Activity Report 2012

Section Partnerships and Cooperations

AMIB Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

J. M. Steyaertwas the coordinator of RNA-omics Digiteo project, P. Clote (Boston College) being a Digiteo chair until June 2012.

A. Denise is the coordinator of the "Japarin-3D" Digiteo project 2012-2016. This project, in collaboration with PRISM at Versailles, aims to develop new efficient approaches for predicting the 3D structure of large RNA molecules, by applying game theory and graph algorithms.

6.2. National Initiatives

6.2.1. ANR

A. Denise is coordinator of the ANR project AMIS ARN 2009-2012 (ANR-09-BLAN-0160) and is involved in the NSD-NGD ANR project 2010-2014. Y. Ponty is involved in the MAGNUM ANR project (BLAN program, 12/2010–12/2014).

6.3. International Initiatives

6.3.1. Inria Associate Teams

6.3.1.1. ITSNAP

> Title: Intelligent Techniques for Structure of Nucleic Acids and Proteins
>
> Inria principal investigator: Julie Bernauer
>
> International Partner (Institution - Laboratory - Researcher):
>
>> SLAC National Accelerator Laboratory (United States) - Stanford Synchrotron Radiation Laboratory - Henry van den Bedem
>>
>> Stanford University (United States) - Computational Structural Biology, School of Medicine, Structural Biology - Michael Levitt
>
> Duration: 2012 - 2014
>
> See also: http://pages.saclay.inria.fr/julie.bernauer/EA_ITSNAP/

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

6.3.2. Participation In International Programs

J.Bernauer is coordinator with Pr. X. Huang at the Hong-Kong University of Science and Technology of a Partenariat Hubert Curien (PHC) Procore project (2012-2013). The project is entitled *Computational studies of conformational dynamics of the RNA-induced silencing complex and design of miRNAs to target oncogenes*.

Adrien Rougny, an internship student supervised by C. Froidevaux in AMIB, has successfully applied for the 2nd call of 2012 "NII International Internship Program". In February 2013, he will start an internship at NII for an Internship in Pr. Katsumi Inoue's group on the topic "Inference and Learning for Systems Biology and Network Dynamics".

M. Régnier and D. Sherman (MAGNOME-INRIA) participate to a joint project CARNAGE of France-Russia program.

6.4. International Research Visitors

6.4.1. Visits of International Scientists

R. Giegerich

> Institution: Bielefeld University (Germany)
>
> Subject: Efficient algorithms for RNA secondary structure alignment.
>
> Funding: DGAR (Ecole Polytechnique)
>
> R. Giegerich visited the AMIB project-team for a month. He taught dynamic-programming to the students of the BIBS master. He initiated a collaboration on sparsification, an algorithmic technique that speeds up dynamic programming algorithm. A comprehensive review on RNA structure alignment algorithms, to appear in a forthcoming book, was also written during his stay.

J. Waldispühl

> Institution: McGill University (Canada)
>
> Subject: RNA design and tertiary structure prediction.
>
> Funding: DIGITEO (LRI)
>
> J. Waldispühl visited AMIB for a month. He finalized a collaboration on RNA design (Y. Ponty, leading to [16]), established a new collaborative research (with A. Denise and Y. Ponty, on tertiary motifs), laid the foundations of a future X-UPSud exchange program, initiated a workshop on molecular interactions (with J. Bernauer), and started a PhD co-supervision (A. Soulé, co-supervised with J.-M. Steyaert and Y. Ponty).

X. Huang

> Subject: Millisecond dynamics at atomic resolution by Markov State Models
>
> Institution: Hong Kong University of Science and Technology (Hong-Kong)

A. Sim

> Subject: Modeling RNA by hierarchical natural moves
>
> Institution: Stanford University (USA) / A*STAR (Singapore)

L. Pereyaslavets

> Subject: Critical assessment of non bonded part of force fields
>
> Institution: Stanford University (USA)

Y. Okamoto

> Subject: Protein folding, unfolding, and ligand docking by computer simulations
>
> Institution: Nagoya University (Japan)

6.4.1.1. Internships

A. Martirosyan (March-Jul 2012)

> Subject: A Dynamical Model for the Transmembrane Potential Regulation by pH
>
> Institution:Cergy University (Pontoise)
>
> Funding: INRIA
>
> Supervision:L. Paulevé and M. Régnier

B. Brancotte (March-July 2012)

> Subject: Designing a framework to compare biological data ranking methods

Institution: Paris-Sud University (France)

Funding: INRIA

Supervision: S. Cohen-Boulakia and A. Denise

Gh.Fievet (March-Sept 2012)

Subject: Improving `MPAS` software

Institution: Paris-Sud University (France)

Funding: Ecole Polytechnique

Supervision:J.M. Steyaert

J. Weaver (Jun-Aug 2012)

Subject: Efficient Motif Discovery and Evaluation

Institution: Massachusetts Institute of Technology (United States)

Funding: MIT France program

Supervision: Y. Ponty and M. Régnier

A. Menard (Jun-Aug 2012)

Subject: Extending `JalView`'s RNA interconnection with `Varna`

Institution: Université Paris-Sud

Supervision: Y. Ponty and J. Procter (Univ. Dundee, Scotland)

A. Soulé (Jun-Aug 2012)

Subject: Prediction of RNA-RNA interactions in yeast

Institution: Ecole Polytechnique

Supervision: Y. Ponty and J.-M. Steyaert

V. Arendt (Jun-Aug 2012)

Subject: Integrating RNA web services into `JalView` using `Jabaws`

Institution: Duke University (United States)

Funding: Google Summer of Code program

Supervision: Y. Ponty and J. Procter (Univ. Dundee, Scotland)

T. Coulmy & N. Duhamel (Jun-Jul 2012)

Subject: Average-case property analysis of workflows based on hypergraphs

Institution: Université Paris-Sud

Supervision: S. Cohen-Boulakia and Y. Ponty

F.K. Sheong (May-Aug 2012)

Subject: RNA structural design by docking and machine learning

Institution: The Hong Kong University of Science and Technology (Hong Kong, (China))

L. Uroshlev (Oct-Nov 2012)

Subject: Reference state for RNA KB potentials

Institution: IOGEN (Moscou, (Russia))

A. Bari (Oct 2012)

Subject: stress-inducible miRNAs

Institution:El Farabi University (Almaty, (Kazakhstan))

AVIZ Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR FITOC: From Individual To Collaborative Visual Analytics
Participants: Petra Isenberg [correspondant], Jean-Daniel Fekete, Pierre Dragicevic, Wesley Willett.

The project addresses fundamental problems of technological infrastructure and the design of data representation and interaction to build a bridge between individual and team work for visual data analysis. In collaboration with the University of Magdeburg we have begun to tackle this challenge through the design of tangible widgets that help to bridge the gap between individual and collaborative information seeking (see 6.1).

8.1.2. ANR EASEA-Cloud
Participants: Evelyne Lutton [correspondant], Waldo Cancino.

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

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

The consortium is made of thee partners: LSIIT/UDS (which is developing the EASEA platform), ISC-PIR/CREA (for its experience in grid and cloud computing), AVIZ/Inria (for its experience in visualization tools for evolutionary computation) and two subcontractors: LogXLabs (a software development company in order to create industrial-grade code and interfaces) an BIOEMERGENCE-IMAGIF, the "valorisation" department of CNRS Gif s/Yvette. Valorisation will take place in strong collaboration with UNISTRA VALO, the valorisation structure of Université de Strasbourg.

The project started on October 1st, 2012, for 2 years. AVIZ will develop new visualisation tools adapted to the monitoring of the optimization process.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. DREAM

Program: FP7

Project acronym: **DREAM**

Project title: Design and development of REAlistic food Models with well-characterised micro- and macro-structure and composition

Duration: 2009–2013

Coordinator: INRA - CEPIA department, Monique Axelos

Other partners: Technical Research Centre of Finland, Actilait France, ADRIA Développement France, CNRS, INRA Transfert, Société de Recherche et Développement Alimentaire Bongrain, Campden BRI Magyarország Nonprofit Kft. Hungary, Central Food Research Institute Hungary, Teagasc - Agriculture and Food Development Authority Ireland, Consiglio Nazionale delle Ricerche - Istituto di Scienze delle Produzioni Alimentari Italy, Top Institute Food and Nutrition The Netherlands, Wageningen University (WUR) The Netherlands, University of Ljubljana, Biotechnical Faculty Slovenia, Institute for Food and Agricultural Research and Technology Spain, Campden BRI UK, Institute of Food Research UK, United Biscuits (UK) Limited.

Abstract:

The overall goal of DREAM (Design and development of REAlistic food Models with well-characterised micro- and macro-structure and composition) is to develop realistic, physical and mathematical models to be used as standards that can be exploited across all major food categories to facilitate development of common approaches to risk assessment and nutritional quality for food research and industry.

The partnership involves 18 partners from 9 european countries, among which two multinationals. The project is lead by INRA, CEPIA department, and Inria participation is managed by delegation by the ISC-PIF (CNRS-CREA, UMR 7656).

See more at http://dream.aaeuropae.org/.

The role of AVIZ has been to develop evolutionary techniques adapted to the modeling of agrifood process. In 2012, the work was focussed on the development:

- of robust evolutionary methods to learn the structure of Bayesian Networks when experimental data are rare (in collaboration with Alberto Tonda, Cédric Baudrit and Nathalie Perrot of INRA/GMPA and Pierre-Henri Wuillemin od LIP6/DESIR), applied to cheese making and biscuit baking process,
- of a model of milk gel based on partial differential equations, where numerical parameters were learn by artificial evolution (in collaboration with Julie Foucquier, Sébastien Gaucel Alberto Tonda, and Nathalie Perrot of INRA/GMPA).

8.2.1.2. CENDARI

Program: Infrastructures

Project acronym: **CENDARI**

Project title: Collaborative EuropeaN Digital/Archival Infrastructure

Duration: 01/2012 - 12/2015

Coordinator: Trinity College, Dublin (IE),

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

Abstract:

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

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

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

8.2.2. *Collaborations with Major European Organizations*

Fraunhofer Institute, IGD (DE)

We are collaborating on visual analytics, setting up European projects and coordinating European initiatives on the subject.

University of Desden, (DE)

We have been collaborating with Raimund Dachselt on stackable tangible devices for faceted browsing [35], [33].

8.3. International Initiatives

8.3.1. *Inria International Partners*

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

- Google, Mountain View, USA
- Microsoft Research, Redmond, USA
- Purdue University, USA
- New York University, USA
- University of Toronto, Canada
- University of Calgary, Canada
- University of British Columbia, Canada
- City University London, UK,
- University of Kent, UK
- University of Konstanz, Germany
- University of Magdeburg, Germany
- University of Groningen, the Netherlands
- University of Granada, Spain

8.3.2. Collaboration with Google

AVIZ collaborates with Google on several projects, related to the Google Research Grant (see sec 7.1) and to evaluation methodology in information visualization [20]. Heidi Lam from Google spent 3 months at AVIZ to collaborate more closely.

8.3.3. Collaboration with Microsoft Research

AVIZ collaborates with several researchers from Microsoft Research Redmond, in particular on the topic of new interactions for information visualization [21] and brain connectivity visualization.

8.3.4. Collaboration with New-York University

Jean-Daniel Fekete collaborates with Claudio Silva and Juliana Freire from NYU-Poly on the VisTrails workflow system for visual analytics (http://www.vistrails.org). Rémi Rampin, intern from the Univ. Paris-Sud Master in HCI, has spent one month at Orsay and 5 months at NYU-Poly to allow VisTrails to run Java-based applications and Toolkits. Rémi successfully connected the traditional Python-C implementation of VisTrails to the Java virtual machine using the JPype package. Jean-Daniel Fekete is not porting the Obvious Toolkit [53] in this environment to integrate all its components [26].

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Heidi Lam (Google, USA)
- Nathaly Henry-Riche (Microsoft Research, USA)
- Ronald Rensink (University of British Columbia, Canada)

AVIZ organized hosted the following international visitors for a one-day visit:

- Marian Dörk (University of Calgary, Canada)
- Shengdong Zhao (National University of Singapore)
- Oliver Deussen and Hendrik Strobelt (University of Konstanz, Germany)

8.4.1.1. Internships

Basak ALPER (from May 2012 until Sep 2012)

Subject: Visualization of Brain Data Connectivity

Institution: University of California San Diego (United States)

Stefanie Klum (from September 2011 until April 2012)

Subject: Stackable Widgets for Faceted Information Seeking

Institution: University of Magdeburg (Germany)

BYMOORE Exploratory Action (section vide)

COMETE Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR projects

7.1.1.1. ANR-09-BLAN-0169-01

Project acronym: PANDA

Project title: Analysis of Parallelism and Distribution

Duration: October 2009 - March 2013

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

Coordinator: Catuscia Palamidessi, Inria Saclay

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

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

7.1.1.2. ANR-09-BLAN-0345-02

Project acronym: CCP

Project title: Confidence, Proof and Probabilities

Duration: October 2009 - March 2013

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

Coordinator: Jean Goubault-Larrecq, ENS Cachan

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

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

7.1.2. Large-scale initiatives

Project acronym: CAPPRIS

Project title: Collaborative Action on the Protection of Privacy Rights in the Information Society

Duration: October 2011 - September 2015

Coordinator: Daniel Le Metayer, Inria Grenoble

Other partner institutions: The project involves four Inria research centers (Saclay, Saphia-Antipolis, Rennes and Grenoble), CNRS-LAAS, Eurecom and the university of Namur. Besides computer scientists, the consortium also includes experts in sociology and in law, thus covering the complementary areas of expertise required to reach the objectives.

Abstract: The goal of this project is to study the challenges related to privacy in the modern information society, trying to consider not only the technical, but also the social and legal ones, and to develop methods to enhance the privacy protection.

7.2. European Initiatives

7.2.1. FP7 Projects

Program: FP7-PEOPLE-2011-IRSES

Project acronym: MEALS

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

Duration: October 2011 - September 2005

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

Coordinator: Holger Hermans, Saarland University, Germany

Other partner institutions: Rheinisch-Westfälische Technische Hochschule Aachen, Germany. Technische Universität Dresden, Germany. Inria, France. Imperial College of Science, Technology and Medicine, UK, University of Leicester, UK. Technische Universiteit Eindhoven, NL. Universidad Nacional de Cordoba, AR. Universidad de Buenos Aires, AR. Instituto Tecnologico de Buenos Aires, AR. Universidad Nacional de Rio Cuarto, AR.

Abstract: In this project we focus on three aspects of formal methods: specification, verification, and synthesis. We consider the study of both qualitative behavior and quantitative behavior (extended with probabilistic information). We aim to study formal methods in all their aspects: foundations (their mathematical and logical basis), algorithmic advances (the conceptual basis for software tool support) and practical considerations (tool construction and case studies).

7.3. International Initiatives

7.3.1. International Partners

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

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

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

7.3.2. Participation in International Programs

Program: ANR Blanc International

Project acronym: LOCALI

Project title: Logical Approach to Novel Computational Paradigms

Duration: October 2011 - September 2015

Coordinator: Gilles Dowek, Inria Rocquencourt

Other PI's and partner institutions: Catuscia Palamidessi, Inria Saclay. Thomas Erhard, Paris VII. Ying Jiang , Chinese Academy of Science in Beijin (China).

Abstract: This project aims at exploring the interplays between logic and sequential/distributed computation in formalisms like the lambda calculus and the π calculus. Going back to the fundamentals of the definitions of these calculi, the project plans to design new programming languages and proof systems via a logical approach.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

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

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

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

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

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

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

7.4.2. Internships

Name: Lili Xu

Duration: From October 2011 until October 2012)

Subject: Compositionality of privacy on a probabilistic process calculus

Institution: Chinese Academy of Sciences of Beijin (China)

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

Name: Marco Stronati

Duration: From October 2011 until March 2013

Subject: Compositional analysis of queries' sensitivity

Institution: University of Pisa, Italy

Support: Ecole Polytechnique and University of Pisa

Name: Fernán Martinelli

Duration: From September 2012 until March 2013

Subject: Computation of bounds on the information flow

Institution: University of Rio Cuarto, Argentina

Support: FP7 project MEALS

Name: Michela Paolini

Duration: From September 2012 until December 2012

Subject: Compositionality of privacy on a probabilistic process calculus.

Institution: IMT Institute for Advanced Studies, Lucca, Italy

Support: Grant from IMT

COMMANDS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. DGA

Participants: Olivier Bokanowski, Anna Désilles, Hasnaa Zidani.

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

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

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. SADCO

Title: Sensitivity Analysis for Deterministic Controller Design

Instrument: Initial Training Network (ITN)

Duration: January 2011 - December 2014

Coordinator: Inria (France)

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

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

Abstract: Optimisation-based control systems concern the determination of control strategies for complex, dynamic systems, to optimise some measures of best performance. It has the potential for application to a wide range of fields, including aerospace, chemical processing, power systems control, transportation systems and resource economics. It is of special relevance today, because optimization provides a natural framework for determining control strategies, which are energy efficient and respect environmental constraints. The multi-partner initial training network SADCO aims at: Training young researchers and future scientific leaders in the field of control theory with emphasis on two major themes sensitivity of optimal strategies to changes in the optimal control problem specification, and deterministic controller design; Advancing the theory and developing new numerical methods; Conveying fundamental scientific contributions within European industrial sectors.

8.2.2. Collaborations with Major European Organizations

Univ. Rome 1 - La Sapienza: Department of Mathematics

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

Univ. Rome 2: Department of Mathematics

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

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. OCONET

Title: Optimization and control in network economics

Inria principal investigator: J.F. Bonnans

International Partner (Institution - Laboratory - Researcher):

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

Duration: 2012 - 2014

Web page: http://www.cmm.uchile.cl/EA_OCONET

Limited resources in telecommunication, energy, gas and water supply networks, lead to multi-agent interactions that can be seen as games or economic equilibrium involving stochastic optimization and optimal control problems. Interaction occurs within a network, where decisions on what to produce, consume, trade or plan, are subject to constraints imposed by node and link capacities, risk, and uncertainty, e.g. the capacity of generators and transmission lines; capacity of pipeline in gas supply; switches and antennas in telecommunication. At the same time, nonlinear phenomena arise from price formation as a consequence of demand-supply equilibria or multi-unit auction processes in the case of energy and telecommunication. We will focus first in this project in electricity markets in which there are producers/consumers PCs, and an agent called ISO (Independent system operator) in charge of the management of the network. One major application we have in mind is the one of smart (electrical) grids, in view of the increased use of renewable energies, that is, a massive entry of wind, geothermal, solar in particular.

8.3.2. Inria International Partners

Univ. Buenos Aires: Department of Mathematics

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

Moscow State Univ.: Department of Mathematics

Collaboration with Andrei Dmitruk on optimal control with singular arcs.

ENIT, Tunis: Department of Mathematics

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

Louisiane State University, USA

Collaboration with Peter Wolenski on stratified controlled systems.

8.3.3. Participation In International Programs

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

8.4. International Research Visitors

8.4.1. Visits of International Scientists

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

8.4.1.1. Internships

Imene BEN LATIFA (from Feb 2012 until May 2012)

Subject: Numerical computation of swing options

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

Lucas Corrales (from May 2012 until Jul 2012)

Subject: Optimal control for some drug models

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

8.4.2. Visits to International Teams

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

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

6. Partnerships and Cooperations

6.1. European Initiatives

6.1.1. FP7 Projects

6.1.1.1. FOX

Title: FOX

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: May 2009 - September 2012

Coordinator: Inria (France)

Others partners: Thomas Schwentick at the university of Dortmund, Mikołaj Bojańczyk at the university of Warsaw, Leonid Libkin at the university of Edinburgh, Georg Gottlob at the university of Oxford, Frank Neven at the university of Hasselt and Maarten Marx at the university of Amsterdam.

See also: http://fox7.eu

Abstract: The objective of FoX is to study the fundamental issues necessary in order to make the data management over the internet more efficient and more reliable.

6.1.2. ERC grant Webdam

6.1.2.1. Webdam

Title: WebDam

Type: IDEAS

Instrument: ERC Advanced Grant (Advanced)

Duration: December 2008 - November 2013

Coordinator: Serge Abiteboul, Inria (France)

Others partners: Pierre Senellart, Telecom Paristech.

See also: http://webdam.inria.fr

Abstract: The goal is to develop a formal model for Web data management. This model will open new horizons for the development of the Web in a well-principled way, enhancing its functionality, performance, and reliability. Specifically, the goal is to develop a universally accepted formal framework for describing complex and flexible interacting Web applications featuring notably data exchange, sharing, integration, querying and updating. We also propose to develop formal foundations that will enable peers to concurrently reason about global data management activities, cooperate in solving specific tasks and support services with desired quality of service.

6.2. International Initiatives

6.2.1. Inria International Partners

- Victor Vianu, UC San Diego, USA.

6.3. International Research Visitors

6.3.1. Visits of International Scientists

Victor Vianu (from June 2012 until September 2012)
>> Subject: WebDaM
>> Institution: UC San Diego (USA)

Gerome Miklau (from September 2012 to June 2012)
>> Subject: WebDaM
>> Institution: Univesity of Massachusetts at Amherst (USA)

6.3.2. Internships

- David Montoya, Webdam, 04/2012 to 09/2012
- Jules Testard, Webdam, 09/2012 to 12/2012

<div align="center">

DEFI Project-Team

</div>

8. Partnerships and Cooperations

8.1. Regional Initiatives

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

8.2. National Initiatives

8.2.1. ANR

- J.R. Li is the coordinator of the project Simulation du signal d'IRM diffusion dans des tissus biologiques (SIMUDMRI), funded 2010-2013 by the ANR Program COSINUS. Participants : Jing-Rebecca Li, Houssem Haddar, Dang Van Nguyen. Joint proposal between Inria-Saclay and CEA Neurospin. http://www.cmap.polytechnique.fr/~jingrebeccali/grants/simudmri.html
- H. Haddar is the DEFI coordinator of the ANR: Modelization and numerical simulation of wave propagation in metamaterials (METAMATH), program MN, 2011-2015. This is a joint ANR with POEMS, Inria Scalay Ile de France project team (Coordinator, S. Fliss), DMIA, Département de Mathématiques de l'ISAE and IMATH, Laboratoire de Mathématiques de l'Université de Toulon. https://www.rocq.inria.fr/poems/metamath

8.3. European Initiatives

8.3.1. *Collaborations with Major European Organizations*

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

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

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

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

8.4. International Initiatives

8.4.1. *Inria Associate Teams*

8.4.1.1. ISIP

Title: Inverse Scattering and Identification Problems

Inria principal investigator: Houssem HADDAR

International Partner (Institution - Laboratory - Researcher):

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

Duration: 2008 - 2013

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

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

8.4.2. *Inria International Partners*

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

8.4.3. Participation In International Programs

- H. Haddar is member of the EPIC, an Inria team in the framework of LIRIMA.
- Olivier Pantz is in charge of the french side of the PHC (Hubert Curien Project) *Sur l'étude de quelques problèmes d'équations aux dérivées partielles issus de la physique* (with H. Zorgati of the University of Tunis in charge for the Tunisian side).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

Mohamed MAHJOUB (from Feb 2012 until Aug 2012)

Subject: Level set method applied to structural optimization with contact

Institution: Ecole Polytechnique de Tunisie (Tunisia)

Jackie FAN YAN (from June 2012 until Aug 2012)

Subject: Direct and inverse simulation of hyper lenses

Institution: University of Delaware (Tunisia)

DISCO Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

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

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

+   DIGITEO Project (DIM LSC) MOISYR
    Project title: Monotonie, observateurs par intervalles, et systèmes à retard
    Decembre 2011 - Decembre 2014
    Coordinator: Frédéric Mazenc
    Other partners: organisme, labo (pays) L2S, France, Mines-ParisTech, France.
    Abstract: MOISYR is concerned with the creation of the problem of extending the theory of monotone systems to the main families of continuous time systems with delay along with the application of this theory to the design of observers and interval observers. In particular, nonlinear systems with pointwise and distributed delays and stabilizable systems with delay in the input shall be considered. In a second setp, we shall extend our result to discrete time systems and to a specific class of continuous/discrete systems called Networked Control Systems.

8.2. National Initiatives

8.2.1. *Competitivity Clusters*

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

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

Partner 1: Patras University, Greece

Constrained control systems (analysis and design)

Partner 2: Leeds University, United Kingdom

Analysis of delay systems

Partner 3: Bilkent University, Turkey

Modelling of cell dynamics

Partner 4: RWTH Aachen University, Germany

Mathematical systems theory, control theory, symbolic computation.

Alban

8.4. International Initiatives

8.4.1. Inria International Partners

- UNICAMP, Sao Paulo, Brazil

- Kyushu Institute of Technology, Iizuka, Fukuoka, Japan

- Louisiana State University, Baton Rouge, USA

- University of California, San Diego, CA, USA

8.4.2. Participation In International Programs

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

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

8.5. International Research Visitors

8.5.1. Visits of International Scientists

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

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

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

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

GALEN Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Program: DIGITEO CHAIR

    Project acronym: SuBSAmPLE

    Project title: identification and prediction of Salient Brain StAtes through ProbabiListic structure learning towards fusion of Imaging and Genomic data

    Duration: 1/2012-12/2015

    Coordinator: ECP-FR

- Program: DIGITEO OMTE

    Project acronym: CURATEUR

    Project title: Real-time Multi-sensor (2D/3D) Elastic Image Fusion towards Computer-assisted Tumor Removal Surgery

    Duration: 1/2012-6/2014

    Coordinator: ECP-FR

8.2. National Initiatives

8.2.1. ANR

- Program: ANR Blanc International

    Project acronym: ADAMANTIUS

    Project title: Automatic Detection And characterization of residual Masses in pAtients with lymphomas through fusioN of whole-body diffusion-weighTed mrI on 3T and 18F-flUorodeoxyglucoSe pet/ct

    Duration: 9/2012-8/2015

    Coordinator: CHU Henri Mondor - FR

- Program: ANR JCJC

    Project acronym: HICORE

    Project title: HIerarchical COmpositional REpresentations for Computer Vision

    Duration: 10/2010-9/2013

    Coordinator: ECP - FR

8.2.2. Competitivity Clusters

- Program: MEDICEN

    Project acronym: ADOC

    Project title: ADOC – Diagnostic peropératoire numérique en chirurgie du cancer

    Duration: 11/2011-10/2014

    Coordinator: LLTECH - FR

8.3. European Initiatives

8.3.1. FP7 Projects

- Project acronym: MOBOT

  Project title: Intelligent Active MObility Assistance RoBOT integrating Multimodal Sensory Processing, Proactive Autonomy and Adaptive Interaction

  Duration: 36 months

  Coordinator: TUM - DE

- Project acronym: RECONFIG

  Project title: Cognitive, Decentralized Coordination of Heterogeneous Multi-Robot Systems

  Duration: 36 months

  Coordinator: KTH - SE

8.3.2. Collaborations in European Programs, except FP7

- Program: European Research Council

  Project acronym: DIOCLES

  Project title: Discrete bIOimaging perCeption for Longitudinal Organ modEling and computEr-aided diagnosiS

  Duration: 9/2011-8/2016

  Coordinator: ECP - FR

8.3.3. Collaborations with Major European Organizations

Technical University of Munich, Chair for Computer Aided Medical Procedures & Augmented Reality - Computer Science Department (DE): Mono and Multi-modal image fusion using discrete optimization and efficient linear programming.

Università della Svizzera Italiana, Institute of Computational Science (CH), Construction of deformation-invariant surface descriptors [39] and meta-descriptors for surfaces [17].

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. SPLENDID

Title: Self-Paced Learning for Exploiting Noisy, Diverse or Incomplete Data

Inria principal investigator: Pawan Kumar

International Partner (Institution - Laboratory - Researcher):

Stanford University (United States) - Artificial Intelligence Lab

Duration: 2012 - 2014

The goal of the project is to develop methods for learning accurate probabilistic models using diverse (consisting of fully and weakly supervised samples), incomplete (consisting of partially labeled samples) and noisy (consisting of mislabeled samples) data. To this end, we will build on the intuitions gained from self-paced human learning, where a child is first taught simple concepts using simple examples, and gradually increasing the complexity of the concepts and the examples. In the context of machine learning, we aim to impart the learner with the ability to iteratively adapt the model complexity and process the training data in a meaningful order. The efficacy of the developed methods will be tested on several real world computer vision and medical imaging applications using large, inexpensively assembled datasets.

8.4.2. Inria International Partners

- **Department of Diagnostic Radiology, University of Pennsylvania:** The GALEN and the Section of Biomedical Image Analysis - SBIA group (Pr. Christos Davatzikos) have an established collaboration during the past three years in the area of deformable image fusion. In this context, PhD candidates of the GALEN group spend time visiting the SBIA group, while Pr. Paragios participates at a Nantional Institute Health grant led by SBIA. Such a collaboration led to a number of outstanding rank journal and conference publications.

- **Department of Computer Science, StonyBrook, State University of New York:** The GALEN and the Image Analysis Lab - CBL (Pr. Dimitris Samaras) have an established collaboration during the past years in the area of graph-based methods in medical imaging and computer vision. Pr. Samaras holds a research professor position (DIGITEO chair) at Ecole Centrale de Paris. Such a collaboration led to a number of outstanding rank conference publications during the last years.

- **Chang Gung Memorial Hospital – Linkou, Taiwan:** In the context of France-Taiwan program sponsored from the French Science Foundation, GALEN (in collaboration with the department of radiology of Henri Mondor University Hospital), a project (ADAMANTIUS) was initiated with the Chang Gung Memorial Hospital – Linkou that is the largest private hospital in Taiwan. The aim of the project is to study the Automatic Detection And characterization of residual Masses in pAtients with lymphomas through fusioN of whole-body diffusion-weighTed mrI on 3T and 18F-flUorodeoxyglucoSe pet/ct.

8.5. International Research Visitors

8.5.1. Internships

- Aseem BEHL (from Nov 2012 to Dec 2012)

  Subject: Optimizing Average Precision using Weakly Supervised Data. The average-precision support vector machine (AP-SVM) optimizes an upper bound on the average-precision (AP) loss, which is often used as a measure of accuracy for binary classification. However, it does not handle partially annotated datasets. To address this shortcoming of AP-SVM, we proposed a novel latent AP-SVM formulation, which allows us to learn an accurate set of classifier parameters by minimizing a carefully designed difference-of-convex upper bound on the AP loss.

  Institution: International Institute of Information Technology (IIIT), Hyderabad (India).

  Enzo FERRANTE (from June 2012 until October 2012)

  Subject: Plane+Deformation 2D-3D multimodal data fusion. The goal of the internship was to study the use of discrete optimization methods in the context of 2D to 3D registration in biomedical image analysis. In particular the aim was to define a metric free graphical model formulation that is able to determine for a given 2D image the corresponding 3D volume plane along with the in plane deformation. The case of computer assisted surgery was considered as a test case between 2D interventional images and 3D pre-operative high resolution annotated data.

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

- Danny GOODMAN (Aug 2012)

  Subject: Discriminative Parameter Estimation for Random Walks Segmentation. While random walks (RW) provide an efficient formulation for segmentation, there use is restricted by the lack of an accurate learning framework that estimates its parameters. The main difficulty is that a user can only provide a hard segmentation of a training sample, instead of the optimal probabilistic segmentation. We overcome this deficiency by treating the optimal probabilistic segmentation as latent variables, which allows us to employ the latent SVM formulation for parameter estimation.

  Institution: Stanford University (USA).

Ishan MISRA (from May 2012 until Aug 2012)

> Subject: Shape-from Shading analysis for Object Categories. The goal of the internship was to see whether shape-from-shading techniques can be used to recover the 3D geometry within an object category. Mr. Misra experimented with techniques for shape-from-shading under unknown illumination as well as surface recovery from a single image. Mr. Misra has delivered the source code for his software to our team, and we intend to use it in our on-going research.

> Institution: IIIT HYDERABAD (India)

Bharat SINGH (from May 2012 until September 2012)

> Subject: Sub-space real-time Deformable Registration. The aim of this internship was to investigate the use of sub-space image representations towards defining an appropriate metric in the context of mono-modal and multi-modal fusion. Furthermore, it was studied their integration in a graph-theoretic framework for deformable fusion that can benefit from its implementation on modern parallel architectures like graphics processing units.

> Institution: IIT MADRAS (India)

Eduard TRULLS (from January 2012 until April 2012)

> Subject: Segmentation-Aware Image Descriptors. The goal of the internship was to construct appearance descriptors that can exploit segmentation information in order to achieve invariance to background changes. Mr. Trulls implemented a dense descriptor that uses soft segmentation masks, and demonstrated that this results in substantially more invariant descriptors; he evaluated these descriptors on image registration (optical flow) and wide-baseline matching (stereo) where state-of-the-art results were obtained. This work has been submitted for publication and is under evaluation.

> Institution: Universidad Polytecnica de Catalunia (UPC) (Spain)

8.5.2. Visits to International Teams

Matthew BLASCHKO & Iasonas KOKKINOS (from June 2012 until August 2012)

> Subject: Center for Language and Speech Processing: Towards a Detailed Understanding of Objects and Scenes in Natural Images Workshop. The objective of this workshop was to develop novel methods to reliably extract from images a diverse set of attributes, and to use them to improve the accuracy, informativeness, and interpretability of object models. The goal is to combine advances in discrete-continuous optimisation, machine learning, and computer vision, to significantly advance our understanding of visual attributes and produce new state-of-the-art methods for their extraction.

> Institution:John Hopkins University (USA)

Pawan KUMAR (from April 2012 until May 2012)

> Subject: SPLENDID Associate Team

> Institution: Stanford University (United States)

GECO Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- **Digitéo project CONGEO.** CONGEO (2009–2013) is financed by Digitéo in the framework of the DIM *Logiciels et systèmes complexes*. It focuses on the neurophysiology applications. U. Boscain, Y. Chitour (leader), F. Jean and P. Mason are part of the project.

7.2. National Initiatives

- **ANR project GCM.** The project ANR GCM (*programme blanc*, 2009–13) involves the great majority of GECO's members (permanent and external). It focuses on various theoretical aspects of geometric control and on quantum control. It is coordinated by J.-P. Gauthier.
- **ANR ArHyCo.** The project ANR ArHyCo (*programme ARPEGE*, 2009–12) is about switched systems. It is coordinated by J. Daafouz. The first theme of the ANR, on stability of switched systems, is lead by M. Sigalotti.

7.3. European Initiatives

7.3.1. FP7 Projects

Program: ERC Starting Grant

Project acronym: GeCoMethods

Project title: Geometric Control Methods for the Heat and Schroedinger Equations

Duration: 1/5/2010 - 1/5/2015

Coordinator: Ugo Boscain

Abstract: The aim of this project is to study certain PDEs for which geometric control techniques open new horizons. More precisely we plan to exploit the relation between the sub-Riemannian distance and the properties of the kernel of the corresponding hypoelliptic heat equation and to study controllability properties of the Schroedinger equation.

All subjects studied in this project are applications-driven: the problem of controllability of the Schroedinger equation has direct applications in Laser spectroscopy and in Nuclear Magnetic Resonance; the problem of nonisotropic diffusion has applications in cognitive neuroscience (in particular for models of human vision).

Participants. Main collaborator: Mario Sigalotti. Other members of the team: Andrei Agrachev, Riccardo Adami, Thomas Chambrion, Grégoire Charlot, Yacine Chitour, Jean-Paul Gauthier, Frédéric Jean.

7.4. International Initiatives

7.4.1. Inria International Partners

SISSA (Scuola Internazionale Superiore di Studi Avanzati), Trieste, Italy.

Sector of Functional Analysis and Applications, Geometric Control group. Coordinator: Andrei A. Agrachev.

We collaborate with the Geometric Control group at SISSA mainly on subjects related with sub-Riemannian geometry. Thanks partly to our collaboration, SISSA has established an official research partnership with École Polytechnique.

7.4.2. Participation In International Programs

- Laboratoire Euro Maghrébin de Mathématiques et de leurs Interactions (LEM2I)
  http://www.lem2i.cnrs.fr/
- GDRE Control of Partial Differential Equations (CONEDP)
  http://www.ceremade.dauphine.fr/~glass/GDRE/

7.5. International Research Visitors

7.5.1. Visits of International Scientists

Gianluca Panati visited GECO from 18/6 to 18/7 (thanks to an invitation by École Polytechinque). He worked on the control of spin-boson systems in collaboration with U. Boscain, P. Mason and M. Sigalotti.

7.5.1.1. Internships

Guilherme MAZANTI (from Jul 2012 until Nov 2012)

     Subject: Persistent excitation with bounded variation & arbitrary rate of stabilization

     Institution: University of São Paulo (Brazil)

GEOMETRICA Project-Team (section vide)

GRACE Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- CATREL (accepted June 2012, Kickoff December 14, 2012, Starting January 1st, 2013): "Cribles: Améliorations Théoriques et Résolution Effective du Logarithme" (Sieve Algorithms: Theoretical Advances and Effective Resolution of the Discrete Logarithm Problem). The aim of this project is to make effective "attacks" on reduced-size discrete logarithm problem (DLP) instances. It is a key ingredient for the assessment of the security of cryptosystems relying on the hardness of the DLP in finite fields, and for deciding on relevant key sizes.

7.1.2. DGA

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

7.2. European Initiatives

7.2.1. Collaborations in European Programs, except FP7

Program: PHC Hubert Curien PROCOPE

Project acronym: PowerList

Project title: PowerList

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

Coordinator: Daniel Augot

Other partners: Ulm Universität, TAIT group, Germany.

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

7.3. International Initiatives

7.3.1. Inria International Partners

- DTU Lyngby.
- Ulm Universität.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Internships

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

7.4.2. Visits to International Teams

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

GRAND-LARGE Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. Activities starting in 2009

- Franck Cappello, Co-Director of the **Inria - Illinois Joint Laboratory** on PetaScale Computing, since 2009

6.1.2. Other activities

- **CALIFHA project (DIM Digiteo 2011)**: CALculations of Incompressible Fluid flows on Heterogeneous Architectures. Funding for a PhD student. Collaboration with LIMSI/CNRS. Participants: Marc Baboulin (Principal Investigator), Joel Falcou, Yann Fraigneau (LIMSI), Laura Grigori, Olivier Le Maître (LIMSI), Laurent Martin Witkowski (LIMSI).

- **ANR SPADES** Coordinated by LIP-ENS Lyon. (Sylvain Peyronnet, Franck Cappello, Ala Rezmerita)

- **Défi ANR SECSI** Participant to this challenge. From September 2008 to August 2010. Managed by the SAIC. (Thomas Hérault, Sylvain Peyronnet, Sébastien Tixeuil)

- **ANR Cosinus project MIDAS - MIcrowave Data Analysis for petaScale computers** December 2009 - December 2012 (http://www.apc.univ-paris7.fr/APC_CS/Recherche/Adamis/MIDAS09/index.html). Collaboration with APC, University Paris 7 and Lawrence Berkeley Laboratory. This is an interdisciplinary project devised to bring together cosmologists, computational physicists, computer scientists and applied mathematiciancs to face the challenge of the tremendous volume of data as anticipated from current and forthcoming Cosmic Microwave Background (CMB) experiments. (Laura Grigori, Coordinator for Inria Saclay, F. Cappello, J. Falcou, T. Hérault, S. Peyronnet)

- **ANR Cosinus project PETALh - PETascale ALgorithms for preconditioning for scientific applications** January 2011- December 2012. Collaboration with Laboratoire Lions - Universite 6, IFP, Inria Bordeaux and CEA, UC Berkeley and Argonne. The goal is to investigate preconditioning techniques on multicore architectures and apply them on real world applications from IFP, CEA and Argonne. (Laura Grigori, Principal Investigator)

- **ANR Cosinus project PetaQCD - Towards PetaFlops for Lattice Quantum ChromoDynamics** (2009-2012) Collaboration with Lal (Orsay), Irisa Rennes (Caps/Alf), IRFU (CEA Saclay), LPT (Orsay), Caps Entreprise (Rennes), Kerlabs (Rennes), LPSC (Grenoble). About the design of architecture, software tools and algorithms for Lattice Quantum Chromodynamics. (Cédric Bastoul, Christine Eisenbeis, Michael Kruse)

  PI L. Grigori

- Inria Associated Team **"F-J Grid"** with University of Tsukuba, head: Franck Cappello

- Inria funding, **MPI-V**, collaboration with UTK, LALN and ANL, head: Franck Cappello

- ANR CIS Project **FF2A3**, 3 years (2007 - 2010), PI F. Hecht, subproject head L. Grigori

- **HipCal**, ANR CIS, 3 years (2006-2009), http://hipcal.lri.fr/wakka.php?wiki=PagePrincipale, Franck Cappello

6.2. International Initiatives

6.2.1. Inria Associate Teams

- **Inria associated team COALA with Prof. J. Demmel, UC Berkeley, 2010-2013**. This project is proposed in the context of developing Communication Optimal Algorithms for Linear Algebra. The funding covers visits in both directions. The following visits of PhD students and postdoctoral researcher took place in the context of this associated team:
  - Visit of M. Jacquelin to UC Berkeley (August 2011, for 1 month).
  - Visit of S. Moufawad (November 2012, for 1 month).

6.3. European Initiatives

6.3.1. Collaborations in European Programs, except FP7

Program: ITEA2

Project acronym: MANY

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

Duration: 01/09/2011 - 31/08/2014

Coordinator: XDIN AB (formerly ENEA)

Other partners: Universitat Auto`noma de Barcelona (UAB), CEPHIS group (Spain), CAPS-Entreprise, (France), Inria, Grand Large (France), Institut Mines-Te´le´com/Te´le´com Sud Paris (IMT/TSP), Computer Science Department (France), THALES Communications & Security, (France), XDIN AB, (Sweden), ETRI, (Korea), Seven Core Co, Ltd, (Korea), TestMidas Co, Ltd, (Korea), ST-Ericsson BV, (Netherlands), Vector Fabrics BV, (Netherlands), Technische Universiteit Eindhoven, (Netherlands), University of Mons (UMONS), POLE-TI (Belgium)

Abstract: The ability to reuse existing software code has grown in importance as software applications become more complex. With the arrival of many-core semiconductor architectures, application developers face an additional problem: how to rewrite software applications to exploit the increased parallel processing available. The MANY project is developing an improved programming environment for the embedded-systems realm; one which will facilitate faster development of applications for a variety of hardware platforms. (Cédric Bastoul, Léna"ic Bagnères, Taj Khan)

6.4. International Research Visitors

6.4.1. Internships

German SCHINCA (*Date_begin_end ???*)

　　　Subject: Minimizing communication in scientific computing

　　　Institution: University of Buenos Aires (Argentina)

German SCHINCA (*Date_begin_end ???*)

Alessandro Ferreira Leite (October 2012-December 2012)

　　　Subject: Energy issues in Cloud Computing

　　　Institution: University of Brasilia (Brasil)

HIPERCOM Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR: GETRF

Participants: Paul Mühlethaler, Pascale Minet, Cédric Adjih, Emmanuel Baccelli, Salman Malik.

Period: 2012 - 2014.

Partners: DGA/MI, Inria.

The GETRF project aims at improving the effectiveness of communications mechanisms and technologies capable of functioning in extreme conditions and GETRF also aims at opening ways for solutions that are close to the optimum. The following areas will be addressed:

- Compromise time / maximum efficiency for coloring (TDMA), which can be used to take into account the asymmetry of traffic delays to optimize routing.
- Significant energy savings for opportunistic routing (in power saving mode) even where traffic control is limited and where the nodes are idle most of the time ("low-duty cycle")
- From a completely different point of view, the finding optimal network capacity for opportunistic routing variants when designed for mobile networks
- Robustness to mobility and to changes in network conditions (difficult connectivity, foes, ...) extreme network coding - which is moreover an innovative technology in itself applied here in MANETs, at the network and/or application layer, rather than at the physical/or theoretical level as in other proposals.

The project will focus on four technical approaches which are:

- Coloring for the development of a TDMA system for energy saving and delay control,
- Cross-layer (MAC/routing) mechanism for "low-duty-cycle" mode
- Network coding,
- Opportunistic routing and mobile mobility to use relays to minimize retransmissions of packets with a target time.

The first two approaches are intended to provide energy efficient sensor networks. The second two approaches try to provide mechanisms for building ad hoc networks capable of handling high node mobility.

7.1.2. Competitivity Clusters

7.1.2.1. SAHARA
Participants: Pascale Minet, Cédric Adjih, Ridha Soua, Erwan Livolant.

Period: 2011 - 2014.

Partners: EADS, Astrium, BeanAir, Eurocopter, Inria, Oktal SE, Reflex CES, Safran Engineering Systems, CNES, ECE, EPMI,LIMOS.

SAHARA is a FUI project, labelled by ASTECH and PEGASE, which aims at designing a wireless sensor network embedded in an aircraft. The proposed solution should improve the embedded mass, the end-to-end delays, the cost and performance in the transfers of non critical data. Inria is in charge of coordinating the academic partners. During year 2012, we took part to the specification of application requirements. We also defined the functional architecture and made measurements within the plane of SAFRAN.

7.1.2.2. CONNEXION
  Participants: Pascale Minet, Cédric Adjih, Saoucene Mahfoudh Ridene, Ines Khoufi.

Period: 2012 - 2016.

Partners: All4Tec, ALSTOM, AREVA, Atos WorldGrid, CEA, CNRS / CRAN, Corys TESS, EDF, ENS Cachan, Esterel Technologies, Inria, LIG, Predict, Rolls-Royce Civil Nuclear, Telecom ParisTech.

The Cluster CONNECTION (Digital Command Control for Nuclear EXport and renovation) project aims to propose and validate an innovative architecture platforms suitable control systems for nuclear power plants in France and abroad. This architecture integrates a set of technological components developed by the academic partners (CEA, Inria, CNRS / CRAN, ENS Cachan, LIG, Telecom ParisTech) and based on collaborations between major integrators such as ALSTOM and AREVA, the operator EDF in France and "techno-providers" of embedded software (Atos WorldGrid, Rolls-Royce Civil Nuclear, Corys TESS, Esterel Technologies, All4Tec, Predict). With the support of the competitiveness clusters System@tic, Minalogic and Burgundy Nuclear Partnership,the project started in April 2012. The key deliverables of the project covered several topics related demonstration concern-driven engineering models for the design and validation of large technical systems, design environments and evaluation of HMI, the implementation of Wireless Sensor Network context-nuclear, buses business object or real-time middleware facilitating the exchange of heterogeneous data and distributed data models standardized to ensure consistency of digital systems.

The HIPERCOM project-team is involved in wireless sensor networks coping with node mobility. We focused on deployment and redeployment algorithms for mobile wireless sensor networks after a disaster. We began with a state of the art. Many works in the literatures deal with this issue. We can classify these works in several ways:

- First classification:
    - Centralized Algorithms as Practical swarm optimization (PSO), Centralized virtual forces...These algorithms minimize the moves done by nodes since each sensor moves only to its final position computed by the specific node. However, they rely on assumption that may be unrealistic (e.g. network connectivity). Furthermore, they are not scalable.
    - Distributed Algorithms as Distributed Self Spreading algorithm (DSSA), Force-based Genetic Algorithm (FGA), Mass-Sprig -Relaxation Algorithm... These algorithms are more relistic: they adapt to the knowledge progressively acquired during the redeployment. However, there are still pending issues such as nodes oscillation, coverage computation, point of interest...
- Second classification:
    - Grid based approach: sensors will redeploy according to a predetermined grid.
    - The computational geometry based approach uses the Voronoi diagram and the Delaunay triangulation.
    - The virtual force based approach is based on virtual forces to move sensors.

The latter (virtual force based approach) presents many advantages such as simplicity and fast coverage. That is why we adopt this appraoch.

7.1.2.3. SensLab and FIT
  Participants: Cédric Adjih, Emmanuel Baccelli, Ala Eddin Weslati.

Period: 2011 - 2021

Partners: Inria (Lille, Sophia-Antipolis, Grenoble), INSA, UPMC, Institut Télécom Paris, Institut Télécom Evry, LSIIT Strasbourg.

The HIPERCOM team started the development of a testbed for SensLab in 2010. This testbed located in building 21 at Rocqquencourt Inria center consists now of 128 wireless SensLab nodes.

A location has been found for the new testbed of the EQUIPEX FIT: the basement of building 1 at Rocquencourt. An engineer has been recruited for this project.

7.1.2.4. ACRON

Participant: Cédric Adjih.

Period: 2011 - 2014

Partners: Supélec (Télécommunications), Inria, ENS TREC, Inria HIPERCOM, Université Paris-Sud, IEF.

ACRON is a DIMLSC DIGITEO project. It deals with analysis and design of self-organized wireless networks. The HIPERCOM team project will study the theoretical limits of wireless networking.

7.1.2.5. SWAN

Participants: Cédric Adjih, Salman Malik.

Period: 2011 - 2014

Partners: CNRS, Supélec, Université Paris-Sud (L2S), LTCI, LRI, Inria Hipercom and IEF.

SWAN, Source-aWAre Network coding, is a DIMLSC DIGITEO project. It deals with network coding for multimedia.

7.1.2.6. MOBSIM

Participants: Cédric Adjih, Paul Mühlethaler, Hana Baccouch.

Period: 2011 - 2013

Partners: Inria Sophia, Inria Genoble.

MOBSIM is an ADT, Action of Technology Development. It aims at developing the NS3 simulation tool. The HIPERCOM team focuses on routing protocols and MAC protocol (namely the EY-NPMA protocol Elimination Yield Non-Preemptive Multiple Access). An engineer has been recruited for this project.

7.1.3. OCARI2

Participants: Ichrak Amdouni, Pascale Minet, Cédric Adjih, Ridha Soua.

Partners: EDF, LIMOS, TELIT.

At the end of the OCARI (Optimization of Ad hoc Communications in Industrial networks) project, funded by ANR, started in February 2007 and ended in 2010, EDF the coordinator decided to continue the project with a restricted number of partners: TELIT, LIMOS (Clermont Ferrand university) and Inria. The goal was to prove the feasibility on commercially available cards of the OCARI stack designed during the ANR project and to make a public demonstration of this product. During the year 2011, the OCARI stack has been improved and implemented on the ZE51 module of TELIT based on the Texas Instrument CC2530 Chipset. During 2012, we made several demonstrations of the energy-efficient routing protocol EOLSR and the node coloring algorithm OSERENA to save energy.

The OCARI project deals with wireless sensor networks in an industrial environment. It aims at responding to the following requirements which are particularly important in power generation industry and in warship construction and maintenance:

- Support of deterministic MAC layer for time-constrained communication,
- Support of optimized energy consumption routing strategy in order to maximize the network lifetime,
- Support of human walking speed mobility for some particular network nodes, (e.g. sinks).

The development of OCARI targets the following industrial applications:

- Real time centralized supervision of personal dose in electrical power plants,
- Condition Based Maintenance of mechanical and electrical components in power plants as well as in warships,
- Environmental monitoring in and around power plants,
- Structure monitoring of hydroelectric dams.

To meet the requirements of supported applications (remote command of actuators, tele-diagnostic...), new solutions will be brought to manage several communication modes, ranging from deterministic data transfers to delay tolerant transfers. A key issue is how to adapt routing algorithms to the industrial environment, taking into account more particularly limited network resources (e.g.; bandwidth), node mobility and hostile environment reducing radio range.

The OCARI project aims at developing a wireless sensor communication module, based on IEEE 802.15.4 PHY layer and supporting EDDL and HART application layer. The Inria contribution concerns more particularly energy efficient routing and node activity scheduling.

- The energy efficient extension of OLSR, called EOLSR, is implemented on top of the MAC protocol defined by LATTIS and LIMOS. The MAC protocol is a variant of ZigBee ensuring some determinism and quality of service and allowing leave nodes (e.g. sensor, actuator) as well as router nodes to sleep. The EOLSR protocol avoids nodes with low residual energy and selects the routes minimizing the energy consumed by an end-to-end transmission.

- SERENA, the protocol used to schedule router node activity, is based on three-hop coloring. It allows any node to sleep during the slots that are attributed neither to its color nor to its one-hop neighbors. SERENA contributes to a more efficient use of energy: less energy is spent in the idle and interference states. Hence, network lifetime is considerably increased. SERENA has been optimized for the specific context of OCARI (i.e.; very limited bandwidth 250kbps, small size messages 127 bytes, limited memory and limited processing power) have been delivered.

These protocols have been implemented in the OCARI stack, operating on a ZE51 module of TELIT.

7.2. European Initiatives

7.2.1. Collaborations in European Programs, except FP7

Program: CSOSG

Project acronym: SAFEST

Project title:

Duration: May 2012-April 2015

Coordinator: Emmanuel Baccelli

Other partners: Freie Universitat Berlin, Hamburg University, Sagem, Daviko, FOS, Fraunhofer

Abstract: Public spaces, such as airports, railway stations, or stadiums bring together large numbers of people on limited space to use security-sensitive infrastructure. These spaces pose two distinct challenges to public security: (a) detecting unauthorized intrusions and (b) monitoring large crowds in order to provide guidance in case of unexpected events (e.g., mass panic). To ensure the safety of the general public as well as individuals, we thus require a flexible and intelligent method for area surveillance. One example in which current monitoring systems proved to be dangerously inefficient is the Love Parade music festival in Duisburg, Germany, July 2010. Crowd control failed to provide guidance to a large crowd, resulting in a mass panic with 21 deaths and several hundred injured. In this particular case, overloaded communication infrastructure led to a lack of information about the density and the movement of the crowd, which in turn resulted in misjudgments on appropriate strategies to resolve the situation. This incident highlights the need for more sophisticated and reliable methods for area surveillance. The SAFEST project aims to analyse the social context of area surveillance and to develop a system that can fulfill this task, both in terms of technology as well as

acceptance by the general public. The system will operate in distributed way, collect anonymised data, securely transfer this data to a central location for evaluation, and if necessary notify the operator and/or issue alerts directly to the general public. SAFEST addresses the following topics: (i) it proposes a solution for crisis management, addressing social, technical, and economic issues, (ii) it enhances the protection of the population against risks and dangers, including the evaluation of acceptance of said solution, and (iii) it addresses the protection of critical infrastructures by the means of a comprehensive technical solution.

7.3. International Initiatives

7.3.1. IT-SG-WN

Title: Information Theory, Stochastic Geometry, Wireless Networks

Inria principal investigator: Paul Muhlethaler

International Partner (Institution - Laboratory - Researcher):

Stanford University (United States) - Information Systems Laboratory, Department of Electrical Engineering - Abbas El Gamal

Duration: 2011 - 2013

See also: http://www.di.ens.fr/~baccelli/IT_SG_WN_web_site.htm

The activity of this proposal is centered on the inter-play between stochastic geometry and network information theory, whith a particular emphasis on wireless networks. In terms of research, three main lines of thought will be pursued:1. Error exponents and stochastic geometry2. Stochastic geometry and network Information Theory3. Cognitive radio and stochastic geometry

7.3.2. Participation In International Programs

7.3.2.1. AWSN2012

Program: Euromediterranean 3+3

Title: Auto-adaptivity in Wireless Sensor Networks

Inria principal investigator: Pascale Minet

International Partners (Institution - Laboratory - Researcher):

University of Catania (Italy) - DIEEI - Lucia Lo Bello

Ecole Nationale Supérieure d'Informatique et d'Analyse des Systèmes (Morocco) - ND-SRG - Mohamed Erradi

Ecole Nationale des Sciences de l'Informatique (Tunisia) - CRISTAL - Leila Azouz Saidane

Duration: Jan 2012 - Dec 2015

See also: euromed

Wireless sensor networks (WSNs) allow the development of numerous applications in various domains, such as security and surveillance, environment protection, precision agriculture, intelligent transportation, homecare of elderly and disabled people...

Communication in such WSNs has to cope with limited capacity resources, energy depletion of sensor nodes, important fluctuations of traffic in the network, changes in the network topology (radio link breakage, interferences ...) or new application requirements.

In the AWSN project, we focus on the different techniques to be introduced in the WSNs to make them auto-adaptive with regard to these various changes while meeting the application requirements. Thus, we will address:

- network deployment and redeployment in order to fulfill the application requirements,

- QoS (Quality of Service) optimization taking into account real-time traffic and dynamic bandwidth allocation,

- energy efficiency and replacement of failed sensor node,

- component generation and dynamic adaptation of the application.

After a kick-off meeting in Paris in February, we organized three workshops where each team presented its works:

- a workshop in Rabat in October 2012, where each team presented its works,

- a workshop in Tunis in November 2012. This workshop was open to non-members and was preceded by a call for paper. It was held in conjunction with the IEEE NoF 2012 conference (Network of the Future).

- a workshop in Catania in December 2012, where new results have been presented.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- **Mauro Fonseca**, Pontifical Catholic University of Paraná, Curitiba, Brazil, July 2012-June 2013 (Saclay),

- **Anelise Munaretto**, Federal Technological University of Paraná, Curitiba, Brazil, July 2012-June 2013 (Saclay),

- **Leila Saidane**, ENSI, Tunis, Tunisia, February and July 2012 (Rocquencourt),

- **Lucia Lo Bello**, UniCT, Catania, Italy, February 2012 (Rocquencourt),

- **Mohammed Erradi**, ENSIAS, Rabat, Morocco, February 2012 (Rocquencourt),

- **Bernard Mans**, Macquarie University, March-August 2012 (Rocquencourt).

7.4.1.1. Internships

Kanchana Thilakarathna, NICTA/University of New South Wales, Sydney, Australia, March-September 2012 (Saclay)

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

DigiPods (2012-2015) – The *Distant Collaborative Interaction Between Heterogeneous Visualization Platforms* project is funded by the "Équipement mi-lourd SESAME 2012" program of the Région Île-de-France. 6 academic partners: FCS Paris-Saclay (coordinator), Université Paris-Sud, Inria, CNRS, CEA, Institut Telecom ParisTech with an overall budget of 1.9 Meuros, including 850 keuros public funding from Région Île-de-France. Stéphane Huot: coordinator and principal investigator for the whole project. The goal is to equipe Digiscope platforms (see below) with high-end input and interaction devices/systems. These interaction facilities should be: (i) specific to each kind of platform (e.g., haptic devices for immersive rooms, multitouch devices for high-resolution visualization walls); or (ii) generic for all platforms, in order to allow collaboration between heterogeneous platforms. The latter will be the more innovative, providing users with a personal and configurable interaction space, similar on every platform of the project. Designed for studying distant collaborative interaction, these systems will also serve as a testbed for exploring and addressing the challenges of configurability and adaptability for the end-user.

7.2. National Initiatives

*Digiscope - Collaborative Interaction with Complex Data and Computation (2011-2020)*http://digiscope.fr. "Equipment of Excellence" project funded by the "Invesissements d'Avenir" program of the French government. 10 academic partners: FCS Paris-Saclay (coordinator), Université Paris-Sud, CNRS, CEA, Inria, Institut Telecom ParisTech, Ecole Centrale Paris, Université Versailles - Saint-Quentin, ENS Cachan, Maison de la Simulation. Overall budget: 22.5 Meuros, including 6.7 Meuros public funding from ANR. Michel Beaudouin-Lafon: coordinator and principal investigator for the whole project. The goal of the project is to create nine high-end interactive rooms interconnected by high-speed networks and audio-video facilities to study remote collaboration across interactive visualization environments. The equipment will be open to outside users and targets four main application areas: scientific discovery, product lifetime management, decision support for crisis management, and education and training. In Situ will contribute the existing WILD room, a second room called WILDER funded by the project, and its expertise in the design and evaluation of advanced interaction techniques and the development of distributed software architectures for interactive systems.

MDGest - Interacting with Multi-Dimensional Gestures (2011-2014). In Situ is the only academic partner. Funded by the French National Research Agency (ANR), Programme JCJC (Junior researchers): 88 Keuros. Caroline Appert (coordinator) and Theophanis Tsandilas. This project investigates new interactions for small devices equipped with a touchscreen. Complementing the standard point-and-click interaction paradigm, the MDGest project explores an alternative way of interacting with a user interface: tracing gestures with the finger. According to previous work, this form of interaction has several benefits, as it is faster and more natural for certain contexts of use. The originality of the approach lies in considering new gesture characteristics (dimensions) to avoid complex shapes that can be hard for users to memorize and activate. Dimensions of interest include drawing speed (local or global), movement direction, device orientation or inclination, and distinctive drawing patterns in a movement.

DRAO – Adrian Bosseau (Inria, Sophia Antipolis) submitted a successful ANR grant with members from INSITU Fanis Tsandilas (Inria) and Wendy Mackay, and Prof. Maneesh Agrawala (Berkeley), called DRAO, to create interactive graphics tools to support sketching. The kickoff meeting was held in Nov. 2012 and included interviews with designers from Toyota.

7.3. European Initiatives

VCoRE – Visual COmputing Runtime Environment. Inria ADT (Technology Transfer Initiative), two academic partners: Inria (Grenoble, Lille, Rennes, Saclay, Sophia Antipolis) and IGD Fraunhofer Institute (Darmstadt, Germany). Stéphane Huot: coordinator and principal investigator for INSITU / Inria Saclay–Île-de-France, Romain Primet: investigator for INSITU / SED / Inria Saclay–Île-de-France. The VCoRE project aims to share resources and to develop a new software framework for advanced Mixed/Augmented/Virtual Reality and Visualization platforms. The advantages of this shared framework will be (i) to provide engineers and researchers with unified and flexible development tools to support research projects; (ii) to ease the development and porting of applications on heterogeneous immersive and visualization platforms, while still making the most of their capabilities (specific hardware, computing power, interaction devices, etc.). All the partners are conducting research projects on such platforms and have a strong background in computer graphics, human-computer interaction, software engineering, real-time simulation, parallel computing, etc. In VCoRE, INSITU will contribute with its expertise in HCI and software engineering, thanks to the knowledge gained from the WILD project. In concrete terms, several of the software tools and methods for designing and programming interaction developed at INSITU will be improved and integrated into VCoRE as the framework interaction management tools (FlowStates, WILDInputServer).

7.4. International Initiatives

BayScope – Prof. Bjorn Hartman (Berkeley), Michel Beaudouin-Lafon and Wendy Mackay submitted a successful NSF CNIC grant "Architectures and Interaction Paradigms for Multi-surface Environments" to support travel between France and Berkeley in conjunction with the BayScope project, the goal of which is to link our work on DigiScope within France to our partners in the SIRIUS Equipe Associé, in California, specifically at Berkeley and at U.C. San Diego.

7.4.1. *Inria Associate Teams*

SIRIUS – INSITU has an Equipe Associée called *SIRIUS: Situated Interaction Research at Inria, UCSD and Stanford* with U.C. San Diego and Stanford University. The creation of Inria Silicon Valley, and the move of Prof. Bjoern Hartmann to Berkeley, has meant that we've included Berkeley in the research group. The primary area of collaboration has been in the context of our DigiScope project and interaction with wall-sized displays, which led to the creation of BayScope at Berkeley and collabortions on the 75-screen wall at UCSD. We have also collaborated on design process and interactive paper with Stanford.

The SIRIUS Associate Team includes INSITU, (head: W. Mackay), the HCI group at Stanford, (head: Prof. Scott Klemmer), and the DCOG-HCI group at UCSD (head: Prof. Jim Hollan). Arvind Satyanarayan completed his undergraduate degree at UCSD and started a Ph.D. at Stanford in the fall of 2011, with three visits to INSITU in 2012 to work on the Multimedia Interactive Schedule project for CHI'13. Bjorn Hartman completed his Ph.D. at Stanford and joined the UC Berkeley faculty in 2011, and is continuing to collaborate on the HydraScope project. Lora Oehlberg completed her Ph.D. at Berkeley in October, 2011 and began an Inria-Silicon Valley post-doc at INSITU. Daniel Strazzula completed his Masters at Stanford and began a Ph.D. on a CORDI grant at INSITU. Melody Kim, an undergraduate at UCSD, visited INSITU in the fall quarter. Both are working with A. Satyanarayan on the Multimedia Interactive Schedule. W. Mackay worked on Combinatorix [28] with B. Schneider (Stanford Ph.D. student). W. Mackay and F. Tsandilas had several meetings with A. Bosseau as part of the ANR DRAO project, which includes Prof. Maneesh Agrawala from Berkeley). W. Mackay and M. Beaudouin-Lafon visited UCSD (J. Hollan and N. Weibel). W. Mackay, M. Beaudouin-Lafon, A. Satyanarayan and J. Hollan attended the Dagstuhl HCI seminar in Germany. SIRIUS helped sponsor two international workshops, one at Berkeley and one in Orsay, France on interaction in multi-surface environments.

7.4.2. *Participation In International Programs*

CIRIC Chili – Emmanuel Pietriga joined Inria Chile in July 2012 and is now heading the Massive Data project, continuing the close collaboration with ALMA 6.3 and starting new industrial transfer projects related to the visualization of massive datasets and to the engineering of interactive systems.

7.5. International Research Visitors

7.5.1. Internships

Jéronimo Barbosa, Master student, "Linking digital tabletops with physical paper for creative interactions", Universidade Federal de Pernambuco (CIn/UFPE), Recife, Brazil. May 2012 - October 2012, Inria International Internships Program. Supervision: Theophanis Tsandilas, Anastasia Bezerianos.

Melody Kim, "Interaction with large displays", Undergraduate student, University of California, San Diego, USA. UCSD. Supervision: Wendy Mackay.

Arvind Satyanarayan, "Interaction with large displays", PhD student, Stanford University, Computer Science Dpt. (HCI and Visualization group), Stanford, USA. Sirius associate team. Supervision: Wendy Mackay, Michel Beaudouin-Lafon.

7.5.2. Visits to International Teams

Wendy Mackay and Michel Beaudouin-Lafon completed their two-year sabbatical at Stanford University in June, 2012, where they collaborated closely with the Stanford HCI group (Prof.s S. Klemmer and S. Card) and the Berkeley Institute of Design (BID) (Prof. B. Hartmann). D. Strazzula, who completed his Master's degree at Stanford, returned to U. Paris on an Inria Cordi Ph.D. grant and L. Oehlberg, who completed her Ph.D. at Berkeley, joined INSITU as a Post-Doctoral Fellow. Julie Wagner (Ph.D., INSITU) and Emilien Ghomi (Ph.D., INSITU), and Stéphane Huot (MC, INSITU) visited W. Mackay and M. Beaudouin-Lafon at Stanford, in April and in May. W. Mackay visited Prof. Marcelo Wanderley at McGill University in Canada.

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

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 Projects

7.1.1.1. EUHEART

Title: euHeart

Type: COOPERATION (ICT)

Defi: Virtual Physiological Man

Instrument: Integrated Project (IP)

Duration: June 2008 - May 2012

Coordinator: Philips Technologie GmbH Forschungslaboratorien (Germany)

Others partners: Philips Technologie GmbH (DE), The University of Oxford (UK), Universitat Pompeu Fabra (SP), The University of Sheffield (UK), Inria, French National Research Institute in Informatics and Mathematics (FR), King's College London (UK), Academisch Medisch Centrum bij de Universiteit van Amsterdam (NL), Universität Karlsruhe (TH) (DE), Institut National de la Santé et de la Recherche Médicale, INSERM (FR), Philips Medical Systems Nederland BV (NL), Berlin Heart GmbH (DE), HemoLab BV (NL), Universitätsklinikum Heidelberg (DE), Volcano Europe SA / NV (BE), Hospital Clínico San Carlos de Madrid (SP), Philips Ibérica S.A. (SP)

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

Abstract: The euHeart project (Ref 224495), is a 4-year integrated European project which aims at developing personalized, and clinically validated multi-physics, multi-level models of the heart and great vessels. Those models need to be tightly integrated with signal and image processing tools in order to assist clinical decision making and to help reducing morbidity and mortality rates associated with cardiovascular diseases. Asclepios is leading a workpackage on radiofrequency ablation for which electromechanical models of the heart are used to improve the planning of radiofrequency ablation lines for patient suffering from atrial fibrillation and ventricular tachycardia.

7.1.1.2. VPH-Share

Title: VPH-Share

Type: COOPERATION (ICT)

Defi: Virtual Physiological Human : Sharing for Healthcare

Instrument: Integrated Project (IP)

Duration: March 2011 - February 2015

Coordinator: Univ. Sheffield (UK)

Others partners: Cyfronet (Cracow), University College London, Istituto Ortopedico Rizzoli (Bologna), NHS, IBM Israel, Univ. Auckland, Agència d'Informació, Avaluació i Qualitat en Salut (Barcelona), Biocomputing Competence Centre (Milano), Universitat Pompeu Fabra (Barcelona), Philips Research, TUE (Eindhoven), Sheffield Teaching Hospitals, Atos Origin (Madrid), the Open University (UK), Univ. Vienna, King's College London, Empirica (Bonn), Fundació Clínic (Barcelona), Univ. Amsterdam

See also: http://vph-share.org/

Abstract: VPH-Share aims at developing the organisational fabric (the infostructure) and integrate the optimised services to expose and share data and knowledge, to jointly develop multiscale models for the composition of new VPH workflows, and to facilitate collaborations within the VPH community. Within this project, the Macs team is in charge of developing some high-performance data assimilation software tools.

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. CARDIO

Title: Mathematical modelling and Numerical Simulation for Cardiovascular Applications

Inria principal investigator: Philippe Moireau

International Partner (Institution - Laboratory - Researcher):

> University of California San Diego (United States) - Mechanical and Aerospace Engineering - Alison MARSDEN

Duration: 2008 - 2013

See also: https://idal.inria.fr/cardio/

To improve disease understanding, surgical repair or medical device design, mathematical and numerical tools have been the subject of much efforts over the last decades. In this context, we propose a research subject on cardiovascular and air flow modeling. It extends the project of the previous associated team on blood flow modeling to flow of air in the lungs. The goal is to continue to work on bringing together methods developed in the different teams, to compare them if necessary, and to apply them to in-vivo (animal or human) physiologically relevant situations. All the different team members have a strong will to work close to the applications. They all have links to clinicians or biologists, which drive the concrete applications that will be studied: congenital heart disease pathophysiology and repair, artery wall compliance study in normal and pathophysiological cases, heart valve pathophysiology assessment, aerosol deposition in the lungs. Furthermore, the associated team facilitates the breadth of researcher knowledge by exposure to different ways of thinking, methods and/or applications, and by the training of students as they interact with the other institutes.

MAXPLUS Project-Team

8. Partnerships and Cooperations

8.1. Actions nationales/National Initiatives

8.1.1. ANR

- Projet ANR Arpège ASOPT (Analyse statique et Optimisation), responsable B. Jeannet. Partenaires: équipe-projet Popart (Inria Grenoble), équipe MeASI, EADS, et Maxplus. Ce projet a été labellisé par le pôle de compétitivité System@tic. Ce projet a financé notamment le postdoc de S. Sergeev dans l'équipe.
- Participation au projet ANR CPP (Confidence, Proof and Probabilities), responsable J. Goubault Larecq. Partenaires: LSV, CEA List, Inria Saclay (Comète [responsable], Parsifal, Maxplus), Supelec L2S, Supelec SSE.
- Participation de Cormac Walsh au projet ANR FINSLER (Géométrie de Finsler et applications), démarrage 1 Dec 2012.

8.1.2. Programme Gaspard Monge pour l'Optimisation

Projet intitulé "Méthodes tropicales pour l'optimisation", responsable X. Allamigeon, faisant intervenir M. Akian, P. Benchimol, S. Gaubert, R. Katz, et Z. Qu.

8.2. Actions internationales/International Initiatives

8.2.1. Participation In International Programs

- La thèse de Pascal Benchimol est financée par une bourse Monge/DGA prévoyant des visites régulières du doctorant dans l'équipe de Michael Joswig (TU-Darmstadt).
- La thèse de Zheng Qu est co-encadrée par Shanjian Tang de l'université Fudan (Shanghai), dans l'équipe duquel la doctorante effectue une partie de son travail de recherche.
- Les membres de l'équipe sont partenaires du Grant RFBR–CNRF 11-01-93106 "Tropical Mathematics and Mathematical Physics", porté par l'équipe de Grigori Litvinov (Moscou independent University), qui a financé le séjour de M. Akian et C. Walsh auWorkshop "Tropical and idempotent Mathematics", Moscou, 26-31 août 2012.

8.3. Accueils de chercheurs étrangers/International Research Visitors

8.3.1. Chercheurs étrangers/Visits of International Scientists

- Srinivas Sridharan (University of California San Diego), 1 semaine en mai.
- Ngoc Tran (Berkeley University), 3 jours en Juin.
- Visites d'un ou deux jours de Paul Van Dooren, Roberto Tempo, Konstantin Avrachenkov (autour de la thèse d'Olivier Fercoq, avec séminaire).
- Visites d'un jour de Maurizio Falcone, Xavier vasseur, Yvan Notay (autour de la thèse de Sylvie Detournay).
- Ricardo Katz (Conicet, Rosario, Argentine), 1 mois en octobre-novembre, financé par DIGITEO.
- Alexander Guterman (Université d'état de Moscou), 5 jours en décembre.

8.3.1.1. Stagiaires/Internships

- Soren Ravn, stage de M2 du 15 mars au 9 mai.

8.3.2. Séjours à l'étranger/Visits to International Teams

- P. Benchimol, visite à TU Darmstadt, 19 au 24 mars 2012.
- Z. Qu: séjour à l'Université Fudan, août - sep 2012.

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

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

7.2. National Initiatives

7.2.1. ANR

Participants: Sandie Balaguer, Thomas Chatain, Stefan Haar, Serge Haddad.

The Project ANR **ImpRo** ANR-2010-BLAN-0317 involves *IRCCyN* (Nantes), *IRISA* (Rennes), *LIP6*(Paris), *LSV* (Cachan), *LIAFA* (Paris) and *LIF* (Marseille). It addresses issues related to the practical implementation of formal models for the design of communication-enabled systems: such models abstract away from many complex features or limitations of the execution environment. The modeling of *time*, in particular, is usually idealized, with infinitely precise clocks, instantaneous tests or mode communications, etc. Our objective is thus to study to what extent the practical implementation of these models preserves their good properties. We aim at a generic mathematical framework to reason about and measure implementability, and then study the possibility to integrate implementability constraints in the models. A particular focus is on the combination of several sources of perturbation such as resource allocation, the distributed architecture of applications, etc. We also study implementability through control and diagnosis techniques, and apply the developed methods to a case study based on the AUTOSAR architecture, a standard in the automotive industry.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. Hycon2

Title: Highly Complex and Networked Control Systems

Type: COOPERATION (ICT)

Defi: Engineering of Networked Monitoring and Control Systems

Instrument: Network of Excellence (NoE)

Duration: September 2010 - August 2014

Coordinator: CNRS (France)

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

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

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

7.3.1.2. Univerself

Title: Univerself

Type: COOPERATION (ICT)

Defi: The Network of the Future

Instrument: Integrated Project (IP)

Duration: September 2010 - August 2013

Coordinator: Alcatel Lucent (France)

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

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

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

7.4. International Initiatives

7.4.1. Inria International Partners

The CMI (Chennai Mathematical Institute) is a long-standing partner of our team. The project *Île de France/Inde* in the *ARCUS* program from 2008 to 2011 has allowed several exchange visits between Cachan and Chennai, organizations of ACTS workshops with french and indian researchers in Chennai, internships in Cachan, and two theses in *co-tutelle* (Akshay Sundararaman, defended in 2010) and Aiswarya Cyriac (thesis in progress).

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

7.4.2. Participation In International Programs

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

7.5. International Research Visitors

7.5.1. Visits of International Scientists

Supported by the LIA INFORMEL,

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

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

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

7.5.1.1. Internships

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

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

Institution: IIT Bombay, India

Gaurav MAHAJAN (from May 2012 until Jul 2012)

Subject: Probabilistic Unfolder for Petri Nets

Institution: IIT Delhi (India)

7.5.2. *Visits to International Teams*

The team members made several *short* visits:

- Supported by the LIA INFORMEL, Paul Gastin visited the Chennai Mathematical Institute (CMI) in India from January 9 to 21.

- Benedikt Bollig and Aiswarya Cyriac were visiting Thomas Schwentick's group at TU Dortmund University (March 13 – 16).

- Benjamin Monmege was visiting Martin Leucker's group at the University of Lübeck (July 9 – 14 and October 28 – November 2).

- Stefan Schwoon visited Javier Esparza's group at TU Müchen and gave a talk in April 2012.

- Serge Haddad visited Rolf Hennicker's group at LMU Munich in November 2012.

OAK Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. DW4RDF

This Digiteo DIM LSC (*Logiciels et Systèmes Complexes*) project has started in October 2011. The aim is to design and implement data warehouse-style models and technologies for RDF data. This project supports the PhD scholarship of A. Roatis.

8.2. National Initiatives

8.2.1. ANR

The ANR Codex project (Coordination, dynamicity and efficiency for XML, 2009-2012) has ended; the final review has taken place in Lyon in January 2012. The project was coordinated by Ioana Manolescu; Nicole Bidoit, Dario Colazzo and François Goasdoué also participated.

The ANR DataBridges project (Data integration for digital cities, 2011-2012) has ended; the final review has taken place in Paris in September 2012. The project was coordinated by Ioana Manolescu; François Goasdoué also participated.

The ANR ConnectedCities project (Clouds for digital cities, 2011-2012) has ended; the final review has taken place in Paris in September 2012. Dario Colazzo, François Goasdoué and Ioana Manolescu have participated to the project.

The ANR DataRing project (Massive data management in peer-to-peer, 2009-2012) has ended; the final review has taken place in Lyon in January 2012. Ioana Manolescu has participated to the project.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: KIC EIT ICT Labs

Project acronym: DataBridges

Project title: Data Integration for Digital Cities

Duration: January 2012 - December 2012

Coordinator: Ioana Manolescu

Other partners: Université Paris Sud (France), Technical University of Delft (The Netherlands), DFKI (Germany), Aalto University (Finland), KTH (Sweden), Alcatel-Lucent Bell Labs (France), DataPublica (France)

Abstract: DataBridges work focuses on two main topics: (i) the interoperability, enrichment and personalization of data, e.g. data on the cultural activities within a city, based on user profiles; (ii) efficient techniques for large-scale RDF data management, to be applied (among others) on digital city data.

Program: KIC EIT ICT Labs

Project acronym: Europa

Project title: Efficient cloud-based data management

Duration: January 2012 - December 2012

Coordinator: Volker Markl (Technical Univ. Berlin)

Other partners: Université Paris Sud (France), Technical University of Delft (The Netherlands), DFKI (Germany), Aalto University (Finland), SICS (Sweden)

Abstract: Europa aims at developing techniques for large-scale efficient data management based on a cloud (massively parallel) processing paradigm. Within Europa, we have finalized the Amada platform, and our ongoing work focuses on an algebraic translation framework from XQuery into PACT programs. PACT is the parallel data processing language proposed by the Berlin partner.

8.3.2. Collaborations with Major European Organizations

Partner 1: organisme 1, labo 1 (pays 1)

Sujet 1 (max. 2 lignes)

Partner 2: organisme 2, labo 2 (pays 2)

Sujet 2 (max. 2 lignes)

8.4. International Research Visitors

8.4.1. Visits of International Scientists

We have been visited by:

- Prof. Paolo Atzeni (Università Roma Tré), in June
- Prof. Alin Deutsch (UCSD, USA) in June-July (Digiteo invited scientist)
- Prof. Evi Pitoura (University of Ioannina, Greece), in October
- Prof. Vassilis Christophides (FORTH, Greece) in December
- Prof. Themis Palpanas (University of Trento, Italy) in December
- Prof. Yanlei Diao (U. Massachussets at Amherst, USA) in December

8.4.1.1. Internships

Three students visited the team within the Inria Internship program: Karan Aggaral, Abishek Choudhary and Kuldeep Reddy.

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

7. Partnerships and Cooperations

7.1. Regional initiatives

7.1.1. Digiteo/DIM

7.1.1.1. HIDINIM Digiteo project
Participants: Bertrand Thirion [Correspondant], Virgile Fritsch.

High-dimensional Neuroimaging– Statistical Models of Brain Variability observed in Neuroimaging

This is a joint project with Select project team and with SUPELEC Sciences des Systèmes (E3S), Département Signaux & Systèmes Électroniques (A. Tennenhaus).

Statistical inference in a group of subjects is fundamental to draw valid neuroscientific conclusions that generalize to the whole population, based on a finite number of experimental observations. Crucially, this generalization holds under the hypothesis that the population-level distribution of effects is estimated accurately. However, there is growing evidence that standard models, based on Gaussian distributions, do not fit well empirical data in neuroimaging studies.

In particular, Hidinim is motivated by the analysis of new databases hosted and analyzed at Neurospin that contain neuroimaging data from hundreds of subjects, in addition to genetic and behavioral data. We propose to investigate the statistical structure of large populations observed in neuroimaging. In particular, we will investigate the use of region-level averages of brain activity, that we plan to co-analyse with genetic and behavioral information, in order to understand the sources of the observed variability. This entails a series of modeling problems that we will address in this project: i) Distribution normality assessment and variables covariance estimation, ii) model selection for mixture models and iii) setting of classification models for heterogeneous data, in particular for mixed continuous/discrete distributions.

7.1.1.2. ICOGEN Digiteo project
Participants: Bertrand Thirion, Benoit Da Mota [Correspondant].

ICOGEN : Intensive COmputing for GEnetic-Neuroimaging studies

In this project, we design and deploy some computational tools to perform neuroimaging-genetics association studies at a large scale.

Unveiling the relationships between genetic variability and brain structure and function is one of the main challenges in neuroscience, which can be partly addressed through the information conveyed by high-throughput genotyping on the one hand, and neuroimaging data on the other hand. Finding statistical associations between these different variables is important in order to find relevant biomarkers for various brain diseases and improve patient handling. Due to the huge size of the datasets involved and the requirement for tight bounds on statistical significance, such statistical analysis are particularly demanding and cannot be performed easily at a large scale with standard software and computational tools. In ICOGEN, we design and deploy some computational tools to perform neuroimaging-genetics association studies at a large scale. We will implement and assess on real data the use of novel statistical methodologies and run the statistical analysis on various architectures (grids, clouds), in a unified environment.

Project supported by a Digiteo grant in collaboration with Inria's KerData Team, MSR-Inria joint centre, Supélec Engineer School, Imagen project and CEA/Neurospin.

7.1.1.3. SUBSAMPLE Digiteo chair
Participants: Bertrand Thirion [Correspondant], Gaël Varoquaux, Alexandre Abraham.

Parietal is associated with this Digiteo Chair by Dimitris Samaras, in which we will address the probabilistic structure learning of salient brain states (PhD thesis of Alexandre Abraham).

Cognitive tasks systematically involve several brain regions, and exploratory approaches are generally necessary given the lack of knowledge of the complex mechanisms that are observed. The goal of the project is to understand the neurobiological mechanisms that are involved in complex neuro-psychological disorders. A crucial and poorly understood component in this regard refers to the interaction patterns between different regions in the brain. In this project we will develop machine learning methods to capture and study complex functional network characteristics. We hypothesize that these characteristics not only offer insights into brain function but also can be used as concise features that can be used instead of the full dataset for tasks like classification of healthy versus diseased populations or for clustering subjects that might exhibit similarities in brain function. In general, the amount of correlation between distant brain regions may be a more reliable feature than the region-based signals to discriminate between two populations e.g. in Schizophrenia. For such exploratory methods to be successful close interaction with neuroscientists is necessary, as the salience of the features depends on the population and the observed effects of psychopathology. For this aim we propose to develop a number of important methodological advances in the context of prediction of treatment outcomes for drug addicted populations, i.e. for relapse prediction.

7.1.1.4. MMoVNI Digiteo project

Participants: Bertrand Thirion [Correspondant], Pierre Fillard, Viviana Siless, Stéphanie Allassonnière, Hao Xu.

This is a joint project with CMAP http://www.cmapx.polytechnique.fr/~allassonniere/, for the 2010-2013 period.

Modeling and understanding brain structure is a great challenge, given the anatomical and functional complexity of the brain organ. In addition to this, there is a large variability of these characteristics among the population. To give a possible answer to these issues, medical imaging researchers proposed to construct a template image. Most of the time, these analysis only focus on one category of signals (called modality), in particular, the anatomical one was the main focus of research these past years. Moreover, these techniques are often dedicated to a particular problem and raise the question of their mathematical foundations. The MMoVNI project aims at building atlases based on multi-modal images (anatomy, diffusion and functional) data bases for given populations. An atlas is not only a template image but also a set of admissible deformations which characterize the observed population of images. The estimation of these atlases will be based on a new generation of deformation and template estimation procedures that builds an explicit statistical generative model of the observed data. Moreover, they enable to infer all the relevant variables (parameters of the atlases) thanks to stochastic algorithms. Lastly, this modeling allows also to prove the convergence of both the estimator and the algorithms which provides a theoretical guarantee to the results. The models will first be proposed independently for each modality and then merged together to take into account, in a correlated way, the anatomy, the local connectivity through the cortical fibers and the functional response to a given cognitive task. This model will then be generalized to enable the non-supervised clustering of a population. This leads therefore to a finer representation of the population and a better comparison for classification purposes for example. The Neurospin center, partner of this project, will allow us to have access to databases of images of high-quality and high-resolution for the three modalities: anatomical, diffusion and functional imaging. This project is expected to contribute to making neuroimaging a more reliable tool for understanding inter-subject differences, which will eventually benefit to the understanding and diagnosis of various brain diseases like Alzheimer's disease, autism or schizophrenia.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. Vimagine project

Participants: Bertrand Thirion [Correspondant], Alexandre Gramfort, Michael Eickenberg, Fabian Pedregosa.

Vimagine is an ANR blanc project (2008-2012), which aims at building a novel view on the retinotopic organization of the visual cortex, based on MEG and MRI. Vimagine should open the way to understanding the dynamics of brain processes for low-level vision, with an emphasis on neuropathologies. This project is leaded by S. Baillet (Dynamic Neuroimaging Lab, McGill University), in collaboration with M.Clerc, T. Papadopoulos (Inria Sophia-Antipolis, Odyssée) and J. Lorenceau(LPPA, CNRS, Collège de France). The fMRI part of the project will be done by PARIETAL, and will consist in a study of spatially resolved retinotopic maps at the mm scale, the decoding of retinotopic information and the comparison of retinotopy with sulco-gyral anatomy.

7.2.1.2. BrainPedia project

Participants: Bertrand Thirion [Correspondant], Gaël Varoquaux, Yannick Schwartz, Virgile Fritsch.

BrainPedia is an ANR JCJC (2011-2015) which addresses the following question: Neuroimaging produces huge amounts of complex data that are used to better understand the relations between brain structure and function. While the acquisition and analysis of this data is getting standardized in some aspects, the neuroimaging community is still largely missing appropriate tools to store and organize the knowledge related to the data. Taking advantage of common coordinate systems to represent the results of group studies, coordinate-based meta-analysis approaches associated with repositories of neuroimaging publications provide a crude solution to this problem, that does not yield reliable outputs and looses most of the data-related information. In this project, we propose to tackle the problem in a statistically rigorous framework, thus providing usable information to drive neuroscientific knowledge and questions.

7.2.1.3. IRMgroup project

Participants: Bertrand Thirion [Correspondant], Alexandre Gramfort, Michael Eickenberg.

This is a joint project with Polytechnique/CMAP http://www.cmap.polytechnique.fr/: Stéphanie Allassonnière and Stéphane Mallat (2010-2013).

Much of the visual cortex is organized into visual field maps, which means that nearby neurons have receptive fields at nearby locations in the image. The introduction of functional magnetic resonance imaging (fMRI) has made it possible to identify visual field maps in human cortex, the most important one being the medial occipital cortex (V1,V2,V3). It is also possible to relate directly the activity of simple cells to an fMRI activation pattern and Parietal developed some of the most effective methods. However, the simple cell model is not sufficient to account for high-level information on visual scenes, which requires the introduction of specific semantic features. While the brain regions related to semantic information processing are now well understood, little is known on the flow of visual information processing between the primary visual cortex and the specialized regions in the infero-temporal cortex. A central issue is to better understand the behavior of intermediate cortex layers.

Our proposition is to use our mathematical approach to formulate explicitly some generative model of information processing, such as those that characterize complex cells in the visual cortex, and then to identify the brain substrate of the corresponding processing units from fMRI data. While fMRI resolution is still too coarse for a very detailed mapping of detailed cortical functional organization, we conjecture that some of the functional mechanisms that characterize biological vision processes can be captured through fMRI; in parallel we will push the fMRI resolution to increase our chance to obtain a detailed mapping of visual cortical regions.

7.2.1.4. Niconnect project

Participants: Bertrand Thirion, Gaël Varoquaux [Correspondant], Alexandre Abraham.

- **Context:** The project NiConnect arises from an increasing need of medical imaging tools to diagnose efficiently brain pathologies, such as neuro-degenerative and psychiatric diseases or lesions related to stroke. Brain imaging provides a non-invasive and widespread probe of various features of brain organization, that are then used to make an accurate diagnosis, assess brain rehabilitation, or make a prognostic on the chance of recovery of a patient. Among different measures extracted from brain imaging, functional connectivity is particularly attractive, as it readily probes the integrity of brain networks, considered as providing the most complete view on brain functional organization.

- **Challenges:** To turn methods research into popular tool widely usable by non specialists, the NiConnect project puts specific emphasis on producing high-quality open-source software. NiConnect addresses the many data analysis tasks that extract relevant information from resting-state fMRI datasets. Specifically, the scientific difficulties are i) conducting proper validation of the models and tools, and ii)providing statistically controlled information to neuroscientists or medical doctors. More importantly, these procedures should be robust enough to perform analysis on limited quality data, as acquiring data on diseased populations is challenging and artifacts can hardly be controlled in clinical settings.

- **Outcome of the project:** In the scope of computer science and statistics, NiConnect will push forward algorithms and statistical models for brain functional connectivity. In particular, we are investigating structured and multi-task graphical models to learn high-dimensional multi-subject brain connectivity models, as well as spatially-informed sparse decompositions for segmenting structured from brain imaging. With regards to neuroimaging methods development, NiConnect will provide systematic comparisons and evaluations of connectivity biomarkers and a software library embedding best-performing state-of-the-art approaches. Finally, with regards to medical applications, the NiConnect project will also play a support role in on going medical studies and clinical trials on neurodegenerative diseases.

- **Consortium**
  - Parietal Inria research team: applied mathematics and computer science to model the brain from MRI
  - LIF INSERM research team: medical image data analysis and modeling for clinical applications
  - CATI center: medical image processing center for large scale brain imaging studies
  - Henri-Mondor hospital neurosurgery and neuroradiology: clinical teams conducting research on treatments for neurodegenerative diseases, in particular Huntington and Parkinson diseases
  - Logilab: consulting in scientific computing

7.3. International Initiatives

7.3.1. Inria Associate Teams

Title: Analysis of structural MR and DTI in neonates

Inria principal investigator: Pierre Fillard

International Partner:

      Institution: University of Southern California (United States)

      Laboratory: Image Lab at Children Hospital at Los Angeles

      Researcher: Natasha Lepore

International Partner:

      Institution: University of Pennsylvania (United States)

      Laboratory: Penn Image Computing and Science Laboratory

      Researcher: Caroline Brun

Duration: 2011 - 2013

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

While survival is possible at increasingly lower gestational ages at birth, premature babies are at higher risk of developing mental disorders or learning disabilities than babies born at term. A precise identification of the developmental differences between premature and control neonates is consequently of utmost importance. Nowadays, the continuously improving quality and availability of MR systems makes it possible to precisely determine, characterize and compare brain structures such as cortical regions, or white matter fiber bundles. The objective of this project is to understand the developmental differences of premature versus normal neonates, using structural and diffusion MRI. This work will consist in identifying, characterizing and meticulously studying the brain structures that are different between the two groups. To do so, we propose to join forces between the Parietal team at Inria and the University of Southern California. Parietal has a recognized expertise in medical image registration and in statistical analyses of groups of individuals. USC has a broad knowledge in MR image processing. In particular, the Children's Hospital at Los Angeles (CHLA), which is part of USC, is in the process of collecting a unique database of several hundreds of premature and normal neonates MR scans. This joint collaboration is consequently a unique chance of addressing key questions pertaining to neonatal and premature development. It will make it possible to elaborate new tools to analyze neonate MR images while tremendously increasing our knowledge of neuroanatomy at such an early stage in life.

7.3.2. Inria International Partners

- LIAMA http://www.nlpr.ia.ac.cn/jiangtz/: B.Thirion, G.Varoquaux, V. Siless and Y. Schwartz visited LIAMA (contact person: Shan Yu) and gave a presentation. We plan to develop come collaborations on fMRI data analysis and functional connectivity in the future.

- Donders institute https://sites.google.com/a/distrep.org/distrep/marcel-van-gerven: We share with M. van Gerven some interest on biological vision and on the use of fMRI to probe specific hypotheses related to computational models of vision. We plan to exchange students in the next years.

- Biomedical Image analysis group, Imperial College, London http://www.doc.ic.ac.uk/~dr/. We have started some joint work on the comparison of functional and anatomical connectivity using machine learning tools.

- MIT, CSAIL http://www.csail.mit.edu/, P.Golland's group. We regularly visit each other and share common interests in the use of machine learning for neuroimaging, in the introduction of functional information into co-registration procedures, and in the study and comparison of anatomical and functional connectivity.

7.3.3. Participation In International Programs

Parietal has taken part to the program Inria@SiliconValley, and had a 18-months post-doc funded to work on the comparison of anatomical and functional connectivity (18 months, 2011-2013):

In this project, we would like to build probabilistic models that relates quantitatively the observations in anatomical and functional connectivity. For instance given a set of brain regions, the level of functional integration might be predicted by the anatomical connectivity measurement derived from the fibers in a given population of subjects. More generally, we will seek to extract latent factors explaining both connectivity measures across the population. Such models require specifically that a generative model is proposed to explain the observations in either domain, so that a meaningful and testable link is built between the two modalities. The inference problem can then be formulated as learning the coupling parameters that are necessary to model the association between modalities, and tested e.g. by assessing the ability of the learned model to generalize to new subjects. The aim is then to provide the mathematical and algorithmic tools necessary to build a standardized model of brain connectivity informed by both modalities, associated with confidence intervals to take into account between subject variability. Such an atlas is a long-term project, that requires adequate validation on high-resolution data, but it will probably be tightly linked to this project.

PARSIFAL Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 Projects

7.1.1.1. Proofcert

> Title: ProofCert: Broad Spectrum Proof Certificates
>
> Type: IDEAS
>
> Instrument: ERC Advanced Grant (Advanced)
>
> Duration: January 2012 - December 2016
>
> Coordinator: Inria (France)
>
> See also: https://team.inria.fr/parsifal/proofcert/
>
> Abstract: The ProofCert proposal aims at building a foundation that will allow a broad spectrum of formal methods—ranging from automatic model checkers to interactive theorem provers—to work together to establish formal properties of computer systems. This project starts with a wonderful gift to us from decades of work by logicians and proof theorist: their efforts on logic and proof has given us a universally accepted means of communicating proofs between people and computer systems. Logic can be used to state desirable security and correctness properties of software and hardware systems and proofs are uncontroversial evidence that statements are, in fact, true. The current state-of-the-art of formal methods used in academics and industry shows, however, that the notion of logic and proof is severely fractured: there is little or no communication between any two such systems. Thus any efforts on computer system correctness is needlessly repeated many times in the many different systems: sometimes this work is even redone when a given prover is upgraded. In ProofCert, we will build on the bedrock of decades of research into logic and proof theory the notion of proof certificates. Such certificates will allow for a complete reshaping of the way that formal methods are employed.

7.1.2. Collaborations in European Programs, except FP7

7.1.2.1. STRUCTURAL: ANR blanc International

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

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

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

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

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

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

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

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

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

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

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

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

7.2. International Initiatives

7.2.1. Inria Associate Teams

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

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

Inria principal investigator: Kaustuv Chaudhuri

International Partner:

Institution: McGill University (Canada)

Laboratory: School of Computer Science

Researcher: Prof. Brigitte Pientka

International Partner:

Institution: Carnegie Mellon University (United States)

Laboratory: Department of Computer Science

Researcher: Prof. Frank Pfenning

International Partner:

Institution: University of Minnesota (United States)

Laboratory: Department of Computer Science and Engineering

Researcher: Prof. Gopalan Nadathur

Duration: 2011 - 2013

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

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

7.2.2. Inria International Partners

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

Title: Interactive Resource Analysis

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

Inria principal investigator: Dale Miller

Inria Partner:

Institution: Inria

Team: FOCUS

Researcher: Ugo Dal Lago

Inria Partner:

Institution: Inria

Team: pi.r2

Researcher: Pierre-Louis Curien

Duration: 2011 - 2013

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

7.3. International Research Visitors

7.3.1. *Visits of International Scientists*

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

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

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

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

7.3.2. *Internships*

Yuting WANG (May – August)

Subject: Development of the Abella theorem prover.
Institution: University of Minnesota (United States)

Florence Clerc (March – July)

Subject: Relating double-negation translations and focused proof systems
Institution: Master Parisien de Recherche en Informatique

Zakaria Chihani (April – September)

Subject: Proof certificates for some basic proof systems in classical logic
Institution: Master Parisien de Recherche en Informatique

7.3.3. *Visits to International Teams*

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

POEMS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- ANR project *AEROSON: Simulation numérique du rayonnement sonore dans des géométries complexes en présence d'écoulements réalistes*
  Partners: EADS-IW, CERFACS, Laboratoire d'Acoutique de l'Université du Maine.
  Start : 10/01/2009, End : 02/28/2013. Administrator : CNRS. Coordinator : Jean-François Mercier.

- ANR project *PROCOMEDIA: Propagation d'ondes en milieux complexes*
  Partners: ESPCI, Laboratoire d'Acoutique de l'Université du Maine, Departamento de Fisica de la Universidad de Chile.
  Start : 04/01/2011, End : 03/30/2014. Administrator : CNRS. Coordinator for POEMS : Jean-François Mercier.

- ANR project *METAMATH: modélisation mathématique et numérique pour la propagation des ondes en présence de métamatériaux.* Partners: EPI DEFI (Inria Saclay), IMATH-Université de Toulon, DMIA-ISAE.
  Start : 12/01/2011, End : 11/30/2015. Administrator : Inria. Coordinator : Sonia Fliss.

- ANR project *CHROME: Chauffage , réflectométrie et Ondes pour les plasmas magnétiques)* Partners: Université Pierre et Marie Curie (Paris 6), Université de Lorraine
  Start : 10/01/2012, End : 10/01/2015 Administrator : Inria Coordinator for POEMS: Eliane Bécache

- ANR project *SODDA: Diagnostic de défauts non francs dans les réseaux de câbles* Partners: CEA LIST, ESYCOM, LGEP (Supelec)
  Start : 10/01/2012, End : 10/01/2015 Administrator : Inria Coordinator for Poems: Patrick Joly

8.1.2. Competitivity Clusters

- GDR Ultrasons: this GDR, which regroups more than regroup 15 academic and industrial research laboratories in Acoustics and Applied Mathematics working on nondestructive testing. It has been renoveled this year with the participation of Great Britain.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. SIMPOSIUM

Title: Simulation Platform for Non Destructive Evaluation of Structures and Materials

Type: COOPERATION (ICT)

Defi: PPP FoF: Digital factories: Manufactoring design and product lifecycle manage

Instrument: Integrated Project (IP)

Duration: September 2011 - August 2014

Coordinator: CEA (Pierre Calmont) (France)

Others partners:SERCO LIMITED (UNITED KINGDOM), SIMULAYT LTD (UNITED KING-DOM), SKF SVERIGE AB (SWEDEN), UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II (ITALY), UNIVERSITA DEGLI STUDI DI CASSINO (ITALY), VOLKSWAGEN AG (GERMANY), ARCELORMITTAL MAIZIÈRES RESEARCH SA (FRANCE), EXTENDE (FRANCE), EUROPEAN AERONAUTIC DEFENCE AND SPACE COMPANY EADS FRANCE SAS (FRANCE), IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE (UNITED KINGDOM), SAARSCHMIEDE GMBH FREIFORMSCHMIEDE* (GERMANY), KATHOLIEKE UNIVERSITEIT LEUVEN (BELGIUM), FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V (GERMANY).

See also: http://cordis.europa.eu/projects/rcn/99653_en.html

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- *Sergei Nazarov*, Professor at the University of Saint-Petersbourg.

POPIX Exploratory Action

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. FP7 Projects

The Drug Disease Model Resources (DDMoRe) consortium will build and maintain a universally applicable, open source, model-based framework, intended as the gold standard for future collaborative drug and disease modeling and simulation.

The DDMoRe project is supported by the Innovative Medicines Initiative (IMI), a large-scale public-private partnership between the European Union and the pharmaceutical industry association EFPIA.

Marc Lavielle is leader of WP6: "New tools for Model Based Drug Development".

DDMoRe website: http://www.ddmore.eu

Duration: 2010 - 2015

Project members: Uppsala Universitet, Sweden; University of Navarra, Spain; Universiteit Leiden, Netherlands; Université Paris Diderot, France; Universita degli Studi di Pavia, Italy; UCB Pharma , Belgium; Simcyp, UK; Pfizer, UK; Optimata , Israel; Novo Nordisk , Denmark; Novartis, Switzerland; Merck Serono, Switzerland; Mango Business Solutions , UK; Lixoft, France; Interface Europe, Belgium; Institut de Recherches Internationales Servier, France; Inria, France; GlaxoSmithKline Research and Development, UK; Freie Universitat Berlin, Germany; F. Hoffmann - La Roche , Switzerland; EMBL - European Bioinformatics Institute, UK; Eli Lilly , UK; Cyprotex Discovery, UK; Consiglio Nazionale delle Ricerche, Italy; AstraZeneca, Sweden.

<h2 style="text-align:center;color:red;">REGULARITY Project-Team</h2>

8. Partnerships and Cooperations

8.1. National Initiatives

Erick Herbin is member of the CNRS Research Groups:

- GDR Mascot Num, devoted to stochastic analysis methods for codes and numerical treatment;
- GDR Math-Entreprise, devoted to mathematical modeling of industrial issues.

8.2. International Initiatives

8.2.1. Inria International Partners

- Regularity collaborates with Bar Ilan university on theoretical developments around set-indexed fractional Brownian motion and set-indexed Lévy processes (invitations of Erick Herbin in Israël during five months in 2006, 2007, 2008, 2009 and 2011 and invitation of Prof. Ely Merzbach at Ecole Centrale Paris in 2008, 2009, 2010 and 2011). The PhD thesis of Alexandre Richard is co-supervised by Erick Herbin and Ely Merzbach.

  Erick Herbin was invited to the Mathematics Colloquium (Bar Ilan University, Israel) in July, 2012. Talk: "Haudorff dimension of the graph of Gaussian processes".

- Regularity collaborates with Michigan State University (Prof. Yimin Xiao) on the study of fine regularity of multiparameter fractional Brownian motion (invitation of Erick Herbin at East Lansing in 2010).

- Regularity collaborates with St Andrews University (Prof. Kenneth Falconer) on the study of multistable processes.

- Regularity collaborates with Acadia University (Prof. Franklin Mendivil) on the study of fractal strings, certain fractals sets, and the study of the regularization dimension.

- Regularity collaborates with Milan University (Prof. Davide La Torre) on the study of certain economic growth models. A joint project has just been selected in the frame of the Galilée program.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Professors Ely Merzbach from Bar Ilan University and Franklin Mendivil from Acadia University have visited the team this year.

8.3.1.1. Internships

Ankush GOYAL (from May 2012 until Jul 2012)

Subject: Stochastic calculus with multistable Lévy motion and applications in finance

Institution: IIT Delhi (India)

7. Partnerships and Cooperations

7.1. Regional Initiatives

- DIM Digiteo project RedPill: Malware Detection on Virtualized Architectures, Oct. 2009-Sept. 2012. Sole partner: LSV. Funds Hedi Benzina's PhD Thesis.
- DIM Digiteo project API: Automated Proofs of Indistinguishability, 2010-2013. Partners: EPI SECSI, EPI CASCADE. Oct. 2010-Sept. 2013. Funds Vincent Cheval's PhD Thesis.

7.2. National Initiatives

7.2.1. ANR

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

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

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

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

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

  The goal of the ProSe project is to increase the confidence in security protocols, and in order to reach this goal, provide security proofs at three levels: the *symbolic* level, in which messages are terms; the *computational* level, in which messages are bitstrings; and the *implementation* level: the program itself. This project is a continuation of the FormaCrypt project. See https://crypto.di.ens.fr/projects:prose:main.

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

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

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

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

7.3. International Initiatives

7.3.1. Participation In International Programs

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

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

7.4. International Research Visitors

7.4.1. Visits of International Scientists

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

7.4.1.1. Internships

Umang MATHUR (from May 2012 until Jul 2012)

Subject: Estimating the information leakage of a recursive probabilistic program

Institution: IIT Bombay (India)

SELECT Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

SELECT is animating a working group on model selection and statistical analysis of genomics data with the Biometrics group of Institut Agronomique Nationale Paris-Grignon (INAPG).

Pascal Massart is co-organizing a working group at ENS (Ulm) on Statistical Learning. This year the group focused interest on regularization methods in regression. Most of SELECT members are involved in this working group.

SELECT is animating a working group on Classification, Statistics and fMRI imaging with Neurospin.

SELECT is animating a working group on Unsupervised Classification with the CMAP (École Polytechnique)

8.2. European Initiatives

Gilles Celeux and Pascal Massart are members of the PASCAL (Pattern Analysis, Statistical Learning and Computational Learning) network.

8.3. International Initiatives

Gilles Celeux is one of the co-organizers of the Working Group on Model-Based Clustering. This year this workshop took place in Guelph (Canada).

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **JASMIN**– 2010-2012 (205 kEur). DRIRE *programme FEDER.*
  Participants: CADLM, Intercim, TAO (Michèle Sebag) .

- **CSDL**– 2009-2012 (290 kEur). FUI System@tic (Région Ile de France grant). *Complex System Design Lab*
  Participants: Anne Auger, Nikolaus Hansen, Ilya Loshchilov, Raymond Ros, Verena Heidrich-Meisner, Marc Schoenauer.

- **TIMCO**– 2012-2015 (432 kEur). FUI-System@tic (Région Ile de France grant).
  Participants: Cécile Germain, Marc Schoenauer, Lovro Ilijasic.

8.2. National Initiatives

- **OMD2** – 2009-2012 (131 kEur).*Optimisation Multi-Disciplinaire Distribuée*, ANR *programme COSINUS* Coordinator Maryan Sidorkiewicz, RENAULT Technocentre;
  Participants: Anne Auger, Yohei Akimoto, Nikolaus Hansen, Marc Schoenauer, Olivier Teytaud.

- **SyDiNMaLaS** – 2009-2012 (158 kEur).*Integrating Symbolic Discovery with Numerical Machine Learning for Autonomous Swarm Control*, ANR *programme BLANC* Coordinator Michèle Sebag, CNRS;
  Participants: David Meunier, Marc Schoenauer, Michèle Sebag.

- **TRAVESTI** – 2009-2012 (206 kEur).*Estimation du volume de Trafic par Interface Spatio-temporelle*, ANR *programme SYSCOMM 2008* Coordinator Cyril Furtlehner, Inria;
  Participants: Anne Auger, Cyril Furtlehner, Victorin Martin, Maxim Samsonov.

- **ASAP** – 2009-2013 (178 kEur). *Apprentissage Statistique par une Architecture Profonde*, ANR *programme DEFIS 2009* Coordinator Alain Rakotomamonjy, LITIS, Université de Rouen, France;
  Participants: Sylvain Chevallier, Hélène Paugam-Moisy, Sébastien Rebecchi, Michèle Sebag.

- **IOMCA** 2010-2013 (264 kEur). Including Ontologies in Monte-Carlo Tree Search and Applications, ANR international project coordinated by O. Teytaud (Tao, Inria).
  Participants: Adrien Couëtoux, O. Teytaud.

- **EXPLORA** 2010-2012 (289 kEur, to be shared with Inria Lille). EXPLOitation pour l'Allocation efficace de Ressources. Applications l'optimisation. ANR Project coordinated by R. Munos (Inria Lille).
  Participants: David Auger, Olivier Teytaud.

- **DESCARWIN** 2010-2013 (201 kEur). Coordinateur P. Savéant, Thalès.
  Participants: Mostepha-Redouane Khouadjia, Marc Schoenauer.

- **SIMINOLE** 2010-2014 (1180k, 250k for TAO). Large-scale simulation-based probabilistic inference, optimization, and discriminative learning with applications in experimental physics,

  ANR project, Coordinator B. Kégl (CNRS LAL).

  Participants: Balázs Kégl, Djalel Benbouzid, Nikolaus Hansen, Michèle Sebag, Cécile Germain

- **NUMBBO** 2012-2016 (290k for TAO). Analysis, Improvement and Evaluation of Numerical Black-box Optimizers, ANR project, Coordinator Anne Auger, Inria. Other partners: Dolphin, Inria Lille, Ecole des Mines de Saint-Etienne, TUD Dortmund
  Participants: Anne Auger, Nikolaus Hansen, Marc Schoenauer, Ouassim Ait ElHara

- **LOGIMA** 2012-2016 (136k for TAO). Logics, structural representations, mathematical morphology and uncertainty for semantic interpretation of images and videos, ANR project, Coordinator Céline Hudelot, MAS-ECP. Other partners: TAO , LTCI-Telecom ParisTech
  Local coordinator: Jamal Atif

8.2.1. Other

- **GCO** - 2011-2012) *Green Computing Observatory* PEPS-INS2I. Coordinator Cécile Germain. Participants: Cécile Germain, Julien Nauroy, Michèle Sebag.
- **GO** (2011-2013) *Observatoire de la Grille* Action de Développement technologique Inria. Coordinator Cécile Germain. Participants: Dawei Feng, Cécile Germain, Julien Nauroy, Michèle Sebag. Also funded by the France Grilles national initiative.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. SYMBRION

Title: Symbiotic Evolutionary Robots Organisms

Type: COOPERATION (ICT)

Defi: Embedded systems design

Instrument: Integrated Project (IP)

Duration: February 2008 - January 2013

Coordinator: Universität Stuttgart (Germany)

Others partners: Almende, Netherlands; Universität Graz, Austria; Universität Karlsruhe, Germany; Vlaams Interuniversitair Instituut Voor biotechnologie VZW, Blegium; University of the West of England, Bristol, United Kingdom; Eberhard Karls Universität Tübingen, Germany; University of York, United Kingdom; Université libre de Bruxelles, Belgium; Inria, France.

See also: http://symbrion.eu

8.3.1.2. MASH

Title: Massive Sets of Heuristics For Machine Learning

Type: COOPERATION (ICT)

Defi: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project (STREP)

Duration: January 2010 - December 2012

Coordinator: IDIAP Research Institute (Switzerland)

Others partners: Centre National de la Recherche Scientifique, France; Weierstrass-Institut fur Angewandte Analysis Und Stochastik, Part of Furschungsverbund Berlin E.V, Germany; Inria, France; Ceske Vysoke Uceni Technicke V Praze,Czech Republic.

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

Abstract: The Mash project is about massive crowd-sourcing. It is based on several artificial applications. We however used the codes also for our favorite applications, because the original Mash applications have nearly no user, which make it hard to have massive crowd-sourcing; for our applications, we have a moderate number of users, but at least they are motivated. Our contributions are twofolds:

- Building solvers on top of existing expert solvers; this is quite related to our Metis platform (Section 5.1) and our work on Minesweeper and on the mixing of direct policy search and Monte-Carlo Tree Search;

- Adapting solvers for cases in which we can not "undo" on the problem, i.e. if we apply a decision, we can not come back to the previous time step; this makes planning much harder and slower. This is developped in [63].

8.3.1.3. CitInES

Title: City and Industry Energy Strategy

Type: COOPERATION (ICT)

Defi: Design of a decision support tool for sustainable, reliable and cost-effective e

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2011 - March 2014

Coordinator: Artelys (France)

Others partners: Artelys (http://www.artelys.com), Inescp (http://www2.inescporto.pt/, Portugal), Ait (http://www.ait.ac.at/, Austria), Armines (Ecole des Mines, Paris http://www.ensmp.fr), Tupras (http://www.tupras.com.tr, Turkey), Ervet (http://www.ervet.it/, Italy), Schneider (http://www.schneider-electric.com), Cesena (Italy), Bologna (Italy)

See also: http://www.citines.com

Abstract: According to OECD, 67% of world energy is used by cities and 70% of CO_2 emissions come from cities. Therefore, optimizing urban energy investments is a key challenge for reducing polluting emissions and financial exposition to fuel price uncertainties. However, the definition of a sustainable, reliable and cost-effective energy strategy requires to simulate the whole energy chain (consumption, transport, distribution, storage, production) with different types of energy (electricity, gas, heat, wind, waste, etc.) and to assess the environmental and financial impacts of various long-term scenarios (fuel prices, consumption scenarios, etc.).

Local authorities facing this issue have today only partial answers to these questions (simulation of a given type of energy, of a part of the energy chain only or without any long-term risk assessment) and lack a global analysis.

The goal of the CitInES project is to design and develop decision-support software to help local authorities / industries to :

- Assess and compare energy strategies through detailed energy chain simulations
- Optimize local energy strategy to cost-effectively integrate green energy and reduce CO_2 emissions
- Define robust energy schemes to face fuel price uncertainties.

The CitInES project is financed by the European Commission, under 7th Framework Programme. It gathers:

- 4 high-level research centers (INESCP for electric system modelling, AIT for building and energy infrastructure planning, ARMINES for long-term energy strategies and Inria for optimization algorithms)
- 1 SME specialized in decision-support software in the energy field (Artelys, leader of the consortium)
- 2 well-known industrial groups (Schneider Electric for its expertise in electric systems; TUPRAS, Turkish refineries as end-user) and 1 national company (ERVET for its expertise in energy processes)
- 2 large cities (Cesena and Bologna as end-users).

8.3.1.4. EGI-Inspire

Title: Integrated Sustainable Pan-European Infrastructure for Researchers in Europe

Type: Research Infrastructures (CP-CSA)

Defi: European Grid Infrastructure Ecosystem

Instrument: Integrated Project (IP)

Duration: May 2010 - April 2014

Coordinator: EGI.eu (Netherlands)

Others partners: 50 institutions, coordinator for France: CNRS.

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

Abstract: The EGI-InSPIRE project supports the transition from a project-based system to a sustainable pan-European e-Infrastructure, by supporting 'grids' of high-performance computing (HPC) and high-throughput computing (HTC) resources. EGI-InSPIRE supports the establishment of a sustainable model for a European Grid Infrastructure (EGI) that integrates resources contributed by national and domain-specific resource providers. Key to this process is a new organisation, EGI.eu, coordinator on behalf of the European resource provider community of the EGI-InSPIRE project. The EGI is a federation of independent national and domain specific resource providers, who support specific research communities and international collaborators both within Europe and worldwide.

8.3.2. Collaborations in European Programs, except FP7

Program: COST

Project acronym: Action IC0804

Project title: Energy Efficiency in Large Scale Distributed Systems

Duration: January 2009 - May 2013

Coordinator: IRIT

Other partners: see http://www.cost804.org

Abstract: The main objective of the Action is to foster original research initiatives addressing energy awareness/saving and to increase the overall impact of European research in the field of energy efficiency in distributed systems.

8.3.3. Collaborations with Major European Organizations

Partner 1: organisme 1, labo 1 (pays 1)

Sujet 1 (max. 2 lignes)

Partner 2: organisme 2, labo 2 (pays 2)

Sujet 2 (max. 2 lignes)

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. INDEMA

Title: Intelligent Decision Making Mechanisms with Hidden Information, and Application to Electricity Generation

Inria principal investigator: Olivier Teytaud

International Partner (Institution - Laboratory - Researcher):

> National University of Tainan (Taiwan) - Ontology Application and Software Engineering - Chang-Shing Lee

Duration: 2012 - 2014

See also: http://www.lri.fr/~teytaud/indema.html

The objectives of the project are three-folds:

- Objective 1: Designing consistent iterative realistic algorithms for partially observ- able 1-player or 2-player games. We mean:
  - consistent algorithms, in the sense that they are mathematically, provably, optimal asymptotically in the computation time.
  - iterative algorithms in the sense that when you give more time to the algorithm, it should be better; and with little time, it should do its best for replying something acceptable. This is also termed an anytime algorithm. Most algorithm which survive decades are iterative.
  - realistic algorithms; we mean that one can easily design a consistent iterative algorithm that will never work in practice in a real-world setting; so, additionally, we want an algorithm which looks reasonnable and we refer to the second objective for the assesment of this property

  We consider our work on MineSweeper[31] and combining Mcts and Dps [38] as realizations of this principle; we also apply this principle for real applications in the related Citines project.

- Objective 2: Impressive visible applications, e.g. applications in games or puzzles, because such games are very clear assessment tools. Possibilities include Minesweeper (on which we believe that much progress is still possible), Chinese Dark Chess, Kriegspiel, Phantom-Go, card games. Such nice results are critical for advertising and assessing our research. Since the beginning of the project, we had results on MineSweeper, Urban Rivals.

- Objective 3: Big industrial applications. Having both mathematics and visible real- izations in games and industrial applications might be considered as too much; yet, we have chosen to request the maximum possible funding and to include many people in the travelling; also, the persons in the project are all people working in related subjects, with various terminologies, and we already have concrete applications in mind, just far enough from our past activities for being new (we want to tackle in a principled manner partial observability which was somehow ignored in many past works) and close enough for strongly reducing the "warm up" time. In the fully observable case, we worked successfully for these three objectives and want to do the same in the partially observable case. More precisely, when working on real applications in the field of energy generation, we have seen that many problems are simplified so that they boil down to fully observable problems, but that this is a bad application; and our solvers must include some tricks for the partial observability. This is the main motivation for this project; we assume that mathematical analysis can be done on this (objective 1); that it will provide big results in games (objective 2) where many main programs are based on non-consistent algorithms. We believe that requirements above (objective 1) and visible realizations will facilitate the migration to real-world application; also we point out that previous research projects involving us facilitated contacts with industry, in particular in the field of energy generation, which is a key point for this third objective. A roadmap for objective 3 is as follows:
  - Check on simple versions of energy production problems whether the fully observable approximation is ok. We guess that in many cases it is not ok, and we want to clearly state to which extent (by how many percents) we loose in terms of loss function.
  - Experiment our algorithms on real industrial problems. We will work both on Taiwan-centered and on Europe-Centered electricity generation problems in order to widen the scope of the analysis and so that both partners can be helpful in terms of applications in their own countries.

  We have made papers related to energy management, including papers in very applied conferences. We are in the process of creating a company in Taiwan, hopefully during the

2nd semester of 2013. One student (Adrien Couëtoux) has spent 6 months there, another student has spent 5 months; Adrien just starts a second 6 months stay there.

8.4.2. Inria International Partners

8.4.2.1. Microsoft Research Cambridge

Within the *Microsoft-Inria Joint Lab*, the collaboration with Youssef Hamadi (Microsoft Research Cambridge), through the *Adapt* project, has been pursued, in spite of the departure of the 2 PhD students Alvaro Fialho and Alejandrao Arbelaez. Nadjib Lazaar and Manuel Loth have been hired as post-doc, and a new collaboration with Christian Shulte (KTH Stockholm) based on the use of Bandit algorithm within GECODE has recently given its first results [52] (see Section 3.2).

8.4.3. Participation In International Programs

- The UCT-SIGhas started a collaboration with Inria Chile around energy management; for the moment this is only preliminary discussions (a few face-to-face meetings in Paris, a visioconference with Inria Chile).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Christian Shulte (Software and Computer Systems, School of Information and Communication Technology, KTH - Royal Institute of Technology in Stockholm, Sweden), Jan. 24-27, to initiate the generic implementation of Bandit algorithms in Gecode (see Section 3.2).
- Visits from a Taiwanese delegation, see the Franco-Taiwanese week. This included visits to Univ. Paris-Sud, to other universities (Paris-Nord, Limoges), to companies working around energy.
- One month visit from Cheng-Wei Chou, Taiwanese ph.D. student from National Dong-Hwa University.
- Francis Maes, Post-doc, Leuven University, Leuven, Nov. 20 to Dec. 21.
- One week visit from Muneki Yasuda associate professor in the department of Information science, Tohoku University.

Xiangliang ZHANG (25-31 October 2012)

Continued collaboration on large scale clustering.

Institution: KAUST-King Abdullah University of Science and Technology (Saudi Arabia)

8.5.1.1. Internships

Christopher DELGADO (from Apr 2012 until Sep 2012)

Subject: Designing lean classifiers for detectors and triggers

Institution: Massachusetts Institute of Technology (United States)

Gaurav MAHESHWARI (from Apr 2012 until Sep 2012)

Subject: Sampling-based statistical analysis in large-scale physics experiments

Institution: IIT HYDERABAD (India)

Mauro DI MASSO (from Mar 2012 until Sep 2012)

Subject: Evolutionary Adaptation and the Emergence of Speciation in a Population of Autonomous Robots

Institution: National University of Rosario (Argentina)

8.5.2. Visits to International Teams

- Olivier Teytaud has made a one-year visit (August 2011 to July 2012) in National University of Tainan, Taiwan, and to many other universities.

TOCCATA Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Hisseo*

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

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

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

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

8.1.2. *Coquelicot*

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

Coquelicot is a 3 years Digiteo project that started in September 2011. http://coquelicot.saclay.inria.fr. S. Boldo is the principal investigator of this project.

The Coquelicot project aims at creating a modern formalization of the real numbers in Coq, with a focus on practicality [30], [22]. This is sorely needed to ease the verification of numerical applications, especially those involving advanced mathematics.

Partners: LIX (Palaiseau), University Paris 13

8.1.3. *Pactole*

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

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

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

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

8.2. National Initiatives

8.2.1. *ANR BWare*

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

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

It is an industrial research project that aims to provide a mechanized framework to support the automated verification of proof obligations coming from the development of industrial applications using the B method and requiring high guarantees of confidence. The methodology used in this project consists in building a generic platform of verification relying on different theorem provers, such as first-order provers and SMT solvers. The variety of these theorem provers aims at allowing a wide panel of proof obligations to be automatically verified by the platform. The major part of the verification tools used in BWare have already been involved in some experiments, which have consisted in verifying proof obligations or proof rules coming from industrial applications [29]. This therefore should be a driving factor to reduce the risks of the project, which can then focus on the design of several extensions of the verification tools to deal with a larger amount of proof obligations.

The partners are: Cedric laboratory at CNAM (CPR Team, project leader) ; Inria teams Gallium, Deducteam and Asap ; Mitsubishi Electric R&D Centre Europe, the ClearSy company that mdevelop and maintains *Atelier B* and the OCamlPro start-up.

8.2.2. ANR DECERT

Participants: Sylvain Conchon, Évelyne Contejean.

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

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

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

8.2.3. ANR FOST

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

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

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

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

8.2.4. ANR U3CAT

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

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

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

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

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

8.2.5. ANR Verasco

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

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

The main goal of the project is to investigate the formal verification of static analyzers and of compilers, two families of tools that play a crucial role in the development and validation of critical embedded software. More precisely, the project aims at developing a generic static analyzer based on abstract interpretation for the C language, along with a number of advanced abstract domains and domain combination operators, and prove the soundness of this analyzer using the *Coq* proof assistant. Likewise, it will keep working on the CompCert C formally-verified compiler, the first realistic C compiler that has been mechanically proved to be free of miscompilation, and carry it to the point where it could be used in the critical software industry.

Partners: teams Gallium and Abstraction (Inria Paris-Rocquencourt), Airbus avionics and simulation (Toulouse), IRISA (Rennes), Verimag (Grenoble).

8.2.6. *Systematic: Hi-Lite*

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

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

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

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

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

8.3. European Initiatives

8.3.1. *Collaborations in European Programs, except FP7*

8.3.1.1. *FoVeOOS*

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

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

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

Project title: Formal Verification of Object-Oriented Software

Duration: May 2008 - April 2012

Coordinator: B. Beckert, University Karlsruhe, Germany

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

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

8.4. International Initiatives

8.4.1. Participation In International Programs

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

8.4.2. Other International Partners

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

8.5. International Research Visitors

8.5.1. Visits to International Teams

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

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. ParalITP (ANR-11-INSE-001)

Goal: Improve the performances and the ergonomics of interactive provers by taking advantage of modern, parallel hardware.
Leader: B. Wolff. Participants: A. Mahboubi, E. Tassi.
Website: http://paral-itp.lri.fr/.

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

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

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. FORMATH

Title: Formath

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: March 2010 - February 2013

Coordinator: Univ Götegorg (Sweden)

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

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

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