Activity Report 2013

Section Partnerships and Cooperations

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

6. Partnerships and Cooperations

6.1. Regional Initiatives

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

6.2.2. PEPS

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

6.3. European Initiatives

Program: Partenariat Hubert Curien (PHC) Procope (Jointly funded by Egide and DAAD)

Project acronym: SOSW

Project title: Sharing and Optimizing Scientific Workflows

Duration: 2013 - 2015

Coordinator: Sarah Cohen-Boulakia

International Partner

U. Humboldt (Berlin, Allemagne)

Institute for Computer Science

Ulf Leser

Abstract : Considerable effort has been put into the development of scientific workflow management systems. They support scientists in developing, running, and monitoring chains of data analysis programs. A variety of systems have reached a level of maturity that allows them to be used by scientists for their bioinformatics experiments, especially including analysis of NGS data. However, each scientific group has its own way of analyzing NGS data, using a particular set of tools, in a particular order. The aim of this project is to exploit the complementary skills of the two European groups involved to develop approaches promoting exchange of (optimized) workflows.

6.4. International Initiatives

6.4.1. Inria Associate Teams

6.4.1.1. ITSNAP

Title: Intelligent Techniques for Structure of Nucleic Acids and Proteins

Inria principal investigator: Julie Bernauer

International Partner (Institution - Laboratory - Researcher):

Stanford University (United States) - Computational Structural Biology, School of Medicine, Structural Biology - Julie Bernauer

Duration: 2012 - 2014

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

6.4.2. Inria International Partners

6.4.2.1. Declared Inria International Partners

CARNAGE

Program: Inria-Russia

Title: CARNAGE: Combinatorics of Assembly and RNA in GEnomes

Inria principal investigator: Mireille Régnier

International Partner (Institution - Laboratory - Researcher):

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

Duration: 2012- 2014

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

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

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

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

6.4.2.2. Informal International Partners

Polytechnique/UPSud and McGill/U. Montréal

Program: CFQCU

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

Inria principal investigator: Jean-Marc Steyaert

International Partner (Institution - Laboratory - Researcher):

Mc Gill and Université de Montréal (Canada)

Computer Science Department

Jérôme Waldispühl

Duration: 2012 - 2014

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

6.4.3. Inria International Labs

R. Fonseca spent 5 months at SLAC in Stanford to work with Henry van den Bedem. J. Bernauer spent two weeks at SLAC. The associated team members also presented their work at the Inria BIS 2013 Workshop in Stanford https://project.inria.fr/inria-siliconvalley/workshops/bis2013/.

6.4.4. Participation In other International Programs

6.4.4.1. NII International Internship Program

Adrien Rougny has been an intern at NII from February to August 2013 with a support of "NII International Internship Program. He worked on the topic "Inference and Learning for Systems Biology and Network Dynamics" in Pr. Katsumi Inoue's group, a long-term collaboration of Ch. Froidevaux.

6.4.4.2. PHC Procore

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*.

6.5. International Research Visitors

6.5.1. Visits of International Scientists

H.K. Hwang

> Subject: Probabilistic Analysis of A Simple Evolutionary Algorithm

> Institution:Taipeh University (Taiwan)

V. Reinharz

> Subject: RNA 3D structure analysis

> Institution: McGill University (Canada)

E. Furletova

> Subject: word enumeration

> Institution: Institute of Mathematical Problems in Biology (Russia)

6.5.1.1. Internships

- C. Moutet (May and June 2013)

  > Subject: Poor mappability regions in assembly

  > Institution: ENS Lyon and Ecole Polytechnique Fédérale de Lausanne

  > Funding: INRIA

  > Supervision: M. Régnier

- F. Pirot (May and June 2013)

  > Subject: Exceptional words in *Archae* genomes

  > Institution: ENS Lyon

  > Funding: INRIA

  > Supervision: M. Régnier

- B. Fang (May to July 2013)

  > Subject: Clumps combinatorics, automata and word asymptotics

  > Institution: Princeton University (United States)

  > Funding: Ecole Polytechnique

  > Supervision: M. Régnier

- J. Moussu (April to July 2013)

Subject: Repeats in genomic sequences

Institution: Rennes University

Funding: INRIA

Supervision: M. Régnier

- M. Pichene (April to July 2013)

    Subject: Graph algorithms and protein-protein interactions

    Institution: Paris-Sud University

    Funding: INRIA

    Supervision: J. Bernauer

- L. Uroshlev (June 2013)

    Subject: Reference state for RNA KB potentials

    Institution: IOGEN (Moscou, (Russia))

    Funding: INRIA (CARNAGE)

    Supervision: J. Bernauer

- O. Berillo (January and december 2013)

    Subject: miRNAs and oncogenes.

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

    Funding: El Farabi University

    Supervision: M. Régnier

- A. Bari (March 2013)

    Subject: stress-inducible miRNAs

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

    Funding: El Farabi University

    Supervision: M. Régnier

6.5.2. Visits to International Teams

- Sep. 2013–Sep. 2014: Y. Ponty is visiting PIMS and Simon Fraser University (Vancouver, Canada)

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. *ANR FITOC: From Individual To Collaborative Visual Analytics*

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

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

8.1.2. *ANR EASEA-Cloud*

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

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

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

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

8.2. European Initiatives

8.2.1. *FP7 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 Dresden, (DE)

We have been collaborating with Raimund Dachselt on stackable tangible devices for faceted browsing [70], [69].

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

AVIZ researchers collaborate with a number of international partners, including:
- Google, Mountain View, USA
- Microsoft Research, Redmond, USA
- New York University, USA
- University of Toronto, Canada
- University of Calgary, Canada
- University of British Columbia, Canada
- University of Kent, UK
- University of Konstanz, Germany
- University of Magdeburg, Germany

8.3.1.2. Informal International Partners
- Arizona State University, USA
- University of Groningen, the Netherlands
- University of Granada, Spain

8.3.2. Inria International Labs
- *Massive Data team*, Inria Chile.

8.3.3. Collaboration with Google

AVIZ collaborates with Google on several projects, related to the Google Research Grant (see Section 7.1) and to evaluation methodology in information visualization [71]. Heidi Lam from Google spent 3 months at AVIZ to collaborate more closely.

8.3.4. Collaboration with Microsoft Research

AVIZ collaborates with several researchers from Microsoft Research Redmond, in particular on the topic of new interactions for information visualization [72] and brain connectivity visualization.

8.3.5. Collaboration with New-York University

Jean-Daniel Fekete collaborates with Claudio Silva and Juliana Freire from NYU-Poly on the VisTrails workflow system for visual analytics (http://www.vistrails.org). Rémi Rampin, intern from the Univ. Paris-Sud Master in HCI, has spent one month at Orsay and 5 months at NYU-Poly to allow VisTrails to run Java-based applications and Toolkits. Rémi successfully connected the traditional Python-C implementation of VisTrails to the Java virtual machine using the JPype package. Jean-Daniel Fekete is not porting the Obvious Toolkit [61] in this environment to integrate all its components [64].

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Stefan Manegold, in May, from CWI Amsterdam on Big-Data Visual Analytics

8.4.1.1. Internships

- Candemir Doger, from June 2013 to September 2013
  Subject: Interactive Visualization on Tablet-sized Devices
  Institution: Sabanci University, Istanbul, Turkey

- Qi Lan, from April 2013 to September 2013
  Subject: Multi-touch selection for data graphics
  Institution: Université Paris Sud, France

- Sai Ganesh Swaminathan, from June 2013 to October 2013
  Subject: Software Tools for Physical Visualizations
  Institution: none – student from M1 HCID / M2R Interaction

8.4.2. Visits to International Teams

- Tobias Isenberg: University of Granada, Spain, April 2013

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

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

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. MEALS

Program: FP7-PEOPLE-2011-IRSES

Project acronym: MEALS

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

Duration: October 2011 - September 2015

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

Coordinator: Holger Hermans, Saarland University, Germany

Coordinator for the Inria sites: Catuscia Palamidessi, Inria Saclay

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

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

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. PRINCESS

Title: Protecting privacy while preserving data access

Inria principal investigator: Catuscia Palamidessi

International Partners:

Geoffrey Smith, Florida International University (United States)

Andre Scedrov, University of Pennsylvania (United States)

Duration: 2013 - 2016

URL: http://www.lix.polytechnique.fr/comete/Projects/Princess/

Abstract: PRINCESS is an Inria associated team focusing on the protection of privacy and confidential information. In particular, we study the issues related to the leakage of confidential information through public observables.

We aim at developing a meaningful notion of measure in order to quantify the leakage of information, and to design mechanisms to limit the amount of leakage, without interfering too severely with the utility of the information that is meant to be disclosed.

The main topics currently investigated are quantitative information flow, where we are developing a decision-theoretic approach, and differential privacy, where we are developing an extension which lifts the basic notion of privacy meant for databases to arbitrary domains.

7.3.2. Inria International Partners

7.3.2.1. Informal International Partners

- **Charles Carroll Morgan,** Professor, University of New South Wales
- **Moreno Falaschi,** Professor, University of Siena
- **Mario Ferreira Alvim Junior,** Assistant Professor, Federal University of Minas Gerais
- **Annabelle Mciver,** Associate Professor, Macquarie University
- **Carlos Olarte,** Associate Professor, Universidad Javeriana Cali

7.3.3. Participation In other International Programs

7.3.3.1. PACE

- **Program:** ANR Blanc International
- **Project title:** Beyond plain Processes: Analysis techniques, Coinduction and Expressiveness
- **Duration:** January 2013 - December 2016
- **URL:** http://perso.ens-lyon.fr/daniel.hirschkoff/pace/
- **Coordinator:** Daniel Hirschkoff , Ecole Normale Supérieure de Lyon
- **Other PI's and partner institutions:** Catuscia Palamidessi, Inria Saclay. Davide Sangiorgi, University of Bologna (Italy). Yuxi Fu, Shanghai Jiao Tong University (China).
- **Abstract:** This project objective is to enrich and adapt these methods, techniques, and tools to much broader forms of interactive models, well beyond the realm of "traditional" processes.

7.3.3.2. LOCALI

- **Program:** ANR Blanc International
- **Project title:** Logical Approach to Novel Computational Paradigms
- **Duration:** October 2011 - September 2015
- **URL:** http://lcs.ios.ac.cn/~locali2013/
- **Coordinator:** Gilles Dowek, Inria Rocquencourt
- **Other PI's and partner institutions:** Catuscia Palamidessi, Inria Saclay. Thomas Erhard, Paris VII. Ying Jiang , Chinese Academy of Science in Beijin (China).
- **Abstract:** This project aims at exploring the interplays between logic and sequential/distributed computation in formalisms like the lambda calculus and the π calculus. Going back to the fundamentals of the definitions of these calculi, the project plans to design new programming languages and proof systems via a logical approach.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- **Nikita Borisov,** Associate Professor, University of Illinois at Urbana-Champaign, from Nov 2013 until Dec 2013
- **Moreno Falaschi,** Professor, University of Siena, from Sep 2013 until Sep 2013
- **Mario Ferreira Alvim Junior,** Assistant Professor, Federal University of Minas Gerais, from Nov 2013 until Dec 2013
- **Fabio Gadducci,** Associate Professor, University of Pisa, from Jun 2013 until Aug 2013
- **Dominik Luecke,** Postdoc, from Apr 2013 until Apr 2013
- **Annabelle Mciver,** Associate Professor, Macquarie University, from Dec 2013 until Dec 2013
- **Charles Carroll Morgan,** Professor, University of New South Wales, from Dec 2013 until Dec 2013

- **Carlos Olarte,** Associate Professor, Universidad Javeriana Cali, from June 2013 until Jul 2013
- **Camilo Rueda,** Professor, Universidad Javeriana Cali, from Nov 2013 until Dec 2013
- **Vladimiro Sassone,** Professor, University of Southampton, from Apr 2013 until May 2013
- **Mauricio Toro Bermudez,** Postdoc, University of Cyprus, from Jun 2013 until Jun 2013

7.4.2. Internships

7.4.2.1. Xiao Wang

- **Duration:** From May 2013 until August 2013
- **Subject:** Differential privacy and applications of privacy protection in location-based services
- **Institution:** LIX, Ecole Polytechnique

7.4.2.2. 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

7.4.3. Visits to International Teams

Catuscia Palamidessi visited the team of Andre Scedrov and Benjamin Pierce at the University of Pennsylvania. July 2013.

COMMANDS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. DGA

Participants: Olivier Bokanowski, Anna Désilles, Hasnaa Zidani.

This project is a collaboration in the framework of a 3-year (2012-2015) research program funded by DGA. The title of the project is "Problèmes de commande optimale pour des systèmes non-linéaires en présence d'incertitudes et sous contraintes de probabilité de succès".

7.1.2. ANR HJNet

Participants: Olivier Bokanowski, Zhiping Rao, Hasnaa Zidani.

The team is part of the collaborative project HJNet funded by the French National Research Agency (ANR-12-BS01-0008-01). It started in January 2013 and will end in December 2013. Website: http://hjnet.math.cnrs.fr

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. SADCO

Instrument: Initial Training Network

Duration: January 2011 - December 2014

Coordinator: Inria

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

Inria contact: Hasnaa Zidani

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

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

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. OCONET

Title: Optimization and control in network economics

Inria principal investigator: Frédéric Bonnans

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - Center for Mathematical Modeling - Joseph Frédéric Bonnans

Duration: 2012 - 2014

See also: http://www.cmm.uchile.cl/EA_OCONET

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

7.3.2. Inria International Labs

- 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.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Prof. B.S. Goh, Curtin University, Miri, Malaysia; two weeks in February.
- M.S. Aronna, Rosario University, Argentina; one month (February and November).

7.4.1.1. Internships

- Arthur Marly, second year student of ENS Lyon. Two months intership. Subject: optimal control of populations with state constraints. Supervisor: F. Bonnans.

DAHU Project-Team

6. Partnerships and Cooperations

6.1. European Initiatives

6.1.1. FP7 Projects

6.1.1.1. 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

6.2.1.1. Declared Inria International Partners

Victor Vianu, UC San Diego, USA.

6.3. International Research Visitors

6.3.1. Visits of International Scientists

- Benoît Larose

    Subject: Constraint Satisfaction Problems

    Institution: concordia Univeresity, Montreal, Canada.

DEFI Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. 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

- J.R. Li is the coordinator of the Inria partner of the project "Computational Imaging of the Aging Cerebral Microvasculature", funded by ANR Program "US-French Collaboration". French Partners (Coordinating partner CEA Neurospin): CEA Neurospin (Coordinator Luisa Ciobanu), Inria Saclay (Coordinator Jing-Rebecca Li). US Partner: Univ of Illinois, bioengineering department (Coordinator Brad Sutton). Duration: Sept 2013- Sept 2016.

8.2. European Initiatives

8.2.1. Collaborations with Major European Organizations

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

Joint PhD advising of T. Rienmuller, partly funded by French-German university. Correspondant: Armin Lechleiter.

Partner 2: University of Goettingen, Department of Math. (Germany)

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

Partner 3: University of Genova, Department of Math. (Italy)

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

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. ISIP

Title: Inverse Scattering and Identification Problems

Inria principal investigator: Houssem HADDAR

International Partner (Institution - Laboratory - Researcher):

 University of Delaware (United States) - Mathematical Department - Houssem HADDAR

Duration: 2008 - 2013

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

8.3.2. Inria International Partners

8.3.2.1. Declared Inria International Partners

- Mathematical department of the University of Delaware

8.3.3. Participation In other 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).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Sabbatical

- Yassine Boubendir, Department of Mathematical Sciences, New Jersey Institute of Technology (October-December 2013)

8.4.1.2. Internships

- Thi-Phong Nguyen (March-August 2013)

- Mohamed Lakhal (February-June 2013)

- Ahmed Aaddaj Eloudrhiri February 2013-June 2013

- Isaac Harris May 2013-July 2013

- Shixu Meng May 2013-August 2013

- Khieu Van NGUYEN, April-July 2013.

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, observaterus par intervalles et systèmes à retard.

  Dedember 2011- December 2014

  Coordinator: Frédéric Mazenc

  Other partners: L2S, France, Mines-ParisTech, France

  Abstract: MOISYR is concerned with the problem of extending the theory of monotone systems to the main families of continuous time systems with delay along with the application of this theory to the design of observers and interval observers. In particular, nonlinear systems with pointwise and distributed delays and stabilizable systems with delay in the input shall be considered. In a second step, we extend our result to discrete time systems and to a specific class of continuous/discrete systems calles Networked Control Systems.

8.2. National Initiatives

8.2.1. ANR

An ANR Blanc SIMI 3 "Multidimensional Systems: Digression On Stabilities" (MSDOS) was submitted in 2013 and accepted. It will start in 2014 for a period of 4 years. Alban Quadrat is the local leader for Inria Saclay. For more details, see http://www.lias-lab.fr/perso/nimayeganefar/doku.php. Its main goal is to constructively study stabilities and stabilization problems of (nonlinear) multidimensional systems.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: GDRI (European research network founded by CNRS)

Project acronym: DelSys

Project title: Delay Systems

Duration: 2011-2015

Coordinator: Silviu Iulian Niculescu

Other partners: GIPSA-Lab and LAAS France, Ancona University Italy, Czech Technical University in Prague Czech Republic, Kent University Great-Britain, KTH Stockholm Sweden and KU Leuven Belgium.

Abstract: the aim of this GDRI is to bring together the main European teams which work in the fiels of Delay systems. This network meets once a year.

Program: PHC Aurora (Norway)

Project acronym: 28920SB

Project title: Connections between constrained control law synthesis and theory of positive dynamical systems

Duration: 2013

Coordinator: Sorin Olaru (French leader), Morten Hovd (Norwegian leader)

Other partners: NTNU Trondheim

Abstract: The project is constructed with two main scientific objectives: a) The (controlled) invariant set computation and their use in the stability analysis The main objective is the construction of invariant sets of reduced complexity in terms of generators (for example vertices in polyhedral/zonotopic sets). Such invariant sets are related to the positivity by the invariance of the positive orthant of a dual (comparison) state space. The existence of invariant sets will be subsequently linked through this comparison systems with the stability analysis of complex (large scale, interconnected, hybrid, delay-affected or nonlinear) dynamics. The results will be compared with the state of the art methods as for example those related to the feasible set description in Model Predictive Control related problems. b) Control design for constrained dynamical systems Once the invariance tools with manageable complexity are available, the respective set will be employed in the synthesis procedure as Lyapunov level sets. Practically this will lead to polyhedral Lyapunov functions type of constructions for which interpolation based techniques have recently been shown to be effective. Further, the robustness and the performance of the resulting closed-loop dynamics need to be adjusted in accordance with the choice of the interpolation factor. These control design degrees of freedom need to be adjusted with respect to positiveness or monotonicity requirements.

Program: PHC Pessoa (Portugal)

Project acronym: 28750QA

Project title: Robust Distributed Model Predictive Control of Medium- and Large- Scale Systems

Duration: 2013-2014

Coordinator: Cristina Stoica (French leader), Fernando Lobo Perreira (Portuguese leader)

Other partners: Sorin Olaru

Program: PHC Brancusi (Romania)

Project acronym: 28705PF

Project title: Adaptive and predictive control of bioprocesses (modelling, identification and control of interconnected bioprocesses)

Duration: 2013-2014

Coordinator: Sihem Tebbani (French leader), Dan Selisteanu (Romanain leader)

Other partners: Sorin Olaru

Program: PHC Parrot

Project acronym: CASCAC

Project title: Computer Algebra, Symbolic Computation, and Automatic Control

Duration: 2013 - 2014

Coordinator: Alban Quadrat (French leader), Maris Tõnso (Estonian leader)

Other partners: Institute of Cybernetics, University of Tallinn

Abstract: The CASCAC project is at the interfaces of control theory, computer algebra and software engineering. The goals of the project are: 1. Develop new theoretical results on nonlinear control systems defined by functional equations (e.g., ordinary differential equations, partial differential equations, differential time-delay equations, partial difference equations). 2. Implement them on dedicated softwares developed in the computer algebra system Mathematica. In particular, Mathematica versions of the OREMODULES and OREMORPHISMS packages will be developed. 3. Develop an interface between the C library BLAD (http://www.lifl.fr/~boulier/pmwiki/pmwiki.php?n=Main.BLAD) − dedicated to differential algebra techniques − and Mathematica. This interface will allow one to have access to differential elimination techniques in Mathematica and to use them in decision methods for nonlinear control theory. 4. Co-supervise the Master thesis of Kristina Halturina with Prof. Ülle Kotta on constructive aspects of differential flatness and its applications to control theory (e.g., tracking, motion planning).

Program: PHC Rila (Bulgaria)

Project acronym: 29401YJ

Project title: Robust Distributed Model Predictive Control of Medium- and Large- Scale Systems

Duration: 2013-2014

Coordinator: Sorin Olaru (French leader), Alexandra Grancharova (Bulgarian leader)

Other partners: Bulgarian Academy of Science

Abstract: The project intends to address the control design of large scale dynamical systems with an emphasis on distributed predictive control strategies. There are two points of view with respect to the control synthesis in this framework: a. avoid the use of a global prediction model in the receding horizon optimal control of the subsystems and privilege the use of a coordination level in the decision process; b. consider the distributed synthesis for a network of discrete-time constrained linear systems without central coordinator. In the present project we intend to contribute to both of these directions by: a. Prediction of the interactions in between subsystems in a decomposition-coordination scheme. This can be done by imposing a reduced set of constraints for the MPC problems at the lower levels. b. With respect to the MPC design in the absence of coordination one of the issues will be the definition of appropriate terminal sets, ensuring invariance properties or at least recursive feasibility for the global functioning. We will investigate the construction of terminal set for a stabilizing centralized MPC decomposable in the form of a cross product of sets in each subsystem state space. An interesting idea on this direction was presented recently by the participants in this project.

8.3.2. Collaborations with Major European Organizations

Partner 1:University of l'Aquila, Italy

Nonlinear delay systems interconnected with a differential-difference equation.

Partner 2: RWTH Aachen University, Germany

Mathematical systems theory, control theory, symbolic computation

Partner 3: Bilkent University, Turkey

Control of linear and nonlinear systems with delays, medical applications

Partner 4: Tel Aviv University, Israel

Stability analysis of nonlinear Partial Differential Equations

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal 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

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Within the PHC Parrot (Inria Saclay - Institute of Cybernetics, University of Tallinn), Ülle Kotta, Maris Tõnso and Juri Belikov visited the DISCO project (twice for a week).

Within the invited Professor Program of DIGITEO, Prof. Georges BiTSORIS visited the DISCO project and Supélec from January-July 2013 and Emilia Fridman visited the DISCO project in September 2013.

8.5.2. Visits to International Teams

Alban Quadrat was invited by the Mathematics department of the Universidad Nacional de Colombia Bogotá (Colombia) for two weeks, and at the Tempere University of Technology (Finland).

GALEN Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Excellence Clusters

- Program: DIGITEO (OMTE)

    Project acronym: Curator

    Project title: Real-time 2D/3D Deformable Fusion Towards Computer Assisted Surgery

    Duration: 01/2013-01/2014

    Coordinator: ECP - FR

- Program: MEDICEN

    Project acronym: ADOC

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

    Duration: 11/2011-10/2014

    Coordinator: LLTECH - FR

8.2. National Initiatives

8.2.1. ANR

- Program: ANR Blanc International

    Project acronym: ADAMANTIUS

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

    Duration: 9/2012-8/2015

    Coordinator: CHU Henri Mondor - FR

- Program: ANR JCJC

    Project acronym: HICORE

    Project title: HIerarchical COmpositional REpresentations for Computer Vision

    Duration: 10/2010-9/2014

    Coordinator: ECP - FR

- Program: ITMOs Cancer & Technologies pour la santé d'Aviesan / INCa

    Project acronym: CURATOR

    Project title: Slice-to-Image Deformable Registration towards Image-based Surgery Navigation & Guidance

    Duration: 12/2013-11/2015

    Coordinator: ECP - FR

8.3. European Initiatives

8.3.1. FP7 Projects

- Project acronym: MOBOT

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

Duration: 01/2013-12/2015

Coordinator: TUM - DE

- Project acronym: RECONFIG

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

  Duration: 01/2013-12/2015

  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

8.4. 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: Nikos Paragios

International Partner (Institution - Laboratory - Researcher):

Stanford University (United States) - Artificial Intelligence Lab - Nikos Paragios

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

8.4.2.1. Informal International Partners

Europe

- Technical University of Munich (DE) – Collaborative research with the Chair for Computer Aided Medical Procedures & Augmented Reality at the department of Computer Science. Collaboration Topic: Graph-based methods for linear/deformable registration, segmentation, and tracking.
- University College London (UK) – Collaborative research with the Gatsby Computational Neuroscience Unit. Collaboration Topic: Kernel measures of dependence.

- University of Oxford (UK) – Collaborative research with the Visual Geometry Group of the Department of the Electrical Engineering. Collaboration Topic: Structured prediction, invariance, and parts-based models.
- University of Oulu (Finland) – Collaborative research with the Machine Vision Group at the department of Electrical Engineering. Collaboration Topic: Ranking based learning algorithms for cascaded object detection.

Americas

- University of California at Los Angeles (US) – Collaborative research with the UCLA Vision Lab and the UCLA Center for Cognition, Vision, and Learning Lab at the Departments of Computer Science and Statistics. Collaboration Topic: Action Recognition & Object Detection Parsing.
- University of Pensylvania (USA) – Collaborative research with the section of Biomedical Imaging of the Department of Radiology. Collaboration Topic: Graph-based methods for linear/deformable registration.
- StonyBrook University, Computer Science Department (USA) – Collaborative research with the image analysis lab in the context of the SubSample DIGITEO Chair. Collaboration Topic: Higher Order Graph-based methods in graph-matching, cocaine addiction analysis with sparse graph models, object detection and implicit 3D pose estimation
- Ecole Polytechnique de Montreal (CA) – Collaborative research with the Canada Research Chair in Medical Imaging and Assisted Interventions. Collaboration Topic: Higher Order Graph-based methods in Spine Imaging

Asia

- International Institute of Information Technology, Hyderabad (India) – Collaborative research with Center for Visual Information Technology. Collaboration Topic: Average precision with weak supervision & self-paced learning for deep convolutional neural networks.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Professor Spyretta Golemati lecturer at the school of medicine at the University of Athens has visited during her sabbatical the team from June 1st, 2013 to July 30th, 2013.

8.5.1.1. Internships

Siddhartha Chandra

Subject: machine learning for 3D reasoning.

Date: from May 2013 until December 2013.

Institution: IIIT Hyderabad (India)

Dimitrios Damopoulos

Subject: Automatic Detection and Characterization of Liver Tumors

Date: from Nov 2013 until Apr 2014

Institution: National Technical University of Athens (Greece)

José Ignacio Orlando

Subject: Machine Learning for Opthalmology

Date: from Apr 2013 until Sep 2013

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

Eduard Trulls

Subject: Segmentation-aware descriptors

Date: from March 2013 until July 2013

Institution: Polytechnical University of Catalunia (Spain)

8.5.2. Visits to International Teams

- M. Pawan Kumar (Inria): one week visit to Stanford University (May 2013).
- M. Pawan Kumar (Inria): one week visit to Stanford University (June 2013).
- Matthew Blaschko (Inria): one week visit to Stanford University (December 2013).

GECO Project-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.
- **Digitéo project 2012-061D SSyCoDyC.** SSyCoDyC (2013–2014) is financed by Digitéo in the framework of the DIM *Hybrid Systems and Sensing Systems*. It focuses on the application of techniques of hybrid systems to the analysis of retarded equations with time-varying delays. SSyCoDyC finances the post-doc fellowship of Ihab Haidar and is coordinated by Paolo Mason and Mario Sigalotti.

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.

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

7.4.1.1. Informal International Partners

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

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

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

7.4.2. Participation In other International Programs

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

GEOMETRICA Project-Team

8. Partnerships and Cooperations

8.1. Technological Development Actions

8.1.1. ADT PH

Participants: Jean-Daniel Boissonnat, Frédéric Chazal, David Cohen-Steiner, Sonali Digambar Patil, Marc Glisse, Steve Oudot, Clément Maria, Mariette Yvinec.

- Title: Persistent Homology

- Coordinator: Mariette Yvinec (GEOMETRICA)

- Duration: 1 year renewable once, starting date December 2012.
- Others Partners: Inria team ABS, Gipsa Lab (UMR 5216, Grenoble, http://www.gipsa-lab.inpg.fr/)

- Abstract: Geometric Inference is a rapidly emerging field that aims to analyse the structural, geometric and topological, properties of point cloud data in high dimensional spaces. The goal of the ADT PH is to make available, a robust and comprehensive set of algorithmic tools resulting from recent advances in Geometric Inference. The software will include:

> tools to extract from the data sets, families of simplicial complexes,

> data structures to handle those simplicial complexes,

> algorithmic modules to compute the persistent homology of those complexes,

> applications to clustering, segmentation and analysis of scalar fields such as the energy landscape of macromolecular systems.

8.1.2. ADT OrbiCGAL

Participants: Mikhail Bogdanov, Aymeric Pellé, Monique Teillaud.

- Title: OrbiCGAL

- Coordinator: Monique Teillaud (GEOMETRICA)

- Duration: 1 year renewable once, starting date September 2013.
- Abstract: OrbiCGAL is a software project supported by Inria as a Technological Development Action (ADT). It is motivated by applications ranging from infinitely small (nano-structures) to infinitely large (astronomy), through material engineering, physics of condensed matter, solid chemistry, etc

The project consists in developing or improving software packages to compute triangulations and meshes in several types of non-Euclidean spaces: sphere, 3D closed flat manifolds, hyperbolic plane.

8.2. Regional Initiatives

8.2.1. Digiteo project TOPERA

Participants: Frédéric Chazal, Marc Glisse, Anaïs Vergne.

TOPERA is a project that aims at developing methods from Topological Data Analysis to study covering properties and quality of cellular networks. It also involves L. Decreusefond and P. Martins from Telecom Paris.

- Starting date: December 2013

- Duration: 18 months

8.3. National Initiatives

8.3.1. ANR Présage

Participants: Olivier Devillers, Marc Glisse, Ross Hemsley, Monique Teillaud, Rémy Thomasse.

- Acronym: Presage.

- Type: ANR blanc.

- Title: *méthodes PRobabilistes pour l'Éfficacité des Structures et Algorithmes GÉométriques*.

- Coordinator: Xavier Goaoc.

- Duration: 31 december 2011 - 31 december 2015.

- Other partners: Inria VEGAS team, University of Rouen.

- Abstract: This project brings together computational and probabilistic geometers to tackle new probabilistic geometry problems arising from the design and analysis of geometric algorithms and data structures. We focus on properties of discrete structures induced by or underlying random continuous geometric objects. This raises questions such as:

- What does a random geometric structure (convex hulls, tessellations, visibility regions...) look like?

- How to analyze and optimize the behavior of classical geometric algorithms on *usual* inputs?

- How can we generate randomly *interesting* discrete geometric structures?

- Year publications: [16], [31], [51].

8.3.2. ANR GIGA

Participants: Jean-Daniel Boissonnat, Frédéric Chazal, David Cohen-Steiner, Mariette Yvinec, Steve Oudot, Marc Glisse.

- Acronym : GIGA.

- Title : Geometric Inference and Geometric Approximation.

- Type: ANR blanc

- Coordinator: Frédéric Chazal (GEOMETRICA)

- Duration: 4 years starting October 2009.

- Others Partners: Inria team-project Titane, Inria team-project ABS, CNRS (Grenoble), Dassault Systèmes.

- Abstract: GIGA stands for Geometric Inference and Geometric Approximation. GIGA aims at designing mathematical models and algorithms for analyzing, representing and manipulating discretized versions of continuous shapes without losing their topological and geometric properties. By shapes, we mean sub-manifolds or compact subsets of, possibly high dimensional, Riemannian manifolds. This research project is divided into tasks which have Geometric Inference and Geometric Approximation as a common thread. Shapes can be represented in three ways: a physical representation (known only through measurements), a mathematical representation (abstract and continuous), and a computerized representation (inherently discrete). The GIGA project aims at studying the transitions from one type to the other, as well as the associated discrete data structures.

Some tasks are motivated by problems coming from data analysis, which can be found when studying data sets in high dimensional spaces. They are dedicated to the development of mathematically well-founded models and tools for the robust estimation of topological and geometric properties of data sets sampled around an unknown compact set in Euclidean spaces or around Riemannian manifolds.

Some tasks are motivated by problems coming from data generation, which can be found when studying data sets in lower dimensional spaces (Euclidean spaces of dimension 2 or 3). The proposed research activities aim at leveraging some concepts from computational geometry and harmonic forms to provide novel algorithms for generating discrete data structures either from mathematical representations (possibly deriving from an inference process) or from raw, unprocessed discrete data. We target both isotropic and anisotropic meshes, and simplicial as well as quadrangle and hexahedron meshes.

- See also: http://www-sop.inria.fr/geometrica/collaborations/giga/

8.3.3. ANR TOPDATA

Participants: Jean-Daniel Boissonnat, Frédéric Chazal, David Cohen-Steiner, Mariette Yvinec, Steve Oudot, Marc Glisse.

- Acronym : TopData.

- Title : Topological Data Analysis: Statistical Methods and Inference.

- Type : ANR blanc

- Coordinator : Frédéric Chazal (GEOMETRICA)

- Duration : 4 years starting October 2013.
- Others Partners: Département de Mathématiques (Université Paris Sud), Institut de Mathḿatiques (Université de Bourgoogne), LPMA (Université Paris Diderot), LSTA (Université Pierre et Marie Curie)

- Abstract: TopData aims at designing new mathematical frameworks, models and algorithmic tools to infer and analyze the topological and geometric structure of data in different statistical settings. Its goal is to set up the mathematical and algorithmic foundations of Statistical Topological and Geometric Data Analysis and to provide robust and efficient tools to explore, infer and exploit the underlying geometric structure of various data.

Our conviction, at the root of this project, is that there is a real need to combine statistical and topological/geometric approaches in a common framework, in order to face the challenges raised by the inference and the study of topological and geometric properties of the wide variety of larger and larger available data. We are also convinced that these challenges need to be addressed both from the mathematical side and the algorithmic and application sides. Our project brings together in a unique way experts in Statistics, Geometric Inference and Computational Topology and Geometry. Our common objective is to design new theoretical frameworks and algorithmic tools and thus to contribute to the emergence of a new field at the crossroads of these domains. Beyond the purely scientific aspects we hope this project will help to give birth to an active interdisciplinary community. With these goals in mind we intend to promote, disseminate and make our tools available and useful for a broad audience, including people from other fields.

8.4. European Initiatives

8.4.1. FP7 Projects

8.4.1.1. CG-Learning

Type: COOPERATION

Defi: FET Open

Instrument: Specific Targeted Research Project

Objectif: FET-Open: Challenging Current Thinking

Duration: November 2010 - October 2013

Coordinator: Friedrich-Schiller-Universität Jena (Germany)

Others partners: National and Kapodistrian University of Athens (Greece), Technische Universität Dortmund (Germany), Tel Aviv University (Israel), Eidgenössische Technische Hochschule Zürich (Switzerland), Rijksuniversiteit Groningen (Netherlands), Freie Universität Berlin (Germany)

Inria contact: Mariette Yvinec

See also: http://cgl.uni-jena.de/

Abstract: The Computational Geometric Learning project aims at extending the success story of geometric algorithms with guarantees to high-dimensions. This is not a straightforward task. For many problems, no efficient algorithm exist that compute the exact solution in high dimensions. This behavior is commonly called the curse of dimensionality. We try to address the curse of dimensionality by focusing on inherent structure in the data like sparsity or low intrinsic dimension, and by resorting to fast approximation algorithms.

8.5. International Initiatives

8.5.1. Inria Associate Teams

8.5.1.1. COMET

Title: Computational methods for the analysis of high-dimensional data

Inria principal investigator: Steve Y. Oudot

International Partner (Institution - Laboratory - Researcher):

Stanford University (United States) - Computer Science - Leonidas Guibas

Ohio State University (United States) - Computer Science and Engineering - Yusu Wang

Duration: 2011 - 2013

See also: http://geometrica.saclay.inria.fr/collaborations/CoMeT/index.html

CoMeT is an associate team between the Geometrica group at Inria, the Geometric Computing group at Stanford University, and the Computational Geometry group at the Ohio State University. Its focus is on the design of computational methods for the analysis of high-dimensional data, using tools from metric geometry and algebraic topology. Our goal is to extract enough structure from the data, so we can get a higher-level informative understanding of these data and of the spaces they originate from. The main challenge is to be able to go beyond mere dimensionality reduction and topology inference, without the need for a costly explicit reconstruction. To validate our approach, we intend to set our methods against real-life data sets coming from a variety of applications, including (but not restricted to) clustering, image or shape segmentation, sensor field monitoring, shape classification and matching. The three research groups involved in this project have been active contributors in the field of Computational Topology in the recent years, and some of their members have had long-standing collaborations. We believe this associate team can help create new synergies between these groups.

8.6. International Research Visitors

Mirel Ben Chen (Technion - Israel Institute of Technology)

Benjamin Burton (University of Queensland)

Pedro Machado Manhães de Castro (Universidade Federal de Pernambuco)

Arijit Ghosh (Indian Statistical Institute)

Michael Hemmer (University of Technology Braunschweig)

Dmitriy Morozov (Berkeley)

Yusu Wang (Ohio State University)

Jian Sun (Tsinghua University - China)

Yuan Yao (Peking University - China)

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

- ISN-Privacy. From late 2012 through the year 2013, Daniel Augot was heavily involved in the preparation of the *Institut de la société du numérique* (Digital Society Institute) proposal within IDEX Paris-Saclay. Led by N. Boujemaa, this proposal aims to be a catalyst for interdisciplinary research (involving computer scientists and researchers from the humanities) on societal challenges inherent to eLife/life digitization. The proposal has initial funding from the IDEX, and will hopefully be self-funding within three years. Two kick-off projects were defined: joint human & machine interaction, and privacy and digital identity.

  Daniel Augot engaged in monthly brainstorming meetings with researchers from Inria Paris–Rocquencourt (project-team SMIS), Université Jean Monnet's ADIS and CERDI labs (Alain Rallet, Alexandra Bensamoun), and Télécom ParisTech (Claire Levallois-Barth). Topics under discussion include terms of service of various cloud storage providers, SMIS's *TrustedCell* secure token initiative for helding private and secure personnal data, privacy leaks, and measurements on smartphones.

  A seminar will be held in Summer 2014. Within IDEX Paris-Saclay, the PAIP (Pour une Approche Interdisciplinaire de la Privacy) project was proposed and accepted in September 2013, with a small budget (30 keuros) for all the partners of the privacy group.

8.2. National Initiatives

8.2.1. ANR

- CATREL (accepted June 2012, Kickoff December 14, 2012, Starting January 1st, 2013): "Cribles: Améliorations Théoriques et Résolution Effective du Logarithme" (Sieve Algorithms: Theoretical Advances and Effective Resolution of the Discrete Logarithm Problem). This project aims to make effective "attacks" on reduced-size instances of the discrete logarithm problem (DLP). 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.

8.2.2. 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. Guillaume Quintin was hired as a postdoctoral researcher using this funding.
- Daniel Augot is co-advising Gwezheneg Robert with Pierre Loidreau (DGA, Rennes University).

8.2.3. PEPS ICQ (Projet Exploratoire de Premier Soutien - Information et Communication Quantique)

- ToCQ is a one-year project exploring the connections between algebraic topology, combinatorics, and Low Density Parity Check Quantum Codes. Alain Couvreur and Nicolas Delfosse are members of this project. The other partners are Inria Paris–Rocquencourt, Université Bordeaux I and Aix–Marseille Université.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: COST

Project acronym: COST 4175/11

Project title: Random Network Coding and Designs over GF(q) http://www.network-coding.eu/index.html

Duration: 04/2012 - 04/2016

Coordinator: Marcus Greferath

Other partners: Camilla Hollanti, Aalto University, Finland Simon R. Blackburn, Royal Holloway, University of London, UK Tuvi Etzion, Technion, Israel Ángeles Vázquez-Castro, Autonomous University of Barcelona, Spain Joachim Rosenthal, University of Zurich, Switzerland (Chairs of the five working groups).

Abstract: Random network coding emerged through an award-winning paper by R. Koetter and F. Kschischang in 2008 and has since then opened a major research area in communication technology with widespread applications for communication networks like the internet, wireless communication systems, and cloud computing. It allows transmitting information through a network by disregarding any of its topological features. Worldwide, there exists a larger number of workgroups focusing on this topic, which includes several groups located in Europe. This COST Action will set up a European research network and establish network coding as a European core area in communication technology. Its aim is to bring together experts from pure and applied mathematics, computer science, and electrical engineering, who are working in the areas of discrete mathematics, coding theory, information theory, and related fields.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- Martin Bossert, Institute of Communications Engineering, Ulm Universität.
- Steven Galbraith, Department of Mathematics, University of Auckland.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

- Charlotte Scribot is spending the period September 2013 - February 2014 as an intern with GRACE as part of her professional masters program (Paris 7). She is working with Benjamin Smith and François Morain on parameter selection for efficient elliptic curve cryptosystems.

GRAND-LARGE Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

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

6.2. National Initiatives

6.2.1. ANR

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

6.3. European Initiatives

6.3.1. Collaborations in European Programs, except FP7

Program: ITEA

Project acronym: MANY

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

Duration: 09/2011 - 08/2014

Coordinator: XDIN

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

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

6.4. International Initiatives

6.4.1. Inria International Labs

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

6.4.2. Participation In other International Programs

Stic AmSud: BioCloud-EEAmSud **Participants:**   Christine Eisenbeis, Alessandro Ferreira Leite, Claude Tadonki.

BioCloud-EEAmSud is a cooperation project integrated by Brazil, Chile and France following the 2012 STIC-AmSud call. Partners in Brazil are Universidade de Brasilia, Universidade Federal Fluminense, and EMBRAPA-Genetic Resources and Biotechnology (CENARGEN), through the support of the Coordination of Improvement of Senior Staff of the Ministry of Education in Brazil (CAPES). In Chile, the main partner is Universidad de Santiago de Chile, through the support of the National Commission for Scientific and Technological Research of Chile (CONICYT). In France, the institutions involved are Mines ParisTech (CRI) and Inria-Saclay, through the support of the Ministry of Foreign and European Affairs (MAEE). The international project coordinator is Pr. Maria Emília Machado Telles Walter (UnB). Alessandro Ferreira Leite' thesis work is a joint University of Brazilia - université Paris-Sud 11 thesis and is partially supported by BioCloud-EEAmSud. Maria Emilia Machado Telles Walter and Alba Cristian de Melo visited Grand-Large in 2013, as well as Taina Rajol.

6.5. International Research Visitors

6.5.1. Internships

German Schinca

> Subject: Minimizing communication in scientific computing
>
> Date: from Sep 2012 until Mar 2013
>
> Institution: University of Buenos Aires (Argentina)

IN-SITU Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

DigiPods - Remote Collaborative Interaction mong Heterogeneos Visualization Platforms, Région Île-de-France (2012-2015), Coordinator: Stéphane Huot. Partners: Digiteo/FCS Campus Paris-Saclay, Univ. Paris-Sud, Inria, CNRS, CEA, Telecom ParisTech. The goal of DIGIPODS is to design new interactive equipments and devices for collaborative interaction in immersive and high-resolution visualization platforms, connected through a high-end telepresence infrastructure. Beyond the usual interactive devices of such platforms (motion capture, interactive surfaces, haptic devices, audio and video systems), all the platforms will be augmented with new devices to facilitate co-located or remote interaction and collaboration: telepresence robots and the Digicarts, a new kind of interaction devices specifically designed for these needs. These equipments will be used by researchers in Human-Computer Interaction to explore the visualization and manipulation of large datasets, interaction in virtual reality, remote collaboration among heterogeneous platforms; but also by researchers from other fields and by professionals in order to explore and manipulate their complex data.

DigiCarts - Post-doctoral fellow position funded by Digiteo, Coordinator: Stéphane Huot. Partners: Univ. Paris-Sud, Inria, CNRS, CEA, Telecom ParisTech. Complements the DigiPods project with funding for a 18 months post-doctoral position focused on the design, implementation and evaluation of the Digicart devices.

DigiZoom - Funding by DIGICOSME Labex, Coordinator: Olivier Chapuis. Partners: U. Paris-Sud, Inria, Institut Mines-Telecom. Design, modeling and empirical evaluation of multi-scale navigation techniques depending on the input channels and output characteristics of the devices, in particular the size, in single-user and collaborative contexts.

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

DRAO – Adrien Bousseau (Inria, Sophia Antipolis) submitted a successful ANR grant with members from InSitu Theophanis 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.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. CREATIV

Type: IDEAS

Instrument: ERC Advanced Grant

Duration: June 2013 - May 2018

Coordinator: Wendy Mackay

Partner: Inria (France)

Inria contact: Wendy Mackay

Abstract: CREATIV explores how the concept of co-adaptation can revolutionize the design and use of interactive software. Co-adaptation is the parallel phenomenon in which users both adapt their behavior to the system's constraints, learning its power and idiosyncrasies, and appropriate the system for their own needs, often using it in ways unintended by the system designer. The initial goal of the CREATIV project is to fundamentally improve the learning and expressive capabilities of advanced users of creative software, offering significantly enhanced methods for expressing and exploring their ideas. The ultimate goal is to radically transform interactive systems for everyone by creating a powerful and flexible partnership between human users and interactive technology.

8.3.1.2. Social Privacy

Type: PEOPLE

Instrument: Marie Curie International Outgoing Fellowships for Career Development

Duration: September 2012 - August 2015

Coordinator: Wendy Mackay

Partner: Inria (France) and Massachusets Institute of Technology (USA)

Inria contact: Ilaria Liccardi

Abstract: Although users' right to privacy has long been protected, the rapid adoption of social media has surpassed society's ability to effectively regulate it. Today's users lack informed consent: they must make all-or-nothing decisions about on-line privacy regardless of context. The Social Privacy project will first diagnose the problem, exploring privacy issues associated with social media at the level of the individual, the enterprise and society, and then generate effective solutions, from providing users with technical safeguards and informed consent, to establishing corporate guidelines for protecting privacy, to developing and testing recommendations for public policy.

8.3.2. Collaborations in European Programs, except FP7

EIT ICT Labs Master School, European Institute of Technology. Coordinator: M. Beaudouin-Lafon. Partners: KTH (Sweden), U. Paris-Sud (France), U. Aalto (Finland), Technical University Berlin (Germany), Technical University Delft (Netherlands), U. College London (UK), U. Trento (Italy). InSitu participates in the Human-Computer Interaction and Design (HCID) major of the EIT ICT Labs European Master School. Paris-Sud is of the two sites for the first year of this Master Program, and host one of the specialties for second-year students. Students in this program receive a double degree after studying in two countries. https://www.dep-informatique.u-psud.fr/en/formation/lmd/M1_HCID.

8.3.3. Collaborations with Major European Organizations

VCoRE - Next-Generation Visual Computing Platform (ADT Inria, 2011-2014), Coordinator for InSitu: Stéphane Huot. Partners: Inria (Grenoble, Lille, Rennes, Saclay, Sophia Antipolis), IGD Fraunhofer Institute. Collaboration between Inria and IGD Fraunhofer Institute for the specification and development of a software framework dedicated to mixed/augmented/virtual reality and advanced visualization platforms (distributed computer graphics, simulation and interaction).

8.4. International Initiatives

8.4.1. Inria Associate Teams

SIRIUS, Situated Interaction Research, Associate Team between Inria, Stanford Univ. and UC San Diego. Scott Klemmer, Stanford Univ. and Jim Hollan, UC San Diego

Inria Silicon Valley allowed us to expand the scope of our work with Stanford and U.C. San Diego to include U.C. Berkeley (see below). Daniel Strazzula, a Master's student, was accepted as a Ph.D. student (Cordi grant), and Lora Oehlberg, a Ph.D. student, was accepted as a Post-Doc (Cordi Inria Silicon Valley) at InSitu. Members of InSitu went to Stanford and Berkeley for several week-long visits during the year. Volunteers from Berkeley, Stanford and U.C. San Diego were actively involved in the creation technology to support the CHI'13 conference in Paris, including the Interactive Schedule ([29]), author-sourcing [35]; the Video Previews, and the use of HydraScope to create CHIWall, for collaborative scheduling of the CHI'13 conference.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

BayScope - Architectures and Interaction Paradigms for Multi-surface Environments, NSF CNIC (Catalyzing New International Organizations) grant (2012-2013), Coordinator: Wendy Mackay. Partners: InSitu, Berkeley Institute of Design (BiD).

In the context of the 22m€ Digiscope project in France and corresponding projects at UCSD and Berkeley, we continued to work on BayScope, a strategy for creating novel applications for wall-size display and multisurface environments, by aggregating existing or new web-based applications. Prof. Bjoern Hartmann obtained support for this collaboration (NSF grant) that he secured for our collaboration. We developed HydraScope ([24]), a framework for transforming existing web applications into meta-applications that execute and synchronize multiple copies of applications in parallel, with a multi-user input layer for interacting with it, which was validated with five meta-applications.

8.4.3. Inria International Labs

CIRIC Chili (Emmanuel Pietriga & Claude Puech) – Publications on wall displays [27], mobile devices [31], [30] and focus+context navigation [28]. Thesis of C. Pindat.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

- Maria Jesus Lobo, Pontificia Universidad Católica de Chile. *Graphical interaction techniques for undo and redo*, January - March 2013, Caroline Appert & Olivier Chapuis.
- Iuliia Vlasenko, University of Alberta, Canada. *Interactive visualization of temporal data on wall-size display*, June - November 2013, Wendy Mackay.

<p align="center" style="color:red">M3DISIM Team</p>

7. Partnerships and Cooperations

7.1. Regional Initiatives

The team is part of the Mechanics and Living Systems Initiative (Opération Mécanique et Systèmes du Vivant), a joint operation – focused on biomechanical modeling – between the LadHyx and LMS labs (CNRS and Ecole Polytechnique), and Inria.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. VPH-Share

Title: VPH-Share

Type: COOPERATION

Defi: Towards sustainable and personalised healthcare

Instrument: Integrated Project

Objectif: Virtual Physiological Human

Duration: March 2011 - February 2015

Coordinator: Univ. Sheffield (UK)

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

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

Abstract: VPH-Share aims at developing the organisational fabric (the infostructure) and 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.

7.2.1.2. VP2HF

Title: Computer model derived indices for optimal patient-specific treatment selection and planning in Heart Failure

Type: COOPERATION

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

Instrument: Specific Targeted Research Project

Objectif: Virtual Physiological Human

Duration: October 2013 - September 2016

Coordinator: King's College London (UK)

Abstract: Heart failure (HF) is one of the major health issues in Europe affecting 6 million patients and growing substantially because of the ageing population and improving survival following myocardial infarction. The poor short to medium term prognosis of these patients means that, treatments such as cardiac re-synchronisation therapy and mitral valve repair can have substantial impact. However, these therapies, are ineffective in up to 50% of the treated patients and involve significant morbidity and substantial cost. The primary aim of VP2HF is to bring together image and data processing tools with statistical and integrated biophysical models mainly developed in previous VPH projects, into a single clinical workflow to improve therapy selection and treatment optimisation in HF.

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

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.

- Participation de Cormac Walsh au projet ANR FINSLER (Géométrie de Finsler et applications).

- Projet ANR CAFEIN (Combinaison d'approches formelles pour l'étude d'invariants numériques), responsable P.L. Garoche. Partenaires: ONERA, CEA LIST, ENSTA Paristech, Inria Saclay (Maxplus, Toccata, Parkas), Université de Perpignan, Prover, Rockwell Collins France.

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. Inria International Partners

8.2.1.1. Informal International Partners

Collaborations régulières dans le cadre des programmes internationaux ci-dessous, ainsi qu'avec:

- Ricardo Katz (Conicet et Cifasis, Argentine);

- Alexander Guterman (Moscow State University);

- Françoise Tisseur (Université de Manchester) qui participe à l'encadrement de la thèse d'Andrea Marchesini.

8.2.2. Participation In other International Programs

- La thèse de Pascal Benchimol est financée par une bourse Monge/DGA prévoyant des visites régulières du doctorant dans l'équipe de Michael Joswig (TU-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).

8.3. Accueils de chercheurs étrangers/International Research Visitors

8.3.1. Chercheurs étrangers/Visits of International Scientists

- Zur Izhakian, 2 jours en Fevrier.

- Srinivas Sridharan (University of California San Diego), 1 semaine en Mai.

- Ricardo Katz (Conicet, Rosario, Argentine), 2 mois en mars-avril, financé par PGMO.

- Alexander Guterman (Université d'état de Moscou), 5 jours en Septembre.

- Françoise Tisseur (Univ. Manchester), 4 jours en Janvier.

- James Hook (Univ. Manchester), 4 jours en Janvier et 4 jours en Octobre.
- Visite d'un jour de Maurizio Falcone (autour de la thèse de Zheng Qu).
- Visites d'un jour d'Yves Bertot, Didier Henrion, Monique Laurent, Markus Schweighofer, et de 4 jours de Thomas Hales (autour de la thèse de Victor Magron).

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

- P. Benchimol, visite à TU Darmstadt, décembre 2013 (1 semaine).
- A. Marchesini, séjour à l'Université de Manchester, avril 2013 (5 jours).
- M. Akian, séjour à l'Université de Manchester, avril 2013 (2 jours).
- X. Allamigeon, visite à TU Berlin, décembre 2013 (2 jours).

MEXICO Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. DIM/LSC TECSTES - 2011-052D

In this DIGITEO project (No. 6024), Hernán Ponce de Léon, Delphine Longuet (ParisSud) and Stefan Haar cooperate on the subject of conformance testing for concurrent systems, using Event Structures. The project started on September 1, 2011 and is scheduled to end on August 31, 2014.

7.1.2. LOCOREP

In the DIGITEO project LoCoReP (No. 2010-043D), Aiswarya Cyriac, Paul Gastin, and Benedikt Bollig worked on temporal logics for the specification and verification of concurrent recursive programs. The project started on September 1, 2010 and ended on August 31, 2013.

7.2. IRT

7.2.1. SystemX

Participants: Simon Theissing, Stefan Haar.

We participate in the project MIC on multi-modal transport systems with in the IRT *System X*, with academic partners UPMC, IFSTTAR and CEA, and several industrial partners including Alstom (project leader), COSMO and Renault.

7.3. National Initiatives

7.3.1. ANR project IMPRO

Participants: Thomas Chatain, Stefan Haar, Serge Haddad.

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

7.4. European Initiatives

7.4.1. FP7 Projects

7.4.1.1. Hycon2

> Type: COOPERATION
>
> Defi: Engineering of Networked Monitoring and Control Systems
>
> Instrument: Network of Excellence
>
> Objectif: Engineering of Networked Monitoring and Control systems
>
> Duration: September 2010 - August 2014
>
> Coordinator: CNRS
>
> Partner: ETH Zürich, TU Berlin, TU Delft and many others.
>
> Inria contact: C. Canudas de Wit
>
> Abstract: Hycon2 aims at stimulating and establishing a long-term integration in the strategic field of control of complex, large-scale, and networked dynamical systems. It focuses in particular on the domains of ground and aerospace transportation, electrical power networks, process industries, and biological and medical systems.

7.4.1.2. Univerself: realizing autonomics for Future Networks

> Type: COOPERATION
>
> Defi: The Network of the Future
>
> Instrument: Integrated Project
>
> Objectif: The Network of the Future
>
> Duration: September 2010 - August 2013
>
> Coordinator: Alcatel Lucent (France)
>
> Partner: UTwente, AL Ireland, AL Germany, VTT (Finland), U. of Piraeus, FT, Telecom Italia, NU of Athens, Fraunhofer, Interdic. Institue for Broadband Technology, Telefonica, Thales, Nec Europe, U. of Surrey, UCL, IBBT (Belgium)
>
> Inria contact: E. Fabre
>
> 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.

7.5. International Initiatives

7.5.1. Inria International Partners

7.5.1.1. Informal International Partners

> 1. The CMI (Chennai Mathematical Institute) is a long-standing partner of our team. The project *Île de France/Inde* in the *ARCUS* program from 2008 to 2011 has allowed several exchange visits between Cachan and Chennai, organizations of ACTS workshops with french and indian researchers in Chennai, internships in Cachan, and two theses in *co-tutelle* (Akshay Sundararaman, defended in 2010) and Aiswarya Cyriac (thesis in progress).
>
>   Currently, Paul Gastin is co-head (with Madhavan Mukund) of the CNRS International Associated Laboratory (LIA) INFORMEL (INdo-French FORmal Methods Lab, http://projects.lsv.ens-cachan.fr/informel/) . 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.

2. We have been exchanging visits for several years between *MExICo* and the DISCO team (Lucia Pomello and Luca Bernardinello) at University Milano-Bicocca, Italy.

3. Exchanges are frequent with Rolf Hennicker from LMU and Javier Esparza at TUM, both in Munich, Germany.

4. With the computer science and electrical engineering departments at Newcastle University, UK

7.5.2. Participation In Other International Programs (non-Inria)

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.

7.6. International Research Visitors

7.6.1. Visits of International Scientists

- Monika Heiner, Professor at University of Cottbus/Germany, visited *MExICo* from September 15 through October 15, 2013.

- Estibaliz Fraca, PhD student from Zaragossa, visited *MExICo* from november 2012 trough February 2013.

- From 7 to 19 January 2013, Paul Gastin and Aiswarya Cyriac (LSV) visit K. Narayan Kumar and Madhavan Mukund at CMI Chennai. They studied verification problems for concurrent and recursive multi-threaded programs.

- 13 May to 1 June 2013: Madhavan Mukund (CMI) visits LSV, IRISA.

- 8 to 29 June K. Narayan Kumar (CMI) visits LSV, LaBRI. The study verification problems for concurrent and recursive multi-threaded programs was pursued.

- 16 June to 30 June 2013: Saivasan Prakash (CMI) visits LSV and LIAFA. Discussions with Ahmed Bouajjani on Verification of networks of Communicating Recursive Processes. Joint work with M.F.Atig (Uppsala) and manuscript based on this work is under preparation.

- 25 May to 20 July 2013: Bharat Adsul (IIT Bombay) visits LSV and LaBRI to work on cascade products of asynchronous automata.

7.6.1.1. Internships

Gonzalo Amadio

Subject: Diagnosis of Stochastic Systems

Date: from Apr 2013 until Jul 2013

Institution: Universidad National de Rosario (Argentina)

Siddharth Krishna

Subject: Multiple Context Free Grammars

Date: from May 19, 2013 until June 15, 2013

Institution: Chennai Mathematical Institute, India

7.6.2. Visits to International Teams

- Thomas Chatain visited
  - Lucia Pomello and Luca Bernardinello at University of Milano-Bicocca for one week in February 2013,
  - Humboldt Universität Berlin for the KOSMOS-Workshop (November 28-30, 2013)

- 4 to 19 December 2013: Paul Gastin and Aiswarya Cyriac (LSV) visit CMI. With K. Narayan Kumar, they completed the study of verification problems via split-width for concurrent recursive multi-threaded programs (a paper is in preparation). With Madhavan Mukund, they started working on statistical analysis of asynchronous systems.

- Stefan Haar visited
    1. Technische Universitä Berlin in for five days in March 2013 and three days in November 2013 for seminar talks and technical cooperation,
    2. Humboldt Universität Berlin for the KOSMOS-Workshop (Nov. 28-30)
    3. University of Newcastle (UK) June 10-12 and Sep.16-20,
    4. Bucarest Polytechnic (RO) May 29 to June 1, giving a course on verification within the *CAN'TI* summer school, and
    5. University of Cordoba (Argentina) as an invited professor, from Oct 27 to Nov 1.
- Serge Haddad
- Hernán Ponce de Léon visited University of Cordoba (Argentina) for two weeks in October/November.
- César Rodríguez visited Victor Khomenko at the University of Newcastle for one week in May.
- Stefan Schwoon visited the group of Javier Esparza at the Technical University of Munich for two weeks in February.

OAK Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Data Warehousing for RDF (DW4RDF) is a 3-year project sponsored by the Digiteo foundation, between Inria and UNIV. PARIS-SUD. The project aims at defining and deploying a full framework for RDF data analytics, supporting its inherent structural heterogeneity and semantics, while at the same time providing powerful analytic tools for summarizing and analyzing the data. The project supports the PhD of Alexandra Roatiş.

7.2. National Initiatives

7.2.1. ANR

Apprentissage Adaptatif pour le Crowdsourcing Intelligent et l'Accès à l'Information (ALICIA) is a 3.5-year project, starting in February 2014, supported by the ANR CONTINT call. The project is coordinated by Bogdan Cautis, with Nicole Bidoit, Melanie Herschel, and Ioana Manolescu. Its goal is to study models, techniques, and the practical deployment of adaptive learning techniques in user-centric applications, such as social networks and crowdsourcing.

Cloud-Based Organizational Design (CBOD) is a 4-year project accepted by the ANR in 2013 and is currently under financial negotiation. The project is coordinated by prof. Ahmed Bounfour from UNIV. PARIS-SUD. Its goal is to study and model the ways in which cloud computing impacts the behavior and operation of companies and organizations, with a particular focus on the cloud-based management of data, a crucial asset in many companies.

Datalyse is funded for 3.5 years as part of the *Investissement d'Avenir - Cloud & Big Data* national program. The project is led by the Grenoble company Eolas, a subsidiary of Business & Decision. It is a collaboration with LIG Grenoble, U. Lille 1, U. Montpellier, and Inria Rhône-Alpes aiming at building scalable and expressive tools for Big Data analytics.

7.2.2. LabEx, IdEx

Structured, Social and Semantic Search is a 3-year project started in October 2013, financed by the *LabEx (Laboratoire d'Excellence)*DIGICOSME. The project aims at developing a data model for rich structured content enriched with semantic annotations and authored in a distributed setting, as well as efficient algorithms for top-k search on such content.

BizModel4Cloud is a one-year interdisciplinary research project funded under a *Projet Exploratoire Premier Soutien (PEPS)* call joint between the CNRS and the IdEx Paris Saclay. It reunites the same partners as the ANR CBOD project of which it is an initial, short version.

7.3. European Initiatives

7.3.1. Collaborations in European Programs, except FP7

Program: COST

Project acronym: Keystone

Project title: Semantic keyword-based search on structured data sources

Duration: Oct 2013 – Oct 2018

Coordinator: Francesco Guerra (U. Modena, Italy)

Other partners: The project involves 24 countries, see http://www.cost.eu/domains_actions/ict/Actions/IC1302?parties

Abstract: To build efficient and expressive keyword search tools, the action "semantic KEYword-based Search on sTructured data sOurcEs" (KEYSTONE) proposes to draw upon competencies from several disciplines, such as semantic data management, the semantic web, information retrieval, artificial intelligence, machine learning, user interaction, service science, service design, and natural language processing.

Program: KIC EIT ICT Labs "Computing in the Cloud" Action Line

Project acronym: Europa

Project title: Massively Parallel Data Management

Duration: Jan 2013 – Dec 2013

Coordinator: Volker Markl (TU Berlin, Germany)

Other partners: UNIV. PARIS-SUD (France), Aalto Univ (Finland), InternetMemory (France)

Abstract: Europa focuses on massively parallel algorithms and platforms for data management in the cloud. At TU Berlin, the Stratosphere open-source platform has been developed as part of this activity. At Inria and UNIV. PARIS-SUD, our work has focused on developing the AMADA platform for efficiently exploiting Web data in the Amazon cloud.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. OakSaD

Title: Languages and techniques for efficient large-scale Web data management

Inria principal investigator: Ioana Manolescu

International Partner (Institution - Laboratory - Researcher):

University of California San Diego (United States) - Computer Science and Engineering - Ioana Manolescu

Duration: 2013 - 2015

See also https://team.inria.fr/oak/oaksad/

Data on the Web is increasingly large and complex. The ways to process and share it have also evolved, from the classical scenario where users connect to a database, to today's complex processes whereas data is jointly produced on the Web, disseminated through streams, corroborated and enriched through annotations, and exploited through complex business processes, or workflows. The OAK and San Diego teams work together to devise expressive languages, efficient techniques and scalable platforms for such applications. The main areas on which our interest is shared are: semantic Web annotations; large-scale distributed data sharing; monitoring and verification of automated data processing workflows in the cloud.

7.4.2. Inria International Partners

7.4.2.1. Informal International Partners

We collaborate closely with TU Berlin within the Europa KIC EIT ICT Labs Europa project; A. Katsifodimos moved there for his post-doc after completing his PhD in OAK.

We have collaborated significantly with researchers from the University of Pisa and University of Basilicata [15], [16].

7.5. International Research Visitors

7.5.1. Visits of International Scientists

Participant: Stefano Ceri.

Date: September 2013

Institution: Politecnico di Milano, Italy.

Participant: Alin Deutsch.

Date: July-August 2013

Institution: UCSD, USA.

7.5.1.1. Internships

Damian Alexis Bursztyn

Subject: Take What You Need: Efficiently Querying Semantic Web Data

Date: from Mar 2013 until Aug 2013

Institution: University of Buenos Aires (Argentina).

Varun Malhotra

Subject: Task factorization for PACT programs on semistructured data

Date: from May 2013 until Aug 2013

Institution: IIT Delhi (India).

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Digiteo/DIM

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

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

This is a joint project with Select project team and with SUPELEC Sciences des Systèmes (E3S), Département Signaux & Systèmes Électroniques (A. Tennenhaus), 2010-2013.

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 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 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 [Correspondant], Benoit Da Mota.

ICOGEN : Intensive COmputing for GEnetic-Neuroimaging studies

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, 2012-2014.

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 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.

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, 2012-2015).

Cognitive tasks systematically involve several brain regions, and exploratory approaches are generally necessary given the lack of knowledge of the complex mechanisms that are observed. The goal of the project is to understand the neurobiological mechanisms that are involved in complex neuro-psychological disorders. A crucial and poorly understood component in this regard refers to the interaction patterns between different regions in the brain. In this project we will develop machine learning methods to capture and study complex functional network characteristics. We hypothesize that these characteristics not only offer insights into brain function but also can be used as concise features that can be used instead of the full dataset for tasks like classification of healthy versus diseased populations or for clustering subjects that might exhibit similarities in brain function. In general, the amount of correlation between distant brain regions may be a more reliable feature than the region-based signals to discriminate between two populations e.g. in schizophrenia. For such exploratory methods to be successful, close interaction with neuroscientists is necessary, as the salience of the features depends on the population and the observed effects of psychopathology. For this aim we propose to develop a number of important methodological advances in the context of prediction of treatment outcomes for drug addicted populations, 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/, 2010-2013.

Modeling and understanding brain structure is a great challenge, given the anatomical and functional complexity of the brain. 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 build an explicit statistical generative model of the observed data. Moreover, they make it possible 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. 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.

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

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

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.

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

- **Context:** The NiConnect project (2012-2016) arises from an increasing need of medical imaging tools to diagnose efficiently brain pathologies, such as neuro-degenerative and psychiatric diseases or lesions related to stroke. Brain imaging provides a non-invasive and widespread probe of various features of brain organization, that are then used to make an accurate diagnosis, assess brain rehabilitation, or make a prognostic on the chance of recovery of a patient. Among different measures extracted from brain imaging, functional connectivity is particularly attractive, as it readily probes the integrity of brain networks, considered as providing the most complete view on brain functional organization.

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

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

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

7.3. European Initiatives

7.3.1. HBP

Type: COOPERATION

Instrument: Collaborative Project with Coordination and Support Action

Objectif: NC

Duration: October 2013 - March 2016

Coordinator: EPFL, Lausanne

Partner: 86 partners, https://www.humanbrainproject.eu/fr/discover/the-community/partners;jsessionid=10vokilfkjcyhhgmfxu609p40

Inria contact: Olivier Faugeras

Abstract:

Understanding the human brain is one of the greatest challenges facing 21st century science. If we can rise to the challenge, we can gain profound insights into what makes us human, develop new treatments for brain disease and build revolutionary new computing technologies. Today, for the first time, modern ICT has brought these goals within sight.

Convergence of ICT and Biology The convergence between biology and ICT has reached a point at which it can turn the goal of understanding the human brain into a reality. This realisation motivates the Human Brain Project – an EU Flagship initiative in which over 80 partners will work together to realise a new "ICT-accelerated" vision for brain research and its applications.

One of the major obstacles to understanding the human brain is the fragmentation of brain research and the data it produces. Our most urgent need is thus a concerted international effort that uses emerging emerging ICT technologies to integrate this data in a unified picture of the brain as a single multi-level system.

Research Areas The HBP will make fundamental contributions to neuroscience, to medicine and to future computing technology.

In *neuroscience*, the project will use neuroinformatics and brain simulation to collect and integrate experimental data, identifying and filling gaps in our knowledge, and prioritising future experiments.

In *medicine*, the HBP will use medical informatics to identify biological signatures of brain disease, allowing diagnosis at an early stage, before the disease has done irreversible damage, and enabling personalized treatment, adapted to the needs of individual patients. Better diagnosis, combined with disease and drug simulation, will accelerate the discovery of new treatments, drastically lowering the cost of drug discovery.

In *computing*, new techniques of interactive supercomputing, driven by the needs of brain simulation, will impact a vast range of industries. Devices and systems, modelled after the brain, will overcome fundamental limits on the energy-efficiency, reliability and programmability of current technologies, clearing the road for systems with brain-like intelligence.

The Future of Brain Research

Applying ICT to brain research and its applications promises huge economic and social benefits. But to realise these benefits, the technology needs to be made accessible to scientists – in the form of research platforms they can use for basic and clinical research, drug discovery and technology development. As a foundation for this effort, the HBP will build an integrated system of ICT-based research platforms, building and operating the platforms will require a clear vision, strong, flexible leadership, long-term investment in research and engineering, and a strategy that leverages the diversity and strength of European research. It will also require continuous dialogue with civil society, creating consensus and ensuring the project has a strong grounding in ethical standards.

The Human Brain Project will last ten years and will consist of a ramp-up phase and a partially overlapping operational phase.

7.4. International Initiatives

7.4.1. 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.

7.4.2. Inria International Labs

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 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 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 is tightly linked to this project.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

Felipe Yanez made a three months internship (January-March 2013), funded by Inria Chile and Conycit. His research topic was *Improving the fit of functional MRI data through the use of sparse linear models*.

7.5.1.2. Other visitors

Danilo Bzdok (Forschungszentrum Jülich, institue of neuroscience and medicine) visited Parietal in September 2013, to develop collaborations on the use of machine learning techniques to model behavioral variables and find data-driven characterization of brain diseases.

7.5.2. Visits to International Teams

- Yannick Schwartz spent one month in University of Texas at Austin, in Poldrack's lab http://www.poldracklab.org/. This stay was an opportunity to improve our understanding of the main challenges in functional brain imaging modalities.
- Philippe Ciuciu spent two months in the Paul Sabatier University (Toulouse, france), as part of the CIMI labex, where he runs a collaboration on compressed sensing for MRI.

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

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 Projects

7.1.1.1. Proofcert
Participants: Hichem Chihani, Quentin Heath, Dale Miller [correspondant], Fabien Renaud.

Title: ProofCert: Broad Spectrum Proof Certificates

Duration: January 2012 - December 2016

Type: IDEAS

Instrument: ERC Advanced Grant

Coordinator: Dale Miller

Abstract: There is little hope that the world will know secure software if we cannot make greater strides in the practice of formal methods: hardware and software devices with errors are routinely turned against their users. The ProofCert proposal aims at building a foundation that will allow a broad spectrum of formal methods—ranging from automatic model checkers to interactive theorem provers—to work together to establish formal properties of computer systems. This project starts with a wonderful gift to us from decades of work by logicians and proof theorist: their efforts on logic and proof has given us a *universally accepted* means of communicating proofs between people and computer systems. Logic can be used to state desirable security and correctness properties of software and hardware systems and proofs are uncontroversial evidence that statements are, in fact, true. The current state-of-the-art of formal methods used in academics and industry shows, however, that the notion of logic and proof is severely fractured: there is little or no communication between any two such systems. Thus any efforts on computer system correctness is needlessly repeated many time in the many different systems: sometimes this work is even redone when a given prover is upgraded. In ProofCert, we will build on the bedrock of decades of research into logic and proof theory the notion of *proof certificates*. Such certificates will allow for a complete reshaping of the way that formal methods are employed. Given the infrastructure and tools envisioned in this proposal, the world of formal methods will become as dynamic and responsive as the world of computer viruses and hackers has become.

7.1.2. Collaborations in European Programs, except FP7

7.1.2.1. STRUCTURAL: ANR blanc International
Participants: Kaustuv Chaudhuri, Nicolas Guenot, Willem Heijltjes, Stefan Hetzl, Novak Novakovic, François Lamarche, Dale Miller, Lutz Straßburger.

Title: Structural and computational proof theory

Duration: 01/01/2011 – 31/12/2013

Partners:

University Paris VII, PPS (PI: Michel Parigot)

Inria Saclay–IdF, EPI Parsifal (PI: Lutz Straßburger)

University of Innsbruck, Computational Logic Group (PI: Georg Moser)

Vienna University of Technology, Theory and Logic Group (PI: Matthias Baaz)

Total funding by the ANR: 242 390,00 EUR (including 12 000 EUR pôle de compétivité: SYSTEMTIC Paris région)

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

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

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

7.2. International Initiatives

7.2.1. Inria Associate Teams

7.2.1.1. RAPT

Participants: Kaustuv Chaudhuri [correspondant], Dale Miller, Yuting Wang, Olivier Savary-Bélanger.

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: University of Minnesota (United States)

Laboratory: Department of Computer Science and Engineering

Researcher: Prof. Gopalan Nadathur

International Partner:

Institution: Carnegie Mellon University (United States)

Laboratory: Department of Computer Science

Researcher: Prof. Frank Pfenning

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. 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 neglected 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.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Chuck Liang (Professor from Hofstra University, NY, USA) visited for three weeks in May and June and another week in December.

Gopalan Nadathur (Professor from the University of Minnesota) visited for two weeks in May and June.

Elaine Pimentel (Associate Professor, UFRN, Brazil) for four weeks in June and July.

7.3.2. Internships

Olivier Savary-Bélanger (Masters, McGill University, Canada), supervised by Kaustuv Chaudhuri

7.3.3. Visits to International Teams

Fabien Renaud visited Gopalan Nadathur in Minneapolis for two weeks in February.

Dale Miller visited Alwen Tiu at the Australian National University in Canberra, Australia for onc week in May 2013.

Dale Miller visited Christof Benzmüller for one week in February.

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

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

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

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

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

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

- ANR project *RAFFINE: Robustesse, Automatisation et Fiabilité des Formulations INtégrales en propagation d'ondes : Estimateurs a posteriori et adaptivité* Partners: CERFACS, EADS, IMACS, ONERA, Thales
  Start : January 2013. End : december 2016. Administrator : Inria. Coordinator: Marc Bonnet.

- ANR project *ARAMIS: Analyse de méthodes asymptotiques robustes pour la simulation numérique en mécaniques* Partners: Université de Pau, Université technologique de Compiègne
  Start : january 2013. End : december 2016. Administrator : Université de Pau. Participants for POEMS: Marc Bonnet

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 Project : 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)

See also: http://cordis.europa.eu/fetch?CALLER=PROJICT&ACTION=D&CAT=PROJ&RCN=99653

8.3. International Research Visitors

8.3.1. Visits of International Scientists

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

Popix Team

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.

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

8. Partnerships and Cooperations

8.1. National Initiatives

Erick Herbin is member of the CNRS Research Groups:

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

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

- Regularity collaborates with Bar Ilan university on theoretical developments around set-indexed fractional Brownian motion and set-indexed Lévy processes. The PhD thesis of Alexandre Richard is co-supervised by Erick Herbin and Ely Merzbach.
- Regularity collaborates with Michigan State University (Prof. Yimin Xiao) on the study of fine regularity of multiparameter fractional Brownian motion.
- 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.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Ely Merzbach (Bar-Ilan University) visited the team for one month.

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

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- ANR programme blanc CPP ("Confidence, Probability, and Proofs"), 2009-April 2013. 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 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/.

- Inria-DGA contract, on evaluation of the Orchids tool. This is a 3-year contract, starting in April 2013, on the evaluation and improvement of the Orchids intrusion detection tool. The actual contents of the contract is not public.

7.2. International Initiatives

7.2.1. Inria International Partners

7.2.1.1. Informal International Partners

- Mark D. Ryan, U. Birmingham
- Alwen Tiu, Australian National University
- Achim Jung, U. Birmingham
- Frédéric Mynard, Georgia Southern University
- Roberto Segala, U. Verona
- Dominique Unruh, U. Tallinn

7.2.2. Participation In other 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 targeted applications are Online Social Networks, Location Based Services, and Electronic Health Record Systems.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- Dominique Unruh, Tallinn, 1 month, January 2013.
- Mark Ryan, Birmingham, 2 weeks, July 2013.
- Achim Jung, Birmingham, 1 month, April-May 2013.

7.3.1.1. Internships

Stéphanie Delaune et David Baelde co-supervised the following master student:

- Lucca Hirschi, ENS Lyon, "Réduction d'ordre partiel pour les propriétés d'équivalence", 2013.

Jean Goubault-Larrecq supervised the following L2 student:

- Jean-Philippe Lachance, U. Laval, Québec, "Evaluation automatique de la complexité de détection des signatures Orchids", 2013.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

SELECT is animating a working group on model selection and statistical analysis of genomics data with the Biometrics group of AgroParisTech.

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.

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

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 Bologna (Italy).

Specfun Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Project *Coquelicot*, funded jointly by the Fondation de Coopération Scientifique "Campus Paris-Saclay" and Digiteo.
  Goal: Create a new Coq library for real numbers of mathematics.
  Leader: S. Boldo (INRIA Saclay, Toccata). Participant: A. Mahboubi.
  Website: http://coquelicot.saclay.inria.fr/.

8.2. National Initiatives

8.2.1. ANR

- *Psi* (ANR-09-JCJC-0006).
  Duration: 2009-2013. Goal: Proof-Search control in Interaction with domain-specific methods.
  Coordinator: Stéphane Lengrand (CNRS, LIX).
  Participant: A. Mahboubi.
  Website: http://www.lix.polytechnique.fr/~lengrand/PSI/.
- *ParalITP* (ANR-11-INSE-001).
  Goal: Improve the performances and the ergonomics of interactive provers by taking advantage of modern, parallel hardware.
  Leader: B. Wolff (University of Orsay, Paris XI). Participants: A. Mahboubi, E. Tassi.

8.2.2. Other

- PEPS Grant *Holonomix*.
  Goal: Asymptotics of special functions arising in physics, computer science, and number theory.
  Leader: Cyril Banderier (CNRS, LIPN). Participant: A. Bostan, F. Chyzak.
  Website: http://www.cnrs.fr/ins2i/spip.php?article143.

8.3. European Initiatives

8.3.1. FP7 Projects

- *Formalisation of Mathematics* (*ForMath*, EU FP7 STREP FET-open project).
  Partners: University of Gothenburg (Sweden); Radboud University Nijmegen (The Netherlands); Inria (France); Universidad de La Rioja (Spain).
  Goal: Investigate how recent advances in the methodology and design of computer-checked libraries of formalized mathematics apply to so-far-unexplored areas of mathematics, like real analysis or certified efficient computations.
  Leader: Th. Coquand (University of Gothenburg, Sweden). Participant: A. Mahboubi (work package leader for WP1).
  Website: http://wiki.portal.chalmers.se/cse/pmwiki.php/ForMath/ForMath.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **TIMCO** – 2012-2015 (432kEuros for TAO). Technology for In Memory Computing. A NUMA architecture with very large memory. FUI project, Coodinator Bull SA, WP *Algorithm adaptation: the paradigm shif* coordinator Cécile Germain.

8.2. National Initiatives

- **ASAP** – 2009-2013 (178 kEuros). *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 kEuros). Including Ontologies in Monte-Carlo Tree Search and Applications, ANR international project coordinated by O. Teytaud (TAO, Inria).
  Participants: Adrien Couëtoux, O. Teytaud.

- **DESCARWIN** – 2010-2013 (201 kEuros). Coordinateur P. Savéant, Thalès R&T.
  Participants: Mostepha-Redouane Khouadjia, Marc Schoenauer.

- **SIMINOLE** – 2010-2014 (1180kEuros, 250kEuros for TAO). Large-scale simulation-based probabilistic inference, optimization, and discriminative learning with applications in experimental physics, ANR project, Coordinator B. Kégl (CNRS LAL).

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

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

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

8.2.1. Other

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

8.3. European Initiatives

8.3.1. FP7 Projects

- **SYMBRION**

  Type: COOPERATION (Integrated Project)

  Program: Embedded systems design

  Instrument: Integrated Project

  Objective: FET proactive: Pervasive adaptation

  Duration: February 2008 - July 2013

Coordinator: Sergey Kornienko and Paul Levi, Stuttgart University (Germany).

Partners: Universität Stuttgart (USTUTT), Universität Graz (IZG), Vrije Universiteit (VU), Universität Karlsruhe (UNIKARL), Flanders Institute for Biotechnology (VIB), University of the West of England, Bristol (UWE), Eberhard Karls Universität Tübingen (UT), University of York (UY), Université Libre de Bruxelles (CENOLI), and Inria-TAO.

Inria contact: M. Schoenauer

Abstract: SYMBRION, an FP7 IP (Integrated Project), involving 10 partners from Robotics (Electronics and Mechanics), Evolutionary Biology, and Computer Science (working on bio-inspired complex systems). Integrating hardware and software design, Symbrion IP aims at designing autonomous swarm robots. The software will involve both time-scales of evolutionary learning and on-line learning, in direct connection with TAO research themes.

- **CitInES**

  Type: COOPERATION (STREP)

  Program: Design of a decision support tool for sustainable, reliable and cost-effective energy strategies in cities and industrial complexes

  Instrument: Specific Targeted Research Project

  Objective: ICT systems for energy efficiency

  Duration: October 2011 - March 2014

  Coordinator: Artelys (SME)

  Other Partners: AIT (Austria), INESC Porto (Portugal), ARMINES (France), Schneider Electric SAS (France), Comune di Cesena (Italy), Comune di Bologna (Italy), TUPRAS (Turkey), ERVET (Italy)

  Inria contact: Olivier Teytaud

  Abstract: The overall objective of CitInES is to design and demonstrate a multi-scale multi-energy decision-making tool to optimise the energy efficiency of cities or large industrial complexes by enabling them to define sustainable, reliable and cost-effective long-term energy strategies. Demonstrations will take place in two cities in Italy, Cesena and Bologna, and in one oil refinery in Turkey, Tupras. Innovative energy system modelling and optimization algorithms will be designed to allow end-users to optimize their energy strategy through detailed simulations of local energy production, storage, transport, distribution and consumption, including demand side management and coordination functionalities enabled by smart grid technologies. All energy vectors (electricity, gas, heat...), usages (heating, air conditioning, lighting, transportation...) and sectors (residential, industrial, tertiary, urban infrastructure) will be considered to draw a holistic map of the city/industry energy behaviour. Energy strategy analyses will encompass advanced long-term risk analysis. As economic and technical situations are constantly evolving, a relevant energy strategy should be robust to different prospective scenarios. Hence, a diversified energy portfolio will allow city and industry authorities to react more efficiently to fuel price stresses and to decrease their exposition to a given energy solution. The expected impacts on end-users are threefold : 1) to assess the economic and environmental impacts of urban planning scenarios in terms of energy; 2) to optimise their local energy strategy to cost-effectively reduce CO_2 emissions, including usage of local renewable energies, electric mobility integration, multi-energy coordination, smart grid integration and demand-side management; and 3) to assess financial and environmental long-term risks and propose robust energy schemes to face fuel and CO_2 price uncertainties. The developed software will also be used as a communication tool for end-users to facilitate consultations between actors and to promote local authority decisions towards citizens. CitInES methodology will be demonstrated by optimizing long-term energy strategies for the two partner cities and for the partner oil refinery. The proposed strategies will be assessed and compared to initial end-user strategies to measure energy and CO_2 emission savings.

- **EGI**

  Program: Collaborative Project and Coordination and Support Action (CP-CSA)

  Project acronym: EGI-Inspire

  Project title: European Grid Infrastructures

  Duration: May 2010 - April 2014

  Coordinator: Steven Newhouse EGI.eu

  Other Partners: 40 in Europe and 8 more worldwide (details on http://www.egi.eu)

  Inria contact: Cécile Germain

  Abstract: Collaborative effort involving more than 50 institutions in over 40 countries. Its mission is to establish a sustainable European Grid Infrastructure (EGI). EGI-InSPIRE is ideally placed to join together the new Distributed Computing Infrastructures (DCIs) such as clouds, supercomputing networks and desktop grids, for the benefit of user communities within the European Research Area.

- **Network of Excellence PASCAL**

  Type: COOPERATION (FP7)

  Program: Pattern Analysis, Statistical Modelling and Computational Learning

  Instrument:

  Objective: PASCAL is a Network of Excellence funded by the European Union. It has established a distributed institute that brings together researchers and students across Europe, and is now reaching out to countries all over the world.

  Duration: March 2008 - July 2013

  Coordinator: John Shawe-Taylor, (Scientific coordinator), University College London, UK and Steve Gunn (Operational), University of Southampton, UK

  Other Partners:

  Inria contact: Michèle Sebag

  Abstract: PASCAL is developing the expertise and scientific results that will help create new technologies such as intelligent interfaces and adaptive cognitive systems. To achieve this, it supports and encourages collaboration between experts in Machine Learning, Statistics and Optimization. It also promotes the use of Machine Learning in many relevant application domains such as Machine vision, Speech, Haptics, Brain-Computer Interface, User-modeling for computer human interaction, Multimodal integration, Natural Language Processing, Information Retrieval, Textual Information Access.

- **MASH**

  Program: Investigation of the design of complex learning systems to increase the performance of artificial intelligence

  Project acronym: MASH

  Project title: Massive Sets of Heuristics

  Duration: October 2010 - June 2013

  Coordinator: Idiap Research Institute (Martigny, Switzerland)

  Other Partners: Heudiasyc laboratory (CNRS and UTC, Compiègne, France), University of Potsdam (Germany), Center for Machine Perception of the Czech Technical University, Pragua.

  Inria contact: Olivier Teytaud

Abstract: The goal of the MASH project is to create new tools for the collaborative development of large families of feature extractors. It aims at starting a new generation of learning software with great prior model complexity. The project is structured around this web platform. It comprises collaborative tools, such as a wiki-based documentation and a forum, and an experiment center to run and analyze experiments continuously. The applications targeted by the project are classical vision problems, and goal-planning in a 3D video game and with a real robotic arm. The scientific issues to be tackled along the course of the project are numerous, from standard Machine Learning questions such as learning and prediction with very large feature spaces and tight computational constraints, to original problems related to clustering in a functional space.

8.3.2. Collaborations in European Programs, except FP7

Program: COST

Project acronym:IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: January 2009 - May 2013

Coordinator:Jean-Marc Pierson IRIT

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

Abstract: The COST Action IC0804 proposes realistic energy-efficient alternate solutions to share IT distributed resources. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, a complementary approach is necessary at the distributed system level, i.e., middleware, network and applications. The Action characterizes the energy consumption and energy efficiencies of these components.

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: National University of Tainan (Taiwan)

Duration: 2012 - 2014

See also: http://www.lri.fr/~teytaud/taiwanday2.html

The objectives of the project are threefolds:

- Objective 1: Designing consistent iterative realistic algorithms for partially observable 1-player or 2-player games. We mean:
  d • 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.

- 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.

- Objective 3: Big industrial applications. Having both mathematics and visible realizations 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 ?eld of energy generation, we have seen that many problems are simpli?ed 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 ?eld 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.

Some continuously updated and more detailed descriptions of several works in progress can be found at http://www.lri.fr/~teytaud/indema.html.

8.4.2. Inria International Partners

- On-going collaboration with Christian Schulte (KTH, Stockholm), one of the main developers of the GECODE Constraint Programming platform (see Section 6.2).

- Shinshu University, Faculty of Engineering, project *Global Research on the Framework of Evolutionary Solution Search to Accelerate Innovation*, from the "Strategic Young Researcher Overseas Visits Program for Accelerating Brain Circulation" program, in which TAO and DOLPHIN (Inria Lille) are partner labs and will host Japanese students in the forthcoming 4 years.

8.4.3. Inria International Labs

Olivier Teytaud, 10 days in Inria Chile: meetings with several companies and institutes. They were followed by video-conferences with Endesa and email discussions between our partner Artelys and Cedec-Sing.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Visit of a Taiwanese delegation, about power systems and E-learning mainly; more information at http://www.lri.fr/~teytaud/france2013.html. Contact: O. Teytaud.

- Visit of a delegation of Shinshu University, Faculty of Engineering, inuding Dr. Miura (University Trustee and VP), Dr. Tanaka, coordinator of the *Global Research on the Framework of Evolutionary Solution Search to Accelerate Innovation* project (see above).

8.5.2. Visits to International Teams

- **Olivier Teytaud**, invited research fellow, National Dong Hwa University, 4.5 months, 2013.

TOCCATA Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Coquelicot*

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

Coquelicot is a 3 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 [100], [68][35], [45]. This is sorely needed to ease the verification of numerical applications, especially those involving advanced mathematics.

Partners: LIX (Palaiseau), University Paris 13

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 [107]. 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 develops and maintains *Atelier B* and the OCamlPro start-up.

8.2.2. *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).

8.2.3. *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 Why3 VC generator.

The results of that project are the basis of SPARK2014, the next generation of the SPARK.

This project was 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. *FP7 Projects*

Project acronym: ERC Deepsea

Project title: Parallel dynamic computations

Duration: Jun. 2013 - Jun. 2018

Coordinator: Umut A. Acar

Other partners: Carnegie Mellon University

Abstract:

The objective of this project is to develop abstractions, algorithms and languages for parallelism and dynamic parallelism with applications to problems on large data sets. Umut A. Acar (affiliated to Carnegie Mellon University and Inria) is the principal investigator of this ERC-funded project. The other researchers involved are Mike Rainey (Inria, Gallium team), who is full-time on the project, and Arthur Charguéraud (Inria, Toccata team), who works 40% of his time to the project. Project website: http://deepsea.inria.fr/.

8.3.2. *Collaborations in European Programs, except FP7*

Project acronym: JsCert

Project title: Certified JavaScript

Duration: Oct. 2011 - ...

Other partners: Imperial College and Inria Rennes – Bretagne Atlantique (Celtique project).

Abstract: This project aims at providing a formal semantics to the JavaScript language. It is joint work with Philippa Gardner, Sergio Maffeis, Gareth Smith, Daniele Filaretti and Daiva Naudziuniene from Imperial College, Alan Schmitt and Martin Bodin from Inria Rennes – Bretagne Atlantique, and Arthur Charguéraud from Inria Saclay –Île-de-France. Project website: http://jscert.org.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- S. Conchon, A. Mebsout and F. Zaidi (VALS group, LRI) collaborate with S. Krstic and A. Goel (Intel Strategic Cad Labs in Hillsboro, OR, USA), in particular around the development of the SMT-based model checker Cubicle (see above). This collaboration is partly supported by an academic grant by Intel.

8.4.2. Participation In other 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".