RESEARCH CENTER
Grenoble - Rhône-Alpes

FIELD

Activity Report 2014

Section Partnerships and Cooperations

Edition: 2015-06-01

ARIC Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

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

8.2. National Initiatives

8.2.1. ANR HPAC Project

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

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

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

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

8.2.2. ANR DYNA3S Project

Participants: Guillaume Hanrot, Gilles Villard.

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

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

8.2.3. ANR FastRelax Project

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

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

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

8.2.4. PEPS Quarenum

Participants: Nicolas Louvet, Nathalie Revol.

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

8.3. International Initiatives

8.3.1. Inria Associate Teams

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

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

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

We also collaborate with Intel (Portland, USA).

8.3.3. Participation In other International Programs

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

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

8.4. International Research Visitors

8.4.1. Visits of International Scientists

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

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

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

8.4.1.1. Internships

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

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

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

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

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

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

COMPSYS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. In Relation with the LYONCALCUL Initiative

Compsys follows or participates to the activities of LyonCalcul (http://lyoncalcul.univ-lyon1.fr/), a network to federate activities on high-performance computing in Lyon. In this context, and with the support of the Labex MILYON (http://milyon.universite-lyon.fr/), Compsys organized a thematic quarter on compilation from April 2013 to July 2013 (http://labexcompilation.ens-lyon.fr). A new thematic quarter is in preparation for 2016, initiated by Violaine Louvet (Institute Camille Jordan), with the participation of the LIP teams Avalon, Compsys, and Roma. Also, Alain Darte and Alexandre Isoard have regular exchanges with Violaine Louvet and Thierry Dumont on tiling code optimizations.

8.1.2. Streaming Day with CITI Laboratory

Compsys has some common research interests with the Socrate Inria team from the CITI laboratory (Insa-Lyon), in particular streaming languages. In this context, Socrate (Lionel Morel), with the help of Compsys (Alain Darte), organized in April 2014, a thematic day on the "compilation and execution of streaming programs" in Domaine des Hautannes, St Germain au Mont d'Or, with 7 speakers and 32 participants. See the webpage of the event http://streaming.conf.citi-lab.fr.

8.2. National Initiatives

8.2.1. French Compiler Community

Until 2010, the french compiler community had no official national meetings. Laure Gonnord and Fabrice Rastello decided to motivate the different french actors to meet regularly. All groups whose activities are related to compilation were contacted and the first "compilation day" was organized in September 2010 in Lyon. The next sessions, in a form of 3-days workshops, took place in Aussois (winter 2010), Dinard (spring 2011), Saint-Hippolyte (autumn 2011), Rennes (summer 2012), Annecy (spring 2013, organized by Compsys again), Dammarie-les-lys (winter 2013), and Nice (summer 2014). This effort is a success: the community (http://compilfr.ens-lyon.fr) is now well identified and such an event occurs at least once a year. The community is still animated by Laure Gonnord and Fabrice Rastello, and now also by Florian Brandner (ENSTA), and is now recognized as a sub-group of the CNRS GDRs ASR (Architecture, System, Network) and GPL (Software Engineering and Programming). As a subgroup of GPL, the community is (from 2014) now in charge of organizing one day during the Research school "Ecole des jeunes chercheurs en Algorithmique et Programmation".

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations: HIPEAC network

Compsys members participate to the European Network of Excellence on High Performance and Embedded Architecture and Compilation (HiPEAC, http://www.hipeac.net/), either as members or affiliate members. The International Workshop on Polyhedral Compilation Techniques (IMPACT, see Section 8.4.1.2), co-created by Christophe Alias in 2011, is now an annual event of the HIPEAC conference, as an official workshop. The 5th edition, IMPACT'15, is co-organized and co-chaired by Alain Darte (see http://impact.gforge.inria.fr/impact2015/).

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

- Christophe Alias has a regular collaboration with Sanjay Rajopadhye from the Colorado State University (USA), through the advising of the PhD thesis of Guillaume Iooss. This year, this collaboration led to several publications, see Sections 6.8 and 6.5 .
- Laure Gonnord has a regular collaboration with Fernando Magno Quintao Pereira from the University of Mineas Gerais (Brazil). This year, this collaboration led to several results, see Sections 6.4 and 6.3 . In Jan.-Feb. 2015, Compsys will host Fernando Pereira as an invited professor.

8.4.1.2. Polyhedral Community

In 2011, as part of the organization of the workshops at CGO'11, Christophe Alias (with C. Bastoul) organized IMPACT'11 (international workshop on polyhedral compilation techniques, http://impact2011.inrialpes.fr/). This workshop in Chamonix was the very first international event on this topic, although it was introduced by Paul Feautrier in the late 80s. Alain Darte gave the introductory keynote talk. After this first very successful edition (more than 60 people), IMPACT continued as a satellite workshop of the HIPEAC conference, in Paris (2012), Berlin (2013), Vienna (2014). Alain Darte is program chair for the next edition, in Amsterdam (2015). The creation of IMPACT, now the annual event of the polyhedral community, helped to identify this community and to make it more visible. This effort was complemented by the organization of the first (and for the moment unique) school on polyhedral code analysis and optimizations (http://labexcompilation.ens-lyon.fr/polyhedral-school/). Alain Darte also manages two new mailing lists for news (polyhedral-news@listes.ens-lyon.fr) and discussions (polyhedral-discuss@listes.ens-lyon.fr) on polyhedral code analysis and optimizations.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

- Romain Labolle, a L3 ENS-Lyon student, worked, from June 2014 to July 2014, on the adaptation of parametric tiling with inter-tile data reuse to GPUs (reuse for global memory, reuse for shared memory, reuse for registers, i.e., register tiling), supervised by Alain Darte and Alexandre Isoard.
- Shikhar Makkar, a student from the National Institute of Technology Kurukshetra in India, worked, from June 2014 to August 2014, on the mapping of piece-wise affine functions on FPGAs, supervised by Christophe Alias. His internship was funded by the LIP.
- Amir Teshome Wonjiga, a M1 ENS-Lyon student from Ethiopia, worked, from May 2014 to August 2014, on an implementation of an operational semantics of the X10 language, supervised by Paul Feautrier and Laure Gonnord. His internship was funded by Compsys and the LIP.

CONVECS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. FSN (Fonds national pour la Société Numérique)

8.1.1.1. OpenCloudware

Participants: Rim Abid, Hugues Evrard, Frédéric Lang, Gwen Salaün [correspondent], Lina Ye.

OpenCloudware [0] is a project funded by the FSN. The project is led by France Telecom / Orange Labs (Meylan, France) and involves 18 partners (among which Bull, OW2, Thalès, Inria, etc.). OpenCloudware aims at providing an open software platform enabling the development, deployment and administration of cloud applications. The objective is to provide a set of integrated software components for: (i) modeling distributed applications to be executed on cloud computing infrastructures; (ii) developing and constructing multi-tier virtualized applications; and (iii) deploying and administrating these applications (PaaS platform) possibly on multi-IaaS infrastructures.

OpenCloudware started in January 2012 for three years and nine months. The main contributions of CONVECS to OpenCloudware (see § 6.5.4) are the formal specification of the models, architectures, and protocols (self-deployment, dynamic reconfiguration, self-repair, etc.) underlying the OpenCloudware platform, the automated generation of code from these specifications for rapid prototyping purposes, and the formal verification of the aforementioned protocols.

8.1.1.2. Connexion

Participants: Hubert Garavel [correspondent], Frédéric Lang, Raquel Oliveira.

Connexion [0] (*COntrôle commande Nucléaire Numérique pour l'EXport et la rénovatION*) is a project funded by the FSN, within the second call for projects "*Investissements d'Avenir — Briques génériques du logiciel embarqué*". The project, led by EDF and supported by the *Pôles de compétitivité* Minalogic, Systematic, and *Pôle Nucléaire Bourgogne*, involves many industrial and academic partners, namely All4Tech, Alstom Power, ArevA, Atos Worldgrid, CEA-LIST, CNRS/CRAN, Corys Tess, ENS Cachan, Esterel Technologies, Inria, LIG, Predict, and Rolls-Royce. Connexion aims at proposing and validating an innovative architecture dedicated to the design and implementation of control systems for new nuclear power plants in France and abroad.

Connexion started in April 2012 for four years. In this project, CONVECS will assist another LIG team, IIHM, in specifying human-machine interfaces formally using the LNT language and in verifying them using CADP (see § 6.5.7).

8.1.2. Competitivity Clusters

8.1.2.1. Bluesky for I-Automation

Participants: Hubert Garavel, Fatma Jebali, Jingyan Jourdan-Lu, Frédéric Lang, Eric Léo, Radu Mateescu [correspondent].

Bluesky for I-Automation is a project funded by the FUI (*Fonds Unique Interministériel*) within the *Pôle de Compétitivité* Minalogic. The project, led by Crouzet Automatismes (Valence), involves the SMEs (*Small and Medium Enterprises*) Motwin and VerticalM2M, the LCIS laboratory of Grenoble INP, and CONVECS. Bluesky aims at bringing closer the design of automation applications and the Internet of things by providing an integrated solution consisting of hardware, software, and services enabling a distributed, Internet-based design and development of automation systems. The automation systems targeted by the project are networks of programmable logic controllers, which belong to the class of GALS (*Globally Asynchronous, Locally Synchronous*) systems.

[0] http://www.opencloudware.org
[0] http://www.cluster-connexion.fr

Bluesky started in September 2012 for three years. The main contributions of CONVECS to Bluesky (see § 6.1.3 and § 6.5.5) are the definition of GRL, the formal pivot language for describing the asynchronous behavior of logic controller networks, and the automated verification of the behavior using compositional model checking and equivalence checking techniques.

8.1.3. Other National Collaborations

Additionally, we collaborated in 2014 with the following Inria project-teams:

- OASIS (Inria Sophia-Antipolis – Méditerranée): Eric Madelaine and Ludovic Henrio,
- ESTASYS (Inria Rennes – Bretagne Atlantique): Kevin Corre and Axel Legay,
- MEXICO (Inria Saclay – Île-de-France): Alban Linard.

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

- Gaëlle Calvary and Sophie Dupuy-Chessa (LIG, Grenoble),
- Fabrice Kordon and Lom Messan Hillah (LIP6, Paris),
- Alexandre Hamez (ISAE, Toulouse),
- Noël De Palma and Fabienne Boyer (LIG, Grenoble),
- Xavier Etchevers (Orange Labs, Meylan),
- Matthias Güdemann (Systerel, Aix-en-Provence),
- Meriem Ouederni (IRIT, Toulouse),
- Christophe Deleuze, Ioannis Parissis, and Mouna Tka Mnad (LCIS, Valence),
- Pascal Poizat (LIP6, Paris).

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. SENSATION

Participants: Hubert Garavel [correspondent], Radu Mateescu, Jose Ignacio Requeno, Wendelin Serwe.

SENSATION [0] (*Self ENergy-Supporting Autonomous computaTION*) is a European project no. 318490 funded by the FP7-ICT-11-8 programme. It gathers 9 participants: Inria (ESTASYS and CONVECS project-teams), Aalborg University (Denmark), RWTH Aachen and Saarland University (Germany), University of Twente (The Netherlands), GomSpace (Denmark), and Recore Systems (The Netherlands). The main goal of SENSATION is to increase the scale of systems that are self-supporting by balancing energy harvesting and consumption up to the level of complete products. In order to build such Energy Centric Systems, embedded system designers face the quest for optimal performance within acceptable reliability and tight energy bounds. Programming systems that reconfigure themselves in view of changing tasks, resources, errors, and available energy is a demanding challenge.

SENSATION started on October 1st, 2012 for three years. CONVECS contributes to the project regarding the extension of formal languages with quantitative aspects (see § 6.3.1), studying common semantic models for quantitative analysis, and applying formal modeling and analysis to the case studies provided by the industrial partners (see § 6.5.6).

8.2.2. Collaborations with Major European Organizations

The CONVECS project-team is member of the FMICS (*Formal Methods for Industrial Critical Systems*) working group of ERCIM [0]. R. Mateescu was the chairman of the FMICS working group until November 1st, 2014. H. Garavel is member of the FMICS board, in charge of dissemination actions.

[0] http://sensation-project.eu/
[0] http://fmics.inria.fr

H. Garavel was appointed to a new Working Group within Informatics Europe: "*Parallel Computing (Supercomputing) Education in Europe: State-of-Art*". This is a relatively small working group (about 10 people) with the following missions: to show the need for urgent changes in higher education in the area of computational sciences, to compose a survey of the current landscape of parallel computing and supercomputing education in Europe with respect to different universities and countries, and to prepare a set of recommendations on how to bring ideas of parallel computing and supercomputing into higher educational systems of European countries.

8.2.3. Other European Collaborations

In addition to our partners in aforementioned contractual collaborations, we had scientific relations in 2014 with several European universities and research centers, including:

- Saarland University (Alexander Graf-Brill, Holger Hermanns, and Felix Freiberger),
- RWTH Aachen (Joost-Pieter Katoen and Xiaoxiao Yang),
- Oxford University (Ernst-Moritz Hahn and Marta Kwiatkowska),
- University of Birmingham (Dave Parker),
- Technical University of Eindhoven (Anton Wijs),
- University of Twente (Marieke Huisman and Jaco van de Pol),
- University of Málaga (Carlos Canal, Francisco Duran and Ernesto Pimentel), and
- Brandenburg University of Technology Cottbus - Senftenberg (Monika Heiner).

Our partnership with Saarland University was sustained by the Humboldt Forschungspreis received by H. Garavel, who continued his regular visits to Saarland University.

8.3. International Initiatives

8.3.1. Inria International Labs

H. Garavel is a member of IFIP (*International Federation for Information Processing*) Technical Committee 1 (*Foundations of Computer Science*) Working Group 1.8 on Concurrency Theory chaired successively by Luca Aceto and Jos Baeten.

8.3.2. Other International Collaborations

In 2014, we had scientific relations with several universities abroad, including:

- University of California at Santa Barbara, USA (Tevfik Bultan),
- University of Utah, USA (Chris Myers and Zhen Zhang), and
- Universidad Nacional de Cordoba, Argentina (Pedro d'Argenio).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Alexandre Hamez (ISAE, Toulouse) visited us on March 26-28, 2014. He gave a seminar entitled "*Symbolic Model Checking and Hierarchical Set Decision Diagrams*".
- Chris Myers (University of Utah, USA) visited us from July 7–11, 2014. He gave a talk entitled "*Genetic Design Automation*" on July 8, 2014.
- The annual CONVECS seminar was held in Herbelon (France) on June 23-25, 2014. The following invited scientists attended the seminar:
  - Laurence Pierre (TIMA, Grenoble, France) gave on June 23, 2014 a talk entitled "*Verification of Correctness and Safety Requirements for SoC Models*".
  - Matthias Güdemann (Systerel, Aix-en-Provence) gave on June 24, 2014 a talk entitled "*Industrial Formal Methods*".
  - Lom Messan Hillah (LIP6, Paris) gave on June 25, 2014 a talk entitled "*Formal Methods in Model-Driven Development and Model-Driven Development in Formal Methods: Practice Makes a Better Bridge*".

DICE Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

DICE is involved in a regional project of the Rhône-Alpes region, ARC6 "Innovative Services for Social Networks", with Telecom Saint Etienne.

7.2. National Initiatives

7.2.1. ANR

DICE is involved in two ANR projects, to start at the end of 2013,

- C3PO, on Collaborative Creation of Contents and Publishing using Opportunistic networks, with LT2C Telecom Saint-Etienne, INSA LYON, IRISA, ChronoCourse, et Ecole des Mines de Nantes.
- Socioplug, Social Cloud over Plug Networks, Enabling Symmetric Access to Data and Preserving Privacy, with LINA / Université de Nantes, Université de Rennes 1, INSA Lyon.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

DICE is involved in the CSA project "Big data roadmap and cross-disciplinarY community for addressing socieTal Externalities (BYTE)", Objective ICT-2013.4.2 Scalable data analytics (c) Societal externalities of Big Data roadmap.

7.4. International Initiatives

7.4.1. Inria International Labs

DICE is involved in the Inria IPL citylab project headed by Valerie Issarny.

7.4.2. Participation In other International Programs

DICE has a joint project on BigData and intermediation "Promises of intermediation platforms for services frugal in resources" that is carried out within the cooperation framework JORISS between ENS Lyon and ECNU Shanghai.

DICE is starting a cooperation with CERN for the design of a new Javascript 2D/3D architecture for LHC event display experiments.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

In 2014, the team DICE supervised three internships of master students, including two international students.

GCG Team

8. Partnerships and Cooperations

8.1. International Initiatives

8.1.1. Inria International Partners

8.1.1.1. Informal International Partners

- P. Sadayappan, OSU, Columbus, Ohio, USA: Collaboration on automatic analysis of I/O complexity (several co-publications); collaboration on code optimization (one join paper + one submitted paper)
- Fernando Pereira, UFMG, Bello Horizonte, Brazil: Collaboration on static analysis (on join paper); collaboration on hybrid analysis (one submitted paper)

8.2. International Research Visitors

8.2.1. Visits of International Scientists

- Prof. Fernando Magno Pereira, 1 months 1/2, UFMG Brazil

8.2.2. Visits to International Teams

8.2.2.1. Research stays abroad

- Fabrice Rastello: 2 months at OSU, Columbus, Ohio with the team of P. Sadayappan.

PRIVATICS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Privamov'

Title: Privamov'

Type: Labex IMU.

Duration: September 2013 - 2015.

Coordinator: LIRIS.

Others partners: EVS-ITUS, Inria Urbanets.

Abstract: The objective of this project is to provide researchers the IMU community traces of urban mobility allowing further their research and validate their assumptions and models. Indeed , many communities need to know the modes of urban transport : sociologists, philosophers , geographers, planners or computer scientists. If these traces are an important feature for researchers or industrial, they are more for users who have helped to build: attacks jeopardize the privacy of users. Anonymization techniques developed within the project will make available to the greatest number of these traces, while ensuring that the entire process (from collection to data analysis) will be made in respect of the privacy of users involved.

7.1.2. SCCyPhy

Title: SCCyPhy

Type: Labex Persyval.

Duration: September 2013 - 2015.

Coordinator: Institut Fourier.

Others partners: Inria MOAIS, Verimag, CEA/LETI, LIG, GIPSA-Lab, TIMA.

Abstract: A main motivation of this action-team is to provide a structure to the Grenoble community in computer security and cryptography in the spirit of the PERSYVAL-lab Labex. Our emphasize, within the PCS workpackage, is around complementary areas of research with high impact for science and technology, with the following target applications: embedded systems (including smartphones and sensors network), at both software and hardware levels, distributed architectures (including "cloud" and "sky"), privacy and protection of information systems against cyberattacks of various origins.

7.2. National Initiatives

7.2.1. FUI

7.2.1.1. XDATA

Title: XDATA.

Type: FUI.

Duration: April 2013 - April 2015.

Coordinator: Data Publica

Others partners: Inria, Orange, EDF, LaPoste, Hurance, Cinequant, IMT.

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

Abstract: The X-data project is a “projet investissements d’avenir” on big data with Data Publica (leader), Orange, La Poste, EDF, Cinequant, Hurence and Inria (Indes, Privatics and Zenith) . The goal of the project is to develop a big data plaftform with various tools and services to integrate open data and partners’s private data for analyzing the location, density and consuming of individuals and organizations in terms of energy and services. In this project, the Zenith team leads the workpackage on data protection and anonymization.

7.2.2. ANR

7.2.2.1. BIOPRIV

Title: Application of privacy by design to biometric access control.

Type: ANR.

Duration: April 2013 - March 2017.

Coordinator: Morpho (France).

Others partners: Morpho (France), Inria (France), Trusted Labs (France).

See also: http://planete.inrialpes.fr/biopriv/.

Abstract: The objective of BIOPRIV is the definition of a framework for privacy by design suitable for the use of biometric technologies. The case study of the project is biometric access control. The project will follow a multidisciplinary approach considering the theoretical and technical aspects of privacy by design but also the legal framework for the use of biometrics and the evaluation of the privacy of the solutions.

7.2.2.2. BLOC

Title: Analysis of block ciphers dedicated to constrained environments.

Type: ANR.

Duration: October 2013 - September 2015.

Coordinator: INSA-Lyon (France).

Others partners: CITI Laboratory XLIM Laboratory, University of Limoges, Inria Secret, CryptoExperts (PME).

See also: http://bloc.project.citi-lab.fr/.

Abstract: BLOC aims at studying the design and analysis of block ciphers dedicated to constrained environments. The four milestones of BLOC are: security models and proofs, cryptanalysis, design and security arguments and performance analyzes and implementations of lightweight block ciphers. The aims of the project are the following ones: Security models and proofs Cryptanalysis Design C library of lightweight block ciphers We also aim at providing at the end of the project a lightweight block cipher proposal.

7.2.2.3. pFlower

Title: Parallel Flow Recognition with Multi-Core Processor.

Type: ANR.

Duration: March 2011 - September 2014.

Coordinator: LISTIC Université de Savoie.

Others partners: ICT-CAS Insititute of Computing Technology (China), LISTIC Université de Savoie.

Abstract: The main objective of this project is to take advantage of powerful parallelism of multi-thread, multi-core processors, to explore the parallel architecture of pipelined-based flow recognition, parallel signature matching algorithms.

7.2.3. Other

7.2.3.1. MOBILITICS

Title: MOBILITICS

Type: joint project.

Duration: January 2012 - Ongoing.

Coordinator: CNIL.

Others partners: CNIL.

Abstract: Platform for mobile devices privacy evaluation. This project strives to deploy an experimental mobile platform for studying and analyzing the weaknesses of current online (smartphone) applications and operating systems and the privacy implications for end-users. For instance, one of the objectives is to understand trends and patterns collected when they are aimed at obtaining general knowledge that does not pertain to any specific individual. Examples of such tasks include learning of commuting patterns, inference of recommendation rules, and creation of advertising segments.

7.2.3.2. CAPPRIS

Title: CAPPRIS

Type: Inria Project Lab

Duration: January 2011 - 2014.

Coordinator: PRIVATICS

Others partners: Inria (CIDRE, Comete, Secsi,Smis), Eurecom, LAAS and CRIDS

Abstract: Cappris (Collaborative Action on the Protection of Privacy Rights in the Information Society) is an Inria Project Lab initiated in 2013. The general goal of Cappris is to foster the collaboration between research groups involved in privacy in France and the interaction between the computer science, law and social sciences communities in this area.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. PRIPARE

Title: Preparing industry to privacy-by-design by supporting its application in research.

Type: COOPERATION (ICT).

Instrument: Support Action (SA).

Duration: October 2013 - September 2015.

Coordinator: Trialog (France).

Others partners: American University of Paris (France), Atos (Spain), Fraunhofer SIT (Germany), Galician Research and Development Center in Advanced Telecommunications (Spain), Inria (France), KU Leuven (Belgium), Trialog (France), Trilateral Research (UK), Universidad Politecnica de Madrid (Spain), University of Ulm (Netherlands), Waterford Institute of Technology (UK).

Abstract: the general goal of PRIPARE is to facilitate the application of privacy by design. To this aim, PRIPARE will support the practice of privacy by design by the ICT research community (to prepare for industry practice) and foster risk management culture through educational material targeted to a diversity of stakeholders. The project will specify a privacy by design software and systems engineering methodology combining a multidisciplinary expertise involving legal, engineering and business viewpoints. The project will also provide best practices material and educational material focusing on risk management of privacy for different target audiences (general public, policy makers, users, ICT students and professional). The project will also pave the way for future research by identifying gaps and providing recommendations for a research agenda for privacy by design.

7.3.1.2. PARIS

Title: Privacy preserving infrastructure for surveillance.

Type: COOPERATION (ICT).

Instrument: Specific Targeted Research Project (STREP).

Duration: January 2013 - December 2015.

Coordinator: Trialog (France).

Others partners: AIT (Austria), Inria (France), KU Leuven (Belgium), Trialog (France), Universidad de Malaga (Spain), Université de Namur (Belgium), Thales (France), Visual Tools (Spain).

See also: http://www.paris-project.org/.

Abstract: PARIS will define and demonstrate a methodological approach for the development of surveillance infrastructure which enforces the right of citizens for privacy, justice and freedom and takes into account the evolving nature of such rights (e.g. aspects that are acceptable today might not be acceptable in the future), and the social and ethical nature of such rights (e.g. perception of such rights varies). The methodological approach will be based on two pillars, first a theoretical framework for balancing surveillance and data protection which fully integrates the concept of accountability, and secondly an associated process for the design of surveillance systems which takes from the start privacy (i.e. Privacy by Design) and accountability (i.e. Accountability by Design).

7.3.2. Collaborations in European Programs, except FP7

7.3.2.1. FI-WARE

Title: Future Internet Ware.

Type: COOPERATION (ICT).

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

Instrument: Integrated Project (IP).

Duration: May 2011 - April 2014.

Coordinator: Telefonica. (Spain)

Others partners: SAP (Germany), IBM (Israel, Switzerland), Inria (France), Thales Communications (France), Telecom Italia (Italy), France Telecom (France), Nokia Siemens Networks (Germany, Hungary, Finland), Deutsche Telekom (Germany), Technicolor (France), Ericsson (Sweden), Atos Origin (Spain), Ingeneria Informatica (Italy), Alcatel-Lucent (Italy, Germany), Siemens (Germany), Intel (Ireland), NEC (United Kingdom), Fraunhofer Institute (Germany), University of Madrid (Spain), University of Duisburg (Germany), University of Roma La Sapienza (Italy), University of Surrey (United Kingdom).

See also: http://www.fi-ware.eu/.

Abstract: The goal of the FI-WARE project is to advance the global competitiveness of the EU economy by introducing an innovative infrastructure for cost-effective creation and delivery of services, providing high QoS and security guarantees. FI-WARE is designed to meet the demands of key market stakeholders across many different sectors, e.g., healthcare, telecommunications, and environmental services. The project unites major European industrial actors in an unique effort never seen before. The key deliverables of FI-WARE will deliver an open architecture and implementation of a novel service infrastructure, building upon generic and reusable building blocks developed in earlier research projects. This infrastructure will support emerging Future Internet (FI) services in multiple Usage Areas, and will exhibit significant and quantifiable improvements in the productivity, reliability and cost of service development and delivery - building a true foundation for the Future Internet.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. CLOUDY

Title: Secure and Private Distributed Data Storage and Publication in the Future Internet

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (ÉTATS-UNIS)

Duration: 2012 - 2014

See also: http://planete.inrialpes.fr/cloudy-associated-team/

Cloud computing is a form of computing where general purpose clients (typically equipped with a web browser) are used to access resources and applications managed and stored on a remote server. Cloud applications are increasingly relied upon to provide basic services like e-mail clients, instant messaging and office applications. The customers of cloud applications benefit from outsourcing the management of their computing infrastructure to a third-party cloud provider. However, this places the customers in a situation of blind trust towards the cloud provider. The customer has to assume that the "cloud" always remains confidential, available, fault-tolerant, well managed, properly backed-up and protected from natural accidents as well as intentional attacks. An inherent reason for today's limitations of commercial cloud solutions is that end users cannot verify that servers in the cloud and the network in between are hosting and disseminating tasks and content without deleting, disclosing or modifying any content. This project seeks to develop novel technical solutions to allow customers to verify that cloud providers guarantee the confidentiality, availability and fault-tolerance of the stored data and infrastructure.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Explorer programme

Cunche Mathieu

Date: Oct 2014 - Nov 2014

Institution: NICTA (Australia)

SPADES Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Projects

8.1.1.1. PiCoq (ANR project)

Participant: Jean-Bernard Stefani.

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

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

The project partners include Inria (CELTIQUE and SPADES teams), LIP (PLUME team), and Université de Savoie. The project runs from November 2010 to October 2014.

8.1.1.2. REVER (ANR project)

Participant: Jean-Bernard Stefani.

The REVER project aims to develop semantically well-founded and composable abstractions for dependable distributed computing on the basis of a reversible programming model, where reversibility means the ability to undo any program execution and to revert it to a state consistent with the past execution. The critical assumption behind REVER is that by combining reversibility with notions of compensation and modularity, one can develop systematic and composable abstractions for dependable programming.

The REVER work program is articulated around three major objectives:

- To investigate the semantics of reversible concurrent processes.
- To study the combination of reversibility with notions of compensation, isolation and modularity in a concurrent and distributed setting.
- To investigate how to support these features in a practical (typically, object-oriented and functional) programming language design.

The project partners are Inria (FOCUS and SPADES teams), Université de Paris VII (PPS laboratory), and CEA (List laboratory). The project runs from December 2011 to November 2015.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

Program: COST

Project acronym: IC1405

Project title: Reversible Computation

Duration: 2015-2019

Coordinator: I. Ulidowski (U. Leicester, UK)

Abstract: This recently launched COST Action aims to establisjh a research network of excellence on reversible commputation. Reversible computation is an emerging paradigm that extends the standard forward-only mode of computation with the ability to execute in reverse, so that computation can run backwards as naturally as it can go forwards. It aims to deliver novel computing devices and software. the potential benefits include the design of new reversible logic gates and circuits – leading to low-power computing –, and new conceptual frameworks, language abstractions and software tools for reliable and recovery-oriented distributed systems.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. RIPPES

Title: RIgorous Programming of Predictable Embedded Systems

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (USA)

University of Auckland (New Zealand)

Duration: 2013 - 2015

See also: https://wiki.inria.fr/rippes

The RIPPES associated teams gathers the SPADES team from Inria Grenoble Rhône-Alpes, the Ptolemy group from UC Berkeley (EECS Department), and the Embedded Systems Research group from U. Auckland (ECE Department). The planned research seeks to reconcile two contradictory objectives of embedded systems, more predictability and more adaptivity. We propose to address these issues by exploring two complementary research directions: (1) by starting from a classical concurrent C or Java programming language and enhancing it to provide more predictability, and (2) by starting from a very predictable model of computation (SDF) and enhancing it to provide more adaptivity.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

University of Bologna, Department of Computer Science (Italy)

Topics: reversibility in concurrent languages

TU Braunschweig, (Germany)

Topics: typical worst-case schedulability analysis

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- April 2014: Eugene Yip (PhD student, U. Auckland) visited Inria Grenoble to work on the semantics of the FOREC PRET programming language (RIPPES associated team).

- April 2014: David Broman (Ass. Prof. KTH Stockholm and UC Berkeley) visited Inria Grenoble to attend the RePP'14 workshop and to work on PRET programming (RIPPES associated team).
- September 2014: Ismail Assayad (Ass. Prof. U. Casablanca) visited Inria Grenoble to work on multi-criteria optimization and scheduling for embedded system.
- September 2014: Lilia Sfaxi (Ass. Prof. ENSI Tunis) and Imen Boudabous (PhD student, ENSI Tunis) visited Inria Grenoble to work on scheduling and energy optimization of data-flow applications on multi-core chips.
- November and December 2014: Partha Roop (Senior Lecturer, U. Auckland) and Hugh Wang (PhD student, U. Auckland) visited Inria Grenoble to work on the FOREC PRET programming language (RIPPES associated team).

8.4.2. Visits to International Teams

- Alain Girault visited UC Berkeley (USA) in February 2014 to work on the parametric dataflow model of computation and on PRET programming (RIPPES associated team).

BIPOP Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

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

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

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

8.3. International Initiatives

8.3.1. Inria International Labs

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

8.4. International Research Visitors

8.4.1. Visits of International Scientists

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

8.4.2. Visits to International Teams

8.4.2.1. Sabbatical programme

Acary Vincent

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

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

MISTIS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **PERSYVACT project.** MISTIS is involved in a 2-year exploratory project, funded (20 keuros for the whole project) by the PERSYVAL labex (https://persyval-lab.org/en), with other teams from local laboratories, LJK, GIPSA-Lab and TIMC. The goal of this research project is to build tools for analyzing hierarchically structured models for high dimensional complex data. In parallel, MISTIS received **15 keuros** from the labex for the PhD of A. Chiancone co-advised with J. Chanussot from GIPSA-Lab.
- **Grenoble Pole Cognition (2013-14).** We received in 2012, 2013 and 2014 **2.5 keuros** from the Grenoble Pole Cogntion, http://www.grenoblecognition.fr/, for collaborative projects involving the GIN and NeuroSpin. This funding was used this year for the internship of Alexis Arnaud on MRI analysis for small animals.
- MISTIS is involved in three regional initiatives: PEPS (funded by CNRS and the PRES of Grenoble), AGIR (funded by Université Grenoble 1 and Grenoble-INP) and the MOTU project (funded by UPMF). The first two projects focus on the modelling of the extreme risk and its application in social science. The partners include the LTHE (Laboratoire d'étude des Transferts en Hydrologie et Environnement) and the 3S-R lab (Sols, Solides, Structures - Risques). The third project focuses on the use of statistical techniques for transportation data analysis and involves the GAEL laboratory (Grenoble Applied Economics Laboratory).
- MISTIS participates in the weekly statistical seminar of Grenoble. Jean-Baptiste Durand is in charge of the organization and several lecturers have been invited in this context.
- S. Girard is at the head of the probability and statistics department of the LJK since september 2012.

8.2. International Initiatives

8.2.1. Informal International Partners

The context of our research is also the collaboration between MISTIS and a number of international partners such as the Statistics Department of University of Washington in Seattle, the Russian Academy of Science in Moscow, the National University of Ireland in Galway, and more recent partners like IDIAP involved in the HUMAVIPS project, Université Gaston Berger in Senegal and University of Melbourne in Australia. We will also work at turning other current European contacts, *e.g.* at EPFL (A. Roche at University Hospital Lausanne and Siemens Healthcare), into more formal partnerships and eventually explore the possibility for a H2020 project in the *Personalizing Health and Care* axis.

The main international collaborations that we are currently trying to develop are with:

- Fabrizio Durante, Free University of Bozen-Bolzano, Italy.
- Emma Holian and John Hinde from National University of Ireland, Galway, Ireland.
- K. Qin and D. Wraith from RMIT in Melbourne, Australia and Queensland University of Technology in Brisbane, Australia.
- E. Deme and S. Sylla from Saint Louis university and IRD in Saint Louis, Senegal.
- Alexandre Nazin and Russian Academy of Science in Moscow, Russia.
- Alexis Roche and University Hospital Lausanne/Siemens Healthcare, Advanced Clinical Imaging Technology group, Lausanne, Switzerland.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Seydou Nourou Sylla (Université Gaston Berger, Sénégal) has been hosted by the MISTIS team for four months.
- Darren Wraith (Queensland University of Technology in Brisbane, Australia) has been hosted by the MISTIS team for 2 weeks.

8.3.1.1. Internships

Alexis Arnaud (Master, from Feb 2014 until June 2013)

Subject: Mixtures of generalized Student multivariate distributions: application to tumor characterisation from multiparametric MRI.

Institution: University Montpellier 2

Anne Charlier (2nd year)

Subject: Estimation of gaz concentrations in a gaz mixture from spectrophotometric measures.

Institution: PHELMA, Grenoble-INP

Lisa Qian-ru (Master)

Subject: Inverse regression to identify and quantify polluants from UV spectroscopy measures.

Institution: Univ. PMF, Hemera, Meylan

Seydou-Nourou Sylla (PhD, from September 2014 to December 2014)

Subject: Classification for medical data

Institution: Université Gaston Berger (Sénégal)

NANO-D Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

We have funding from the Rhone-Alpes region through an ARC6 grant for the development of parallel algorithms for adaptively restrained particle simulations. This grant is funding Krishna Kant Singh's PhD project.

6.2. National Initiatives

6.2.1. ANR

In 2014, NANO-D had funding from two ANR programs:

- **ANR Jeunes Chercheurs Jeunes Chercheuses (JCJC)**: 340,000 Euros over three years (2011-2014). This grant has been provided to S. Redon by the French Research Agency for being a finalist in the ERC Starting Grant 2009 call, and is for two PhD students and an engineer.
- **ANR Modeles Numeriques (MN)**: 180,000 Euros over four years (2011-2015). This project, coordinated by NANO-D (S. Grudinin), gathers biologists and computer scientists from three research groups: Dave Ritchie at LORIA, Valentin Gordeliy at IBS (total grant: 360,000 Euros).

6.2.2. PEPS

Sergei Grudinin participates in the Cryo-CA PEPS project. Cryo-CA (Computational algorithms for biomolecular structure determination by cryo-electron microscopy) is a 2-years project, supported by the Projets Exploratoires Pluridisciplinaires (PEPS) program in the panel Bio-Maths-Info provided by CNRS (French National Centre for Scientific Research). The project started on the 01/09/2012. Its main goal is to develop computational algorithms for cryo-electron microscopy (cryo-EM).

The partners of the Cryo-CA project are: Inria Nancy / Team Orpailleur (David Ritchie); Inria Grenoble / Team NANO-D (Sergei Grudinin); and INSERM IGBMC/ Team Integrated structural Biology (Annick Dejaegere, Patrick Schultz, and Benjamin Schwarz).

The main scientific aim of this cross-disciplinary project is to develop computational algorithms to help experimentalists and molecular modelers to solve more rapidly and accurately the structures of macromolecular complexes using cryo-electron microscopy (cryo- EM) and integrative structural biomolecular modeling techniques. More specifically, this PEPS initiative aims to address two important challenges in single particle cryo-EM, namely particle picking and multi-dimensional structure fitting. In the longer term, a further driving aim of this project is to develop strong collaborations amongst the participating teams to position ourselves for a larger project proposal to ANR or ERC.

6.3. European Initiatives

6.3.1. FP7 & H2020 Projects

6.3.1.1. ADAPT

Type: IDEAS

Defi: NC

Instrument: ERC Starting Grant

Objectif: Theory and algorithms for adaptive particle simulation

Duration: September 2012 - August 2017

Coordinator: Stephane Redon

Inria contact: Stephane Redon

6.4. International Initiatives

6.4.1. Inria International Partners

6.4.1.1. Informal International Partners

- We have a collaboration with Boston University on the development of docking algorithms (Dima Kozakov).
- We have a collaboration with ETH Zurich on the development of interactive algorithms for quantum chemistry (Markus Reiher).

6.5. International Research Visitors

6.5.1. Visits of International Scientists

Prof. Dima Kozakov visited the group in 2014. Dima Kozakoz is a Research Assistant Professor at Boston University (http://www.bu.edu/bmerc/people/affiliated-faculty/). Proteomics revolution provided blue-print of molecular interactions in the cell, however, full mechanistic understanding of how molecules interact comes only from three-dimensional structures. As was shown by Protein Structure Initiative (PSI), it is much more difficult to obtain structures of the protein complexes using high resolution experimental approaches, such as an X-ray or NMR, rather than structures of its individual components. Our groups (at Boston University and Inria / LJK Grenoble) have developed highly efficient protein docking approaches, which were successful in the CAPRI protein docking competition, and thus our next goal is to apply these to genome scale studies. We hope that structural modeling can not only provide potential complex structures, but also clean up uncertainty of the data obtained from high-trhoughtput approaches.

NECS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. PEPS META-TRAM

META-TRAM is a PEPS-CNRS project funded for two years (2013-2015). It aims at studying tensor methods for analyzing traffic data. Indeed, for a better management of mobility in modern cities (avoid or better control episodes of congestion, accurately predict traffic trends, finely analyze urban and suburban trips via multimodal networks), it is necessary to develop appropriate analytic tools that integrate multimodality and heterogeneity of networks from inherently multidimensional measures. Three areas are studied: tensor modeling for estimating origin-destination matrices, dynamic clustering flow and synthesis of distributed algorithms adapted to large volume of data, diversity of sensors, and their spatial dispersion. This project involves also I3S Lab (Sophia Antipolis) and CRAN (Nancy).

8.1.2. Projet exploratoire Persyval LOCATE-ME

LOCATE-ME (LOcalization teChniques for pedestriAn navigaTion based on inErtial MEasurements in indoor environments) is a Persyval project funded from April 2014 to August 2015. It aims at proposing a new and fresh look on innovative technologies for localization. It will construct the scientific foundations for development of a prototype of a pedestrian indoor localization system, which has the ability to monitor and track the positions of pedestrians in an indoor environment, where GPS is not available. LOCATE-ME will bring some responses on how to advance the current pedestrian navigation solutions for the critical domains, using robust software. The specific contribution of LOCATE-ME will be the development of a novel fusion algorithm merging two different methods of localization (INS and SHS) to obtain a concrete improvement on tracking position. This project involves also Tyrex team (LIG, Inria Grenoble).

8.1.3. Other collaborations

Inertial and magnetic data integration for human movements analysis

The goal of this consortium, which is in its second year, is to work on how to deal with inertial data in different or complementary fields. Orange Grenoble lab works on the analysis of inertial data and sells some smart-phones equipped with inertial unit. The goal of Orange is to develop from these data some analysis bricks. The bricks are identified by: a) Monitoring of activity by identifying postures and deduce the activity by a correlation table, b) Prevention of falls by an analysis of walking monitoring, c) Monitoring of indoor and outdoor trajectory, d) Position of the sensor, and e) Identification of the dynamic parts of the signal. Orange offers to provide laboratories participating in the consortium: a) The database created through a 2012 IGS experiment where 7 peoples wore smart-phones for 3 months and the report of the experiment, b) The ability to store the data recorded by the consortium on a server in the capacity limit of the predefined server, c) The loan of smart-phones, and d) A schedule of specifications of a service activity monitoring of remote person. A consortium agreement has been signed by eight laboratories: INSA-INL, UJF-AGIM, UJF-GIPSA, CNRS-LAAS, CNRS-IRIT, Ecole des mines de Douai, ISFTTAR, UTT et Orange Labs.

8.2. European Initiatives

8.2.1. Hycon2

Type: COOPERATION

Objective: Engineering of Networked Monitoring and Control Systems

Instrument: Network of Excellence

Objective: Engineering of Networked Monitoring and Control systems

Duration: September 2010 - August 2014

Coordinator: CNRS (France)

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

Inria contact: C. Canudas de Wit

Abstract: Hycon 2 aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems. It focuses in particular on the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems.

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

8.2.2. SPEEDD (Scalable ProactivE Event-Driven Decision making)

Type: STREP

Objective: ICT-2013.4.2a – Scalable data analytics – Scalable Algorithms, software frameworks and viualisation

Duration: Feb. 2014 to Jan. 2017.

Coordinator: National Centre of Scientific Research 'Demokritos' (Greece)

Partners: IBM Israel, ETH Zurich (CH), Technion (Israel), Univ. of Birmingham (UK), NECS CNRS (France), FeedZai (Portugal)

Inria contact: C. Canudas de Wit

Abstract: SPEEDD will develop a prototype for robust forecasting and proactive event-driven decision-making, with on-the-fly processing of Big Data, and resilient to the inherent data uncertainties. NECS will lead the intelligent traffic-management use and show case.

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

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. COMFORT

Title: COntrol and FOrecasting in Transportation networks

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (ÉTATS-UNIS)

Duration: 2014 - 2016

See also: http://necs.inrialpes.fr/v2/pages/comfort/EA_homepage_COMFORT.html

COMFORT is an Associate Team between Inria project-team NeCS and the Berkeley University project PATH. The joint team is in its 1st year of activity. COMFORT addresses open issues for Intelligent Transportation Systems (ITS). The goal of these systems is to use information technologies (sensing, signal processing, machine learning, communications, and control) to improve traffic flow, as well as enhance the safety and comfort of drivers. It has been established over the past several decades, through field studies and many scholarly publications, that the tools of ITS can significantly improve the flow of traffic on congested freeways and streets. Traffic operators can manage the system in a top-down fashion, for example, by changing the speed limit on a freeway, or by controlling the flow on the onramps (ramp metering). Individual drivers can also affect traffic conditions from the bottom up, by making decisions based on reliable predictions. These predictions must be provided by a centralized system that can evaluate the decisions based on global information and sophisticate modeling techniques. It is now crucial to develop efficient algorithms for control and prediction

that are well adapted to current and emerging sensing and communication technologies. The areas of traffic modeling and calibration, state estimation, and traffic control remain central to this effort. Specifically, COMFORT will address issues related to model validation before developing new traffic forecasting and distributed control algorithms. In particular the crucial issue of robustness will be considered through a complementary approach based on both stochastic and deterministic methods. The efficiency of the derived methods will be assessed using large networks simulators and real data obtained from the Californian and the Grenoble's testbed. Three main objectives will be addressed in this collaboration: a) Model validation and robust modeling for traffic estimation, control and forecasting; b) New methods for traffic forecasting; c) New methods for distributed traffic control and estimation.

8.3.2. Inria International Partners

H. Fourati has a collaboration with the Kazakhstan National Technical University (KazNTU). He co-advised (with Pr. Olga Shiryayeva in KazNTU) Zarina Samigulina, a PhD student in KazNTU, which defended her PhD Thesis in May 2014.

8.3.3. Participation In other International Programs

F. Garin, A. Kibangou, P. Grandinetti, and C. Canudas de Wit participated in the workshop Berkeley-Inria-Stanford (BIS'2014, Paris) wich is the joint research program inria@Silicon Valley.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

- Massinissa Boudraham, Master student, University of Bordeaux, from March to September 2014, co-advised by H. Fourati and P. Geneves, master thesis: *Systèmes de navigation pédestre : Analyse et étude comparative*.

8.4.2. Visits to International Teams

8.4.2.1. Sabbatical programme

- C. Canudas de Wit spent one week at the UC Berkeley. He has several meetings with Prof. Horowitz and Dr. Gomes to set up the ground for the collaboration with the student Giovanni De Nunzio on the problem of bandwidth optimization of green waves under eco-driving constraints. He has also two working meetings with Prof. Varaiya on issues of back-pressure control for light intersections, and discussion on modeling limitations of the CTM. He participated also in two seminars organized by the Transportation Institute at UC Berkeley. He also met with Prof. Murat Arcak and his student Sam Coogan and have some discussions on issues of monotonicity in traffic models.
- A. Kibangou spent one week in the Advanced Sensor Networks Group of the department of Electrical and Electronical Engineering of the University of Pretoria (South Africa), one of the top university in Africa.

8.4.2.2. Explorer programme

Giovanni De Nunzio

Date: 24/09/2014 – 14/12/2014

Institution: University of California Berkeley (USA) Visit of Giovanni De Nunzio (Ph.D. student at NeCS team) at PATH, UC Berkeley. Collaboration with Dr. Gabriel Gomes and Prof. Roberto Horowitz. Participation to weekly meeting both for Freeway Traffic research group (held by Prof. Howitz) and Arterial Traffic research group (held by Prof. Varaiya). Two presentations were given at the Arterial meeting: one about the preliminary results with Dr. Gomes, one about the research activities carried out at NeCS team. Participation to the bi-weekly Intelligent Transportation Systems seminars at UC Berkeley.

OPALE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Project "SOKA"

OPALE team is coordinator of the project SOKA, funded by INSEP. The objective is the optimization of the shape of racing canoes in the perspective of 2016 Olympic Games in Rio. Other partners are the Ecole Centrale de Nantes and FFCK (French Federation of Canoe-Kayak).

7.1.2. Project "OASIS"

The OASIS project, Optimization of Addendum Surfaces In Stamping, is an R&D consortium (CS, Arcelor-Mittal, ErDF, Inria, UTC, EURODECISION, ESILV, NECS, DeltaCAD, SCILAB-DIGITEO) of the Pole Systemtic Paris-Region dedicated to develop an optimal design framework (methods-software platforms-applications) for stamping processes. The EPI OPALE/Inria is the leader within the consortium for the Optimization work-package (one of six WP), the role of which is to develop efficient tools well adapted to Pareto front identification of the multicriteria-dependent stamping processes.

The OASIS project yields 2.4 Meuro total financial support (one Ph.D thesis, two post-doctoral positions and 12 months internship for OPALE).

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. GRAIN 2

Type: Cooperation

Defi: Transport (incl. Aeronautics)

Instrument: Coordination and Support Action (CSA)

Objectif: NC

Duration: October 2013 - June 2016

Coordinator: Centre Internacional de Metodes Numerics en Enginyeria, Barcelone (Spain)

Partner: Airbus (Sp), Alenia (I), EADS-IW (F), Rolls-Royce (UK), Ingenia (Sp.), Numeca (B), U. Sheffield (UK), U. Birmingham (UK), CIRA (I), VKI (B), Airbone (NL), Leitat (Sp), Cerfacs (F), U. Cranfield (UK), CAE (CN), GTE (CN), ARI (CN), FAI (CN), ASRI (CN), SAERI (CN), BIAM (CN), ACTRI (CN), BUAA (CN), NPU (CN), PKU (CN), NUAA (CN), ZIU (CN)

Inria contact: Toan Nguyen

Abstract: The main objective of GRAIN2 is to focus its greening activities following the Flight Path 2050 Vision for Aircraft en route to the very ambitious challenge "Protecting the environment and the energy supply" in three major following lines: i) greening the air vehicle, ii) greening the Air transport System and iii) Reducing the carbon foot print of aviation via sustainable alternative fuels. GRAIN2 will identify innovative R & D methods, tools and HPC environments (supercomputers and GPGPUs) in the different KGTs according to the needs of major aeronautical industries to deeper understand the mechanism of engine exhaust emissions, to improve fuel efficiency and environmental performance, to lower noise for landing gear and high lift surfaces, to introduce new materials with multiple functions, to help significantly the development of biofuels for greenhouse gas emission reduction, etc.

http://www.cimne.com/grain2/

7.2.1.2. TraM3

Type: FP7

Defi: NC

Instrument: ERC Starting Grant

Objectif: NC

Duration: October 2010 - March 2016

Coordinator: Inria

Inria contact: Paola Goatin

Abstract: The project intends to investigate traffic phenomena from the macroscopic point of view, using models derived from fluid-dynamics consisting in hyperbolic conservation laws. The scope is to develop a rigorous analytical framework and fast and efficient numerical tools for solving optimization and control problems, such as queues lengths control or buildings exits design. See also: http://www-sop.inria.fr/members/Paola.Goatin/tram3.html

7.2.1.3. VELaSSCo

Type: FP7 (Strep)

Defi: ICT, Technologies for Digital Content and Languages

Instrument: Specific Targeted Research Project

Objectif: Scalable data analytics

Duration: January 2014-December 2016

Coordinator: Centre Internacional de Metodes Numerics en Enginyeria (Spain)

Partners: JOTNE (No.), SINTEF (No.), Fraunhofer IGD (D), ATOS (SP), Univ. Edinburgh (UK)

Inria contact: Toan Nguyen

Abstract: VELaSSCo aims at developing a new concept of integrated end-user visual analysis methods with advanced management and post-processing algorithms for engineering modelling applications, scalable for real-time petabyte level simulations [59]. The interface will enable real-time interrogation of simulation data, generating key information for analysis. Main concerns have to do with handling of large amounts of data of a very specific kind intrinsically linked to geometrical properties; how to store, access, simplify and manipulate billion of records to extract the relevant information; how to represent information in a feasible and flexible way; and how to visualise and interactively inspect the huge quantity of information they produce taking into account end-user's needs. VELaSSCo achieves this by putting together experts with relevant background in Big Data handling, advanced visualisation, engineering simulations, and a User Panel including research centres, SMEs and companies form key European industrial sectors such as aerospace, household products, chemical, pharmaceutical and civil engineering.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. ORESTE

Title: Optimal REroute Strategies for Traffic managEment

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (ÉTATS-UNIS)

Duration: 2012 - 2014

See also: http://www-sop.inria.fr/members/Paola.Goatin/ORESTE

ORESTE is an associated team between OPALE project-team at Inria and the Mobile Millennium / Integrated Corridor Management (ICM) team at UC Berkeley focused on traffic management. With this project, we aim at processing GPS traffic data with up-to-date mathematical techniques to optimize traffic flows in corridors. More precisely, we seek for optimal reroute strategies to reduce freeway congestion employing the unused capacity of the secondary network. The project uses macroscopic traffic flow models and a discrete approach to solve the corresponding optimal control problems. The overall goal is to provide constructive results that can be implemented in practice. Both teams have actively contributed to recent advances in the subject, and we think their collaboration is now mature enough to take advantage of the associate team framework. The Inria team and its theoretical knowledge complement the Berkeley team, with its engineering knowledge anchored in practice.

7.3.2. Participation In other International Programs

- Inria@SILICONVALLEY :

  ORESTE Associated Team with UC Berkeley takes part to the program.

- LIRIMA Team ANO 2010-2014:

  The agreement governing the creation of the International Laboratory for Research in Computer Science and Applied Mathematics (LIRIMA) was signed on 24th November 2009 in Yaoundé. LIRIMA enables cooperation between Inria research teams and teams in Africa (Sub-Saharan Africa and the Maghreb) to be reinforced. It is the continuation of the major operation undertaken by the SARIMA program (2004-08 Priority Solidarity Fund created by the French Ministry of Foreign & European Affairs).

  The LIRIMA team ANO : Numerical analysis of PDEs and Optimization is a partnership between Opale project and the EMI engineering college, Rabat / National Centre for Scientific and Technical Research (CNRST) Morocco. The Team leader is Prof. Rajae Aboulaïch, EMI. Other french participants are the Project Commands at Saclay, Palaiseau and the team-project DRACULA at Inria Lyon.

  The ANO team is composed of ten senior researchers from Morocco and ten senior researchers from France and more than fifteen PhD students.

  The themes investigated are biomathematics (Models for plants growth, cardiovascular and cerebral diseases, cardio image segmentation), mathematical finance (optimal portfolio, risk management, Islamic finance), multiobjective optimization in structural mechanics, and vehicle traffic and crowd motion. Refer to the website http://www.lirima.uninet.cm/index.php/en/ for more details on the LIRIMA Africa themes and teams.

- PHC PROCOPE Team *Transport Networks Modeling and Analysis*
  Duration : Jan. 2014- Dec. 2015
  Coordinator: P. Goatin (France), S. Göttlich (Germany)
  Other partner: University of Mannheim (Germany)
  Abstract: The proposed research cooperation focuses on the development and analysis of methods for time-dependent transport phenomena in complex systems. Such systems are given for example by traffic flow networks, production lines, gas and water networks, or chemical reactions. Our particular importance is to model physical processes according to their scale by suitable mathematical means. To this end a model hierarchy using a discrete description for the small scale effects and a continuous model to describe large scale phenomena is investigated. These novel and nonstandard approaches allow to incorporate detailed nonlinear dynamic behavior, which is currently not possible with the widely used classical mixed?integer linear approaches. Through the coupling of discrete and continuous models, both on the theoretical and the applied level, we will contribute to the quantification of uncertainty as well as on control problems for these systems. The modeling is achieved by first considering transport phenomena such as traffic, production, gas and water before controlling the systems. We analyze system properties and derive and implement efficient

numerical algorithms for simulation and optimization purposes. In this setting, the proposed project yields a significant contribution for tackling large dynamical problems not only restricted to traffic management but also in other engineering areas.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Senior Researchers

Pr. Rinaldo M. Colombo

Subject: Conservation laws with non-local flux function.

Institution: Brescia University , Brescia (Italy)

Pr. Simone Göttlich

Subject: Optimization of traffic flows on networks.

Institution: Mannheim University , Mannheim (Germany)

Pr. Moez Kallel

Subject: Data completion for heat-elasticity systems

Institution: ENIT, Tunis al Manar University (Tunisia)

7.4.1.2. Internships

- E. Bertino from Ecole Centrale de Nantes (uncertainty quantification in traffic flow models).
- C. Fiorini from Politecnico di Milano (multiple gradient descent algorithm applied to unsteady optimization).
- S. Scialanga from Roma La Sapienza University (traffic flow models with non-local velocity)

BAMBOO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ABS4NGS

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

7.1.2. Colib'read

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

7.1.3. Exomic

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

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

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

7.1.5. ExHyb

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

7.1.6. IMetSym

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

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

7.1.7. ImmunSymbArt

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

7.1.8. Metagenomics of Bemisia tabaci

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

7.1.9. SpeciAphid

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

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. BacHBerry

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

Coordinator: Jochen Förster, DTU Danemark

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

Type: FP7 - KBBE (2013-2016)

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

7.2.1.2. DroParCon

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

7.2.1.3. Microme

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

7.2.1.4. SISYPHE

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

7.2.1.5. SWIPE

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

7.2.1.6. Symbiox

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

7.3. International Initiatives

7.3.1. Inria International Labs

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

7.3.2. Inria International Partners

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

7.3.3. Participation In other International Programs

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

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

7.4. International Research Visitors

7.4.1. Visits of International Scientists

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

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

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

BEAGLE Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. Labex Ecofect Call

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

6.2. National Initiatives

6.2.1. ANR

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

6.3. European Initiatives

6.3.1. FP7 & H2020 Projects

6.3.1.1. EvoEvo

Type: FP7

Defi: Future and Emerging Technologies

Instrument: Specific Targeted Research Project

Objectif: FET Proactive: Evolving Living Technologies

Duration: September 2013 - August 2016

Coordinator: Guillaume Beslon

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

Inria contact: Guillaume Beslon

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

6.3.1.2. Neuron-Astro-Nets

Type: FP7

Defi: NC

Instrument: Marie Curie International Outgoing Fellowships for Career Development

Objectif: NC

Duration: (2013-2017)

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

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

Inria contact: Maurizio DE PITTA

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

6.4. International Initiatives

6.4.1. Inria International Partners

6.4.1.1. Declared Inria International Partners

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

6.4.1.2. Informal International Partners

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

6.4.2. Participation In other International Programs

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

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

6.5. International Research Visitors

6.5.1. Visits of International Scientists

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

6.5.1.1. Internships

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

6.5.2. Visits to International Teams

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

DRACULA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

Projects coordination by a member of Dracula

- ANR (jeunes chercheurs) ProCell "Mathematical Methods for Erythropoiesis Modelling: from Proteins to Cell Populations", 2009-2014.
  Participants: Samuel Bernard, Fabien Crauste [Coordinator], Olivier Gandrillon, Thomas Lepoutre, Philippe Michel, Laurent Pujo-Menjouet, Vitaly Volpert.
- ANR BIMOD "Hybrid models of cell populations. Application to cancer modelling and treatment", 2010-2014.
  Participants: Mostafa Adimy, Fabien Crauste, Vitaly Volpert [Coordinator].
- ANR STOCHAGENE "Role of the chromatin dynamics on the stochasticity in gene expression in higher eukaryotic cells", 2011-2015.
  Participant: Olivier Gandrillon [Coordinator].

Collaboration in other projects

- ANR RPIB PrediVac "Innovative modeling tools for the prediction of CD8 T cell based vaccine efficacy", 2013-2015. Partners: U1111 Inserm (J. Marvel, coordinator), Dracula, Altrabio (small company), CoSMo (small company). For Dracula, the budget from 2013 to 2015 is 198 keuros, including three one-year post-doc positions (one post-doc has been recruited in April 2014 (Xuefeng Gao)), and the members are Fabien Crauste and Olivier Gandrillon.
- Thomas Lepoutre participates in the ANR (jeunes chercheurs) MODPOL (head Vincent Calvez (ENS Lyon)) "Cell polarization modeling", 2011-2015.
- Thomas Lepoutre is a member of the ANR KIBORD (head L. Desvillettes) dedicated to "kinetic and related models in biology". 2012-2016.
- Olivier Gandrillon participates in the ANR (Investissement d'Avenir) Iceberg (head Gregory Batt (Inria)) "From population models to model populations: single cell observation, modeling, and control of gene expression".

8.1.2. Other projects

- Inria ADT : SiMuScale "Simulations Multi-Échelles de Populations Cellulaires", 2014-2016.
  Participants: Samuel Bernard [Coordinator], Fabien Crauste, David Parsons.
- Association France Alzheimer Sciences Médicales 2014 : PAMELA "Prion et Alzheimer : Modélisation et Expérimentation d'une Liaison Agressive", 2014. Partners: UR0892 VIM (Virologie et Immunologie Moléculaires), INRA Domaine de Vilvert, Jouy-en-Josas.
  Participants: Mostafa Adimy, Samuel Bernard, Thomas Lepoutre, Laurent Pujo-Menjouet [Coordinator], Léon Tine.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, except FP7 & H2020

- Research program PHC POLONIUM (2014-2015) "Applications of reaction-diffusion equations in biology and medicine". Partners: Warsaw, Poland (Slawomir Bialecki, Jolanta Ciesielska, Bogdan Kazmierczak (coordinator), Marek Kochanczyk, Tomasz Lipniacki).
  Participants: Mostafa Adimy, Abdennasser Chekroun, Laurent Pujo-Menjouet [Coordinator], Alen Tosenberger, Vitaly Volpert.

8.2.2. Collaborations with Major European Organizations

- University of Valladolid (Spain). Collaboration with Oscar Angulo, Juan Carlos Lopez-Marcos and Miguel Ange Lopez-Marcos, on the analysis of an age-structured model describing erythropoiesis, and its numerical resolution.
- Karolinska University Hospital of Stockholm (Sweden). Collaboration with Peter Arner, Mats Eriksson, Erik Arner, Mikael Rydén and Kirsty L. Spalding, on the study of dynamics of human adipose lipid turnover in health and metabolic disease.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. Modelling leukemia

Title: Modeling quiescence and drug resistance in Chronic Myeloid Leukemia

International Partner (Institution - Laboratory - Researcher):

Center for Scientific Computation And Mathematical Modelling, University of Maryland (United States).

Duration: 2013 - 2015.

See also: http://dracula.univ-lyon1.fr/modelling_leukemia.php

Leukemia is the most famous disease of the blood cell formation process (hematopoiesis). Chronic myeloid leukemia results in a uncontrolled proliferation of abnormal blood cells. As the hematopoiesis involves stem cells (not accessible to observations), mathematical modeling is here a great tool to test hypothesis. We will join the expertise of Inria team DRACULA specialized on the modeling of blood cell formation and the Center for Scientific Computation and Applied Mathematical Modeling (CSCAMM, University of Maryland, College Park). The theoretical and modeling experience of team DRACULA and the numerical expertise combined with the links with experimentalists of members of CSCAMM will allow us to study deeply evolution of leukemia. We will especially focus on the behavior of leukemic stem cells and their possibility of becoming quiescent (dormant). Then we will study (using the knowledge obtained on leukemic stem cells) the phenomenon of drug resistance and its propagation over time and finally the mechanisms of multidrug resistance.

8.3.2. Participation In other International Programs

8.3.2.1. M3CD

Program: Euromediterranean 3+3

Title: Mathematical Models and Methods in Cell Dynamics

Inria principal investigator: Mostafa Adimy

International Partners (Institution - Laboratory - Researcher):

Institut Pasteur de Tunis (Tunisia) - Slimane Ben Miled

Consiglio Nazionale delle Ricerche- Istituto per le Applicazioni del Calcolo Mauro Picone (Italy) - Istituto per le Applicazioni del Calcolo Mauro Picone - Roberto Natalini

Cadi Ayyad University (Morocco) - Populations Dynamics Laboratory - Moulay Lhassan Hbid

Duration: Jan 2012 - Dec 2015

The aim of this project is to establish a network working on mathematical and computational models in cell dynamics. This network consists of five groups which have already established close bilateral relations. Those are the Inria teams Bang and Dracula in Paris and Lyon, France, the team IAC-CNR in Rome, Italy, the laboratory of Mathematical Population Dynamics (LMDP) from the university of Marrakech in Morocco, and the team of Mathematical Modelling and Computing in Biology (MoMinBi) from the Pasteur Institute in Tunis. Modelling cell dynamics and related processes is one of the main subjects of interest for the partners for many years. The issues addressed in the present project can be divided into five parts:

1) Analysis of structured models in cell population dynamics ;

2) Dynamics of normal and pathological haematopoiesis ;

3) Dynamics of Darwinian adaptation, in particular by drug resistance in competing cell or parasite populations, healthy and pathological / pathogenic (cancer, bacteria, parasites) ;

4) Dynamics of chemical and physical determinants of filament formation and intracellular spatial organisation of the cytoskeleton conformation ;

5) Coupling of the molecular mechanisms of control of the cell division cycle and cell proliferation.

The first part has been developed for many years by all the partners in this project. It tackles issues related to cell dynamics and biological mechanisms, physiological and chemical properties of cells and cell populations. The other four aspects of the project have been studied in the past by the Inria teams "Bang" and "Dracula" (**2**, **4**, **5**) and the IAC-CNR team (Rome), or are a rapidly emergent theme in Bang (**3**, cell Darwinism) with possible and natural connections with the other teams, in particular IAC-CNR and MoMinBi in Tunisia. Themes (**2**, **4**, **5**) have also been initiated (for their fundamental part) in a recent collaboration between Dracula and the teams from Morocco and Tunisia. The objectives of the present project are to pursue and deepen the study of cell proliferation dynamics and cellular mechanisms using structured models that take into account some new structure variables. The development of computer models will also be investigated in this project. Training and research activities related to these topics are currently underway between the Inria teams and the teams from Marrakech and Tunis, and between the Italian team and Bang. Two co-supervised theses are currently in progress, a Spring school on this subject will be organised by the partners in 2012. This program comes at the right time to give a new impetus to this collaboration. It will lead to the establishment of a multi-site laboratory expertise in population dynamics modelling, especially in cellular dynamics. This project will also allow the teams from Morocco and Tunisia to use their knowledge on mathematics applied to cell dynamics.

8.3.2.2. FCRF

Program: Fonds France Canada pour la recherche (FFCR)- France Canada research fund (FCRF) "New research collaboration" 2014-2015.

Title: Mathematical modelling of megakaryopoiesis and applications to platelet related diseases

Participants: Mostafa Adimy, Fabien Crauste, Laurent Pujo-Menjouet [Coordinator].

International Partners : Canada (Jiguo Cao, Nemanja Kosovalic, Jianhong Wu).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Anass Bouchnita

Subject: Numerical simulations of blood flows and blood coagulation

Date: from March 2014 until May 2014

Institution: École Mohammadia d'Ingénieurs (EMI), Rabat, Morocco

IBIS Project-Team

7. Partnerships and Cooperations

7.1. National initiatives

Project name	AlgeaInSilico: Prédire et optimiser la productivité des microalgues en fonction de leur milieu de croissance
Coordinator IBIS participants Type	O. Bernard H. de Jong Inria Project Lab (2013-)

Project name	GeMCo – Model reduction, experimental validation, and control for the gene expression machinery in *E. coli*
Coordinator IBIS participants Type Web page	M. Chaves E. Cinquemani, J. Geiselmann, C. Gomez Balderas-Barillot, E. Grac, H. de Jong, S. Lacour, C. Pinel, D. Ropers ANR Blanc (2010-2014) http://www-sop.inria.fr/members/Madalena.Chaves/ANR-GeMCo/main.html

Project name	RESET – Arrest and restart of the gene expression machinery in bacteria: from mathematical models to biotechnological applications
Coordinator IBIS participants Type Web page	H. de Jong E. Cinquemani, J. Geiselmann, C. Gomez Balderas-Barillot, E. Grac, H. de Jong, S. Lacour, Y. Markowicz, C. Pinel, D. Ropers Bioinformatics call, Investissements d'Avenir program (2012-2016) https://project.inria.fr/reset/

Project name	Fonction du système de régulation post-transcriptionnel CSR dans la dynamique de l'adaptation métabolique chez la bactérie modèle Escherichia coli
Coordinators IBIS participants Type Web page	M. Cocaign-Bousquet (Inra, LISBP), B. Enjalbert (INSA, LISBP), D. Ropers M. Morin, D. Ropers Contrat Jeune Scientifique Inra-Inria (2012-2016) http://www.inra.fr/les_hommes_et_les_femmes/rejoignez_nous/completer_sa_formation/le_recrutement_de_doctorants/cjs__1/inra_inria

7.2. International collaborations

IBIS has strong collaborations with the group of Giancarlo Ferrari-Trecate at the Computer Engineering & Systems Science Department of the University of Pavia (Italy) and the group of John Lygeros at the Automatic

Control Lab at ETH Zürich (Switzerland). This collaboration started with the FP6 project Hygeia, in which the above groups and IBIS (then HELIX) participated. Over the years, it has resulted in a dozen of co-authored papers and the co-supervision of a PhD thesis by Hidde de Jong and Giancarlo Ferrari-Trecate. Eugenio Cinquemani was a post-doctoral fellow at ETH in the framework of the Hygeia project, and joined the IBIS group as a research scientist in the fall of 2009. Andres Gonzales-Vargas, PhD student of Giancarlo Ferrari-Trecate, will spend six months in IBIS in 2014.

7.3. International research visitors

Visiting PhD student	Andres Gonzalez Vargas (University of Pavia, Italy)
Subject	Stochastic modeling and identification of regulatory networks

Invited professor	Alberto Soria-Lopéz (Centro de Investigación y de Estudios Avanzados (Cinestav) of Instituto Politécnico Nacional (IPN), Mexico)
Subject	Development of an automatically-controlled system of multiplexed mini-bioreactors

KALIFFE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

Our group participates to the following ANR projects with different colleagues of us in Lyon

- ANR STAB on stability for the asymptotic behavior of PDEs, stochastic processes and their discretization. The Principal Investigator is I. Gentil (UCB Lyon) and F. Filbet is a participant.
- ANR BOND on boundaries, numerics and dispersion. The Principal Investigator is S. Benzoni (UCB Lyon) and L. M. Rodrigues is a participant.
- ANR de groupe "*Highly-Efficient ATmospheric modelling*" (HEAT), 2014–2018. The Principal Investigator is Th. Dubos and D. Le Roux is a participant.

On the other hand, we have submitted a projet on the call 2015 on adapted dynamic and multi-scale methods. F. Filbet, M. Bergot are participants.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

This is the last year of the ERC Project Nusikimo devoted to the mathematical and numerical analysis in statistical physics with a special interest to applications in Plasma Physics (CEA-CELIA laboratory in Bordeaux, where the Mega-Joule Laser is built) and micro-technology with MEMS (university of Catania). Our project gathers young researchers in applied mathematics from the group in Mathematical Modelling and Scientific Computing in Lyon.

7.2.2. Collaborations in European Programs, except FP7 & H2020

Program: Eurofusion - Enabling Research Project for the implementation of the fusion roadmap

Project acronym: Verification of global gyrokinetic code.

Project title: Verification of global gyrokinetic codes and development of new algorithms for gyrokinetic and kinetic codes.

Duration: 1 year.

Coordinator: E. Sonnendrücker.

Other partners: Max Planck Intitute (Garching, Germany).

Abstract: The aim of this proposal the improvement of the numerical methods for gyrokinetic models and to investigate new ideas towards fully kinetic simulations of tokamaks and stellarators. It consists of three main parts: the first is devoted to the definition of verification models that enable to verify that the implemented codes are a good approximation to a given continuous model and that contain the most challenging numerical problems in the most simple possible setting. New benchmarks of the codes will also be performed. The second part is devoted to the improvement of each category of codes and the third to experimenting new ideas that can lead to better codes in the longer term

7.3. International Initiatives

7.3.1. Inria International Partners

Our team is a partner on the CoKLyCo project. It is the acronym of the project COffee-Kyoto-LYon-COperation. The project if funded by Inria, through its International Affairs programs and the Japan Society for the Promotion of Science (JSPS), through the cooperation program AYAME (Wink: Ayame means iris. . .).

Kinetic theory plays a central role in many areas of mathematical physics, from nanoscales to continuum mechanics. It is an indispensable tool in the mathematical description of applications in physical science from its origin in dilute gases, to wide applications such as semiconductors, polymers, cells, plasma, galaxies, traffic networking, and swarming. Many challenges remain in both the analysis and efficient computational techniques for such problems. The project is concerned with the modeling of rarefied gas dynamics for Micro-Electro-Mechanical Systems. The design of such devices with tiny scales leads to new questions related to the intricate particles/structures interactions. Strongly motivated by the specific technological content, we wish to develop original computational tools, based on rigorous mathematical basis. This project is therefore concerned with the mathematical analysis and the numerical simulation of systems of PDEs of kinetic type, or their hydrodynamic counter-part, set in a moving domain. In 2014, we started working on several aspects of these questions, owing to a couple of visits and meetings during conferences, like the one in CIRM, Nov, 2014.

7.3.1.1. Informal International Partners

- F. Filbet collaborates with J. M. Qiu from the University of Houston on positive method for Vlasov type models.
- F. Filbet collaborates with G. Russo and S. Boscarino at University of Catania (Italy) on high order numerical schemes for time evolution equation and with L. Pareschi at the University of Ferrara (Italy) on spectral methods for Boltzmann equations [7].
- L. M. Rodrigues collaborates with M. Johnson (Kansas University) and K. Zumbrun (Indiana University) and their group on stability issues and asymptotic model reduction.

MOISE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Clémentine Prieur is a member of the project "Soutien à l'Excellence et à l'Innovation Grenoble INP" MEPIERA (MEthodologies innovantes Pour l'Ingénierie de l'Eau et des Risques Associés) leaded by A.- C. Favre (LTHE).
- N. Feyeux PhD is sponsored by the action ARC3 Environment of the Region Rhone-Alpes.

8.1.1. Collaborations with Various Regional Research Teams

- LGGE Grenoble, Edge team (C. Ritz, O. Gagliardini, F. Gillet-Chaulet, G. Durand), see paragraphs 6.3.2 .
- LTHE, A.C. Favre: hydrological risk assessment.
- LTHE, Thierry Lebel, Théo Vischel: tracking of mesoscale convective systems,
- LTHE, MISTIS, LJK: AGIR project. Clémentine Prieur obtained the funding for a thesis on risk assessment.
- Univ. Lyon 1 collaboration with V. Maume-Deschamps.
- LGGE, MEOM team : 6.2.3 ,6.3.1 ,6.2.3.1 ,6.2.5 , 6.2.1 , 6.1.1 .

8.2. National Initiatives

8.2.1. Interactions with other Inria Project-Teams or Actions

Participants	Inria Project-Team	Research topic	Link
M. Nodet C.Prieur, P. Tencaliec	LEMON MISTIS	Life-Fluid coupling hydrological risk assessment	https://team.inria.fr/lemon/ 6.6
L. Gilquin, C. Helbert, C.Prieur, A. Vidard	STEEP	Calibration and sensitivity analysis for LUTI models	6.8
C.Prieur, L. Viry	GRAAL	Grid deployment for the study of West African Monsoon	6.4
A. Vidard M. Nodet F.X. Le Dimet	CLIME, FLUMINANCE	Image assimilation	6.2.3
A. Vidard, M. Nodet, E.Kazantsev	SCIPORT	Ocean Adjoint Modelling	6.3.1 ,6.2.5

8.2.2. Collaborations with other Research Teams in France

Participants	Research Team	Research topic	Link
C. Prieur	IMT Toulouse, EDF	Sensitivity analysis	6.4.1
C. Helbert, S. Nanty, C. Prieur	CEA Cadarache	Sensitivity analysis	6.4.1
C. Prieur	ICJ Lyon 1, CEDRIC CNAM	Multivariate risk indicators	6.6
C. Prieur	IMT Toulouse, Caracas	Non parametric estimation for hypoelliptic diffusions	6.7
A. Vidard	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique (Toulouse), Mercator-Océan (Toulouse), Laboratoire de Physique des Océans (Brest),	Ocean Data Assimilation	6.3.1
A. Vidard	LOCEAN (Paris)	Ocean Adjoint Modelling	6.3.1
A. Vidard	LPO (Brest), CERFACS	Ocean data assimilation	6.3.1
F. Lemarié, L. Debreu	Ifremer (Brest), LEGOS (Toulouse), LOCEAN (Paris), UPS (Toulouse), SHOM (Toulouse)	Numerical schemes for ocean modelling	6.1.1
F. Lemarié	LPO (Brest), Meteo France (Toulouse), Mercator-Ocean (Toulouse)	Atmospheric boundary layer modeling	6.1.2
L. Debreu, F. Lemarié	LMD (Paris), CNRM (Toulouse), LSCE (Saclay)	Numerical schemes for atmospheric modelling	6.1.1
E. Blayo, F. Lemarié	LSCE (Saclay)	Coupling methods for climate models	6.1.2

8.2.3. Other National Initiatives

- C. Prieur chairs GdR MASCOT NUM, in which are also involved M. Nodet, E. Blayo, C. Helbert, L. Viry, S. Nanty, L. Gilquin.

  http://www.gdr-mascotnum.fr/doku.php
- C. Prieur is the leader of the LEFE/MANU project MULTIRISK (2014-2016) on multivariate risk analysis, which gathers experts from Lyon 1 University, CNAM, LSCE and Grenoble University mainly.
- M. Nodet is involved in GDR Calcul and GDR Ondes.
- A. Vidard leads a group of projects gathering multiple partners in France and UK on the topic "Variational Data Assimilation for the NEMO/OPA9 Ocean Model", see 6.3.1 .
- E. Blayo is the chair of the CNRS-INSU research program on mathematical and numerical methods for ocean and atmosphere LEFE-MANU. http://www.insu.cnrs.fr/co/lefe
- L. Debreu is the coordinator of the national group COMODO (Numerical Models in Oceanography)
- E.Kazantsev, E.Blayo, F. Lemarié participate in the project "PACO - Vers une meilleure paramétrisation de la côte et des conditions limites dans les modèles d'océan" supported by LEFE-GMMC and LEFE-MANU .

8.2.4. ANR

- A 4-year ANR contract: ANR TOMMI (Transport Optimal et Modèles Multiphysiques de l'Image), see paragraphs 6.2.3.2 ,6.2.3 .

- A 4 year ANR contract (2011-2015): ANR COMODO (Communauté de Modélisation Océanographique) on the thematic "Numerical Methods in Ocean Modelling". (coordinator L. Debreu) 6.1.1
- A 4-year ANR contract (2014-2018) : ANR HEAT (Highly Efficient Atmospheric modelling) on the development of numerical schemes for atmospheric models (coordinator: T. Dubos, LMD)
- A 3.5 year ANR contract: ANR CITiES (numerical models project selected in 2012). http://steep.inrialpes.fr/?page_id=46

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. ERA-CLIM2

Type: COOPERATION

Instrument: Specific Targeted Research Project

Program: Collaborative project FP7-SPACE-2013-1

Project acronym: ERA-CLIM2

Project title: European Reanalysis of the Global Climate System

Duration: 01/2014 - 12/2016

Coordinator: Dick Dee (ECMWF, Europe)

Other partners: Met Office (UK), EUMETSAT (Europe), Univ Bern (CH), Univ. Vienne (AT), FFCUL (PT), RIHMI-WDC (RU), Mercator-Océan (FR), Météo-France (FR), DWD (DE), CERFACS (FR), CMCC (IT), FMI (FI), Univ. Pacifico (CL), Univ. Reading (UK), Univ. Versailles St Quentin en Yvelines (FR)

Inria contact: Arthur Vidard

8.3.2. Collaborations with Major European Organizations

Partner: GDR-E CONEDP

Subject: Control of Partial Differential Equations.

Partner: University of Reading, Department of Meteorology, Department of Mathematics

Subject: Data assimilation for geophysical systems.

Partner: European Centre for Medium Range Weather Forecast. Reading (UK)

World leading Numerical Weather Center, that include an ocean analysis section in order to provide ocean initial condition for the coupled ocean atmosphere forecast. They play a significant role in the NEMOVAR project in which we are also partner.

Partner: Met Office (U.K) National British Numerical Weather and Oceanographic service. Exceter (UK).

We do have a strong collaboration with their ocean initialization team through both our NEMO, NEMO-ASSIM and NEMOVAR activities. They also are our partner in the NEMOVAR consortium.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

Jose R. León (UCV, Caracas) was funded for a 1,5 months invitation.

8.4.2. Participation In other International Programs

- C. Prieur collaborates with Jose R. León (UCV, Central University of Caracas).
- C. Prieur is leader of a project ECOS Nord with Venezuela (2012-2015).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Jose-Raphael Leon-Ramos, Caracas University, 3 months
- Victor Shutyaev, Russian Academy of Sciences, 2 weeks

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

- M. Nodet visited the University of Reading Data Assimilation group and gave a seminar.
- F.-X. Le Dimet visited the Florida State University, department of meteorology and oceanography during three weeks in June 2014 (Invitation of Prof. Xiaolei Zou). One seminar given on assimilation of images 6.2.3 .
- F.-X. Le Dimet visited the Harbin Institute of Technology, department of mathematics during one month in October 2014 (Invitation of Prof. Jianwei Ma). A serie of four one-hour seminars has been delivered on variational methods in data assimilation.

NUMED Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Two regional grants for mobility to develop collaborations with A. Samson (Grenoble) and Didier Bresch (Chambéry) respectively.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. DDMoRE

Type: FP7

Duration: February 2011 - January 2016

Inria contact: Marc Lavielle

URL : http://www.ddmore.eu/

7.2.2. Collaborations with Major European Organizations

ERC Grant for Vincent Calvez.

7.3. International Research Visitors

7.3.1. Explorer programme

Emeric Bouin will spent three months as a post doc at Stanford university.

7.3.2. Research stays abroad

E. Bouin and V. Calvez worked two weeks in Austarlia. E. Grenier spent one week in Princeton. P. Vigneaux goes for two months in Sevilla.

STEEP Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

In 2012, we started an informal collaboration with Serge Fenet from the University of Lyon (LIRIS lab), which among others accompanied Brindusa Smaranda's MSc thesis. In 2013, a project we submitted to the IXXI Complex Systems Institute of the Rhône-Alps region, together with the CERAG lab, was accepted. The project is about modeling and data mining applied to territorial ecology.

8.2. National Initiatives

8.2.1. ANR

CITiES (*Calibrage et valIdation de modèles Transport - usagE des Sols*)
Program: "*Modèles Numériques*" 2012, ANR
Duration: 2013 – 2016
Coordinator: Emmanuel Prados (STEEP)
Other partners: LET, IDDRI, IRTES-SET ("Systemes and Transports" lab of Univ. of Tech. of Belfort-Montbéliard), IFSTTAR-DEST Paris (formerly INRETS), LVMT ("*Laboratoire Ville Mobilité Transport*", Marne la Vallée), VINCI (Pirandello Ingenierie, Paris), IAU Île-De-France (Urban Agency of Paris), AURG (Urban Agency of Grenoble), MOISE (Inria project-team)
Abstract: Calibration and validation of transport and land use models.

8.2.2. FRB (Fondation pour la Recherche sur la Biodiversité)

ESNET (Futures of ecosystem services networks for the Grenoble region)
Program: "Modeling and Scenarios of Biodiversity" flagship program, Fondation pour la Recherche sur la Biodiversité (FRB). This project is funded by ONEMA (*Office National de l'Eau et des Milieux Aquatiques*).
Duration: 2013 – 2016
Coordinator: Sandra Lavorel (LECA)
Other partners: EDDEN (UPMF/CNRS), IRSTEA Grenoble (formerly CEMAGREF), PACTE (UJF/CNRS), ERIC (Lyon 2/CNRS)
Abstract: This project explores alternative futures of ecosystem services under combined scenarios of land-use and climate change for the Grenoble urban area in the French Alps. In this project, STEEP works in particular on the modeling of the land use and land cover changes, and to a smaller extent on the interaction of these changes with some specific services.

8.3. International Initiatives

8.3.1. Participation In other International Programs

TRACER (*TRANUS, analyse de la calibration et des erreurs, retours sur Grenoble et Caracas*)
Program: Ecos-NORD
Duration: 2012 – 2014
Coordinator: Mathieu Saujot (IDDRI)
Other partners: University of Caracas (Venezuela)

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Brian Morton

Date: May 2014 - Jul 2014

Institution: University of North Carolina at Chapel Hill (USA)

8.4.1.1. Internships

Jayasi Mehar

Date: May 2014 - Jul 2014

Institution: IIIT-D (Inde)

Solange Blundi

Date: Jul 2014 - Jan 2015

Institution: Universidad de Buenos Aires (Argentina)

Luciano Gervasoni

Date: Jun 2014 - Dec 2014

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

Patricio Inzaghi

Date: Jul 2014 - Jan 2015

Institution: Universidad de Buenos Aires (Argentina)

Abdelrahman Ahmed Mohamed

Date: Mar 2014 - Jul 2014

Institution: Nile University (Egypt)

Iman Boukhriss

Date: Mar 2014 - Aug 2014

Institution: INSA (Lyon)

AVALON Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

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

8.1.1.1. FSN XLcloud, 2012-2014

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

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

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

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

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

8.1.2. French National Research Agency Projects (ANR)

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

Participants: Gilles Fedak, Sylvain Bernard.

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

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

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

Participants: Christian Perez, Laurent Lefèvre, Frédéric Suter.

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

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

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

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

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

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

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

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

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

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

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

8.1.3. Inria Large Scale Initiative

8.1.3.1. HEMERA, 4 years, 2010-2014

Participants: Christian Perez, Laurent Pouilloux, Laurent Lefèvre.

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

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

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

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

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

8.1.4. Inria ADT

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

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

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

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. PRACE 2IP

Participants: Vincent Lanore, Christian Perez, Jérôme Richard.

Title: PRACE – Second Implementation Phase Project

Type: Integrated Infrastructure Initiative Project (I3)

Instrument: Combination of Collaborative projects and Coordination and support action

Duration: September 2011 - August 2014

Coordinator: Thomas Lippert (Germany)

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

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

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

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

8.2.1.2. PaaSage

Participants: Christian Perez, Jonathan Rouzaud-Cornabas.

Title: PaaSage: Model-based Cloud Platform Upperware

Type: Seventh Framework Programme

Instrument: Collaborative project

Duration: October 2012 - September 2016 (48 months)

Coordinator: Pierre Guisset (GEIE ERCIM)

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

See also: http://paasage.eu

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

8.2.2. Collaborations in European Programs, except FP7 & H2020

8.2.2.1. CHIST-ERA STAR

Participants: Laurent Lefèvre, Olivier Glück.

Title: SwiTching And tRansmission project

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

Duration: 2013-2015

Coordinator: Jaafar Elmirghani (University of Leeds - UK)

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

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

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

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

8.2.2.2. COST IC1305 : Nesus

Participants: Laurent Lefèvre, Marcos Dias de Assunçao.

Program: COST

Project acronym: IC1305

Project title: Network for Sustainable Ultrascale Computing (NESUS)

Duration: 2014-2019

Coordinator: Jesus Carretero (Univ. Madrid)

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

8.2.2.3. SEED4C

Program: Celtic-Plus

Project acronym: SEED4C

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

Duration: 2012-2015

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

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

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

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

8.3. International Initiatives

8.3.1. Inria International Labs

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

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

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

8.3.2. Participation In other International Programs

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

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

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

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

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Tchimou N'Takpé, Assistant Professor

Date: Oct 2014 - Nov 2014

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

Mircea Moca, Assistant Professor

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

Institution: Babes-Bolyai University (Roumania)

Mircea Moca, Assistant Professor

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

Institution: Babes-Bolyai University (Roumania)

Asma Ben Cheikh Ahmed, PhD Student

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

Institution: Faculté des Sciences de Tunis (Tunisia)

Miranda Qian Zhang, PhD Student

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

Institution: Australian National University (Australia)

Julio Anjos, PhD student

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

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

8.4.1.1. Internships

Anshul Gupta

Date: May 2014 - Jul 2014

Institution: LNM Institute of Information Technology (India)

CTRL-A Exploratory Action

8. Partnerships and Cooperations

8.1. Regional Initiatives

The Labex Persyval-lab is a large regional initiative, supported by ANR, where we are contributing through two projects:

8.1.1. Projet Exploratoire STAARS

This project, defined for one and a half year, grouped members from Inria, LIG and Gipsa-lab, and concerned the general topic of control for computing, with a special emphasis on relating stochastic models with logical discrete control. It enabled us to organize two international workshops in Grenoble: https://persyval-lab.org/en/exploratory-project/staars

8.1.2. Equipe-action HPES

This project groups members from Inria, LIG, Gipsa-lab, TIMA and Gipsa-lab, around the topic of High-Performance Computing benefitting from technologies originally developed for Embedded Systems. Ctrl-A is directly involved in the co-advising of the PhD of Naweiluo Zhou, with J.F. Méhaut (LIG), on the topic of autonomic management of software transactional memory mechanisms: https://persyval-lab.org/en/sites/hpes

8.2. National Initiatives

8.2.1. ANR

Ctrl-Green[0] is an ANR project on Autonomic energy management for virtualized datacenter. The Coordinator is UJF, and the duration: 2011-2014. Others Partners are: Inria Rennes, IRIT, Eolas.

In Ctrl-A, it is funding the PhD thesis of Soguy Gueye, defended in december 2014; before that it funded the post-doc of Nicolas Berthier in 2012. In both cases, co-advising was done with Noeël de Palma (LIG).

8.2.2. Informal National Partners

We have contacts with colleagues in France, with whom we are submitting collaboration projects, co-organizing events and workshops, etc. They feature : Avalon Inria team in Lyon (F. Desprez), LIP6 (J. Malenfant), Scales Inria team in Sophia-Antipolis (L. Henrio), LIRRM in Montpellier (A. Gamatié, K. Godary, D. Simon), IRISA/Inria Rennes (J. Buisson, J.L. Pazat, ...), Telecom Paris-Tech (A. Diaconescu, E. Najm), LAAS (Thierry Monteil).

8.2.3. Informal National Industrial Partners

We have ongoing discussions with several industrial actors in our application domains, some of them in the framework of cooperation contracts, other more informal: Eolas/Business decision (G. Dulac), ST Microelectronics (V. Bertin), Schneider Electric (C. El-Kaed, P. Nappey, M. Pitel), Orange labs (J. Pulou, G. Privat).

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

We have ongoing relations with international colleagues in the emerging community on our topic of control for computing e.g., in Sweden at Lund (K.E. Arzen, M. Maggio) and Linnaeus Universities (D. Weyns, N. Khakpour), in the Netherlands at CWI/leiden University (F. Arbab), in China at Heifei University (Xin An), in Italy at University Milano (C. Ghezzi, A. Leva), in the USA at Ann Arbor University (S. Lafortune).

[0] http://www.en.ctrlgreen.org/

8.3.2. Participation In other International Programs

Eric Rutten is a member of the IFAC Technical Committee 1.3 on Discrete Event and Hybrid Systems, for the 2011-2014 triennium, and for the 2014-2017 triennum http://tc.ifac-control.org/1/3 ; and of the IEEE Control Systems Society Discrete Event Systems Technical Committee http://discrete-event-systems.ieeecss.org.

DANTE Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. IXXI

8.1.1.1. Linguistic usage and social networks: agent based models and direct observation of verbal interactions. (ULMMA)
Participants: Éric Fleury, Márton Karsai.

8.1.1.2. A sociolinguistics of Twitter : social links and linguistics variation
Participants: Éric Fleury, Márton Karsai.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. Equipex FIT (Futur Internet of Things)
Participant: Éric Fleury.

FIT is one of 52 winning projects in the Equipex research grant program. It will set up a competitive and innovative experimental facility that brings France to the forefront of Future Internet research. FIT benefits from 5.8€¨ million grant from the French government Running from 22.02.11 – 31.12.2019. The main ambition is to create a first-class facility to promote experimentally driven research and to facilitate the emergence of the Internet of the future.

8.2.1.2. ANR INFRA DISCO (DIstributed SDN COntrollers for rich and elastic network services)
Participants: Thomas Begin [correspondant], Anthony Busson, Isabelle Guérin Lassous.

The DANTE team will explore the way SDN (Software Designed Network) can change network monitoring, control, urbanisation and abstract description of network resources for the optimisation of services. More specifically, the team will address the issues regarding the positioning of SDN controllers within the network, and the implementation of an admission control that can manage IP traffic prioritization.

8.2.1.3. ANR REFLEXION (REsilient and FLEXible Infrastructure for Open Networking)
Participants: Thomas Begin [correspondant], Anthony Busson, Isabelle Guérin Lassous.

The DANTE team will work on the monitoring of NFV proposing passive and light-weight metrology tools. They will then investigate the modeling of low-level resources consumptions and finally propose methods to dynamically allocate these resources taking into account performance constraints.

8.2.1.4. ANR CONTINT CODDDE
Participants: Éric Fleury [correspondant], Christophe Crespelle, Márton Karsai.

It is a collaborative project between the ComplexNetwork team at LIP6/UPMC; Linkfluence and Inria Dante. The CODDDE project aims at studying critical research issues in the field of real-world complex networks study:

- How do these networks evolve over time?
- How does information spread on these networks?
- How can we detect and predict anomalies in these networks?

In order to answer these questions, an essential feature of complex networks will be exploited: the existence of a community structure among nodes of these networks. Complex networks are indeed composed of densely connected groups of that are loosely connected between themselves.

The CODDE project will therefore propose new community detection algorithms to reflect complex networks evolution, in particular with regards to diffusion phenomena and anomaly detection.

These algorithms and methodology will be applied and validated on a real-world online social network consisting of more than 10 000 blogs and French media collected since 2009 on a daily basis (the dataset comprises all published articles and the links between these articles).

8.2.1.5. ANR RESCUE

Participants: Thomas Begin, Isabelle Guérin Lassous [correspondant].

In the RESCUE project, we investigate both the underlying mechanisms and the deployment of a substitution network composed of a fleet of dirigible wireless mobile routers. Unlike many projects and other scientific works that consider mobility as a drawback, in RESCUE we use the controlled mobility of the substitution network to help the base network reduce contention or to create an alternative network in case of failure. The advantages of an on-the-fly substitution network are manifold: Reusability and cost reduction; Deployability; Adaptability.

The RESCUE project addresses both the theoretical and the practical aspects of the deployment of a substitution network. From a theoretical point of view, we will propose a two-tiered architecture including the base network and the substitution network. This architecture will describe the deployment procedures of the mobile routing devices, the communication stack, the protocols, and the services. The design of this architecture will take into account some constraints such as quality of service and energy consumption (since mobile devices are autonomous), as we want the substitution network to provide more than a best effort service. From a practical point of view, we will provide a proof of concept, the architecture linked to this concept, and the necessary tools (*e.g.*, traffic monitoring, protocols) to validate the concept and mechanisms of on-the-fly substitution networks. At last but not least, we will validate the proposed system both in laboratory testbeds and in a real-usage scenario.

8.2.1.6. ANR FETUSES

Participant: Paulo Gonçalves.

The goals of this ANR project consist in the development of statistical signal processing tools dedicated to per partum fetal heat rate characterization and acidosis detection, and are organized as follows: *(i)* construction of a large dataset of per partum fetal heart rate recordings, which is well documented and of significant clinical value; *(ii)* Developments of adaptive (*e.g.* data driven) algorithms to separate data into trend (deceleration induced by contractions) and fluctuation (cardiac variability) components; *(iii)* Developments of algorithms to characterize the non stationary and multifractal properties of per partum fetal heart rate ; *(iv)* Acidosis detection and assessment using the large datasets; *(v)* Algorithm implementation for performing tests in real clinical situations. ANR is a joint project between DANTE, the Physics Lab of ENS de Lyon (SiSyPhe team) and the *Hôpital Femme-Mère-Enfant* of Bron (Lyon). Fetuses started in january 2012 and will end in june 2015.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

University of Namur: Department of Mathematics/Naxys (Belgium). Collaboration with Renaud Lambiotte on dynamical processes on dynamical networks and communities detections.

Aalto University: Department of Biomedical Engineering and Computational Science (Finland). Collaboration with Jari Saramaki on modeling temporal networks and community like modular structure

Central European University (Hungary). Collaboration with János Kertész on modeling complex contagion phenomena.

ISI Foundation (Italy). Collaboration with Laetitia Gauvin on multiplex networks and transportation systems

UPC (Spain): Department of Telematic Engineering. Collaboration with Monica Aguilar Igartua and Luis J. de la Cruz Llopis on vehicular and community networks.

University of Bergen: Institute of Computer Science (Norway). Collaboration with Pinar Heggernes on graph editing problems for analysis and modeling of complex networks.

Ecole Polytechnique Fédérale de Lausanne (Switzerland). Collaboration with Pierre Vandergheynst on Graph Signal Processing

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

- Taiwan, ACADEMIA SINICA & IIIS. Signature of a MoU in the framework of IoT-LAB.

8.4.2. Participation in other International Programs

8.4.2.1. STIC AMSUD

- Understanding and predicting human demanded COntent and mObiLity (UCOOL). To define solutions for the identification and modeling of correlations between the user mobility – describing changes in the user positioning and the current environment he/she is in – and the traffic demand he/she generates. Partners are: LNNC Brasil, Facultad de Ingenieri´a, Universidad de Buenos Aires (FI/UBA), Universidad Tecnica Federico Santa Maria (USM) Chile,

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Invited professors

Ha Duong PHAN (invited professor of ENS Lyon and UCBL)

Date: March 2014 - April 2014

Institution: Institute of Mathematics of the Vietnam Academy of Science and Technology (Vietnam).

Alexandre BRANDWAJN (Invited Inria Researcher Program)

Date: September 29, 2014 - October 29, 2014

Institution: University of California, Santa Cruz (USA).

8.5.1.2. Invited researchers

Laetita Gauvin

Date: one week each month, February 2014 - December 2014

Institution: ISI Foundation (Italy)

Tommaso Panini (PhD Student)

Date: from Oct 2014 until Jan 2014

Institution: Collegio Carlo Alberto (Italy)

Andres Marcelo Vazquez Rodasi (PhD Student)

Date: from un 2014 until Sep 2014

Institution: UPC (Spain)

8.5.1.3. Internships

Karathanos Christos

Date: Apr 2014 - Jul 2014

Institution: Université Nationale Capodistrienne d'Athènes (Greece)

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

- Thomas Begin, 2 weeks in Spring 2014, University of California Santa Cruz, Jack Baskin School of Engineering, USA.
- Christophe Crespelle, 1 week in December 2014, Institute of Computer Science of the University of Bergen, Norway.
- Christophe Crespelle is in CNRS delegation for 1 year (2014-2015) at the Institute of Mathematics, Vietnam Academy of Science and Technology, Hanoï.
- Christophe Crespelle, 2 months in June-July 2014, Vietnam Institute for Advanced Study in Mathematics (VIASM), Hanoï.
- Christophe Crespelle, 2 months in January-February 2014, Institute of Mathematics, Vietnam Academy of Science and Technology, Hanoï.
- Márton Karsai, 2 times 2 weeks in March and July 2014, Department of Biomedical Engineering and Computational Science, Aalto University, Finland
- Márton Karsai, 1 week June 2014, ISI Foundation Torino, Italy
- Márton Karsai, 1 week December 2014, Central European University, Hungary

MESCAL Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CIMENT

The CIMENT project (Intensive Computing, Numerical Modeling and Technical Experiments, http://ciment.ujf-grenoble.fr/) gathers a wide scientific community involved in numerical modeling and computing (from numerical physics and chemistry to astrophysics, mechanics, bio-modeling and imaging) and the distributed computer science teams from Grenoble. Several heterogeneous distributed computing platforms were set up (from PC clusters to IBM SP or alpha workstations) each being originally dedicated to a scientific domain. More than 600 processors are available for scientific computation. The MESCAL project-team provides expert skills in high performance computing infrastructures. The members of MESCAL involved in this project are Pierre Neyron and Olivier Richard.

8.1.2. Cluster Région

Partners: the Inria GRAAL project-team, the LSR-IMAG and IN2P3-LAPP laboratories.

The MESCAL project-team is a member of the regional "cluster" project on computer science and applied mathematics, the focus of its participation is on handling large amount of data large scale architecture.

8.2. National Initiatives

8.2.1. Inria Large Scale Initiative

- *HEMERA, 2010-2014* Leading action "Completing challenging experiments on Grid'5000 (Methodology)" (see https://www.grid5000.fr/Hemera).

  Experimental platforms like Grid'5000 or PlanetLab provide an invaluable help to the scientific community, by making it possible to run very large-scale experiments in controlled environment. However, while performing relatively simple experiments is generally easy, it has been shown that the complexity of completing more challenging experiments (involving a large number of nodes, changes to the environment to introduce heterogeneity or faults, or instrumentation of the platform to extract data during the experiment) is often underestimated.

  This working group explores different complementary approaches, that are the basic building blocks for building the next level of experimentation on large scale experimental platforms.

8.2.2. ANR

- *ANR GAGA (2014-2017)*

  GAGA is a "Young Researchers" project funded by the French National Research Agency (ANR) to explore the Geometric Aspects of GAmes. The GAGA teamis spread over three different locations in France (Paris, Toulouse and Grenoble), and is coordinated by Vianney Perchet, assistant professor (Maître de Conférences) in the Probabilities and Random Models laboratory in Université Paris VII.

  As the name suggests, our project's focus is game theory, a rapidly developing subject with growing applications in economics, social sciences, computer science, engineering, evolutionary biology, etc. As it turns out, many game theoretical topics and tools have a strong geometrical or topological flavor: the structure of a game's equilibrium set, the design of equilibrium-computing algorithms, Blackwell approachability, the geometric character of the replicator dynamics, the use of semi-algebraicity concepts in stochastic games, and many others. Accordingly, our objective is to perform a systematic study of these geometric aspects of game theory and, by so doing, to establish new links between areas that so far appeared unrelated (such as Hessian-Riemannian geometry and discrete choice theory).

- *ANR MARMOTE, 2013-2016*. Partners: Inria Sophia (MAESTRO), Inria Rocquencourt (DIOGEN), PRiSM laboratory from University of Versailles-Saint-Quentin, Telecom SudParis (SAMOVAR), University Paris-Est Créteil (*Spécification et vérification de systèmes*), Université Pierre-et-Marie-Curie/LIP6.

  The project aims at realizing a software prototype dedicated to Markov chain modeling. It gathers seven teams that will develop advanced resolution algorithms and apply them to various domains (reliability, distributed systems, biology, physics, economy).

- *ANR NETLEARN, 2013-2015*. Partners: PRiSM laboratory from University of Versailles-Saint-Quentin, Telecom ParisTech, Orange Labs, LAMSADE/University Paris Dauphine, Alcatel-Lucent, Inria (MESCAL).

  The main objective of the project is to propose a novel approach of distributed, scalable, dynamic and energy efficient algorithms for managing resources in a mobile network. This new approach relies on the design of an orchestration mechanism of a portfolio of algorithms. The ultimate goal of the proposed mechanism is to enhance the user experience, while at the same time to better utilize the operator resources. User mobility and new services are key elements to take into account if the operator wants to improve the user quality of experience. Future autonomous network management and control algorithms will thus have to deal with a real-time dynamicity due to user mobility and to traffic variations resulting from various usages. To achieve this goal, we focus on two central aspects of mobile networks (the management of radio resources at the Radio Access Network level and the management of the popular contents users want to get access to) and intend to design distributed learning mechanisms in non-stationary environments, as well as an orchestration mechanism that applies the best algorithms depending on the situation.

- *ANR SONGS, 2012-2015*. Partners: Inria Nancy (Algorille), Inria Sophia (MASCOTTE), Inria Bordeaux (CEPAGE, HiePACS, RunTime), Inria Lyon (AVALON), University of Strasbourg, University of Nantes.

  The last decade has brought tremendous changes to the characteristics of large scale distributed computing platforms. Large grids processing terabytes of information a day and the peer-to-peer technology have become common even though understanding how to efficiently exploit such platforms still raises many challenges. As demonstrated by the USS SimGrid project funded by the ANR in 2008, simulation has proved to be a very effective approach for studying such platforms. Although even more challenging, we think the issues raised by petaflop/exaflop computers and emerging cloud infrastructures can be addressed using similar simulation methodology.

  The goal of the SONGS project (Simulation of Next Generation Systems) is to extend the applicability of the SimGrid simulation framework from grids and peer-to-peer systems to clouds and high performance computation systems. Each type of large-scale computing system will be addressed through a set of use cases and led by researchers recognized as experts in this area.

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

8.2.3. National Organizations

Jean-Marc Vincent is member of the scientific committees of the CIST (Centre International des Sciences du Territoire).

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. Mont-Blanc

Program: FP7 Programme

Project acronym: Mont-Blanc

Project title: Mont-Blanc: European scalable and power efficient HPC platform based on low-power embedded technology

Duration: October 2011 - October 2014

Coordinator: Alex Ramirez

Other partners: BSC (Barcelone), Bull, ARM (UK), Julich (Germany), Genci, CINECA (Italy), CNRS (LIRMM, LIG)

Abstract: There is a continued need for higher compute performance: scientific grand challenges, engineering, geophysics, bioinformatics, etc. However, energy is increasingly becoming one of the most expensive resources and the dominant cost item for running a large supercomputing facility. In fact, the total energy cost of a few years of operation can almost equal the cost of the hardware infrastructure. Energy efficiency is already a primary concern for the design of any computer system and it is unanimously recognized that Exascale systems will be strongly constrained by power.

The analysis of the performance of HPC systems since 1993 shows exponential improvements at the rate of one order of magnitude every 3 years: One petaflops was achieved in 2008, one exaflops is expected in 2020. Based on a 20 MW power budget, this requires an efficiency of 50 GFLOPS/Watt. However, the current leader in energy efficiency achieves only 1.7n GFLOPS/Watt. Thus, a 30x improvement is required.

In this project, the partners believe that HPC systems developed from today's energy-efficient solutions used in embedded and mobile devices are the most likely to succeed. As of today, the CPUs of these devices are mostly designed by ARM. However, ARM processors have not been designed for HPC, and ARM chips have never used in HPC systems before, leading to a number of significant challenges.

8.3.1.2. Mont-Blanc 2

Program: FP7 Programme

Project acronym: Mont-Blanc 2

Project title: Mont-Blanc: European scalable and power efficient HPC platform based on low-power embedded technology

Duration: October 2013 - September 2016

Coordinator: BSC (Barcelone)

Other partners: BULL - Bull SAS (France), STMicroelectronics - (GNB SAS) (France), ARM - (United Kingdom), JUELICH - (Germany), BADW-LRZ - (Germany), USTUTT - (Germany), CINECA - (Italy), CNRS - (France), Inria - (France), CEA - (France), UNIVERSITY OF BRISTOL - (United Kingdom), ALLINEA SW LIM - (United Kingdom)

Abstract: Energy efficiency is already a primary concern for the design of any computer system and it is unanimously recognized that future Exascale systems will be strongly constrained by their power consumption. This is why the Mont-Blanc project has set itself the following objective: to design a new type of computer architecture capable of setting future global High Performance Computing (HPC) standards that will deliver Exascale performance while using 15 to 30 times less energy. Mont-Blanc 2 contributes to the development of extreme scale energy-efficient platforms, with potential for Exascale computing, addressing the challenges of massive parallelism, heterogeneous computing, and resiliency. Mont-Blanc 2 has great potential to create new market opportunities for successful EU technology, by placing embedded architectures in servers and HPC.

The Mont-Blanc 2 proposal has 4 objectives:
1. To complement the effort on the Mont-Blanc system software stack, with emphasis on programmer tools (debugger, performance analysis), system resiliency (from applications to architecture support), and ARM 64-bit support.

2. To produce a first definition of the Mont-Blanc Exascale architecture, exploring different alternatives for the compute node (from low-power mobile sockets to special-purpose high-end ARM chips), and its implications on the rest of the system.
3. To track the evolution of ARM-based systems, deploying small cluster systems to test new processors that were not available for the original Mont-Blanc prototype (both mobile processors and ARM server chips).
4. To provide continued support for the Mont-Blanc consortium, namely operations of the Mont-Blanc prototype, and hands-on support for our application developers

8.3.1.3. QUANTICOL

Program: The project is a member of Fundamentals of Collective Adaptive Systems (FOCAS), a FET-Proactive Initiative funded by the European Commission under FP7.

Project acronym: QUANTICOL

Project title: A Quantitative Approach to Management and Design of Collective and Adaptive Behaviours

Duration: 04 2013 – 03 2017

Coordinator: Jane Hillston (University of Edinburgh, Scotland)

Other partners: University of Edinburgh (Scotland); Istituto di Scienza e Tecnologie della Informazione (Italy); IMT Lucca (Italy) and University of Southampton (England).

Abstract: The main objective of the QUANTICOL project is the development of an innovative formal design framework that provides a specification language for collective adaptive systems (CAS) and a large variety of tool-supported, scalable analysis and verification techniques. These techniques will be based on the original combination of recent breakthroughs in stochastic process algebras and associated verification techniques, and mean field/continuous approximation and control theory. Such a design framework will provide scalable extensive support for the verification of developed models, and also enable and facilitate experimentation and discovery of new design patterns for emergent behaviour and control over spatially distributed CAS.

8.3.1.4. NEWCOM#

Program: FP7-ICT-318306

Project acronym: NEWCOM#

Project title: Network of Excellence in Wireless Communications

Duration: 11 2012 – 10 2015

Coordinator: Consorzio Nazionale Interuniversitario per le Telecomunicazioni (Italy)

Other partners: Aalborg Universitet (AAU). Denmark; Bilkent Üniversitesi (Bilkent). Turkey; Centre National de la Recherche Scientifique (CNRS). France; Centre Tecnològic de Telecomunicacions de Catalunya (CTTC). Spain; Institute of Accelerating Systems and Applications (IASA). Greece; Inesc Inovacao; Instituto de Novas Tecnologias (INOV). Portugal; Poznan University of Technology (PUT). Poland; Technion - Israel Institute of Technology (TECHNION). Israel; Technische Universitaet Dresden (TUD). Germany; University of Cambridge (UCAM). United Kingdom; Universite Catholique de Louvain (UCL). Belgium; Oulun Yliopisto (UOULU). Finland

Abstract: NEWCOM# is a project funded under the umbrella of the 7th Framework Program of the European Commission (FP7-ICT-318306). NEWCOM# pursues long-term, interdisciplinary research on the most advanced aspects of wireless communications like Finding the Ultimate Limits of Communication Networks, Opportunistic and Cooperative Communications, or Energy- and Bandwidth-Efficient Communications and Networking.

8.3.2. Collaborations in European Programs, except FP7 & H2020

8.3.2.1. CROWN

Program: European Community and Greek General Secretariat for Research and Technology

Project acronym: CROWN

Project title: Optimal Control of Self Organized Wireless Networks

Duration: 2012-2015

Coordinator: Tassiulas Leandros

Other partners: Thales, University of Thessaly, National and Kapodistrian University of Athens, Athens University of Economics and Business

Abstract: Wireless networks are rapidly becoming highly complex systems with large numbers of heterogeneous devices interacting with each other, often in a harsh environment. In the absence of central control, network entities need to self-organize to reach an efficient operating state, while operating in a distributed fashion. Depending on whether the operating criteria are individual or global, nodes interact in an autonomic or coordinated way. Despite recent progress in autonomic networks, the fundamental understanding of the operational behaviour of large-scale networks is still lacking. This project will address these emergent network properties, by introducing new tools and concepts from other disciplines.

We will first analyze how imperfect network state information can be harvested and distributed efficiently through the network using machine learning techniques. We will design flexible methodologies to shape the competition between autonomous nodes for resources, with aim to maintain robust social optimality. Both cooperating and non-cooperating game-theoretic models will be used. We also consider networks with nodes coordinating to achieve a joint task, e.g., global optimization. Using algorithms inspired from statistical physics, we will address two representative paradigms in the context of wireless ad hoc networks, namely connectivity optimization and the localization of a network of primary sources from a sensor network.

Finally, we will explore delay tolerant networks as a case study of an emerging class of networks that, while sharing most of the characteristics of traditional autonomic or coordinated networks, they present unique challenges, due to the intermittency and constant fluctuations of the connectivity. We will study tradeoffs involving delay, the impact of mobility on information transfer, and the optimal usage of resources by using tools from information theory and stochastic evolution theory.

8.3.3. Collaborations with Major European Organizations

University of Athens: Panayotis Mertikopoulos was an invited professor for 3 months.

EPFL: Laboratoire pour les communications informatiques et leurs applications 2, Institut de systèmes de communication ISC, Ecole polytechnique fédérale de Lausanne (Switzerland). We collaborate with Jean-Yves Leboudec (EPFL) and Pierre Pinson (DTU) on electricity markets.

University of Antwerp: we collaborate with Benny Van Houdt on caching problems.

TU Wien: Research Group Parallel Computing, Technische Universität Wien (Austria). We collaborate with Sascha Hunold on experimental methodology and reproducibility of experiments in HPC.

8.4. International Initiatives

8.4.1. Inria International Labs

8.4.1.1. North America

- JLESC (former JLPC) (Joint Laboratory for Extreme-Scale Computing) with University of University of Illinois Urbana Champaign, Argonne Nat. Lab and BSC. Several members of MESCAL are partners of this laboratory, and have done several visits to Urbana-Champaign or NCSA.
- Associated Team with Berkeley. MESCAL is thus involved in the Inria@SiliconValley program.

8.4.2. Inria Associate Teams

8.4.2.1. EXASE

Title: Exascale Computing Scheduling and Energy

International Partner (Institution - Laboratory - Researcher):

Universidade Federal do Rio Grande do Sul (Brazil)

Duration: 2014 -

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

The main scientific goal of this collaboration for the three years is the development of state-of-the-art energy-aware scheduling algorithms for exascale systems. Three complementary research directions have been identified : (1) Fundamentals for the scaling of schedulers: develop new scheduling algorithms for extreme exascale machines and use existing workloads to validate the proposed scheduling algorithms (2) Design of schedulers for large-scale infrastructures : propose energy-aware schedulers in large-scale infrastructures and develop adaptive scheduling algorithms for exascale machines (3) Tools for the analysis of large scale schedulers : develop aggregation methodologies for scheduler analysis to propose synthetized visualizations for large traces analysis and then analyze schedulers and energy traces for correlation analysis

8.4.2.2. CLOUDSHARE

Title: Guaranteed Application Performance on Idle Data Center Resources

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (United States)

Duration: 2009 - 2014

See also: http://mescal.imag.fr/membres/derrick.kondo/ea/ea.html

Data centers are often 85% idle as they must over-provision to ensure service level agreements. At the same time, high data center utilization is essential for efficient resource usage and optimal revenue. One way to improve utilization is for low-priority applications to use the idle resources of data centers, allowing high-priority applications to preempt them at any time. While users benefit from the lower costs of using these idle resources, parallel applications such as Map-Reduce can suffer severe overheads and unpredictable performance due to unexpected preemption and unavailability. The goal of this project is to enable complex applications to utilize idle data center resources with guaranteed performance. Our approach will be as follows. First, we will investigate novel statistical methods to predict the execution time of complex batch applications. Second, we will apply machine learning methods to predict idleness in data centers. Third, we will craft fair scheduling algorithms for multiple applications that compete for idle data center resources. The collaboration bridges experts in statistical modeling and simulation from the Inria MESCAL team with system and scheduling experts in the Berkeley BOINC team and the Google Infrastructure team.

8.4.3. Inria International Partners

8.4.3.1. Declared Inria International Partners

- MESCAL has strong connections with both UFRGS (Porto Alegre, Brazil) and USP (Sao Paulo, Brazil). The creation of the LICIA common laboratory (see next section) has made this collaboration even tighter.
- MESCAL has strong bounds with the University of Illinois Urbana Champaign, within the (Joint Laboratory on Petascale Computing, see previous section).
- MESCAL also has long lasting collaborations with University of California in Berkeley.

8.4.4. Participation In other International Programs

8.4.4.1. South America

- LICIA. The CNRS, Inria, the Universities of Grenoble, Grenoble INP and Universidade Federal do Rio Grande do Sul have created the LICIA (*Laboratoire International de Calcul intensif et d'Informatique Ambiante*). Jean-Marc Vincent is the director of the laboratory, on the French side.

  The main themes are high performance computing, language processing, information representation, interfaces and visualization as well as distributed systems.

  More information can be found at http://www.inf.ufrgs.br/licia/.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Rhonda Righter (UC Berkeley), two weeks in May.
- Mario Bravo (University of Chile), one week in March.
- Josu Donsel (LAAS), two weeks in September.
- William H. Sandholm (University of Wisconsin), 4 days in September.
- Jian Li (Texas-A&M University) visited as a PhD intern for two months.
- Wenjing Wu (Chinese Academy of Science) (one month, Sept.- Oct.)
- Rafael Tesser (UFRGS) visited as a PhD intern for one month.
- Philippe Navaux (UFRGS), Nicolas Maillard (UFRGS) and Alexandre Carissimi (UFRGS) and Lucas Schnorr (UFRGS) visited Mescal for two weeks in Jan. and Oct. 2014.

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

- Panayotis Mertikopoulos visited the University of Athens for one trimester to the Department of Physics and the Department of Economics (invited by Aris L. Moustakas and Andreas Polydoros).
- Panayotis Mertikopoulos visited the Univeristy of Neuchâtel for one week (Department of Mathematics, invited by Michel Benaïm).
- Panayotis Mertikopoulos visited the University of Wisconsin–Madison for one week (Department of Economics, invited by William H. Sandholm).
- Arnaud Legrand, Luka Stanisic and Augustin Degomme visited the Barcelona Supercomputer Center in November 2014.
- Jean-Marc Vincent visited UFRGS for two weeks in Feb. - Mar. 2014.

MOAIS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- **ANR grant MOEBIUS (2013-2015).** Multi-objective scheduling for large computing platforms. Coordinator: Grenoble INP (Moais team). Partners: Grenoble INP, Inria, BULL.
- **ANR grant EXAVIZ (2011-2015).** Large Scale Interactive Visual Analysis for Life Science. Partners: Inria Rhône-Alpes, Université d'Orléans, the LBT lab from IBPC, the LIMSI from Université d'Orsay, and the CEMHTI labs from CNRS.
- **ANR HPAC (2012-2015)**. High Performance Algebraic Computing. Coordinator: UJF (LJK/CASYS team). Partners: project-team MOAIS (Grenoble), project-team ARENAIRE (LIP, Lyon), project-team SALSA (LIP6, Paris), the ARITH group (LIRMM lab, Montpellier).
- **Equipex Kinovis (2012-2017)**. 2.6 Meuros. Large scale multi-camera platform (extension of the Grimage platform to 60 cameras, depth and X-ray cameras). Coordinator E Boyer, LJK Inria MORPHEO team. Partners: Inria Rhône-Alpes and the LJK, LIG, LADAF and GIPSA labs.
- **ANR-11-LABX-0025 PERSYVAL-Lab** funds the following PhD in collaboration with other labs:
  - in collaboration with Verimag: Multi-objective optimization for resource management on multicore systems, (PhD Abhinav Srivastav, since 9/2012)
  - In collaboration with Gipsa-lab and Inria BiBop: Simulations of Fibrous Materials. (PhD Gilles Daviet, since 9/2013)
  - in collaboration with Inria Privatics and Verimag: Secure Outsourcing (PhD Amrit Kumar, since 11/2013)

7.1.2. Competitivity Clusters

- **SoC-Trace**, Minalogic 2011-2014 contract. This project aims the development of tools for the monitoring and debug of mumticore systems on chip. Leader: ST-Microelectonic. Partners: Inria (Mescal, Moais); UJF (TIMA, LIG/Hadas); Magilem, ProBayes. Moais contributes with technics and tools for visual aggregation of application traces. The contract funds 1 phD thesis (Damien Dosimont) and 1 year engineer.
- **ARAMIS, PIA contract n°P3342-146798 (2014-2017)**: Architecture Robuste pour les Automates et Mate´riels des Infrastructures Sensibles. Coordinator: ATOS-WorldGrid; Partners: CEA, SecLab, UJF. The UJF gathers the folowing teams: LIG (Moais, Drakkar, Vasco); LJK (Casys); IF; Verimag (DCS). BPI funds UJF with 775 ke (funds 4 PhDs and 5 years egineers), among which 410ke for LIG. Moais co-advises two PhD Thesis: Nicolas Kox with LIG-VASCO team (Rupture de protocole avec garanties de se´curite´ pour les syste`mes de contro^le-commande); Maxime Puys with VERIMAG-DCS (Processus de ge´ne´ration de filtres certifie´s pour les syste`mes de contro^le-commande).
- **PIA ELCI (2014-2017)**. Environnement Logiciel pour le Calcul Intensif. Coordinator BULL. Partners: BULL, CEA, Inria, SAFRAB, UVSQ.

7.1.3. National ADT

- ADT K'STAR with cooperation between EPIs MOAIS and RUNTIME (Bordeaux). Coordinator: T. Gautier. https://gforge.inria.fr/projects/kstar. The main objective is to provide OpenMP-3.1 with some extension from OpenMP-4.0 standard to perform OpenMP programs on multi-CPUs multi-GPUs by using XKaapi and StarPU runtimes.

7.1.4. Inria Project Lab

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

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

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

T. Gautier is coordinator of the Pole 4: Programming Models.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. VISIONAIR

Type: FP7

Defi: NC

Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUPPORT ACTIONS

Objectif: NC

Duration: February 2011 - January 2015

Coordinator: Frederic Noël, Grenoble INP.

Partner: Gather 27 European Partners.

Inria contact: G. Dumont

Abstract: Federation of European Virtual Reality and Scientific Visualization Platforms opened to European researchers. Moais involved through the Grimage Platform.

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. ANOMALIES@EXASCALE

Title: Anomalies Detection and Handling towards Exascale Platforms

International Partner (Institution - Laboratory - Researcher):

University of Chicago (ÉTATS-UNIS)

Duration: 2014 - 2016

See also: http://intra-id.imag.fr/

The Anomalies@exascale project intends to prospect new scheduling solutions for very large parallel computing platforms. In particular, we consider the new problems related to fault tolerance raising with the developments of exascale platforms. We expect to define new ways to detect both execution failures and more transient performance anomalies. Information gathered from the detectors will then be taken into account by schedulers to implement corrective measures.

7.3.1.2. ExaSE

Title: Exascale Computing Scheduling and Energy

International Partner (Institution - Laboratory - Researcher):

UFRGS, PUC Minas and UPS (Brazil)

Duration: 2014 - 2016

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

The main scientific context of this project is high performance computing on Exascale systems: large-scale machines with billions of processing cores and complex hierarchical structures. This project intends to explore the relationship between scheduling algorithms and techniques and the energy constraints present on such exascale systems.

7.3.2. Participation to other International Programs

7.3.2.1. LICIA

Title: International Laboratory in High Performance and Ubiquitous Computing

International Partner (Institution - Laboratory - Researcher):

UFRGS (Brazil)

Duration: 2011 - 2018

See also: http://licia-lab.org/

The LICIA is an Internacional Laboratory and High Performance and Ubiquitous Computing born in 2011 from the common desire of members of Informatics Institute of the Federal University of Rio Grande do Sul and of Laboratoire d'Informatique de Grenoble to enhance and develop their scientific parternship that started by the end of the 1970. LICIA is an Internacional Associated Lab of the CNRS, a public french research institution. It has support from several brazilian and french research funding agencies, such as CNRS, Inria, ANR, European Union (from the french side) and CAPES, CNPq, FAPERGS (from the Brazilian side). Moais is deeply invovled in the creation and animation of LICIA. Bruno Raffin is LICIA associate director.

7.3.2.2. CAPES/COFECUB StarShip

Title: Scalable Tools and Algorithms para Resilient, Scalable, Hybrid Interactive Processing

International Partner (Institution - Laboratory - Researcher):

UFRGS (Brazil)

Duration: 2013 - 2016

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Guochuan Zhang. Professor at Zhejiang University, China, one month stay at Moais in 2014.
- Adel Safi, Associate Professor ar ESSTT, Tunisia, 2 weeks stay at Moais in 2014.
- Andreï Tchernykh, Researcher at CICESE, Mexico, one month stay at Moais in 2014.
- Monica Liliana Hernandez Ariza, Master Student at University of Santander, Colombia, 4 months stay at Moais in 2014.

ROMA Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

ANR White Project RESCUE (2010-2015), 4 years. The ANR White Project RESCUE was launched in November 2010, for a duration of 48 months (and was later extended for 6 additional months). It gathers three Inria partners (ROMA, Grand-Large and Hiepacs) and is led by ROMA. The main objective of the project is to develop new algorithmic techniques and software tools to solve the *exascale resilience problem*. Solving this problem implies a departure from current approaches, and calls for yet-to-be-discovered algorithms, protocols and software tools.

This proposed research follows three main research thrusts. The first thrust deals with novel *checkpoint protocols*. The second thrust entails the development of novel *execution models*, i.e., accurate stochastic models to predict (and, in turn, optimize) the expected performance (execution time or throughput) of large-scale parallel scientific applications. In the third thrust, we will develop novel *parallel algorithms* for scientific numerical kernels.

ANR Project SOLHAR (2013-2017), 4 years. The ANR Project SOLHAR was launched in November 2013, for a duration of 48 months. It gathers five academic partners (the HiePACS, Cepage, ROMA and Runtime Inria project-teams, and CNRS-IRIT) and two industrial partners (CEA/CESTA and EADS-IW). This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computers equipped with accelerators.

The proposed research is organized along three distinct research thrusts. The first objective deals with linear algebra kernels suitable for heterogeneous computing platforms. The second one focuses on runtime systems to provide efficient and robust implementation of dense linear algebra algorithms. The third one is concerned with scheduling this particular application on a heterogeneous and dynamic environment.

8.1.2. Inria Project Lab C2S@Exa - Computer and Computational Scienecs at Exascale

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

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues

in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. SCORPIO

Type: FP7

Defi: Future and Emerging Technologies

Instrument: Specific Targeted Research Project

Objectif: Challenging current Thinking

Duration: June 2013 - May 2016

Coordinator: Nikolaos Bellas

Partners: CERTH, Greece; EPFL, Switzerland; RWTH Aachen University, Germany; The Queen's University of Belfast, UK; IMEC, Belgium

Inria contact: Frédéric Vivien

Abstract: A new computing paradigm that exploits uncertainty to design systems that are energy-efficient and scale gracefully under hardware errors by operating below the nominal operating point, in a controlled way, without inducing massive or fatal errors.

8.3. International Initiatives

8.3.1. Inria International Labs

In 2014, the University of Illinois at Urbana-Champaign, Inria, the French national computer science institute, Argonne National Laboratory, Barcelona Supercomputing Center, and Jülich Supercomputing Centre formed the Joint Laboratory on Extreme Scale Computing (JLESC), a follow-up of the Inria-Illinois Joint Laboratory for Petascale Computing. The Joint Laboratory is based at Illinois and includes researchers from Inria, and the National Center for Supercomputing Applications, ANL, BSC, and JSC. It focuses on software challenges found in extreme scale high-performance computers.

Research areas include:

- Scientific applications (big compute and big data) that are the drivers of the research in the other topics of the joint-laboratory.
- Modeling and optimizing numerical libraries, which are at the heart of many scientific applications.
- Novel programming models and runtime systems, which allow scientific applications to be updated or reimagined to take full advantage of extreme-scale supercomputers.
- Resilience and Fault-tolerance research, which reduces the negative impact when processors, disk drives, or memory fail in supercomputers that have tens or hundreds of thousands of those components.
- I/O and visualization, which are important part of parallel execution for numerical silulations and data analytics
- HPC Clouds, that may execute a portion of the HPC workload in the near future.

Several members of the ROMA team are involved in the JLESC joint lab through their research on resilience. Yves Robert is the scientific representant of Inria in JLESC.

8.3.2. Inria Associate Teams

The ALOHA associate-team is a joint project of the ROMA team and of the Information and Computer science Department of the University of Hawai'i (UH) at Mānoa, Honolulu, USA. Building on a vast array of theoretical techniques and expertise developed in the field of parallel and distributed computing, and more particularly application *scheduling*, we tackle database questions from a fresh perspective. To this end, this proposal includes:

- a group that specializes in database systems research and who has both industrial and academic experience, the group of Lipyeow Lim (UH);
- a group that specializes in practical aspects of scheduling problems and in simulation for emerging platforms and applications, and who has a long experience of multidisciplinary research, the group of Henri Casanova (UH);
- a group that specializes in the theoretical aspects of scheduling problems and resource management (the ROMA team).

The research work focuses on the following three thrusts:

1. Online, multi-criteria query optimization
2. Fault-Tolerance for distributed databases
3. Query scheduling for distributed databases

8.4. International Research Visitors

8.4.1. Visits to International Teams

8.4.1.1. Research stays abroad

Yves Robert has been appointed as a visiting scientist by the ICL laboratory (headed by Jack Dongarra) at the University of Tennessee Knoxville. He collaborates with several ICL researchers on high-performance linear algebra and resilience methods at scale.

SOCRATE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Equipex FIT- Future Internet of Things (2011-..., 1.064 k€)

The FIT projet is a national equipex (*equipement d'excellence*), headed by the Lip6 laboratory. As a member of Inria, Socrate is in charge of the development of an Experimental Cognitive Radio platform that should be used as test-bed for SDR terminals and cognitive radio experiments. This should be operational in 2013 for a duration of 7 years. To give a quick view, the user will have a way to configure and program through Internet several SDR platforms (MIMO, SISO, and baseband processing nodes).

8.1.2. ANR - Cormoran - "Cooperative and Mobile Wireless Body Area Networks for Group Navigation" (2012-2015, 150 keuros)

Cormoran project targets to figure out innovative communication functionalities and radiolocation algorithms that could benefit from inter/intra-BAN cooperation. More precisely, the idea is to enable accurate nodes/body location, as well as Quality of Service management and communications reliability (from the protocol point of view), while coping with inter-BAN coexistence, low power constraints and complying with the IEEE 802.15.6 standard. The proposed solutions will be evaluated in realistic applicative scenarios, hence necessitating the development of adapted simulation tools and real-life experiments based on hardware platforms. For this sake, Cormoran will follow an original approach, mixing theoretical work (e.g. modelling activities, algorithms and cross-layer PHY/MAC/NWK design) with more practical aspects (e.g. channel and antennas measurement campaigns, algorithms interfacing with real platforms, demonstrations).

8.1.3. ANR - MetalibM - "Automatic generation of function and filters" (2014-2017, 200 keuros)

The goal of the Metalibm project is to provide a tool for the automatic implementation of mathematical (libm) functions. A function f is automatically transformed into machine-proven C code implementing an polynomial approximation in a given domain with given accuracy. This project is led by Inria, with researchers from Socrate and AriC; PEQUAN team of Laboratoire d'Informatique de Paris 6 (LIP6) at Université Pierre et Marie Curie, Paris; DALI team from Université de Perpignan Via Domitia and Laboratoire d'Informatique, Robotique et Microélectronique de Montpellier (LIRMM); and SFT group from Centre Européen de Recherche Nucléaire (CERN).

8.1.4. FUI ECONHOME - "Energy efficient home networking" (2010-2014, 309 keuros)

The project aims at reducing the energy consumption of the home (multimedia) data networks, while maintaining the quality requirements for heterogeneous services and flows, and preserving, or even enhancing the overall system performance. the equipments under concern are residential gateways, set-top-boxes , PLC modules, Wifi extenders, NAS. The user equipment, such as smartphones, tablets or PCs are not concerned. The approach relies on combining both individual equipments IC and system level protocols that have to be eco-designed.

8.1.5. FUI SMACS - "SMart And Connected Sensors" (2013-2016, 267 keuros)

The SMACS projet targets the deployement of an innovating wireless sensor network dedicated to many domains sport, health and digital cities. The projet involves Socrate (Insavalor), HIKOB and wireless broadcasting company Euro Media France. The main goal is to develop a robust technologie enabling real-time localization of mobile targets (like cyclist for instance), at a low energy (more generaly low cost). The technology will be demonstrated at real cycling races (Tour de France 2013 and 2014). One of the goal is to include localisation information with new radio technology. Another subject of study is distributed wireless consensus algorithms for maintaining a neighborhood knowledge with a low energy budget that scales (more than 200 cycles together)

8.2. European Initiatives

8.2.1. Greentouch GTT project- "Interference Alignment" (2013-2014, 63 keuros)

The Greentouch GTT (Green transmission technology) project aims at proposiing new energy efficient transmission techniques, and focus specifically on the Energy efficiency - spectral efficiency (EE-SE) trade-off. Interference management is a critical issue and socrate aims at designing a dynamic and distributed approach allowing to cancel strong interfers by combining control theory and interference alignment principles.

8.3. International Initiatives

8.3.1. Inria International Partners

Socrate has strong collaborations with several international partners.

- **Princeton University**, School of Applied Science, Department of Electrical Engineering, NJ. USA. This cooperation with Prof. H. Vincent Poor is on topics related to decentralized wireless networks. Samir Perlaza has been appointed as Visiting Research Collaborator at the EE Department. Jean-Marie Gorce spent his Sabatical year at the EE Department. Scientific-Leader at Inria: Jean-Marie Gorce.
- **University of Sheffield**, Department of Automatic Control and Systems Engineering, Sheffield, UK. This cooperation with Prof. Inaki Esnaola is on topics related to information-driven energy systems. Scientific-in-charge at Inria: Samir Perlaza.
- **Virginia Tech**, Discovery Analytics Center, Department of Computer Science, Blacksburg, VA, USA. This cooperation with Prof. Ravi Tandon is on topics related to channel-output feedback in wireless networks. Scientific-Leader at Inria: Samir Perlaza.
- **University of Cyprus**, Department of Electrical and Computer Engineering, University of Cyprus (ECE), Nicosia, Cyprus. This cooperation with Prof. Ioannis Krikidis is on topics related to energy-harvesting and wireless communications systems. Scientific-Leader at Inria: Guillaume Villemaud.

8.3.1.1. Informal International Partners

- **Universidade Federal do Ceará**, Department of Tele-informatics, GTEL lab. A formal cooperation is currently under preparation but, exchange of researchers for seminars and courses already took place between 2012 and 2014. Mutual topics of interests include interference management and massive MIMO.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Sabbatical programme

Gorce Jean-Marie

Princeton University (USA). September 2013 - July 2014. CMIRA regional council Scholarship Programme.

8.4.1.2. Research stays abroad

Samir Perlaza spent few months visiting the following academic partners:

University of Sheffield (UK), May 2014 and October 2014.

Princeton University (UK), June - July 2014.

TYREX Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. Investissements d'avenir

CLAIRE

Title: Community Learning through Adaptive and Interactive multichannel Resources for Education

Call: Technologies for e-education

Duration: March 2012 - February 2014

Coordinator: OpenClassrooms, ex-SimpleIT

Others partners: LIRIS

See also: http://www.projet-claire.fr/

Abstract: Project CLAIRE aims at developing an open-source tool for collaborative authoring in an e-learning environment (Learning Content Management System), targeting teachers and students in high-school and universities. Its innovative features include:

- a platform for collaborative structured editing of rich media and "semantic" content, e.g.: tools for chaptering video, and for generating interactive evaluation tests
- processes for continuous enhancement of content, e.g.: social annotation, behaviour analysis, accessible multi-support publishing, e.g.: web, PDF, ODT, LaTeX, smartphones, tablets.

Datalyse

Title: Entrepôt Intelligent pour Big Data hétérogènes. Investissements d'Avenir Développement de l'Economie Numérique.

Call: Cloud Computing, num 3 – Big Data.

Duration: May 2013 - November 2016

Coordinator: Business & Decision Eolas

Others partners: Groupement des Mousquetaires, Inria Saclay (OAK EPC), LIG (Hadas and Erods teams), LIRMM (Montpellier), LIFL (Lille).

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

Abstract: Project Datalyse aims at designing and deploying an infrastructure for big data storage, collection, certification, integration, categorisation, enrichment and sharing over very large heterogeneous data sets. It relies on an industrial platform, to be made available on the cloud, and focuses on three flagship applications, showcasing three uses of big data over different data sets:

- Data-Center Monitoring: The goal of this application is to provide features such as traceability, reporting, optimisation and analysis of abnormal behaviour regarding energy efficiency and security issues. The application will be built with an existing application called ScopeBR (Eolas) and will be deployed in two different green data centers, those of Eolas and GDF SUEZ.
- "Territoire de données ouvertes et liées": This application aims at extracting and provisioning public open data collected from the city of Grenoble and its suburbs. The goal is to make public data available to third-party application developers and to federate local actors around a single platform.
- Real-time Business Intelligence for the management and processing of points of sale: this application will focus on real-time data analytics and will be deployed within "Groupement des Mousquetaires" in support of their business intelligence platforms.

7.1.2. ANR

Typex

Title: Typeful certified XML: integrating language, logic, and data-oriented best practices
Call: Programme Blanc
Duration: January 2012 - December 2014
Coordinator: PPS (CNRS - Paris 7 Diderot)
Others partners: LRI (Orsay)
See also: http://typex.lri.fr
Abstract: The highly ambitious and final goal of this project is to produce a new generation of XML programming languages stemming from the synergy of integrating three approaches into a unique framework:

- a logical approach based on solvers
- a programming language (PL) approach
- a data-oriented approach

These languages will feature precise and polymorphic type systems that merge PL typing techniques with logical-solver-based type inference. They will be implemented efficiently using the latest research on tree automata and formally certified using modern theorem prover technology. They will offer the capacity to specify and formally verify invariants, business rules, and data integrity, and will have a direct and immediate impact on standardization processes.

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

VENTURI

Title: immersiVe ENhancemenT of User-woRld Interactions
Type: Cooperation (ICT)
Call: FP7-ICT-20111.5 Networked Media and Search Systems
Instrument: Specific Targeted Research Project (STREP)
Duration: October 2011 - September 2014
Coordinator: Fondazione Bruno Kessler (Italy)
Others partners: Fraunhofer Heinrich Hertz Institute (Germany), ST Microelectronics (Italy), ST-Ericsson (France), Metaio (Germany), e-Diam Interactive (Spain), Sony-Ericsson (Sweden)
See also: https://venturi.fbk.eu/
Abstract: Venturi aims to create a pervasive Augmented Reality paradigm, where available information will be presented in a user- rather than device-specific way. The goal is to create an experience that is always present whilst never obstructing. Venturi will exploit, optimize and extend current and next generation mobile platforms; verifying platform and QoE performance through life-enriching use cases and applications to ensure device-to-user continuity.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Prof. Boualem Benatallah, Professor at the School of Computer Science and Engineering (CSE), the University of New South Wales (UNSW) in Sydney, Australia, visited our group for one week in July 2014. The goal of this visit was to initiate common work on the formal verification of web services orchestration and verified API-driven web programming.

7.3.1.1. Internships

Martì Bosch Padros from Universitat Politècnica de Catalunya (UPC) Spain spent six months in the team to work on Automated Refactoring for Size Reduction of CSS Style Sheets.

Joel Ferreira Dos Santos from Universidade Federal Fluminense, UFF, Brasil is spending a one year sandwich PhD in the team to work on the formal verification of multimedia presentations.

URBANET Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- BQR INSA CROME 12/2013-12/2016
  Participants: Fabrice Valois
  The partners in this project are the CITI DynaMid team and LIRIS. The project studies the coordination of a fleet of mobile robots for the multi-view analysis of complex scenes.
- Labex IMU Priva'Mov 10/2013-10/2016
  Participants: Djamel Benferhat, Patrice Raveneau, Hervé Rivano, Razvan Stanica
  The partners in this project are DRIM LIRIS, Inria Privatics, INSA EVS, and LET ENTPE. The aim of this project is to develop and deploy a crowdsensing platform to collect mobility traces from a sample of real users equipped with android devices, while carrying research on privacy preservation issues. Our contribution consists on developing the platform and using the collected data to analyze cellular network offloading strategies.

8.2. National Initiatives

8.2.1. ANR

- ANR ABCD 10/2013-04/2017.
  Participants: Diala Naboulsi, Marco Fiore, Razvan Stanica
  The partners in the ANR ABCD project are: Orange Labs, Ucopia, Inria UrbaNet, UPMC LIP6 PHARE, Telecom ParisTech. The objective of ABCD is to characterize large-scale user mobility and content consumption in urban areas via mobile data mining, so as to achieve efficient deployment and management of cloud resources via virtual machines. Our contribution in the project consists on the characterization of human mobility and service consumption at a city scale, and the design of appropriate resource allocation techniques at the cellular network level.
- ANR IDEFIX 10/2013-04/2017.
  Participants: Soukaina Cherkaoui, Hervé Rivano, Fabrice Valois
  The partners in the ANR IDEFIX project are: Orange Labs, Alcatel Lucent - Bell Labs, Telecom Paris Tech, Inria UrbaNet, Socrate and Dyogene.

8.2.2. Pôle ResCom

- Ongoing participation (since 2006)
  Communication networks, working groups of GDR ASR, CNRS (http://rescom.inrialpes.fr). Hervé Rivano is member of the scientific committee of ResCom.

8.2.3. Common Laboratory Inria/Alcatel-Lucent Bell Labs

- ADR Green
  UrbaNet is part of the ADR Green of the common laboratory Inria/Alcatel-Lucent Bell Labs. This ADR provides the PhD grant of Soukaina Cherkaoui on the adaptation of wireless sensor network control protocols for optimizing the energy consumption of heterogeneous cellular LTE networks.

8.2.4. EquipEx

- SenseCity
  We have coordinated the participation of several Inria teams to the SenseCity EquipEx. Within the SenseCity project, several small reproduction of 1/3rd scale city surroundings will be built under a climatically controlled environment. Micro and nano sensors will be deployed to experiment on smart cities scenarios, with a particular focus on pollution detection and intelligent transport services. Urbanet will have the opportunity to tests some of its capillary networking solutions in a very realistic but controlled urban environment. The first deployment is scheduled early 2015.

8.2.5. Inria Project lab

- CityLab
  Urbanet is involved in the CityLab Inria Project Lab lead by Valérie Issarny. Within this project, Hervé Rivano is the networking referent for the PhD thesis of Raphael Ventura, advised by Vivien Mallet, in the Clime Inria team.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

- ReFleX 04/2014-03/2018.
  Participants: Marco Fiore
  ReFleX (http://www.wcsg.ieiit.cnr.it/Reflex/website/) is a European Union-funded project, within the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme (FP7/2007-2013) under Research Executive Agency grant agreement n.630211. ReFleX aims at characterizing in a comprehensive manner the topological features of large-scale urban vehicular networks built on top of DSRC-based V2V and V2I communication technologies. To that end, the project adopts a multidisciplinary approach, bringing together tools from vehicular networking, wireless communications, transportation theory, and complex network science.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- **Politecnico di Torino (Italy)**. Multiple publications co-authored with members of the Telecommunication Networks Group.
- **University of Waterloo (Ontario, Canada)**. Cooperation and joint publications on the optimization of wireless mesh networks.

8.5. International Research Visitors

8.5.1. Internships

- S. Ancona, MS thesis, Politecnico di Bari, Italy: Offloading Cellular Networks through Residential Wi-Fi Access Points (4 months).
- A. Hadji, MS thesis, SupCom, Tunis, Tunisia: Coordination Model for Fleets of Mobile Robots (5 months).
- O. Jimenez Hidalgo, intern, Simon Bolivar University, Caracas, Venezuela: Visualization of Mobile Data Statistics (3 months).
- I. Keskes, MS thesis, ENIT Tunis, Tunisia: Floating Car Data Resource Allocation in Mobile Vehicular Networks (5 months).
- D. Martella, intern, Politecnico di Torino, Italy: Performance Evaluation of Coordinated Mobility Algorithms with Connectivity Constraints (3 months).

- P. Mikulski, intern, University of Lodz, Poland: Combining DSRC and VLC in Safety Vehicular Networks (3 months).
- B. Mordzak, intern, University of Lodz, Poland: Offloading Capacity of Residential Wi-Fi Networks (3 months)
- C. Ortegon Barajas, intern, University Icesi, Cali, Colombia: Performance Evaluation of Coordinated Mobility Algorithms with Connectivity Constraints (3 months).
- A. Vaidya, intern, Nanyang Technological University, Singapore: Simulation of Vehicular Networks (5 months).

8.5.2. Visits to International Teams

8.5.2.1. Research stays abroad

- **Razvan Stanica** and **Fabrice Valois** were visiting researchers at University of Yaoundé 1 (Cameroon), in June 2014 (one week).
- **Diala Naboulsi** was a visiting scholar within the Telecommunication Networks Group at Politecnico di Torino (Italy), between Sep 2013 and Jan 2014, under the CMIRA Explora'Doc programme.

E-MOTION Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 Projects

European Project (Strep) Bambi (Bottom-up Approaches to Machines dedicated to Bayesian Inference). The Bambi project started January 1st 2014 for a period of three years. The participant to this project are CNRS, HUJI (ISRAEL), ULG (Belgique), ISR(Portugal) ProbaYes(France). We propose a theory and a hardware implementation of probabilistic computation inspired by biochemical cell signaling. We will study probabilistic computation following three axes: algebra, biology, and hardware. In each case, we will develop a bottom-up hierarchical approach starting from the elementary components, and study how to combine them to build more complex systems. We propose Bayesian gates operating on probability distributions on binary variables as the building blocks of our probabilistic algebra. These Bayesian gates can be seen as a generalization of logical operators in Boolean algebra. We propose to interpret elementary cell signalling pathways as biological implementation of these probabilistic gates. In turn, the key features of biochemical processes give new insights for new probabilistic hardware implementation. We propose to associate conventional electronics and novel stochastic nano-devices to build the required hardware elements. Combining them will lead to new artificial information processing systems, which could, in the future, outperform classical computers in tasks involving a direct interaction with the physical world. For this purpose, this project associates research in Bayesian probability theory, molecular biology, nanophysics, computer science and electronics. The e-motion team is mainly concerned by : The development of Stochastic temporal coding of probabilistic information and the adaptation and learning in probabilisitc machines

7.1.2. Collaborations with Major European Organizations

Department of Electrical & Computer Engineering: University of Thrace, Xanthi (GREECE)

Subject: 3D coverage based on Stochastic Optimization algorithms

BlueBotics: BlueBotics Company, Lausanne (Switzerland)

Subject: Implementation of self-calibration strategies for wheeled robots and SLAM algorithms for industrial purposes

Autonomous System laboratory: ETHZ, Zurich (Switzerland)

Subject: Vision and IMU data Fusion for 3D navigation in GPS denied environment.

Robotics and Perception Group: University of Zurich (Switzerland)

Subject: Vision and IMU data Fusion for 3D navigation in GPS denied environment.

Universidade de Aveiro (Portugal)

Subject: Leader following. Co-directed phD.

Centro De Automatica y Robotica, UPM-CSIC, Madrid (Spain)

Subject: Target interception.

Social Robotics Laboratory, Freiburg (Germany)

Subject: Human behavior understanding.

7.2. International Initiatives

7.2.1. "PRETIV"

[November 2011- October 2014]

Multimodal Perception and REasoning for Transnational Intelligent Vehicles" (PRETIV) is a three-year ANR project accepted in the framework of the Blanc International II Programme with participants from France (e-Motion of Inria, Heudiasyc of CNRS, PSA Peugeot Citroen DRIA in Velizy) and China (Peking University, PSA Peugeot Citroen Technical Center in Shanghai). The project aims at developing of an online multimodal perception system for a vehicle and offline reasoning methods, dealing with incompleteness and uncertainties in the models and sensor data, as well as at conducting experiments in typical traffic scenarios in France and China to create an open comparative dataset for traffic scene understanding. The perception system will incorporate vehicle localization, mapping of static environmental objects, detecting and tracking of dynamic objects in probabilistic frameworks through multimodal sensing data and knowledge fusion. The reasoning methods are based on sensor data to learn semantics, activity and interaction patterns (vehicle - other objects, vehicle - infrastructure) to be used as a priori information to devise effective online perception algorithms toward situation awareness. The comparative dataset will contain experimental data of typical traffic scenarios with ground-truth, which will be used to learn country-specific traffic semantics and it will be open to the public.

7.2.1.1. SAMPEN

Title: self adaptive mobile perception and navigation

International Partner (Institution - Laboratory - Researcher):

NTU (TAIWAN)

Duration: 2014 - 2016

See also: http://emotion.inrialpes.fr/people/spalanzani/HomeSAMPEN.html

The associate team project is a Robotic project. The aim of the project is to propose a self-adaptive system of perception combined with a system of autonomous navigation. Usually, systems of perception rely on a set of specific sensors and a calibration is done in a specific environment. We propose to develop some methods to make perception systems adaptive to the environmental context and to the set of sensors used. This perception, that can be embedded on the mobile robot as well as on home structures (wall, ceiling, floor), will be helpful to localize agents (people, robot) present in the scene. Moreover, it will give information to better understand social scenes. All information will be used by the navigation system to move with a behavior that fit the context.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Mario Garzon, PhD student at Universidade de Madrid was in our team from February 2014 until April 2014.
Yufeng Yu, PhD student at Peking University was in our team until February 2014.
Suryansh Kumar, IIIT-Hyderabad, was in our team from September 2013 to March 2014.

7.3.2. Visits to International Teams

7.3.2.1. Research stays abroad

Chiara Troiani

Date: 2013

Institution: University of Zürich (Switzerland)

EXMO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Datalift

Program: ANR-ContInt

Project acronym: Datalift

Project title: DATALIFT

Instrument: platform

Duration: September 2010 - March 2014

Coordinator: Inria EXMO/François Scharffe

Participants: Jérôme Euzenat, Zhengjie Fan, Jérôme David

See also: http://www.datalift.org

Abstract: EXMO coordinates with LIRMM the DATALIFT project whose goal is to produce a platform for publishing governmental data as linked data. EXMO is particularly involved in the generation of links between datasets (see §6.3).

7.1.2. ANR Lindicle

Program: ANR-Blanc international 2

Project acronym: LINDICLE

Project title: Linking data in cross-lingual environment

Duration: January 2013 - December 2016

Coordinator: Inria EXMO/Jérôme David

Participants: Jérôme Euzenat, Manuel Atencia Arcas, Jérôme David, Tatiana Lesnikova, Adam Sanchez Ayte

Other partners: Tsinghua university (CN)

See also: http://lindicle.inrialpes.fr

Abstract: The LINDICLE project investigates multilingual data interlinking between French, English and Chinese data sources (see §6.3).

7.2. European Initiatives

7.2.1. FP7 & H2020 Projects

7.2.1.1. Ready4SmartCities

Type: CAPACITIES

Defi: ICT-2013.6.4 - Optimising Energy Systems in Smart Cities

Instrument: Coordination and Support Action

Project acronym: Ready4SmartCities

Project title: ICT Roadmap and Data Interoperability for Energy Systems in Smart Cities

Objectif: Optimising Energy Systems in Smart Cities

Duration: October 2013 - September 2015

Coordinator: D'appolonia Spa (Italy)

Other partners: D'appolonia (Italy) Universidad Politecnica de Madrid (Spain) CSTB (France), CERTH (Grèce), VTT (Finland), AIT (Austria), AEC3 (UK), Politecnico di Torino (Italy), Empirica (Germany)

Inria contact: Jérôme Euzenat

Participants: Jérôme Euzenat, Luz Maria Priego-Roche, Jérôme David, Adam Sanchez Ayte

See also: http://www.ready4smartcities.eu

Abstract: The Ready4SmartCities project aims at increasing awareness and interoperability for the adoption of OCT and semantic technologies in energy system to obtain a reduction of energy consumption and CO_2 emission at smart cities community level through innovative relying on RTF and innovation outcomes and ICT-based solutions.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- Giuseppe Pirrò (Free University of Bozen-Bolzano) visited EXMO in February 2014 working on web query languages.
- Juanzi Li and Zhigang Wang (Tsinghua university) visited EXMO in October 2014, working on multilingual data interlinking.
- Kate Revoredo and Frenanda Baião (Federal University of the State of Rio de Janeiro) visited EXMO in October, 2014, working on learning alignments.

IMAGINE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Scenoptique (12/2012 - 03/2014)

Participant: Rémi Ronfard.

In October 2011, we started a collaboration with Theatre des Celestins in Lyon on the topic of interactive editing of rehearsals. This research program is funded by the Region Rhone Alpes as part of their CIBLE project, with a budget for a doctoral thesis (Vineet Gandhi) and three large sensor video cameras. Theatre des Celestins is interested in novel tools for capturing, editing and browsing video recordings of their rehearsals, with applications in reviewing and simulating staging decisions. We are interested in building such tools as a direct application and test of our computational model of film editing, and also for building the world's first publicly available video resource on the creative process of theatre rehearsal. Using state-of-the-art video analysis methods, this corpus is expected to be useful in our future work on procedural animation of virtual actors and narrative design. The corpus is also expected to be shared with the LEAR team as a test bed for video-based action recognition.

8.1.2. Labex Persyval

Participants: Rémi Ronfard, Olivier Palombi, Armelle Bauer.

We received a doctoral grant from LABEX PERSYVAL, as part of the research program on authoring augmented reality (AAR) for PhD student Adela Barbelescu. Her thesis is entitled *directing virtual actors by imitation and mutual interaction - technological and cognitive challenges*. Her advisors are Rémi Ronfard and Gérard Bailly (GIPSA-LAB).

Additionally, this project funds the PhD thesis of Armelle Bauer which has started in October, co-advised by François Faure, Olivier Palombi, and Jocelyne Troccaz from TIMC-GMCAO. The goal is to tackle the scientific challenges of visualizing one's self anatomy in motion using Augmented Reality techniques.

8.1.3. TAPIOCA, Persyval Grant (11/2013 - 11/2015)

Participants: Damien Rohmer, Jean-Claude Léon, Marie-Paule Cani.

Tapioca (Tangibilité Physiologique Instrumentée: Outil mixte redimensionnable pour la conception d'artefact) is a *projet exploratoire* of the Persyval Grant. This project aim to study the use of resizable interactive interface to ease the generation of virtual models. This project is in collaboration with LIG, Gipsa-lab and GSCOP.

8.2. National Initiatives

8.2.1. ANR SOHUSIM (10/2010-09/2014)

Participants: Ali Hamadi Dicko, François Faure.

Sohusim (Soft Human Simulation) is a ANR Project which started on October 1st 2010. It is done in collaboration between: EVASION (Inria), Fatronik France (TECNALIA), DEMAR (Inria), HPC PROJECT and the CHU de Montpellier.

This project deals with the problem of modeling and simulation of soft interactions between humans and objects. At the moment, there is no software capable of modeling the physical behavior of human soft tissues (muscles, fat, skin) in mechanical interaction with the environment. The existing software such as LifeMod or OpenSim, models muscles as links of variable length and applying a force to an articulated stiff skeleton. The management of soft tissues is not taken into account and does not constitute the main objective of this software.

A first axis of this project aims at the simple modeling and simulation of a passive human manipulated by a mecatronics device with for objective the study and the systems design of patient's manipulation with very low mobility (clinic bed). The second axis concentrates on the detailed modeling and the simulation of the interaction of an active lower limb with objects like orthesis, exoskeleton, clothes or shoes. The objective being there also to obtain a tool for design of devices in permanent contact with the human who allows determining the adequate ergonomics in terms of forms, location, materials, according to the aimed use.

8.2.2. ANR CORPUS SPECTABLE EN LIGNES (01/2013-01/2015)

Participant: Rémi Ronfard.

Spectacle En Ligne(s) amplifies our collaboration with the Theatre des Celetins in Lyon, which was started with the Scenoptique project in 2011. Scenoptique investigates novel techniques for recording ultra-high definition video, reframing them and editing them into interactive movies. Spectacle En Ligne(s), is targeted on the creation and diffusion of an original data set of integral vídeo recordings of theatre and opera rehearsals. The data set is naturally suited to researchers interested in the creation process and the genetic analysis of dramatic art and mise en scene. To support research in this area, we are extending the audio and visual analysis tools developed in the Scenoptique project.

8.2.3. FUI Dynam'it (01/2012 - 02/2014)

Participant: Francois Faure.

2-year contract with two industrial partners: TeamTo (production of animated series for television) and Artefacts Studio (video games). The goal is to adapt some technologies created in SOFA, and especially the frame-based deformable objects [43], [42] to practical animation tools. This contract provides us with the funding of two engineers and one graphical artist during two years.

8.2.4. FUI Collodi (October 2013 - October 2016)

Participants: Francois Faure, Romain Testylier.

This 3-year contract with two industrial partners: TeamTo and Mercenaries Engineering (software for production rendering), is a follow-up and a generalization of Dynamit. The goal is to propose an integrated software for the animation and final rendering of high-quality movies, as an alternative to the ever-ageing Maya. It will include dynamics similarly to Dynamit, as well as innovative sketch-based kinematic animation techniques invented a Imagine by Martin Guay and Rémi Ronfard. This contract, started in October, funds 2 engineers for 3 years.

8.2.5. ANR CHROME (01/2012 - 08/2015)

Participant: Rémi Ronfard.

Chrome is a national project funded by the French Research Agency (ANR). The project is coordinated by Julien Pettré, member of MimeTIC. Partners are: Inria-Grenoble IMAGINE team (Remi Ronfard), Golaem SAS (Stephane Donikian), and Archivideo (Francois Gruson). The project has been launched in september 2012. The Chrome project develops new and original techniques to massively populate huge environments. The key idea is to base our approach on the crowd patch paradigm that enables populating environments from sets of pre-computed portions of crowd animation. These portions undergo specific conditions to be assembled into large scenes. The question of visual exploration of these complex scenes is also raised in the project. We develop original camera control techniques to explore the most relevant part of the animations without suffering occlusions due to the constantly moving content. A long-term goal of the project is to enable populating a large digital mockup of the whole France (Territoire 3D, provided by Archivideo). Dedicated efficient human animation techniques are required (Golaem). A strong originality of the project is to address the problem of crowded scene visualisation through the scope of virtual camera control, as task which is coordinated by Imagine team-member Rémi Ronfard.

Three phd students are funded by the project. Kevin Jordao is working on interactive design and animation of digital populations and crowds for very large environments. His advisors are Julien Pettré and Marie-Paule Cani. Quentin Galvanne is working on automatic creation of virtual animation in crowded environments. His advisors are Rémi Ronfard and March Christie (Mimetic team, Inria Bretagne). Julien Pettre. Chen-Kin Lim is working on crowd simulation and rendering of the behaviours of various populations using crowd patches. Her advisors are Rémi Ronfard and March Christie (Mimetic team, Inria Bretagne). Julien Pettre.

8.2.6. Action3DS (Caisse des dépôts) (10/2011 - 09/2014)

Participant: Rémi Ronfard.

Action3DS is a national project funded by Caisse des Dépots, as part of the *projet Investissements d'avenir ACTION3DS* research program entitled *Technologies de numérisation et de valorisation des contenus culturels, scientifiques et éducatifs*.

The project is coordinated by Thales Angénieux (Patrick Defay). Partners are Inria (Rémi Ronfard), Lutin Userlab (Charles Tijus), LIP6 (Bernadette Bouchon-Meunier), GREYC (David Tschumperlé), École nationale supérieure Louis Lumière (Pascal Martin), Binocle (Yves Pupulin), E2V Semiconductors and Device-Alab.

The goal of the project is the developpement of a compact professional stereoscopic camera for 3D broadcast and associated software. Rémi Ronfard is leading a work-package on real-time stereoscopic previsualization, gaze-based camera control and stereoscopic image quality.

The project is funding our new postdoc researcher Christophe Lino who is working on learning-based camera control for stereoscopic 3D cinematography with Rémi Ronfard.

8.2.7. AEN MorphoGenetics (10/2012 - 09/2015)

Participant: François Faure.

3-year collaboration with Inria teams Virtual Plants and Demar, as well as INRA (Agricultural research) and the Physics department of ENS Lyon. The goal is to better understand the coupling of genes and mechanical constraints in the morphogenesis (creation of shape) of plants. Our contribution is to create mechanical models of vegetal cells based on microscopy images. This project funds the Ph.D. thesis of Richard Malgat, who started in October, co-advised by François Faure (IMAGINE) and Arezki Boudaoud (ENS Lyon).

8.2.8. PEPS SEMYO (10/2012 - 09/2014)

Participant: François Faure.

2-year collaboration with Inria team DEMAR (Montpellier) and Institut de Myologie (Paris) to simulate 3D models of pathological muscles, for which no standard model exist. The main idea is to use our mesh-less frame-based model to easily create mechanical models based on segmented MRI images.

8.3. European & International Initiatives

8.3.1. ERC Grant Expressive (04/2012-03/2017)

Participants: Marie-Paule Cani, Stefanie Hahmann, Jean-Claude Léon.

To make expressive and creative design possible in virtual environments, the goal is to totally move away from conventional 3D techniques, where sophisticated interfaces are used to edit the degrees of freedom of pre-existing geometric or physical models: this paradigm has failed, since even trained digital artists still create on traditional media and only use the computer to reproduce already designed content. To allow creative design in virtual environments, from early draft to progressive refinement and finalization of an idea, both interaction tools and models for shape and motion need to be revisited from a user-centred perspective. The challenge is to develop reactive 3D shapes – a new paradigm for high-level, animated 3D content – that will take form, refine, move and deform based on user intent, expressed through intuitive interaction gestures inserted in a user-knowledge context. Anchored in Computer Graphics, this work reaches the frontier of other domains, from Geometry, Conceptual Design and Simulation to Human Computer Interaction.

8.3.2. Piper (2013-2017)

The main objective of this European FP7 project is to develop new tools to position and personalize advanced human body models for injury prediction in car crashes. Our partners are automobile constructors and biomechanics research labs. Our main task is to provide tools for the interactive positioning of the models in the cockpits prior to the crash simulation, using our real-time simulation software SOFA. This 42-month contract funds one engineer in Imagine, and we plan to hire post-doc students next year.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Bob Sumner: Character depiction, posing and synthesis, Disney Research (Zurich) (13/11/2014).
- Tamy Boubekeur: Spatial, Statistical and Morphological Analysis for 3D Shape Modeling, Telecom ParisTech (23/10/2014)
- Jacob Wenzel: Capturing and simulating the interaction of light with the world around us, ETH Zurich (09/10/2014)
- Mariët Theune: Nicolas Szilas, Ulrike Spierling, Paolo Petta, Remi Ronfard. Storytelling seminar (21/07/2014)
- Mark Finlayson: Learning Narrative Structure from Annotated Stories, MIT (03/07/2014)
- Matthias Teschner: Particle-based Fluid Simulation, University of Freiburg (17/06/2014)
- Melina Skouras. Design and Fabrication of Deformable Objects, ETH Zurich (05/06/2014)
- Boris Thibert. Flat torus and smooth fractals, LJK Grenoble (15/05/2014)
- Olga Sorkine. Reality-inspired constraints for shape modeling and editing, ETH Zurich (28/03/2014)
- Jernej Barbic: Model reduction for elasticity problems in computer graphics and animation, University of Southern California (02/27/2014)
- Chris Wojtan: Compensating for Defects in Geometric Models and Liquid Surfaces, IST Austria (02/20/2014)

LEAR Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Project Qcompere

Participants: Guillaume Fortier, Cordelia Schmid, Jakob Verbeek.

This three-and-a-half year project started in November 2010. It is aimed at identifying people in video using both audio (using speech and speaker recognition) and visual data in challenging footage such as news broadcasts, or movies. The partners of this project are the CNRS laboratories LIMSI and LIG, the university of Caen, Inria's LEAR team, as well as two industrial partners Yacast and Vecsys Research.

8.1.2. ANR Project Physionomie

Participants: Frédéric Jurie [University of Caen], Jakob Verbeek, Shreyas Saxena.

Face recognition is nowadays an important technology in many applications ranging from tagging people in photo albums, to surveillance, and law enforcement. In this 3-year project (2013–2016) the goal is to broaden the scope of usefulness of face recognition to situations where high quality images are available in a dataset of known individuals, which have to be identified in relatively poor quality surveillance footage. To this end we will develop methods that can compare faces despite an asymmetry in the imaging conditions, as well as methods that can help searching for people based on facial attributes (old/young, male/female, etc.). The tools will be evaluated by law-enforcement professionals. The participants of this project are: Morpho, SensorIT, Université de Caen, Université de Strasbourg, Fondation pour la Recherche Stratégique, Préfecture de Police, Service des Technologies et des Systèmes d'Information de la Sécurité Intérieure, and LEAR.

8.1.3. ANR Project Macaron

Participants: Julien Mairal, Zaid Harchaoui, Laurent Jacob [CNRS, LBBE Laboratory], Michael Blum [CNRS, TIMC Laboratory], Joseph Salmon [Telecom ParisTech].

The project MACARON is an endeavor to develop new mathematical and algorithmic tools for making machine learning more scalable. Our ultimate goal is to use data for solving scientific problems and automatically converting data into scientific knowledge by using machine learning techniques. Therefore, our project has two different axes, a methodological one, and an applied one driven by explicit problems. The methodological axis addresses the limitations of current machine learning for simultaneously dealing with large-scale data and huge models. The second axis addresses open scientific problems in bioinformatics, computer vision, image processing, and neuroscience, where a massive amount of data is currently produced, and where huge-dimensional models yield similar computational problems.

This is a 3 years and half project, funded by ANR under the program "Jeunes chercheurs, jeunes chercheuses", which started in October 2014. The principal investigator is Julien Mairal.

8.1.4. PEPS CNRS BMI (Biology - Mathematics - Computer Science), Project FlipFlop

Participants: Elsa Bernard [Institut Curie, Ecoles des Mines-ParisTech], Laurent Jacob [CNRS, LBBE Laboratory], Julien Mairal, Jean-Philippe Vert [Institut Curie, Ecoles des Mines-ParisTech], Anne-Hélène Monsoro-Burq [Institut Curie].

The project is concerned with large-scale sparse estimation techniques for processing RNA-Seq data. It led to a joint publication [4] with partners from Inria Grenoble, Institut Curie in Paris, and the LBBE laboratory in Lyon. The principal investigator was Laurent Jacob (CNRS, LBBE laboratory). The project started in Jun 2012 and ended in Dec 2014.

8.1.5. MASTODONS Program CNRS - Project Gargantua

Participants: Zaid Harchaoui, Julien Mairal.

The project is concerned with machine learning and mathematical optimization for big data. The partners are from LJK (Grenoble), LIG (Grenoble), LIENS (ENS, Paris), Lab. P. Painleve (Lille). Principal investigator/leader: Zaid Harchaoui. Dates: May 2013-Dec. 2014

8.1.6. Equipe-action ADM du Labex Persyval (Grenoble) "Khronos"

Participants: Zaid Harchaoui, Massih-Reza Amini [LIG].

The partners of this project are from the laboratories LJK, LIG, GIPSA, TIMC, CEA. The principal investigators/leaders are Zaid Harchaoui (Inria and LJK), Massih-Reza Amini (LIG). The project started in Jan. 2014 and ends in Dec. 2016.

8.2. European Initiatives

8.2.1. AXES

Participants: Ramazan Cinbis, Matthijs Douze, Zaid Harchaoui, Dan Oneata, Danila Potapov, Cordelia Schmid, Jakob Verbeek, Clement Leray, Anoop Cherian.

This 4-year project started in January 2011 and ends in March 2015. Its goal is to develop and evaluate tools to analyze and navigate large video archives, eg. from broadcasting services. The partners of the project are ERCIM, Univ. of Leuven, Univ. of Oxford, LEAR, Dublin City Univ., Fraunhofer Institute, Univ. of Twente, BBC, Netherlands Institute of Sound and Vision, Deutsche Welle, Technicolor, EADS, Univ. of Rotterdam. See http://www.axes-project.eu/ for more information.

8.2.2. ERC Advanced grant Allegro

Participants: Cordelia Schmid, Karteek Alahari, Jerome Revaud, Pavel Tokmakov, Nicolas Chesneau.

The ERC advanced grant ALLEGRO started in April 2013 for a duration of five years. The aim of ALLEGRO is to automatically learn from large quantities of data with weak labels. A massive and ever growing amount of digital image and video content is available today. It often comes with additional information, such as text, audio or other meta-data, that forms a rather sparse and noisy, yet rich and diverse source of annotation, ideally suited to emerging weakly supervised and active machine learning technology. The ALLEGRO project will take visual recognition to the next level by using this largely untapped source of data to automatically learn visual models. We will develop approaches capable of autonomously exploring evolving data collections, selecting the relevant information, and determining the visual models most appropriate for different object, scene, and activity categories. An emphasis will be put on learning visual models from video, a particularly rich source of information, and on the representation of human activities, one of today's most challenging problems in computer vision.

8.3. International Initiatives

8.3.1. Inria Associate Teams

- **HYPERION: Large-scale statistical learning for visual recognition:** Zaid Harchaoui and Cordelia Schmid have an ongoing collaboration resp. with Pr. Jitendra Malik (EECS) and Pr. Nourredine El Karoui (Stat. dpt.) of UC Berkeley in the fall 2011. This collaboration has been supported by the *associated team "Hyperion"* and the *France-Berkeley Fund* (dates: June 2012-Dec. 2013). The collaboration is focusing on *large-scale statistical learning for computer vision*, ranging from the high-dimensional statistics aspects to real-world applications on large image and video datasets. Several visits of members of each institution and co-supervision of students happened in 2012, 2013, 2014. As part of the "Hyperion" associated team, two papers were published resp. in CVPR'14 and ICML'14, and one paper is currently in revision.

8.3.2. Inria International Partners

- **UC Berkeley:** This collaboration between Bin Yu, Jack Gallant, Yuval Benjamini, Adam Bloniarz (UC Berkeley), Ben Willmore (Oxford University) and Julien Mairal (Inria LEAR) aims to discover the functionalities of areas of the visual cortex. We have introduced an image representation for area V4, adapting tools from computer vision to neuroscience data. The collaboration started when Julien Mairal was a post-doctoral researcher at UC Berkeley and is still ongoing. We are planning to welcome one student from UC Berkeley during the summer 2015 to work on this project.
- **University of Edinburgh:** C. Schmid collaborates with V. Ferrari, associate professor at university of Edinburgh. Vicky Kalogeiton started a co-supervised PhD in September 2013; she is bi-localized between Uni. Edinburgh and Inria. Her subject is the automatic learning of object representations in videos.
- **MPI Tübingen:** C. Schmid collaborates with M. Black, a research director at MPI. In 2013, she spent one month at MPI and worked with a PhD student, S. Zuffi, and a postdoctoral researcher, H. Jhuang. C. Schmid has continued this collaboration in 2014 and spent also one month there.

8.3.3. Participation in Other International Programs

- **France-Berkeley fund:** The LEAR team was awarded in 2014 a grant from the France-Berkeley fund for a project between Julien Mairal and Pr. Bin Yu (statistics department, UC Berkeley) on "Invariant image representations and high dimensional sparse estimation for neurosciences". The award amounts to 10,000 USD for a period of one year, from November 2014 to November 2015. The funds are meant to support scientific and scholarly exchanges and collaboration between the two teams.

8.4. International Research Visitors

8.4.1. Visits to International Teams

- **Sabbatical program** Zaid Harchaoui is currently on sabbatical at New-York university, from October 2014 to September 2015.

MAVERICK Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR BLANC: ALTA

Participants: Nicolas Holzschuch [contact], Cyril Soler.

We are funded by the ANR research program "Blanc" for a joint research project with two other Inria research teams, REVES in Sophia-Antipolis and iPARLA in Bordeaux. The goal of this project is studying light transport operators for global illumination, both in terms of frequency analysis and dimensional analysis. The grant started in October 2011, for 48 months.

6.1.2. ANR CONTINT: Galaxy/veRTIGE

Participants: Jean-Dominique Gascuel, Nicolas Holzschuch, Fabrice Neyret [contact].

RTIGE stands for Real-Time and Interactive Galaxy for Edutainment. This is an ANR CONTINT (Contents and Interactions) research program, for a joint research project with the EVASION Inria project-team, the GEPI and LERMA research teams at Paris Observatory, and the RSA Cosmos company. The goal of this project is to simulate the quality multi-spectral real-time exploration of the Galaxy with Hubble-like images, based on simulation data, statistical data coming from observation, star catalogs, and procedural amplification for stars and dust clouds distributions. RSA-Cosmos aims at integrating the results in digital planetariums. The grant started in December 2010, for 48 months.

6.1.3. ANR COSINUS: ROMMA

Participants: Georges-Pierre Bonneau [contact], François Jourdes.

The ANR project ROMMA has been accepted in 2009. It started in january 2010 for a duration of 4 years. The partners of this project are academic and industry experts in mechanical engineering, numerical simulation, geometric modeling and computer graphics. The aim of the project is to efficiently and robustly model very complex mechanical assemblies. We work on the interactive computation of contacts between mechanical parts using GPU techniques. We also investigate the Visualization of data with uncertainty, applied in the context of the project.

6.1.4. ANR CONTINT: MAPSTYLE

Participants: Joëlle Thollot [contact], Hugo Loi.

The MAPSTYLE project aims at exploring the possibilities offered by cartography and expressive rendering to propose original and new cartographic representations. Through this project, we target two types of needs. On the one hand, mapping agencies produce series paper maps with some renderings that are still derived from drawings made by hand 50 years ago: for example, rocky areas in the series TOP25 (to 1/25000) of the French Institut Géographique National (IGN). The rendering of these rocky areas must be automated and its effectiveness retained to meet the requirements of hikers safety. On the other hand, Internet mapping tools allow any user to become a cartographer. However, they provide default styles that cannot be changed (GeoPortal, Google Maps) or they are editable but without any assistance or expertise (CloudMade). In such cases, as in the case of mobile applications, we identify the need to offer users means to design map styles more personalised and more attractive to meet their expectations (decision-making, recreation, etc.) and their tastes. The grant started on October 2012, for 48 months.

6.2. International Initiatives

6.2.1. Inria International Partners

6.2.1.1. Informal International Partners

We have a continuing collaboration with Professor Kavita Bala, from Cornell University, USA, on the subject of global illumination and simulation of light scattering in participating media. Our work has been accepted at ACM transaction on graphics in 2014.

We currently have a very fruitful collaboration with Derek Nowrouzhezarai, from University of Montreal, Canada, dealing with isotropic filter decomposition in the spherical domain, based on zonal harmonic basis.

We also have frequent exchanges and on-going collaborations with Cyril Crassin from nVIDIA-Research.

6.3. International Research Visitors

6.3.1. Visits to International Teams

6.3.1.1. Research stays abroad

Fabrice Neyret has been visiting WETA Digital (New-Zeland) from July to August 2014.

MORPHEO Project-Team

8. Partnerships and Cooperations

8.1. ARC6 project PADME – Perceptual quality Assessment of Dynamic MEshes and its applications

In this project, we propose to use a new and experimental "bottom-up" approach to study an interdisciplinary problem, namely the objective perceptual quality assessment of 3D dynamic meshes (i.e., shapes in motion with temporal coherence). The objectives of the proposed project are threefold:

1. to understand the HVS (human visual system) features when observing 3D animated meshes, through a series of psychophysical experiments;
2. to develop an efficient and open-source objective quality metric for dynamic meshes based on the results of the above experiments;
3. to apply the learned HVS features and the derived metric to the application of compression and/or watermarking of animated meshes.

This work is funded by the Rhône-Alpes région through an ARC6 grant for the period 2013-2016. The three partners are LIRIS (University Lyon 1, Florent Dupont), GIPSA-Lab (CNRS, Kai Wang) and LJK (University of Grenoble, Franck Hétroy-Wheeler). A PhD student, Georges Nader, is working on this project.

8.2. National Initiatives

8.2.1. Motion analysis of laboratory rodents

In order to evaluate the scalabililty of previous work on motion analysis of laboratory rodents, a collaboration has been initiated with the Institut Clinique de la Souris (ICS), in Institut de Génétique et de Biologie Moléculaire et Cellulaire (IGBMC). This institute is dedicated to phenotypying of mice and requires reliable motion analysis tools. A multicamera plateform has been deployed at ICS and will be exploited next year for tests ranging from one to two hundreds mice.

8.2.2. ANR

8.2.2.1. ANR project Morpho – Analysis of Human Shapes and Motions

Morpho is aimed at designing new technologies for the measure and for the analysis of dynamic surface evolutions using visual data. Optical systems and digital cameras provide a simple and non invasive mean to observe shapes that evolve and deform and we propose to study the associated computing tools that allow for the combined analysis of shapes and motions. Typical examples include the estimation of mean shapes given a set of 3D models or the identification of abnormal deformations of a shape given its typical evolutions. Therefore this does not only include static shape models but also the way they deform with respect to typical motions. It brings a new research area on how motions relate to shapes where the relationships can be represented through various models that include traditional underlying structures, such as parametric shape models, but are not limited to them. The interest arises in several application domains where temporal surface deformations need to be captured and analyzed. It includes human body analyses but also extends to other deforming objects, sails for instance. Potential applications with human bodies are anyway numerous and important, from the identification of pathologies to the design of new prostheses. The project focus is therefore on human body shapes and their motions and on how to characterize them through new biometric models for analysis purposes. 3 academic partners will collaborate on this project: the Inria Rhône-Alpes with the Morpheo team, the GIPSA-lab Grenoble and the Inria Lorraine with the Alice team. Website: http://morpho.inrialpes.fr/.

8.2.3. Competitivity Clusters

8.2.3.1. FUI project Creamove

Creamove is a collaboration between the Morpheo team of the Inria Grenoble Rhône-Alpes, the 4D View Solution company specialised in multi-camera acquisition systems, the SIP company specialised in multimedia and interactive applications and a choreographer. The objective is to develop new interactive and artistic applications where humans can interact in 3D with virtual characters built from real videos. Dancer performances will be pre-recorded in 3D and used on-line to design new movement sequences based on inputs coming from human bodies captured in real time. Website: http://www.creamove.fr.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. Re@ct

Type: FP7 COOPERATION

Defi: IMMERSIVE PRODUCTION AND DELIVERY OF INTERACTIVE 3D CONTENT

Instrument: Specific Targeted Research Project

Objectif: Networked Media ans Search Systems

Duration: December 2011 - November 2014

Coordinator: BBC (UK)

Partner: BBC (UK), Fraunhofer HHI (Germany), University of Surrey (UK), Artefacto (France), OMG (UK).

Inria contact: Jean-Se´bastien Franco, Edmond Boyer

Abstract:RE@CT will introduce a new production methodology to create film-quality interactive characters from 3D video capture of actor performance. Recent advances in graphics hardware have produced interactive video games with photo-realistic scenes. However, interactive characters still lack the visual appeal and subtle details of real actor performance as captured on film. In addition, existing production pipelines for authoring animated characters are highly labour intensive. RE@CT aims to revolutionise the production of realistic characters and significantly reduce costs by developing an automated process to extract and represent animated characters from actor performance capture in a multiple camera studio. The key innovation is the development of methods for analysis and representation of 3D video to allow reuse for real-time interactive animation. This will enable efficient authoring of interactive characters with video quality appearance and motion. The project builds on the latest advances in 3D and free-viewpoint video from the contributing project partners. For interactive applications, the technical challenges are to achieve another step change in visual quality and to transform captured 3D video data into a representation that can be used to synthesise new actions and is compatible with current gaming technology.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Declared Inria International Partners

8.4.1.1.1. Joint project with Forest Research, UK

A common work with an ecophysiologist from Forest Research, Eric Casella, is currently carried out to detect, analyse and correct acquisition noise from terrestrial laser scans (t-LiDAR) of trees. This project is funded by Grenoble university, through the AGIR framework. First results have been presented during the 5th French-Canadian workshop “Use of t-LiDAR systems in forest ecology”.

8.4.1.2. Informal International Partners

8.4.1.2.1. Collaboration with TU Munich

The long term collaboration with TU Munich and Slobodan Ilic on human motion capture is ongoing with the work of Paul Huang [5] that was published atCVPR this year. The work contributes with an approach that identifies and takes benefit of key poses when tracking shapes.

8.5. International Research Visitors

8.5.1. Visits to International Teams

8.5.1.1. Sabbatical programme

Reveret Lionel

Date: Jul 2014 - June 2015

Institution: Brown University (USA)

PERCEPTION Project-Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

6.1.1.1. MIXCAM

Type: ANR BLANC

Duration: March 2014 - February 2016

Coordinator: Radu Horaud

Partners: 4D View Solutions SAS

Abstract: Humans have an extraordinary ability to see in three dimensions, thanks to their sophisticated binocular vision system. While both biological and computational stereopsis have been thoroughly studied for the last fifty years, the film and TV methodologies and technologies have exclusively used 2D image sequences, including the very recent 3D movie productions that use two image sequences, one for each eye. This state of affairs is due to two fundamental limitations: it is difficult to obtain 3D reconstructions of complex scenes and glass-free multi-view 3D displays, which are likely to need real 3D content, are still under development. The objective of MIXCAM is to develop novel scientific concepts and associated methods and software for producing live 3D content for glass-free multi-view 3D displays. MIXCAM will combine (i) theoretical principles underlying computational stereopsis, (ii) multiple-camera reconstruction methodologies, and (iii) active-light sensor technology in order to develop a complete content-production and -visualization methodological pipeline, as well as an associated proof-of-concept demonstrator implemented on a multiple-sensor/multiple-PC platform supporting real-time distributed processing. MIXCAM plans to develop an original approach based on methods that combine color cameras with time-of-flight (TOF) cameras: TOF-stereo robust matching, accurate and efficient 3D reconstruction, realistic photometric rendering, real-time distributed processing, and the development of an advanced mixed-camera platform. The MIXCAM consortium is composed of two French partners (Inria and 4D View Solutions). The MIXCAM partners will develop scientific software that will be demonstrated using a prototype of a novel platform, developed by 4D Views Solutions, and which will be available at Inria, thus facilitating scientific and industrial exploitation.

6.2. European Initiatives

6.2.1. FP7 & H2020 Projects

6.2.1.1. EARS

Type: FP7

Challenge: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project

Objectif: Robotics, Cognitive Systems and Smart Spaces, Symbiotic Interaction

Duration: January 2014 - December 2016

Coordinator: Friedrich Alexander Universiteit (Germany)

Partners: Inria (France), Ben Gurion University (Israel), Imperial College (UK), Humboldt University Berlin (Germany), and Aldebaran Robotics (France)

Inria contact: Radu Horaud

Abstract: The success of future natural intuitive human-robot interaction (HRI) will critically depend on how responsive the robot will be to all forms of human expressions and how well it will be aware of its environment. With acoustic signals distinctively characterizing physical environments and speech being the most effective means of communication among humans, truly humanoid robots must be able to fully extract the rich auditory information from their environment and to use voice communication as much as humans do. While vision-based HRI is well developed, current limitations in robot audition do not allow for such an effective, natural acoustic human-robot communication in real-world environments, mainly because of the severe degradation of the desired acoustic signals due to noise, interference and reverberation when captured by the robot's microphones. To overcome these limitations, EARS will provide intelligent *ears* with close-to-human auditory capabilities and use it for HRI in complex real-world environments. Novel microphone arrays and powerful signal processing algorithms shall be able to localize and track multiple sound sources of interest and to extract and recognize the desired signals. After fusion with robot vision, embodied robot cognition will then derive HRI actions and knowledge on the entire scenario, and feed this back to the acoustic interface for further auditory scene analysis. As a prototypical application, EARS will consider a welcoming robot in a hotel lobby offering all the above challenges. Representing a large class of generic applications, this scenario is of key interest to industry and, thus, a leading European robot manufacturer will integrate EARS's results into a robot platform for the consumer market and validate it. In addition, the provision of open-source software and an advisory board with key players from the relevant robot industry should help to make EARS a turnkey project for promoting audition in the robotics world.

6.2.1.2. VHIA

Type: FP7

Instrument: ERC Advanced Grant

Duration: February 2014 - January 2019

Principal Investigator: Radu Horaud

Abstract: The objective of VHIA is to elaborate a holistic computational paradigm of perception and of perception-action loops. We propose to develop a completely novel twofold approach: (i) learn from mappings between auditory/visual inputs and structured outputs, and from sensorimotor contingencies, and (ii) execute perception-action interaction cycles in the real world with a humanoid robot. VHIA will launch and achieve a unique fine coupling between methodological findings and proof-of-concept implementations using the consumer humanoid NAO manufactured in Europe. The proposed multimodal approach is in strong contrast with current computational paradigms that are based on unimodal biological theories. These theories have hypothesized a modular view of perception, postulating that there are quasi-independent and parallel perceptual pathways in the brain. VHIA takes a radically different view than today's audiovisual fusion models that rely on clean-speech signals and on accurate frontal-images of faces; These models assume that videos and sounds are recorded with hand-held or head-mounted sensors, and hence there is a human in the loop whose intentions inherently supervise both perception and interaction. Our approach deeply contradicts the belief that complex and expensive humanoids (often manufactured in Japan) are required to implement research ideas. VHIA's methodological program addresses extremely difficult issues, such as how to build a joint audiovisual space from heterogeneous, noisy, ambiguous and physically different visual and auditory stimuli, how to properly model seamless interaction based on perception and action, how to deal with high-dimensional input data, and how to achieve robust and efficient human-humanoid communication tasks through a well-thought tradeoff between offline training and online execution. VHIA bets on the high-risk idea that in the next decades robot technology will have a considerable social and economical impact and that there will be millions of humanoids, in our homes, schools and offices, which will be able to naturally communicate with us.

6.3. International Initiatives

6.3.1. Inria International Partners

6.3.1.1. Declared Inria International Partners

- The Czech Technical University in Prague (Dr. Jan Cech)
- The Technion (Prof. Yoav Schechner)
- Queen Mary University London (Dr. Miles Hansard)
- Bar Ilan University (Prof. Sharon Gannot)
- University of Cordoba (Prof. Manuel Jesus Marin Jimenez)
- University of Patras (Prof. Manolis Psarakis)
- Oxford Brookes University (Dr. Fabio Cuzzolin)

6.4. International Research Visitors

6.4.1. Visits of International Scientists

- Prof. Sharon Gannot (Bar Ilan University)
- Prof. Manuel Jesus Marin Jimenez (Cordoba University)

PRIMA Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. CATRENE Project AppsGate - Smart Home Application Gateway

Duration: june 2012 - June 2015

Coordinator: ST Microelectronics

Other partners: Pace, Technicolor, NXP, Myriad France SAS, 4MOD Technology, HI-IBERIA Ingenieria y Proyectos, ADD Semiconductor, Video Stream Network, SoftKinetic, Optrima, Fraunhofer, Vsonix, Evalan, University UJF/LIG, and Institut Telecom.

The Prima Project team has worked with 15 other partners to develop a new generation of set-top box for smart home applications. In close collaboration with ST Microelectronics and Immotronics, Prima has developed the core middleware components for plug and play integration of smart home devices for distributed smart home services, as well as interactive tools for End User Development of Smart Home services.

AppsGate has developed an Open Platform to provide integrated home applications to the consumer mass market. The set-top box is the primary point of entry into the digital home for television services including cable TV, satellite TV, and IPTV. AppsGate will transform the set-box into a residential gateway, capable of delivering multiple services to the home, including video, voice and data. PRIMA is involved in designing End User Development tools dedicated for the Smart Home

7.1.2. ICTLabs Smart Energy Systems Activity 11831 Making Energy Visible

Participants: Sabine Coquillart, James Crowley [correspondant], Patrick Reignier, Mayeul de Werbier d Antigneul.

Smart energy Systems, Smart Grids

Within Activity 11831 Open SES Experience Labs, PRIMA is responsible for the A1405 "Making Energy Visible" within the Smart Energy Systems action line of ICTlabs. The objective of this task is to design, implement and evaluate tools for online and offline interaction with energy usage. The group works with Immotronics to define an open middleware that will enable logging, aggregation and interactive visualization of data and information on energy consumption and on environmental parameters that define comfort. The open middleware will include an SQL Data base, web socket and an xml markup language to define a common naming scheme, tools for assigning location in both space (geometry coordinates) and place (functional places), as well as data aggregation tools.

The open middleware will serve as a common software platform that will be used for the Inria Rapid Deployment mini-kit as well as for data acquisition by other partners using other sensors. Univ Bologna will provide (sell) copies of their new energy measurement meter for integration into the system. Univ of Bologna, Fraunhofer, Fortis and Inria will construct tools for offline and online visualization. The system will be deployed and evaluated by social scientists at the living lab of Politechnico Turin. Turin will specify requirements for visualisation of energy and comfort for smart grid applications, and perform user studies and evaluations on the resulting systems.

Visualisation includes on-line and offline exploration, as well as tools for html web interface, Mobile augmented reality tools, apps for display on mobile devices, 3D visual interaction, and immersive interaction with an oculus Rift.

7.2. National Initiatives

7.2.1. EquipEx AmiQual4Home - Ambient Intelligence for Quality of Life

Participants: Stan Borkowski, Sabine Coquillart, Joelle Coutaz, James Crowley [correspondant], Alexandre Demeure, Thierry Fraichard, Amaury Negre, Patrick Reignier, Dominique Vaufreydaz, Nicolas Bonnefond, Rémi Pincent, Mayeul de Werbier d Antigneul, Rémi Barraquand, David Lombard.

Ambient Intelligence, Equipment d'Excellence, Investissement d'Avenir

The AmiQual4Home Innovation Factory is an open research facility for innovation and experimentation with human-centered services based on the use of large-scale deployment of interconnected digital devices capable of perception, action, interaction and communication. The Innovation Factory is composed of a collection of workshops for rapid creation of prototypes, surrounded by a collection of living labs and supported by a industrial innovation and transfer service. Creation of the Innovation Factory has been made possible by a 2.140 Million Euro grant from French National programme "Investissement d'avenir", together with substantial contributions of resources by Grenoble INP, Univ Joseph Fourier, UPMF, CNRS, Schneider Electric and the Commune of Montbonnot. The objective is to provide the academic and industrial communities with an open platform to enable research on design, integration and evaluation of systems and services for smart habitats.

The AmiQual4Home Innovation Factory is a unique combination of three different innovation instruments: (1) Workshops for rapid prototyping of devices that embed perception, action, interaction and communication in ordinary objects based on the MIT FabLab model, (2) Facilities for real-world test and evaluation of devices and services organised as open Living Labs, (3) Resources for assisting students, researchers, entrepreneurs and industrial partners in creating new economic activities. The proposed research facility will enable scientific research on these problems while also enabling design and evaluation of new forms of products and services with local industry.

The core of the AmiQual4Home Innovation Factory is a Creativity Lab composed of a collection of five workshops for the rapid prototyping of devices that integrate perception, action, interaction and communications into ordinary objects. The Creativity Lab is surrounded by a collection of six Living Labs for experimentation and evaluation in real world conditions. The combination of fabrication facilities and living labs will enable students, researchers, engineers, and entrepreneurs to experiment in co-creation and evaluation. The AmiQual4Home Innovation Factory will also include an innovation and transfer service to enable students, researchers and local entrepreneurs to create and grow new commercial activities based on the confluence of digital technologies with ordinary objects. The AmiQual4Home Innovation Factory will also provide an infrastructure for participation in education, innovation and research activities of the European Institute of Technology (EIT) KIC ICTLabs.

The AmiQual4Home Innovation Factory will enable a unique new form of coordinated ICT-SHS research that is not currently possible in France, by bringing together expertise from ICT and SHS to better understand human and social behaviour and to develop and evaluate novel systems and services for societal challenges. The confrontation of solutions from these different disciplines in a set of application domains (energy, comfort, cost of living, mobility, well-being) is expected to lead to the emergence of a common, generic foundation for Ambient Intelligence that can then be applied to other domains and locations. The initial multidisciplinary consortium will progressively develop interdisciplinary expertise with new concepts, theories, tools and methods for Ambient Intelligence.

The potential impact of such a technology, commonly referred to as "Ambient Intelligence", has been documented by the working groups of the French Ministry of Research (MESR) [32] as well as the SNRI (Stratégie Nationale de la Recherche et de l'Innovation).

In 2013 our efforts were focused on specifying the requirements for major components of the project, and on finalising contractual issues with ANR. We defined the layout and arrangement of the Creativity Lab workshops, we started the specification of the instrumentation needed for the Living Labs, and developed a first version of a set of easy-deployable wireless sensors for infield data acquisition, that we call the Rapid

Deployment Minikit. A set of CNC machines was purchased, including a Fused Filament Fabrication 3D printer, a CO2 Laser cutter and engraver, and a CNC mill.

Following the kickoff meeting of the project held in October 2013, we received positive feedback and interest form local industry and research institutions, and several national project proposals submitted in 2013 identified AmiQual4Home as an important ressource.

7.2.2. FUI PRAMAD

Participants: Claudine Combe, Lucas Nacsa, Maxime Portaz, Amaury Negre, Dominique Vaufreydaz [correspondant].

Pramad is a collaborative project about *Plateforme Robotique dÁssistance et de Maintien à Domicile*. There are seven partners:

- R&D/industry: Orange Labs (project leader) and Covéa Tech (insurance company),
- Small companies: Interaction games (game designer, note that Wizardbox, the original partner was bought by Interaction games) and Robosoft (robot).
- Academic labs: Inria/PRIMA, ISIR (Paris VI) and Hôpital Broca (Paris).

The objectives of this project are to design and evaluate robot companion technologies to maintain frail people at home. Working with its partners, PRIMA research topics are:

- social interaction,
- robotic assistance,
- serious game for frailty evaluation and cognitive stimulation.

7.2.3. Inria Project-Teams PAL

Participants: Rémi Barraquand, Thierry Fraichard, Patrick Reignier, Amaury Negre, Dominique Vaufreydaz [correspondant].

The 12 Inria Project-Teams (IPT) participating in a Large-scale initiative action Personally Assisted Living (PAL http://pal.inria.fr) propose to work together to develop technologies and services to improve the autonomy and quality of life for elderly and fragile persons. The goal of this program is to unite these groups around an experimental infrastructure, designed to enable collaborative experimentations.

PAL is organized arround 12 IPT:

Demar, E-Motion, Flowers, Hephaistos, Lagadic, Lagadic-Sophia, Maia, Madynes, Phoenix, Prima, Stars and Reves.

The role of PRIMA within this project is to develop new algorithms mainly along two research axes:

- assessing frailty degree of the elderly,
- social interaction.

7.3. International Research Visitors

7.3.1. Visits to International Teams

7.3.1.1. Sabbatical programme

Fraichard Thierry, Sabbatical Visit to BIU, ISRAEL, from May 2014 - May 2015

7.3.1.2. Research stays abroad

Varun Jain, 6 month visit to Carnegie-Mellon University, Pittsburgh PA, on a Region Rhone-Alpes ExploraDoc Grant from January 2014 to July 2014