr/en/
[4] http://www.tela-botanica.org/

Other partners: CERTH-ITI (Greece), University of Trento (Italy), HES-SO (Switzerland), Technicolor (France), Vienna University of Technology (Austria), Engineering Ingegneria Informatica SPA (Italy), JRC Institute for Prospective Technological Studies (EU)

Abstract: CHORUS+ http://avmediasearch.eu/ objective is to coordinate national and international projects and initiatives in the Search-engine domain and to extend this Coordination in non-European countries. ZENITH actively participated to this action, Alexis Joly being member of the steering comittee and leader of a work package. We particularly promoted scientific data as an essential challenge to be addressed by this community through the co-organization of international events (CBMI 2012 panel, ImageCLEF 2012, international workshop on search computing) and discussions with leaders of European projects belonging to the cluster of the coordination action. Besides, we did work on technology transfer issues and the potential of benchmarking campaigns as a tool to foster it (conduction of a survey of about hundred people from both academy and industry, organization of a think-tank with about 20 stakeholders, writing of a recommendation report for the EU commission).

8.4. International Initiatives

8.4.1. *Inria International Partners*

We have regular scientific relationships with research laboratories in

- North America: Univ. of Waterloo (Tamer Özsu), Univ. of California, Santa Barbara (Divy Agrawal, Amr El Abbadi).
- 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)

8.4.2. *Participation In International Programs*

We are involved in the following international actions:

- CNPq-Inria project DatLuge (Data & Task Management in Large Scale, 2009-2012) with UFRJ (Marta Mattoso, Vanessa Braganholo, Alexandre Lima), LNCC, Rio de Janeiro (Fabio Porto), and UFPR, Curitiba (Eduardo Almeida) to work on large scale scientifc workflows;
- FAPERJ-Inria project SwfP2Pcloud (Data-centric workflow management in hybrid P2P clouds, 2011-2013) with UFRJ (Marta Mattoso, Vanessa Braganholo, Alexandre Lima) and LNCC, Rio de Janeiro (Fabio Porto) to work on large scale scientific workflows in hybrid P2P clouds;
- 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;
- EGIDE Osmoze project SECC (SErvices for Curricula Comparison, 2011-2012), with Riga Technical University (Janis Grundspenkis, Marité Kirikova) to work on automatic analysis and mapping of conceptual trees and maps acquired from digital documents.

8.5. International Research Visitors

8.5.1. *Visits of International Scientists*

Prof. Jens Dittrich (Univ. Saarland, Germany) gave a seminar at LIRMM on data management with MapReduce.

Prof. Marta Mattoso (UFRJ, Rio de Janeiro) gave a seminar at LIRMM in the context of IBC on data provenance in scientific workflows.

8.5.2. *Visits to International Teams*

Esther Pacitti and Patrick Valduriez were invited researchers at the National University of Singapore in July.