



RESEARCH CENTER  
Saclay - Île-de-France

FIELD

Activity Report 2015

# Section Partnerships and Cooperations

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## COMETE Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### 8.1.1. Large-scale initiatives

Project acronym: CAPPRIS

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

Duration: September 2013 - September 2016

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.

## 8.2. European Initiatives

### 8.2.1. FP7 & H2020 Projects

#### 8.2.1.1. 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 Tecnológico de Buenos Aires, AR. Universidad Nacional de Río 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).

## 8.3. International Initiatives

### 8.3.1. Inria-MSR joint lab

#### 8.3.1.1. Privacy-Friendly Services and Apps

Title: Privacy-Friendly Services and Applications

Inria principal investigator: Catuscia Palamidessi

International Partners:

Cedric Fournet, Microsoft Research Lab, Cambridge, UK

Andy Gordon, Microsoft Research Lab, Cambridge, UK

Duration: 2014 - 2016

URL: <http://www.msr-inria.fr/projects/privacy-friendly-services-and-apps/>

Abstract: This is a project sponsored by Microsoft Research Lab, on methods to preserve privacy in web services and location-based services.

### **8.3.2. Inria Associate Teams**

#### **8.3.2.1. PRINCESS**

Title: Protecting privacy while preserving data access

Inria principal investigator: Catuscia Palamidessi

International Partners:

Geoffrey Smith, Florida International University (United States)

Carroll Morgan, NICTA (Australia)

Annabelle McIver, Maquarie University (Australia)

Duration: 2013 - 2015

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.

### **8.3.3. Inria International Partners**

#### **8.3.3.1. Informal International Partners**

Moreno Falaschi, Professor, University of Siena, Italy

Mario Ferreira Alvim Junior, Assistant Professor, Federal University of Minas Gerais, Brazil

Charles Carroll Morgan, Professor, University of New South Wales, Australia

Daniel Gebler, PhD student at the Free University of Amsterdam, The Netherlands

Camilo Rueda, Professor, Universidad Javeriana Cali, Colombia

### **8.3.4. Participation In other International Programs**

#### **8.3.4.1. PACE**

Program: ANR Blanc International

Project title: Beyond plain Processes: Analysis techniques, Coinduction and Expressiveness

Duration: January 2013 - December 2016

URL: <http://perso.ens-lyon.fr/daniel.hirschhoff/pace/>

Coordinator: Daniel Hirschhoff, 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.

#### 8.3.4.2. LOCALI

Program: ANR Blanc International

Project title: Logical Approach to Novel Computational Paradigms

Duration: January 2012 - December 2016

URL: <http://www.agence-nationale-recherche.fr/?Project=ANR-11-IS02-0002>

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 Beijing (China).

Abstract: This project aims at exploring the interplays between logic and sequential/distributed computation in formalisms like the lambda calculus and the  $\pi$  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.

#### 8.3.4.3. MUSICAL

Program: CNPq Science Without Borders.

Project title: Music and Spatial Interaction with Constraints, Algebra and Logic: Foundations and Applications.

Duration: Oct 2014 - Oct 2016

URL: <http://cic.puj.edu.co/~caolarte/musical/Musical/Welcome.html>

Coordinator: Elaine Pimentel, Universidade Federal do Rio Grande do Norte (Brazil),

Other PI's and partner institutions: Camilo Rueda, PUJ Cali (Colombia). Carlos Olarte, Universidade Federal do Rio Grande do Norte (Brazil). Frank Valencia, CNRS-LIX and Inria Saclay (France). Gerard Assayag, IRCAM (France).

Abstract: This multi-disciplinary project aims to develop and integrate tools from logic and concurrency theory for the design and analysis of reactive systems and to their application to musical processes and multimedia systems.

## 8.4. International Research Visitors

### 8.4.1. Visits of International Scientists

Santiago Quintero, Undergraduate Student, Universidad Javeriana Cali, Colombia, Nov 2015 to Dec 2015

Camilo Rueda, Professor, Universidad Javeriana Cali, Colombia, Nov 2015 to Dec 2015

Mario Ferreira Alvim Junior, Assistant Professor, Federal University of Minas Gerais, Brazil, Dec 2015

Annabelle McIver, Associate Professor, Macquarie University, Australia, Dec 2015

Carroll Morgan, Professor, University of New South Wales and NICTA, Australia, Dec 2015

Geoffrey Smith, Professor, Florida International University, USA, Dec 2014

### 8.4.2. Visits to International Teams

Frank Valencia visited the team of Camilo Rueda (AVISPA) at Pontifical Universidad Javeriana Cali, from Feb 2015 until Feb 2015

Frank Valencia visited the team of Camilo Rueda (AVISPA) at Pontifical Universidad Javeriana Cali, from July 2015 until July 2015

## GEOMETRICA Project-Team

# 9. Partnerships and Cooperations

## 9.1. National Initiatives

### 9.1.1. ANR *Présage*

**Participants:** Marc Glisse, Rémy Thomasse.

- Acronym: *Présage*.
- 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?

### 9.1.2. ANR *TOPDATA*

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

- Acronym : TopData.
- Type : ANR blanc.
- Title : Topological Data Analysis: Statistical Methods and Inference.
- Coordinator : Frédéric Chazal (GEOMETRICA).
- Duration : 4 years starting October 2013.
- Others Partners: Département de Mathématiques (Université Paris Sud), Institut de Mathématiques (Université de Bourgogne), LPMA (Université Paris Diderot), LSTA (Université Pierre et Marie Curie).
- Abstract: TopData aims at designing new mathematical frameworks, models and algorithmic tools to infer and analyze the topological and geometric structure of data in different statistical settings. Its goal is to set up the mathematical and algorithmic foundations of Statistical Topological and Geometric Data Analysis and to provide robust and efficient tools to explore, infer and exploit the underlying geometric structure of various data.

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

- See also: <http://geometrica.saclay.inria.fr/collaborations/TopData/Home.html>

## 9.2. European Initiatives

### 9.2.1. FP7 & H2020 Projects

#### 9.2.1.1. ERC GUDHI

Title: Algorithmic Foundations of Geometry Understanding in Higher Dimensions.

Program: FP7.

Type: ERC.

Duration: February 2014 - January 2019.

Coordinator: Inria.

PI: Jean-Daniel Boissonnat.

'The central goal of this proposal is to settle the algorithmic foundations of geometry understanding in dimensions higher than 3. We coin the term geometry understanding to encompass a collection of tasks including the computer representation and the approximation of geometric structures, and the inference of geometric or topological properties of sampled shapes. The need to understand geometric structures is ubiquitous in science and has become an essential part of scientific computing and data analysis. Geometry understanding is by no means limited to three dimensions. Many applications in physics, biology, and engineering require a keen understanding of the geometry of a variety of higher dimensional spaces to capture concise information from the underlying often highly nonlinear structure of data. Our approach is complementary to manifold learning techniques and aims at developing an effective theory for geometric and topological data analysis. To reach these objectives, the guiding principle will be to foster a symbiotic relationship between theory and practice, and to address fundamental research issues along three parallel advancing fronts. We will simultaneously develop mathematical approaches providing theoretical guarantees, effective algorithms that are amenable to theoretical analysis and rigorous experimental validation, and perennial software development. We will undertake the development of a high-quality open source software platform to implement the most important geometric data structures and algorithms at the heart of geometry understanding in higher dimensions. The platform will be a unique vehicle towards researchers from other fields and will serve as a basis for groundbreaking advances in scientific computing and data analysis.'

## 9.3. International Initiatives

### 9.3.1. CATS

Title: Computations And Topological Statistics.

International Partner (Institution - Laboratory - Researcher):

Carnegie Mellon University (United States) - Department of Statistics - Larry Wasserman

Start year: 2015.

See also: <http://geometrica.saclay.inria.fr/collaborations/CATS/CATS.html>

Topological Data Analysis (TDA) is an emergent field attracting interest from various communities, that has recently known academic and industrial successes. Its aim is to identify and infer geometric and topological features of data to develop new methods and tools for data exploration and data analysis. TDA results mostly rely on deterministic assumptions which are not satisfactory from a statistical viewpoint and which lead to a heuristic use of TDA tools in practice. Bringing together the strong expertise of two groups in Statistics (L. Wasserman's group at CMU) and Computational Topology and Geometry (Inria Geometrica), the main objective of CATS is to set-up the mathematical foundations of Statistical TDA, to design new TDA methods and to develop efficient and easy-to-use software tools for TDA.



## **9.4. International Research Visitors**

### **9.4.1. Visits of International Scientists**

Ramsay Dyer (University of Groningen), May  
Arijit Ghosh (MPII, Saarbrücken), June-July  
Clément Maria (Queen's College, Brisbane), June  
Omer Brobowski (Duke University), May  
Jessica Cisewski (Carnegie Mellon), October  
Jisu Kim (Carnegie Mellon), May-July  
Yanir Kleiman (Tel Aviv University), October  
Bertrand Michel (Paris 6), 2015  
Jan Felix Senge (Bremen), October  
Primoz Skraba (Jozef Stefan Institute), May  
Kelly Spendlove (Rutgers), May-July  
Jian Sun (Tsinghua), February  
Justin Solomon (Stanford), February

#### *9.4.1.1. Internships*

Sivaprasad Sudhir (IIT Bombay), June-July  
Stéphane Lundy (Supélec), July-August  
Siargey Kachanovich (ENS Rennes), March-August  
Anatole Moreau (EPITA), May-August  
Tullia Padellini (Roma University), May-September  
Yuping Ren (Erasmus), January-July

### **9.4.2. Visits to International Teams**

#### *9.4.2.1. Research stays abroad*

- + Steve Oudot spent 1 month in July-August in the group of Benjamin Burton at the Pure Maths Department of University of Queensland, Australia.

## GRACE Project-Team

# 9. Partnerships and Cooperations

## 9.1. Regional Initiatives

### 9.1.1. PEPS Aije-bitcoin

Within the group PAIP (Pour une Approche Interdisciplinaire de la Privacy), D. Augot presented the cryptographic and peer-to-peer principles at the heart of the Bitcoin protocol (electronic signature, hash functions, and so on). Most of the information is publicly available: the history of all transactions, evolution of the source code, developers' mailing lists, and the Bitcoin exchange rate. It was recognized by the economists in our group that such an amount of data is very rare for an economic phenomenon, and it was decided to start research on the history of Bitcoin, to study the interplay between the development of protocol and the development of the economical phenomenon.

The project **Aije-Bitcoin** (analyse informatique, juridique et économique de Bitcoin) was accepted as interdisciplinary research for a PEPS (Projet exploratoire Premier Soutien) cofunded by the CNRS and Université de Paris-Saclay. This one-year preliminary program will enable the group to master the understanding of Bitcoin from various angles, allowing more advanced research in the following years.

Two M2 interns, Loïs Saublet and Kofi Manful, have been hired, located in Aviz team, and D. Augot co-supervised them with Petra and Tobias Isenberg.

### 9.1.2. IDEALCODES

Idealcodes is a two-year Digiteo research project, started in October 2014. The partners involved are the École Polytechnique (X) and the Université de Versailles–Saint-Quentin-en-Yvelines (Luca de Feo, UVSQ). After hiring J. Nielsen the first year, we have hired V. Ducet for the second year, both working at the boundary between coding theory, cryptography, and computer algebra

Idealcodes spans the three research areas of algebraic coding theory, cryptography, and computer algebra, by investigating the problem of lattice reduction (and root-finding). In algebraic coding theory this is found in Guruswami and Sudan's list decoding of algebraic geometry codes and Reed–Solomon codes. In cryptography, it is found in Coppersmith's method for finding small roots of integer equations. These topics were unified and generalised by H. Cohn and N. Heninger [33], by considering algebraic geometry codes and number field codes under the deep analogy between polynomials and integers. Sophisticated results in coding theory could be then carried over to cryptanalysis, and vice-versa. The generalized view raises problems of computing efficiently, which is one of the main research topics of Idealcodes.

## 9.2. National Initiatives

### 9.2.1. ANR

- CATREL (accepted June 2012, ending December 2015): “Cribles: Améliorations Théoriques et Résolution Effective du Logarithme” (Sieve Algorithms: Theoretical Advances and Effective Resolution of the Discrete Logarithm Problem). This project aims to make effective “attacks” on reduced-size instances of the discrete logarithm problem (DLP). This is a key ingredient for the assessment of the security of cryptosystems relying on the hardness of the DLP in finite fields, and for deciding on relevant key sizes.
- MANTA (accepted July 2015, starting January 2016): “Curves, surfaces, codes and cryptography”. This project deals with applications of coding theory error correcting codes to in cryptography, multi-party computation, and complexity theory, using advanced topics in algebraic geometry and number theory. See <http://anr-manta.inria.fr/>

### 9.2.2. DGA

- DIFMAT-3: this one-year project aims to find matrices with good diffusion properties over small finite fields. The principle is to find non-maximal matrices, but with better coefficients and implementation properties. The relevant cryptographic properties to be studied correspond to the weight distribution of the associated code. Since we use Algebraic-Geometry codes, much more powerful techniques can be used for computing these weight distribution, using and improving Duursma's ideas [34].
- Cybersecurity. Inria and DGA contracted for three PhD topics at the national level, one of them involving Grace. Grace started a new PhD, and hired P. Karpman. The topic of this PhD is complementary to the above DIFMAT-3: while DIFMAT-3 provides fundamental methods for dealing with AG codes, in application for diffusion layers in block ciphers, the topic here is to make concrete propositions of block ciphers using these matrices. P. Karpman is coadvised by T. Peyrin (Nanyang Technological University, Singapore), by P.-A. Fouque (Université de Rennes), and D. Augot.

## 9.3. European Initiatives

### 9.3.1. FP7 & H2020 Projects

#### 9.3.1.1. PQCRYPTO

Title: Post-quantum cryptography for long-term security

Programm: H2020

Duration: March 2015 - March 2018

Coordinator: TECHNISCHE UNIVERSITEIT EINDHOVEN

Partners:

Academia Sinica (Taiwan)

Bundesdruckerei (Germany)

Danmarks Tekniske Universitet (Denmark)

Katholieke Universiteit Leuven (Belgium)

Nxp Semiconductors Belgium Nv (Belgium)

Ruhr-Universitaet Bochum (Germany)

Stichting Katholieke Universiteit (Netherlands)

Coding Theory and Cryptology group, Technische Universiteit Eindhoven (Netherlands)

Technische Universitaet Darmstadt (Germany)

University of Haifa (Israel)

Inria contact: Nicolas Sendrier

Online security depends on a very few underlying cryptographic algorithms. Public-key algorithms are particularly crucial since they provide digital signatures and establish secure communication. Essentially all applications today are based on RSA or on the discrete-logarithm problem in finite fields or on elliptic curves. Cryptographers optimize parameter choices and implementation details for these systems and build protocols on top of these systems; cryptanalysts fine-tune attacks and establish exact security levels for these systems.

It might seem that having three systems offers enough variation, but these systems are all broken as soon as large quantum computers are built. The EU and governments around the world are investing heavily in building quantum computers; society needs to be prepared for the consequences, including cryptanalytic attacks accelerated by these computers. Long-term confidential documents such as patient health-care records and state secrets have to guarantee security for many years, but

information encrypted today using RSA or elliptic curves and stored until quantum computers are available will then be as easy to decipher.

PQCRYPTO will allow users to switch to post-quantum cryptography: cryptographic systems that are not merely secure for today but that will also remain secure long-term against attacks by quantum computers. PQCRYPTO will design a portfolio of high-security post-quantum public-key systems, and will improve the speed of these systems, with reference implementations.

### ***9.3.2. Major European Organizations with which the Team have followed Collaborations***

Program: COST

Project acronym: COST 4175/11

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

Duration: 04/2012 - 04/2016

Coordinator: Marcus Greferath

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

Abstract: Random network coding emerged through an award-winning paper by R. Koetter and F. Kschischang in 2008 and has since then opened many new directions in networking, internet, wireless communication systems, and cloud computing. This COST Action will set up a European research network and establish network coding as a European core area in communication technology. Its aim is to bring together experts from pure and applied mathematics, computer science, and electrical engineering, who are working in the areas of discrete mathematics, coding theory, information theory, and related fields.

## **9.4. International Initiatives**

### ***9.4.1. Inria International Partners***

#### *9.4.1.1. Informal International Partners*

- P. Beelen, J. Nielsen, DTU Lyngby
- M. Bossert, Ulm Universität
- S. Galbraith, Department of Mathematics, University of Auckland.

## **9.5. International Research Visitors**

### ***9.5.1. Internships***

- C. Berghoff is a visiting Phd student, from Bonn Universität.

## MEXICO Project-Team

# 9. Partnerships and Cooperations

## 9.1. Regional Initiatives: IRT

### 9.1.1. SystemX

**Participants:** Simon Theissing, Yann Duplouy, Serge Haddad.

We participate in the projects

- MIC on multi-modal transport systems with in the IRT *System X*, with academic partners UPMC, IFSTTAR and CEA, and several industrial partners including Alstom (project leader), COSMO and Renault. MIC is scheduled to be completed late in 2016, and
- the project SVA (*Simulation pour la Sécurité du Véhicule Autonome*), where the PhD Thesis of Yann Duplouy targets the application of formal methods to the development of embedded systems for autonomous vehicles.

## 9.2. National Initiatives

We have not yet been notified about acceptance of our ANR submissions.

## 9.3. European Initiatives

In preparation.

### 9.3.1. FP7 & H2020 Projects

Serge Haddad is participating in the ERC *EQUALIS*, 'Enhancing the Quality of Interacting Systems', directed by Patricia Bouyer.

## 9.4. International Initiatives

### 9.4.1. Inria International Labs projects

LIA INFORMEL with CMI, Chennai, India ; see below.

### 9.4.2. Inria International Partners

#### 9.4.2.1. 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 (defended in 2014).

Currently, Paul Gastin is co-head (with Madhavan Mukund) of the CNRS International Associated Laboratory (LIA) INFORMEL (INdo-French FORMal Methods Lab, <http://projects.lsv.ens-cachan.fr/informel/>), see below.

2. We have been exchanging visits for several years between *MEXICO* the computer science and electrical engineering departments at Newcastle University, UK, with visits in both directions; they involve in particular Maciej Koutny, Alex Yakovlev, Victor Khomenko and Andrey Mokhov, as well as Anil Wipat, co-director of the center for Synthetic Biology and the Bioeconomy at Newcastle University.

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

## 9.5. International Research Visitors

### 9.5.1. Visits of International Scientists

- 5 – 31 March 2015: Prakash Saivasan (CMI) visits LSV to work with Paul Gastin on nested words for higher-order pushdown systems
- 19 May – 6 June 2015: S. Krishna and S. Akshay visit LSV to work with Paul Gastin on split-width techniques for the analysis of timed systems.
- 10 June – 4 July 2015: K. Narayan Kumar (CMI) visit France to pursue several collaborations: with Paul Gastin (LSV) on bounded time-stamping for message passing systems, with Ahmed Bouajjani (LIAFA) on analysis of multi-pushdown systems, and with Pascal Weil (LaBRI) on bounded reachability analysis for shared memory systems.

#### 9.5.1.1. Internships

Georgios Christodoulis

Date: May 2015 - Jul 2015

Institution: National University Athens (Greece)

Supervisor: Stefan Haar

Sougata Bose

Date: May 2015 - Jul 2015

Institution: CMI (India)

Supervisor: Benedikt Bollig and Paul Gastin

### 9.5.2. Visits to International Teams

#### 9.5.2.1. Short stays abroad

- In July 2015, Serge Haddad visited U of Turin, Italy, for a research cooperation with Prof. Giuliana Franceschinis.
- Stefan Haar visited Newcastle University (UK), TU of Eindhoven (NL) and University of Luxemburg for short visits.
- 29 November – 20 December 2015: Paul Gastin (LSV) visits S. Krishna and S. Akshay (IIT Bombay) to work on tree automata techniques for timed-systems.

## PARSIFAL Project-Team

# 8. Partnerships and Cooperations

## 8.1. European Initiatives

### 8.1.1. FP7 & H2020 Projects

#### 8.1.1.1. Proofcert

Title: ProofCert: Broad Spectrum Proof Certificates

Programm: FP7

Type: ERC

Duration: January 2012 - December 2016

Coordinator: Inria

Inria contact: Dale Miller

'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 theorists: their efforts on logic and proof has given us a universally accepted means of communicating proofs between people and computer systems. Logic can be used to state desirable security and correctness properties of software and hardware systems and proofs are uncontroversial evidence that statements are, in fact, true. The current state-of-the-art of formal methods used in academics and industry shows, however, that the notion of logic and proof is severely fractured: there is little or no communication between any two such systems. Thus any efforts on computer system correctness is needlessly repeated many times in the many different systems: sometimes this work is even redone when a given prover is upgraded. In ProofCert, we will build on the bedrock of decades of research into logic and proof theory the notion of proof certificates. Such certificates will allow for a complete reshaping of the way that formal methods are employed. 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.'

## 8.2. International Research Visitors

### 8.2.1. Visits of International Scientists

Professor Chuck Liang visited the team from 25 May to 15 June 2015 in order to continue his collaborations with team members on basic questions of proof theory. This collaboration resulted in a paper that appears in LPAR 2015 on the topic of subexponentials and the Curry-Howard interpretation of logic.

#### 8.2.1.1. Internships

Leonardo Lima is an intern funded by ProofCert during 1 Oct 2015 – 28 Feb 2016. He is a student of Prof. Vivek Nigam from Federal University of Paraíba, Brazil. He is working on formalizing the proof theory of linear logic within the Abella theorem prover.

### 8.2.2. Visits to International Teams

#### 8.2.2.1. Research stays abroad

Graham-Lengrand spent 6 months, from March 2015 to August 2015 at SRI International, USA. This visit was to start a collaboration with N. Shankar and B. Dutertre on new algorithms and new architectures for automated and interactive theorem proving.

## POSTALE Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

- **EDF:** Contract with EDF on improving performance and designing algorithms of iterative solvers on parallel machines with accelerators (Marc Baboulin). This contract enables to hire a postdoc researcher in October 2014.  
**Participants:** Marc Baboulin, Amal Khabou.
- **Inserm** Contract with Paris X / INSERM U669 (Christophe Genolini) in the R++ project. R++ is an open source effort to modernize and increase performance of the R language used by scientists to develop statistical analysis tools. Funding for one research engineer has been received to support this project.  
**Participant:** Joël Falcou.
- **followup of the ANR Cosinus project PetaQCD - Towards PetaFlops for Lattice Quantum ChromoDynamics** Collaboration with Lal (Orsay), LPT (Orsay), LABRI (Bordeaux). About the design of architecture, software tools and algorithms for Lattice Quantum Chromodynamics.  
**Participants:** Christine Eisenbeis, Konstantin Petrov.

## 8.2. International Initiatives

### 8.2.1. Inria Associate Teams not involved in an Inria International Labs

#### 8.2.1.1. R-LAS

Title: Randomized Linear Algebra Software

International Partner (Institution - Laboratory - Researcher):

University of Tennessee, Knoxville (United States) - Innovative Computing Laboratory  
(ICL) - Jack Dongarra

Start year: 2014

See also: <https://www.lri.fr/~baboulin/r-las.html>

The objective of the associate team between Inria and University of Tennessee is to develop a class of fast algorithms and software based on randomization to enhance linear algebra calculations in high-performance computing (HPC) applications. The first application will focus on FFT-like randomization techniques to avoid pivoting in dense and sparse matrix factorizations and thus removing the communication cost due to pivoting. The second application is related to the computation of statistical condition estimates for linear algebra problems in order to assess the numerical quality of solutions computed by HPC applications. The targeted architectures are large scale multicore systems with accelerators. The ultimate goal of the project is to make the randomized solvers designed by the associate team accessible to end-users thanks to a public domain software library.

## 8.3. International Research Visitors

### 8.3.1. Visits of International Scientists

- Masha Sasonkina, Old Dominion University, USA.
- Hartwig Anzt, University of Tennessee, USA.
- Nick Higham, University of Manchester, UK.
- Jean-Luc Gaudiot, UC Irvine, USA.



### **8.3.2. Visits to International Teams**

#### *8.3.2.1. Research stays abroad*

- Marc Baboulin,
  - Invitation at Old Dominion University, Norfolk, USA, (October 2015)
  - Invitation at National Institute of Informatics, Tokyo, Japan (August 2015)
  - Invitation at Académie des Sciences de Prague, République Tchèque (June 2015)
  - Invitation at Inria Bordeaux- équipe Hiepacs (March 2015)

## SPECFUN Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### 8.1.1. ANR

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

Goal: Improve the performances and the ergonomics of interactive provers by taking advantage of modern, parallel hardware.

Leader: B. Wolff (University of Orsay, Paris Paris-Sud). Participants: A. Mahboubi, C. Tankink.

Website: <http://paral-itp.lri.fr/>.

**FastRelax** (ANR-14-CE25-0018).

Goal: Develop computer-aided proofs of numerical values, with certified and reasonably tight error bounds, without sacrificing efficiency.

Leader: B. Salvy (Inria, ÉNS Lyon). Participants: A. Mahboubi, Th. Sibut-Pinote.

Website: <http://fastrelax.gforge.inria.fr/>.

## 8.2. European Initiatives

### 8.2.1. Collaborations in European Programs, except FP7 & H2020

- Program: COST
- Project acronym: EUTYPES (CA15123)
- Project title: The European research network on types for programming and verification
- Duration: October 2015 - October 2019
- Coordinator: Herman Geuvers (Radboud University, Nijmegen, the Netherlands)
- Other partners: Czech Republic, Estonia, Macedonia, Germany, Greece, the Netherlands, Norway, Poland, Serbia, Slovenia, United Kingdom.
- Abstract: Types are pervasive in programming and information technology. A type defines a formal interface between software components, allowing the automatic verification of their connections, and greatly enhancing the robustness and reliability of computations and communications. In rich dependent type theories, the full functional specification of a program can be expressed as a type. Type systems have rapidly evolved over the past years, becoming more sophisticated, capturing new aspects of the behaviour of programs and the dynamics of their execution. This COST Action will give a strong impetus to research on type theory and its many applications in computer science, by promoting: (1) the synergy between theoretical computer scientists, logicians and mathematicians to develop new foundations for type theory, for example as based on the recent development of “homotopy type theory”, (2) the joint development of type theoretic tools as proof assistants and integrated programming environments, (3) the study of dependent types for programming and its deployment in software development, (4) the study of dependent types for verification and its deployment in software analysis and verification. The action will also tie together these different areas and promote cross-fertilisation. Europe has a strong type theory community, ranging from foundational research to applications in programming languages, verification and theorem proving, which is in urgent need of better networking. A COST Action that crosses the borders will support the collaboration between groups and complementary expertise, and mobilise a critical mass of existing type theory research.

## TOCCATA Project-Team

# 9. Partnerships and Cooperations

## 9.1. Regional Initiatives

### 9.1.1. *ELFIC*

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

ELFIC is a working group of the Digicosme Labex. S. Boldo is the principal investigator. It began in 2014 for one year and was extended for one year.

The ELFIC project focuses on proving the correctness of the FELiScE (Finite Elements for Life Sciences and Engineering) C++ library which implements the finite element method for approximating solutions to partial differential equations. Finite elements are at the core of numerous simulation programs used in industry. The formal verification of this library will greatly increase confidence in all the programs that rely on it. Verification methods developed in this project will be a breakthrough for the finite element method, but more generally for the reliability of critical software relying on intricate numerical algorithms.

Partners: Inria team Pomdapi; Ecole Polytechnique, LIX; CEA LIST; Université Paris 13, LIPN; UTC, LMAC (Compiègne).

## 9.2. National Initiatives

### 9.2.1. *ANR CoLiS*

**Participants:** Claude Marché [contact], Andrei Paskevich.

The CoLiS research project is funded by the programme “Société de l’information et de la communication” of the ANR, for a period of 48 months, starting on October 1st, 2015. <http://colis.irif.univ-paris-diderot.fr/>

The project aims at developing formal analysis and verification techniques and tools for scripts. These scripts are written in the POSIX or bash shell language. Our objective is to produce, at the end of the project, formal methods and tools allowing to analyze, test, and validate scripts. For this, the project will develop techniques and tools based on deductive verification and tree transducers stemming from the domain of XML documents.

Partners: Université Paris-Diderot, IRIF laboratory (formerly PPS & LIAFA), coordinator ; Inria Lille, team LINKS

### 9.2.2. *ANR Vocal*

**Participants:** Jean-Christophe Filliâtre [contact], Andrei Paskevich.

The Vocal research project is funded by the programme “Société de l’information et de la communication” of the ANR, for a period of 48 months, starting on October 1st, 2015.

The goal of the Vocal project is to develop the first formally verified library of efficient general-purpose data structures and algorithms. It targets the OCaml programming language, which allows for fairly efficient code and offers a simple programming model that eases reasoning about programs. The library will be readily available to implementers of safety-critical OCaml programs, such as Coq, Astrée, or Frama-C. It will provide the essential building blocks needed to significantly decrease the cost of developing safe software. The project intends to combine the strengths of three verification tools, namely Coq, Why3, and CFML. It will use Coq to obtain a common mathematical foundation for program specifications, as well as to verify purely functional components. It will use Why3 to verify a broad range of imperative programs with a high degree of proof automation. Finally, it will use CFML for formal reasoning about effectful higher-order functions and data structures making use of pointers and sharing.

Partners: team Gallium (Inria Paris-Rocquencourt), team DCS (Verimag), TrustInSoft, and OCamlPro.

### 9.2.3. ANR Ajacs

**Participant:** Arthur Charguéraud [contact].

The AJACS research project is funded by the programme “Société de l’information et de la communication” of the ANR, for a period of 42 months, starting on October 1st, 2014.

The goal of the AJACS project is to provide strong security and privacy guarantees on the client side for web application scripts implemented in JavaScript, the most widely used language for the Web. The proposal is to prove correct analyses for JavaScript programs, in particular information flow analyses that guarantee no secret information is leaked to malicious parties. The definition of sub-languages of JavaScript, with certified compilation techniques targeting them, will allow deriving more precise analyses. Another aspect of the proposal is the design and certification of security and privacy enforcement mechanisms for web applications, including the APIs used to program real-world applications. On the Toccata side, the focus will be on the formalization of secure subsets of JavaScript, and on the mechanization of proofs of translations from high-level languages into JavaScript.

Partners: team Celtique (Inria Rennes - Bretagne Atlantique), team Prosecco (Inria Paris - Rocquencourt), team Indes (Inria Sophia Antipolis - Méditerranée), and Imperial College (London).

### 9.2.4. ANR FastRelax

**Participants:** Sylvie Boldo [contact], Guillaume Melquiond.

This is a research project funded by the programme “Ingénierie Numérique & Sécurité” of the ANR. It is funded for a period of 48 months and it has started on October 1st, 2014. <http://fastrelax.gforge.inria.fr/>

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

Partners: team ARIC (Inria Grenoble Rhône-Alpes), team MARELLE (Inria Sophia Antipolis - Méditerranée), team SPECFUN (Inria Saclay - Île-de-France), Université Paris 6, and LAAS (Toulouse).

### 9.2.5. ANR Soprano

**Participants:** Sylvain Conchon [contact], Évelyne Contejean, Guillaume Melquiond.

The Soprano research project is funded by the programme “Sciences et technologies logicielles” of the ANR, for a period of 42 months, starting on October 1st, 2014.

The SOPRANO project aims at preparing the next generation of verification-oriented solvers by gathering experts from academia and industry. We will design a new framework for the cooperation of solvers, focused on model generation and borrowing principles from SMT (current standard) and CP (well-known in optimization). Our main scientific and technical objectives are the following. The first objective is to design a new collaboration framework for solvers, centered around synthesis rather than satisfiability and allowing cooperation beyond that of Nelson-Oppen while still providing minimal interfaces with theoretical guarantees. The second objective is to design new decision procedures for industry-relevant and hard-to-solve theories. The third objective is to implement these results in a new open-source platform. The fourth objective is to ensure industrial-adequacy of the techniques and tools developed through periodical evaluations from the industrial partners.

Partners: team DIVERSE (Inria Rennes - Bretagne Atlantique), Adacore, CEA List, Université Paris-Sud, and OCamlPro.

### 9.2.6. ANR CAFEIN

**Participant:** Sylvain Conchon [contact].

The CAFEIN research project is funded by the programme “Ingénierie Numérique & Sécurité” of the ANR, for a period of 3 years, starting on February 1st, 2013. <https://cavale.enseeiht.fr/CAFEIN/>.

This project addresses the formal verification of functional properties at specification level, for safety critical reactive systems. In particular, we focus on command and control systems interacting with a physical environment, specified using the synchronous language Lustre.

A first goal of the project is to improve the level of automation of formal verification, by adapting and combining existing verification techniques such as SMT-based temporal induction, and abstract interpretation for invariant discovery. A second goal is to study how knowledge of the mathematical theory of hybrid command and control systems can help the analysis at the controller’s specification level. Third, the project addresses the issue of implementing real valued specifications in Lustre using floating-point arithmetic.

Partners: ONERA, CEA List, ENSTA, teams Maxplus (Inria Saclay - Île-de-France), team Parkas (Inria Paris - Rocquencourt), Perpignan University, Prover Technology, Rockwell Collins.

### 9.2.7. ANR BWare

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

The BWare research project is funded by the programme “Ingénierie Numérique & Sécurité” of the ANR, a period of 4 years, starting on September 1st, 2012. <http://bware.lri.fr>.

BWare is an industrial research project that aims to provide a mechanized framework to support the automated verification of proof obligations coming from the development of industrial applications using the B method and requiring high guarantee of confidence. The methodology used in this project consists of 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 [104]. This therefore should be a driving factor to reduce the risks of the project, which can then focus on the design of several extensions of the verification tools to deal with a larger amount of proof obligations.

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

### 9.2.8. ANR Verasco

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

The Versaco research project is funded by the programme “Ingénierie Numérique & Sécurité” of the ANR, for a period of 4 years and a half, starting on January 1st, 2012. Project website: <http://verasco.imag.fr>.

The main goal of the project is to investigate the formal verification of static analyzers and of compilers, two families of tools that play a crucial role in the development and validation of critical embedded software. More precisely, the project aims at developing a generic static analyzer based on abstract interpretation for the C language, along with a number of advanced abstract domains and domain combination operators, and prove the soundness of this analyzer using the *Coq* proof assistant. Likewise, the project keeps 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).

## 9.3. European Initiatives

### 9.3.1. FP7 & H2020 Projects

Project acronym: ERC Deepsea

Project title: Parallel dynamic computations

Duration: Jun. 2013 - Jun. 2018

Coordinator: Umut A. Acar

Other partners: Carnegie Mellon University

Abstract:

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

### 9.3.2. Collaborations with Major European Organizations

Imperial College London (UK)

Certification of JavaScript, AJACS project

## 9.4. International Research Visitors

### 9.4.1. Visits of International Scientists

- Andrew Tolmach, from Portland State University, visited the team as a one-year Digeo Chair, in collaboration with other groups in the Paris area (LRI/Univ. Paris-Sud, LIX/Polytechnique, Inria Saclay and Rocquencourt). The project is to initiate a new research effort to develop principles, techniques, and tools for large-scale proof engineering. It is focused on the Coq proof assistant and is designed to take advantage of the deep pool of expertise available in the Paris area concerning both the use and the development of Coq. Initial results include: a precise description of requirements for large proof management; sample prototype tools addressing one or more of these requirements; and a technical survey of relevant proof representation options [106].

## COMMANDS Project-Team

# 9. Partnerships and Cooperations

## 9.1. Regional Initiatives

- Axel Kröner, Frederic Bonnans: “Optimal control of partial differential equations using parameterizing manifolds, model reduction, and dynamic programming”. Foundation Mathématique Jacques Hadamard/PGMO

## 9.2. International Initiatives

### 9.2.1. Inria International Labs

Participation to the Inria Chile laboratory.

## 9.3. International Research Visitors

### 9.3.1. Visits of International Scientists

#### 9.3.1.1. Internships

- Justina Jianatti (PhD student, U. Rosario, Argentina). Numerical algorithms for stochastic control problems. Supervised by F. Bonnans.
- Mandy Huo (now PhD at Caltech, USA): International internship of École Polytechnique on aspects of optimal control of bilinear equation. Supervised by A. Kroener.

### 9.3.2. Visits to International Teams

#### 9.3.2.1. Explorer programme

Kröner Axel

Date: Jul 2015 - Aug 2015

Institution: [University of California, Los Angeles](#) (United States)

## **DEFI Project-Team**

# **8. Partnerships and Cooperations**

## **8.1. National Initiatives**

### **8.1.1. ANR**

- H. Haddar is the DEFI coordinator of the ANR: Modelization and numerical simulation of wave propagation in metamaterials (METAMATH), program MN, 2011-2015. This is a joint ANR with POEMS, Inria Scalay Ile de France project team (Coordinator, S. Fliss), DMIA, Département de Mathématiques de l'ISAE and IMATH, Laboratoire de Mathématiques de l'Université de Toulon. <https://www.rocq.inria.fr/poems/metamath>
- J.R. Li is the coordinator of the Inria partner of the project "Computational Imaging of the Aging Cerebral Microvasculature", funded by ANR Program "US-French Collaboration". French Partners (Coordinating partner CEA Neurospin): CEA Neurospin (Coordinator Luisa Ciobanu), Inria Saclay (Coordinator Jing-Rebecca Li). US Partner: Univ of Illinois, bioengineering department (Coordinator Brad Sutton). Duration: Sept 2013- Sept 2016.

## **8.2. European Initiatives**

### **8.2.1. Collaborations with Major European Organizations**

- Partner 1: University of Bremen, Department of Math. (Germany)  
Joint PhD advising of T. Rienmuller, partly funded by French-German university. Correspondant: Armin Lechleiter.
- Partner 2: University of Goettingen, Department of Math. (Germany)  
Development of conformal mapping method to electrostatic inverse problems. Correspondant: Rainer Kress.

## **8.3. International Initiatives**

### **8.3.1. Inria International Labs**

- DEFI is the correpondnat of the LIRIMA Afrique team EPIC. The program ended in 2015. A followup is prepared in the framework of associate team program.

### **8.3.2. Inria International Partners**

#### **8.3.2.1. Declared Inria International Partners**

##### **QUASI**

- Title: Qualitative Approaches to Scattering and Imaging
- International Partners (Institution - Laboratory - Researcher):
  - University of Delaware (United States) - Department of Mathematical Sciences ( Department of Math) - Fioralba Cakoni
- Start year: 2013
- We concentrate on the use of qualitative methods in acoustic and electromagnetic inverse scattering theory with applications to nondestructive evaluation of materials and medical imaging. In particular, we address theoretical and numerical reconstruction techniques to solve the inverse scattering problems using either time harmonic or time dependent measurements of the scattered field. The main goal of research in this field is to not only detect but also identify geometric and physical properties of unknown objects in real time.



## **8.4. International Research Visitors**

### ***8.4.1. Visits of International Scientists***

We had short visits (one week) of the following collaborators

- Fioralba Cakoni
- David Colton
- Ozgur Ozdemir
- Rainer Kress

#### *8.4.1.1. Internships*

- Guilherme Da Costa Sales
- Hoang Trong An TRAN

## DISCO Project-Team

# 9. Partnerships and Cooperations

## 9.1. Regional Initiatives

### **DIGITEO Project (DIM LSC) ALMA3**

Project title: Mathematical Analysis of Acute Myeloid Leukemia (AML) and its treatments

September 2014 - August 2017

Coordinator: Catherine Bonnet

Other partners: Inria Paris-Rocquencourt, France, L2S, France, UPMC, St Antoine Hospital Paris

Abstract: this project follows the regional projects ALMA (2010-2014) and ALMA2 (2011-2013). Starting from the work of J. L. Avila Alonso's PhD thesis in ALMA the aim of this project is to provide a refined coupled model of healthy and cancer cell dynamics in AML whose (stability) analysis will enable evaluation of polychemiotherapies delivered in the case of AML which have a high level of Flt-3 duplication (Flt-3-ITD).

## 9.2. National Initiatives

### 9.2.1. ANR

An ANR Blanc SIMI 3 *Multidimensional Systems: Digression On Stabilities* (MSDOS) has started at the beginning of 2014. Its main goal is to constructively study stabilities and stabilization problems of (nonlinear) multidimensional systems. For more details, see <http://www.lias-lab.fr/perso/nimayeganefer/doku.php>. Alban Quadrat is the local leader for Inria Saclay.

### 9.2.2. Industrial-Academic Institute

Guillaume Sandou is the head of the RISEGrid Institute. The Institute is dedicated to the study, modelling and simulation of smart electric distribution grids and their interactions with the whole electric power system. It is located in Supélec and gathers about 20 people (academic and industrial researchers, PhD students, post-doctoral researchers).

## 9.3. European Initiatives

### 9.3.1. FP7 & H2020 Projects

Sorin Olaru is coordinator of the European project FUTURUSM in the IEF scheme (Dr. Vasso Reppas as postdoctoral fellow).

Sorin Olaru is Principal investigator of the TEMPO ITN (Mohammed Laraba, Rajesh Koduri and Iris Ballesteros as PhD students financed by this training network within L2S).

### 9.3.2. Collaborations in European Programs, except FP7 & H2020

Program: GDRI (European research network founded by CNRS)

Project acronym: DelSys

Project title: Delay Systems

Duration: 2011-2015

Coordinator: Silviu Iulian Niculescu

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

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

### **9.3.3. Collaborations with Major European Organizations**

University of l'Aquila, Department of Electrical and Information Engineering (Italy)

Study of nonlinear systems with delay, (notably differential equations interconnected with difference equations) via Lyapunov-Krasovskii functionals.

Tel Aviv University, (Israel)

Stability analysis of nonlinear Partial Differential Equations, construction of observers (continuous/discrete observers for systems with delay, observers with convergence in finite time).

## **9.4. International Initiatives**

Sorin Olaru is member of the LIA between several universities in Montreal Canada and Laboratoire des Signaux et Systèmes (L2S).

### **9.4.1. Inria International Partners**

#### *9.4.1.1. Informal International Partners*

- Kyushu Institute of Technology, Iizuka, Fukuoka and University of Kyoto, Kyoto, Japan.
- Louisiana State University, Baton Rouge, USA
- School of Electrical Engineering at the Tel-Aviv University
- Unicamp, Campinas, Brazil
- The University of Texas at Austin, Dept. of Aerospace Engineering & Engineering Mechanics
- University of Leeds, UK

## **9.5. International Research Visitors**

### **9.5.1. Visits of International Scientists**

- S. Boatto, Feder. University Rio de Janeiro, Brazil, 20/06-07/10.
- G. Bitsoris, Univ of Patras, Greece.
- A. Fioravanti, UNICAMP Campinas, Brazil, 24/05-10/06.
- E. Fridman, University of Tel-Aviv, Israel, 07/07-13/07.
- M. Hovd, NTNU Trondheim, 01/09-31/12.
- Y. Yamamoto, University of Kyoto, Japan, 03/09-11/11.

#### *9.5.1.1. Internships*

- Licence: Q. Renvoise, *Lemme de perturbation homologique et ses applications en théorie du contrôle*, 03-06, Ecole Normale Supérieure de Rennes. Supervisor: A. Quadrat.
- Master 2: Liu Xuemin, *control of models of bioreactors with delay and piecewise constant feedbacks*, University Paris-Sud/CentraleSupélec. Financial support: iCODE. Supervisor : Frédéric Mazenc.

## **GECO Project-Team**

# **7. Partnerships and Cooperations**

## **7.1. Regional Initiatives**

- Project *Stabilité des systèmes à excitation persistante*, Program MathIng, Labex LMH, 2013-2016. This project is about different stability properties for systems whose damping is intermittently activated. The coordinator is Mario Sigalotti. The other members are Yacine Chitour and Guilherme Mazanti.
- iCODE is the Institute for Control and Decision of the Idex Paris Saclay. It was launched in March 2014 for two years until June 2016. We are involved in three actions funded by iCODE:
  - one action on control of quantum systems, in collaboration with Nicoals Boulant of Neurospin. The action is coordinated by Ugo Boscain;
  - one action on control of wave propagation on networks. The action is coordinated by Mario Sigalotti;
  - one action on switched system. The action is coordinated by Marianne Akian (and handled by MAXPLUS).
- Starting from the end of 2015, we obtained a grant by PGMO (Gaspard Monge Program for Optimisation and operational research) on Geometric Optimal Control. The grant duration is one year and is renewable for up to three years. The grant is coordinated by Luca Rizzi and Mario Sigalotti.

## **7.2. National Initiatives**

### **7.2.1. ANR**

The ANR SRGI starts at the end of 2015, for a duration of four years. GECO is one of one of the partners of the ANR. The national coordinator is Emmanuel Trélat (UPMC) and the local one Ugo Boscain.

SRGI deals with sub-Riemannian geometry, hypoelliptic diffusion and geometric control.

## **7.3. European Initiatives**

### **7.3.1. FP7 & H2020 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/>

## Maxplus Team

# 9. Partnerships and Cooperations

## 9.1. Actions nationales/National Initiatives

### 9.1.1. ANR

- Participation de Cormac Walsh au projet ANR FINSLER (Géométrie de Finsler et applications).
- Projet ANR CAFEIN (Combinaison d’approches formelles pour l’étude d’invariants numériques), responsable P.L. Garoche. Partenaires : ONERA, CEA LIST, ENSTA Paristech, Inria Saclay (Maxplus, Toccata, Parkas), Université de Perpignan, Prover, Rockwell Collins France.
- Projet ANR MALTHY (Méthodes ALgébriques pour la vérification de modèles Temporisés et HYbrides), responsable T. Dang. Partenaires : Verimag, CEA LIST, Inria Rennes, Inria Saclay, VISEO/Object Direct.
- Projet ANR DEMOCRITE ("DEmonstrateur d’un MOteur de Couverture des Risques sur un TERRitoire), responsable Emmanuel Lapébie (CEA). Partenaires : CEA-GRAMAT, BSPP, Inria Saclay (Maxplus), Institut PPRIME - UPR3346 (CNRS, Univ. Poitiers, ISAE-ENSMA), IPSIS, SYSTEL, ARMINES-E.M. Alès-ISR, CERDACC (Univ. de Haute-Alsace).

### 9.1.2. Programme Gaspard Monge pour l’Optimisation

- Projet intitulé “Méthodes tropicales pour l’optimisation”, responsable X. Allamigeon, faisant intervenir M. Akian, V. Boeuf, S. Gaubert, A.Hochart, R. Katz, et M. Skomra.
- Participation de Marianne Akian et Stéphane Gaubert au projet “STORY: Stochastic and Robust Optimization Network and Teaching”, responsables: Laurent El Ghaoui (UC Berkeley) et Michel De Lara(CERMICS).

### 9.1.3. iCODE (Institut pour le Contrôle et la Décision de l’Idex Paris-Saclay)

Projet “blanc” intitulé “Stabilité et stabilisation des systèmes commutés” (Oct. 2014-fin 2015), faisant intervenir M. Akian, X. Allamigeon, S. Gaubert, et des membres de EPI Geco, L2S, LIX, LSV (ENS Cachan), UVSQ.

## 9.2. Actions internationales/International Initiatives

### 9.2.1. Inria International Partners

#### 9.2.1.1. Informal International Partners

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

- Michael Joswig (TU-Berlin), invité 3 mois en 2015 sur un poste rouge du CNRS.
- 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.

### **9.3. Accueils de chercheurs étrangers/International Research Visitors**

#### ***9.3.1. Chercheurs étrangers/Visits of International Scientists***

- Bas Lemmens (Univ. of Kent), 2 jours en mars.
- Brian Lins (Hampden-Sydney College), 2 jours en mars.
- Vassili Kolokoltsov (Warwick Univ.), 4 jours en juillet autour de SIAM CT.
- Visites d'un jour de Peter Butkovic (Univ. of Birmingham), Paul Van Dooren (Univ. Catholique de Louvain) et Françoise Tisseur (Univ. of Manchester) en décembre (autour de la soutenance de thèse d'Andrea Marchesini).

#### ***9.3.2. Séjours à l'étranger/Visits to International Teams***

##### *9.3.2.1. Research stays abroad*

- M. Akian, 1 semaine à Univ. of Bar Ilan en juin.
- A. Niv, 1 week in Birmingham (visit of P. Butkovic and S. Sergeev) in March 2015, few days in Aberdeen (visit of Z. Izhakian) in April 2015, and 2 weeks in Bar-Ilan Univ. (visit of L. Rowen and R. Adin) in June 2015.

## POEMS Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### 8.1.1. ANR

- ANR project *METAMATH: modélisation mathématique et numérique pour la propagation des ondes en présence de métamatériaux*. Partners: EPI DEFI (Inria Saclay), IMATH-Université de Toulon, LJLL-Paris 6 University.  
Start : 12/01/2011, End : 11/30/2016. Administrator : Inria. Coordinator : Sonia Fliss.
- ANR project *CHROME: Chauffage , réflectométrie et Ondes pour les plasmas magnétiques*  
Partners: LJLL-Paris 6 University, Université de Lorraine  
Start : 10/01/2012, End : 10/01/2015 Administrator : Inria Coordinator for POEMS: Eliane Bécache
- ANR project *RAFFINE: Robustesse, Automatisation et Fiabilité des Formulations INTégrales en propagation d'ondes : Estimateurs a posteriori et adaptivité*  
Partners: EADS, IMACS, ONERA, Thales  
Start : January 2013. End : december 2016. Administrator : Inria. Coordinator: Marc Bonnet.
- ANR project *ARAMIS: Analyse de méthodes asymptotiques robustes pour la simulation numérique en mécaniques*  
Partners: Université de Pau, Université technologique de Compiègne  
Start : January 2013. End : December 2016. Administrator : Université de Pau. Participant for POEMS: Marc Bonnet
- ANR project *Non-Local Domain Decomposition Methods in Electromagnetism*.  
Partners: Inria Alpines, Inria POEMS, Inria Magique 3D.  
Start : 2015, End : 2019. Administrator : Inria. Coordinator: Xavier Claeys.

## 8.2. European Initiatives

### 8.2.1. FP7 & H2020 Projects

#### 8.2.1.1. BATWOMAN

Type: FP7 Marie Curie

Objectif: Basic Acoustics Training - & Workprogram On Methodologies for Acoustics - Network

Duration: September 2013 - August 2017

Coordinator: Martin Wifling, VIRTUAL VEHICLE (AT)

Inria contact: P. Joly

Abstract: The BATWOMAN ITN aims at structuring research training in basic and advanced acoustics and setting up a work program on methodologies for acoustics for skills development in a highly diverse research field offering multiple career options.

## 8.3. International Initiatives

### 8.3.1. Inria International Partners

#### 8.3.1.1. Informal International Partners

Wilkins Aquino (Duke University)

Eric Chung (Chinese University of Hong Kong)



Bojan Guzina (University of Minnesota)

Sergei Nazarov (Saint-Petersburg University)

Jeronimo Rodriguez (University of Santiago de Compostela)

### **8.3.2. Participation In other International Programs**

Groupement De Recherche Européen : GDRE-US

This European Research Network (GDRE) entitled *Wave Propagation in Complex Media for Quantitative and Non Destructive Evaluation* aims at giving opportunities for interactions between researchers on the occasion of informal meetings, workshops and colloquia, alternatively in France and in the UK. It linked groups of academics and researchers in Ultrasonic Wave Phenomena with each other, and with industrial research centres and companies. The teams involved focused particularly on the theoretical end of the research spectrum, and include mathematicians, physicists and engineers.

## **SELECT Project-Team**

# **8. Partnerships and Cooperations**

## **8.1. Regional Initiatives**

Pascal Massart co-organizes a working group at ENS (Ulm) on statistical learning.

Gilles Celeux and Christine Keribin have a collaboration with the Pharmacoepidemiology and Infectious Diseases (PhEMI, INSERM) groups.

## **8.2. National Initiatives**

### **8.2.1. ANR**

SELECT is part of the ANR funded MixStatSeq.

## **8.3. International Initiatives**

Gilles Celeux is one of the co-organizers of the international working group on model-based clustering. This year this workshop took place in Seattle (USA).

## **8.4. International Research Visitors**

### **8.4.1. Visits to International Teams**

#### *8.4.1.1. Research stays abroad*

Jean-Michel Poggi visited Anestis Antoniadis at the University of Cape Town (South Africa), Department of Statistical Sciences, 16-26 February 2015

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## TAO Project-Team

# 9. Partnerships and Cooperations

## 9.1. Regional Initiatives

- **TIMCO**, 2012-2015 (432 kEuros)  
Coordinator: Bull SAS  
Participants: Cécile Germain-Renaud, Julien Nauroy, Karima Rafes, Lovro Ilisajic, Gaetan Marceau Caron
- **ROM** *Model Reduction and Multiphysics Optimization*, 2014-2016 (50 Keuros)  
Coordinator: IRT System X  
Participants: Marc Schoenauer, Michèle Sebag, François Gonard (PhD)
- **ISN** *A Collaborative Filtering Approach to Matching Job Openings and Job Seekers*, 2013-2016 (105 kEuros)  
Related to Thomas Schmitt's PhD (funded by ISN).  
Participants: Michèle Sebag, Thomas Schmitt
- **AutoML** *An empirical approach to Machine Learning*, 2014-2017 (104 kEuros)  
Related to Sourava Mishra's PhD  
Participants: Michèle Sebag, Balazs Kégl, Sourava Mishra
- **ReMODeL** *Rewarded Multimodal Online Deep Learning*, 2015-2016 (31,5 kEuros)  
This project lies at the junction of reinforcement learning, deep learning, computational neuroscience and developmental robotic fields. It is closely related to the transversal DIGITEO robotic theme, Roboteo.  
Participants: Michèle Sebag, Mathieu Lefort, Alexander Gepperth
- **AMIQAP**, 2015-2016 (12 months of Postdoctoral fellow). Project funded by ISN  
Participants: Philippe Caillou, Michèle Sebag

## 9.2. National Initiatives

- **SIMINOLE** 2010-2015 (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: Emmanuel Benazera, Nikolaus Hansen, Marc Schoenauer, 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
- **ACTEUR** 2014-2018 (236kEuros). Cognitive agent development for urban simulations, ANR project, Coordinator P. Taillandier (IDEES, Univ Rouen).  
Participants: Philippe Caillou

### 9.2.1. Other

- **POST** 2014-2018 (1,220 MEuros, including 500 kEuros for a 'private' cluster). Platform for the optimization and simulation of trans-continental grids  
ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie)  
Coordinator: ARTELYS  
Participants: Olivier Teytaud, Marie-Liesse Cauwet, Jérémie Decock, Sandra Cecilia Astete Morales, David L. Saint-Pierre, J. Decock

- **E-LUCID** 2014-2017 (194 kEuros)  
Coordinator: Thales Communications & Security S.A.S  
Participants: Marc Schoenauer, Cyril Furtlehner
- **FSN ADAMME** 2015-2018 (258 kEuros)  
Coordinator: Bull SAS  
Participants: Marc Schoenauer, Yann Ollivier, Gaetan Marceau Caron, Guillaume Charpiat, Cécile Germain-Renaud, Michèle Sebag
- **CNES contract** 2015-2017 (70 kEuros)  
Coordinator: Manuel Grizonnet (CNES) & Yuliya Tarabalka (Inria Sophia-Antipolis, Titane team)  
Participants: Guillaume Charpiat

## 9.3. European Initiatives

### 9.3.1. FP7 & H2020 Projects

- **EHRI-II** 2015-2019 (7 969 kEuros). European Holocaust Research Infrastructure, H2020, Coordinator NIOD, Amsterdam. Digital Humanities.  
Participants: Gregory Grefenstette

### 9.3.2. Collaborations with Major European Organizations

- **MLSpaceWeather** 2015-2019. Coupling physics-based simulations with Artificial Intelligence.  
Coordinator: CWI  
Participants: Michèle Sebag, Aurélien Decelle, Cyril Furtlehner.

## 9.4. International Initiatives

### 9.4.1. Inria Associate Teams not involved in an Inria International Labs

#### 9.4.1.1. CIADM

Title: Computational intelligence and Decision making

International Partner (Institution - Laboratory - Researcher):

NUTN (Taiwan) - Multimedia Informatics Lab - Chang-Shing Lee

Start year: 2015

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

The associate team works on computation intelligence for decision making, with different application fields for the various partners: - power systems (Tao) - eLearning (Oase) - games (Ailab)

#### 9.4.1.2. s3-bbo

Title: Threefold Scalability in Any-objective Black-Box Optimization

International Partner (Institution - Laboratory - Researcher):

Shinshu (Japan) - Tanaka-Hernan-Akimoto Laboratory - Hernan Aguirre

Start year: 2015

See also: <http://francejapan.gforge.inria.fr/doku.php?id=associateteam>

This associate team brings together researchers from the TAO and Dolphin Inria teams with researchers from Shinshu university in Japan. Additionally, researchers from the University of Calais are external collaborators to the team. The common interest is on black-box single and multi-objective optimization with complementary expertises ranging from theoretical and fundamental aspects over algorithm design to solving industrial applications. The work that we want to pursue in the context of the associate team is focused on black-box optimization of problems with a large number of decision variables and one or several functions to evaluate solutions, employing distributed and parallel computing resources. The objective is to theoretically derive, analyze, design, and develop scalable black-box stochastic algorithms including evolutionary algorithms for large-scale optimization considering three different axes of scalability: (i) decision space, (ii) objective space, and (iii) availability of distributed and parallel computing resources.

We foresee that the associate team will make easier the collaboration already existing through a proposal funded by Japan and open-up a long term fruitful collaboration between Inria and Shinshu university. The collaboration will be through exchanging researchers and Ph.D. students and co-organization of workshops.

#### **9.4.2. Inria International Partners**

##### *9.4.2.1. Informal International Partners*

- Marc Schoenauer, partner of the ARC-DP (Australian Research Council Discovery Project) *bio-inspired computing methods for dynamically changing environments*. Coordinator: University of Adelaide (Frank Neumann), 5 years, 400 k\$-AUS.

### **9.5. International Research Visitors**

#### *9.5.1. Visits of International Scientists*

- Holger Hoos, University of British Columbia, Canada, 3 weeks in February 2015, follow-up of his 3-months visit at Fall 2014, funded my MSR-Inria joint lab.
- Isabelle Guyon, Chalearn. April-July 2015, 1 month by University Paris Sud, 3 months with TIMCO.
- Youhei Akimoto, Shinshu University, September 2015, a month funded by Digiteo.
- Aditya Gopalan, Indian Institute of Science Bangalore, April 2015, three weeks funded by Digiteo.
- Edgar Galvan Lopez, University College Dublin, April 2015 - March 2016, funded with the ELEVATE Fellowship, the Irish Research Council's Career Development Fellowship co-funded by Marie Curie Actions.

##### *9.5.1.1. Internships*

Lin Ching-Nung

Date: Apr - Oct 2015

Institution: NDHU (Taiwan)

Supervisor: Olivier Teytaud

## AMIB Project-Team

## 7. Partnerships and Cooperations

### 7.1. National Initiatives

#### 7.1.1. FRM

Y. Ponty is the Bioinformatics PI for a *Fondation de la Recherche Médicale*-funded project.

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

- Approche comparatives haut-débit pour la modélisation de l'architecture 3D des ARN à partir de données expérimentales
- 2015–2018
- Y. Ponty, A. Denise, M. Regnier, A. Saaidi (PhD funded by FRM)
- B. Sargueil (Paris V – Experimental partner), J. Waldispühl (Univ. McGill)

### 7.2. European Initiatives

Y. Ponty is the French PI for the French/Austrian RNALANDS project, jointly funded by the French ANR and the Austrian FWF, in partnership with the Theoretical Biochemistry Institute (University of Vienna, Austria), LRI (Univ. Paris-Sud) and EPI BONSAI (Inria Lille-Nord Europe).

ANR International Program

- Fast and efficient sampling of structures in RNA folding landscapes
- RNALANDS (ANR-14-CE34-0011)
- 01/10/2014–30/09/2018
- Y. Ponty (PI), M. Régnier
- EPI BONSAI/INRIA Lille - Nord Europe, Vienna University (Austria)
- LRI, Université Paris-Sud (France)

### 7.3. International Initiatives

#### 7.3.1. Inria International Partners

##### 7.3.1.1. Declared Inria International Partners

AMAVI

Title: Combinatorics and Algorithms for the Genomic sequences

International Partners (Institution - Laboratory - Researcher):

Vavilov Institute of General Genetics (Russia (Russian Federation)) - Department of Computational Biology - Vsevolod Makeev

Start year: 2013

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

VIGG and AMIB teams has a more than 12 years long collaboration on sequence analysis. The two groups aim at identifying DNA motifs for a functional annotation, with a special focus on conserved regulatory regions. In the current 3-years project CARNAGE, our collaboration, that includes Inria-team MAGNOME, is oriented towards new trends that arise from Next Generation Sequencing data. Combinatorial issues in genome assembly are addressed. RNA structure and interactions are also studied.

The toolkit is pattern matching algorithms and analytic combinatorics, leading to common software.

##### 7.3.1.2. Informal International Partners

A long-term cooperation exists with Teheran University (Iran).

### 7.3.2. Participation In other International Programs

#### CONSEIL FRANCO-QUÉBÉCOIS DE COOPÉRATION UNIVERSITAIRE EXCHANGE PROGRAM

- Title: Réseau franco-québécois de recherche sur l'ARN
- International Partners (Institution - Laboratory - Researcher):  
Univ. McGill (Canada) - CS Dept - J. Waldispühl, M. Blanchette  
Univ. Montréal (Canada) - Biology Dept & IRIC - E. Lecuyer, F. Major
- Start year: 2012
- The partners have developed 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.

#### PHC GERMAINE DE STAEL EXCHANGE PROGRAM

- Title: Random constrained permutations
- International Partners (Institution - Laboratory - Researcher):  
Univ. Zürich (Swiss) - Institut für Mathematik - M. Bouvel, V. Féray
- Start year: 2015
- The partners wish to develop new technique for the enumeration, analysis and random generation of constrained permutations.

#### CNRS UMI PIMS-VANCOUVER EXCHANGE PROGRAM

- Title: Extended research stay of Y. Ponty at the Simon Fraser University  
Simon Fraser University - Maths Dept - C. Chauve, M. Mishna, L. Stacho  
Univ. British Columbia - CS Dept - J. Manuch
- Start year: 2013
- Extended research stay in Vancouver to foster new collaborations between EPI Amib and colleagues at SFU on comparative genomics, RNA structures, and enumerative combinatorics.

## 7.4. International Research Visitors

### 7.4.1. Visits of International Scientists

Mark Ward

Date: 23/11/2015- 05/12/2015

Institution: Purdue University (USA)

Can Alkan

Date: 24/11/2015- 30/11/2015

Institution: Bilkent University (Turkey)

Evgenia Furletova

Date: 22/11/2015- 28/11/2015

Institution: IMPB (Russia)

#### 7.4.1.1. Internships

Indrajit Saha

Date: 20/02/2015- 28/02/2015

Institution: ERCIM fellowship (Wroclaw)

Supervisor: M. Régnier

Doris Taining

Date: 01/05/2015- 07/08/2015

Institution: Singapore University (Singapore)

Supervisor: M. Régnier

## **7.4.2. Visits to International Teams**

### *7.4.2.1. Sabbatical programme*

Bernauer Julie

Date: Feb 2014 - Jan 2015

Institution: **Stanford** (United States)

### *7.4.2.2. Research stays abroad*

Yann Ponty

Date: Sept 2013 - Sept 2015

Institution: **Simon Fraser** (Canada)

Amelie Héliou

Date: June 2015 - Aug 2015

Institution: **HKUST** (Hong Kong)

Antoine Soulé

Date: Jan 2015 - Sept 2015

Institution: **McGill** (Canada)

Pauline Pommeret

Date: May 2015 - Aug 2015

Institution: **Vancouver** (Canada)



## GALEN Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

### 8.1.1. Excellence Clusters

- Program: DIGITEO (Chair)
  - Project acronym: SubSample
  - Project title: Identification and prediction of Salient brain States through probabilistic structure learning towards fusion of imaging and genomic data
  - Duration: 01/2012-12/2015
  - Coordinator: ECP - FR
- Program: DIGITEO
  - Project acronym: SOPRANO
  - Project title: Structured Output Prediction on Large Scale Neuroscience Data
  - Duration: 3/2013-3/2016
  - Coordinator: Ecole Centrale Paris - FR
- Program: MEDICEN
  - Project acronym: ADOC
  - Project title: ADOC – Diagnostic peropératoire numérique en chirurgie du cancer
  - Duration: 11/2011-09/2015
  - Coordinator: LLTECH - FR

## 8.2. National Initiatives

### 8.2.1. ANR

- Program: ANR Blanc International
  - Project acronym: ADAMANTIUS
  - Project title: Automatic Detection And characterization of residual Masses in pAtients with lymphomas through fusioN of whole-body diffusion-weighTed mri on 3T and 18F-flUorodeoxyglucoSe pet/ct
  - Duration: 9/2012-8/2015
  - Coordinator: CHU Henri Mondor - FR
- Program: ANR JCJC
  - Project acronym: HICORE
  - Project title: HIERarchical COMpositional REpresentations for Computer Vision
  - Duration: 10/2010-9/2014
  - Coordinator: ECP - FR
- Program: ANR JCJC
  - Project acronym: LearnCost
  - Project title: Learning Model Constraints for Structured Prediction
  - Duration: 2014-2018

Coordinator: Inria Saclay - FR

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

Project acronym: CURATOR

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

Duration: 12/2013-11/2015

Coordinator: ECP - FR

## 8.3. European Initiatives

### 8.3.1. FP7 & H2020 Projects

#### 8.3.1.1. DIOCLES

Title: Discrete bIOimaging perCeption for Longitudinal Organ modElling and computEr-aided diagnosiS

Type: FP7

Instrument: European Research Council

Duration: September 2011 - August 2016

Coordinator: Nikos Paragios

Partner: Ecole Centrale de Paris (FR)

Inria contact: Nikos Paragios

Recent hardware developments from the medical device manufacturers have made possible non-invasive/in-vivo acquisition of anatomical and physiological measurements. Despite enormous progress made on the field of biomedical image analysis still a huge gap exists between clinical research and clinical use. The aim of this proposal is three-fold. First we would like to introduce a novel biomedical image perception framework for clinical use towards disease screening and drug evaluation. Such a framework is expected to be modular (can be used in various clinical settings), computationally efficient (would not require specialized hardware), and can provide a quantitative and qualitative anatomic-pathological indices. Second, leverage progress made on the field of machine learning along with novel, efficient, compact representation of clinical bio-markers toward computer aided diagnosis. Last, using these emerging multi-dimensional signals, we would like to perform longitudinal modelling and understanding the effects of aging to a number of organs and diseases that do not present pre-disease indicators such as brain neurological diseases, muscular diseases, certain forms of cancer, etc.

#### 8.3.1.2. I-SUPPORT

Title: ICT-Supported Bath Robots

Programm: FP7

Duration: March 2015 - March 2018

Coordinator: Robotnik Automation S.L.L.

Partners:

Bethanien Krankenhaus - Geriatisches Zentrum - Gemeinnutzige GMBH (Germany)

Fondazione Santa Lucia (Italy)

Institute of Communication and Computer Systems (Greece)

Karlsruher Institut für Technologie (Germany)

Theofanis Alexandridis Kai Sia Ee (OMEGATECH) (Greece)

Robotnik Automation Sll (Spain)

Scuola Superiore di Studi Universitari E di Perfezionamento Sant'Anna (Italy)

Frankfurt University of Applied Sciences (Germany)

Inria contact: Iasonas Kokkinos

The I-SUPPORT project envisions the development and integration of an innovative, modular, ICT-supported service robotics system that supports and enhances older adults' motion and force abilities and assists them in successfully, safely and independently completing the entire sequence of bathing tasks, such as properly washing their back, their upper parts, their lower limbs, their buttocks and groin, and to effectively use the towel for drying purposes. Advanced modules of cognition, sensing, context awareness and actuation will be developed and seamlessly integrated into the service robotics system to enable the robotic bathing system to adapt to the frail elderly population' capabilities and the frail elderly to interact in a master-slave mode, thus, performing bathing activities in an intuitive and safe way. Adaptation and integration of state-of-the-art, cost-effective, soft-robotic manipulators will provide the hardware constituents, which, together with advanced human-robot force/compliance control that will be developed within the proposed project, will form the basis for a safe physical human-robot interaction that complies with the most up-to-date safety standards. Human behavioural, sociological, safety, ethical and acceptability aspects, as well as financial factors related to the proposed service robotic infrastructure will be thoroughly investigated and evaluated so that the I-SUPPORT end result is a close-to-market prototype, applicable to realistic living settings.

### 8.3.1.3. *MOBOT*

Title: Intelligent Active MObility Aid RoBOT integrating Multimodal Communication

Programm: FP7

Duration: February 2013 - January 2016

Coordinator: Technische Universität München

Partners:

Bartłomiej Marcin Stanczyk (Poland)

Athena Research and Innovation Center in Information Communication & Knowledge Technologies (Greece)

Bethanien Krankenhaus - Geriatisches Zentrum - Gemeinnützige (Germany)

Diaplasia Rehabilitation Center (Greece)

Ecole Centrale des Arts et Manufactures (France)

Technische Universitaet Muenchen (Germany)

Ruprecht-Karls-Universitaet Heidelberg (Germany)

Inria contact: Iasonas Kokkinos

Mobility disabilities are prevalent in our ageing society and impede activities important for the independent living of elderly people and their quality of life. The MOBOT project aims at supporting mobility and thus enforcing fitness and vitality by developing intelligent active mobility assistance robots for indoor environments that provide user-centred, context-adaptive and natural support. Our driving concept envisions cognitive robotic assistants that act (a) proactively by realizing an autonomous and context-specific monitoring of human activities and by subsequently reasoning on meaningful user behavioural patterns, as well as (b) adaptively and interactively, by analysing multi-sensory and physiological signals related to gait and postural stability, and by performing adaptive compliance control for optimal physical support and active fall prevention. Towards these targets, a multimodal action recognition system will be developed to monitor, analyse and predict user actions with a high level of accuracy and detail. The main thrust of our approach will be the enhancement of computer vision techniques with modalities such as range sensor images, haptic information as well as command-level speech and gesture recognition. Data-driven multimodal human behaviour analysis will be conducted and behavioural patterns will be extracted. Findings

will be imported into a multimodal human-robot communication system, involving both verbal and nonverbal communication and will be conceptually and systemically synthesised into mobility assistance models taking into consideration safety critical requirements. All these modules will be incorporated in a behaviour-based and context-aware robot control framework. Direct involvement of end-user groups will ensure that actual user needs are addressed. Finally, user trials will be conducted to evaluate and benchmark the overall system and to demonstrate the vital role of MOBOT technologies for Europe's service robotics.

#### 8.3.1.4. RECONFIG

Type: FP7

Defi: Cognitive Systems and Robotics

Instrument: Specific Targeted Research Project

Objectif: Cognitive Systems and Robotics

Duration: February 2013 - January 2016

Coordinator: Dimos Dimarogonas

Partner: KTH (SE)

Inria contact: Iasonas Kokkinos

The RECONFIG project aims at exploiting recent developments in vision, robotics, and control to tackle coordination in heterogeneous multi-robot systems. Such systems hold promise for achieving robustness by leveraging upon the complementary capabilities of different agents and efficiency by allowing sub-tasks to be completed by the most suitable agent. A key challenge is that agent composition in current multi-robot systems needs to be constant and pre-defined. Moreover, the coordination of heterogeneous multi-agent systems has not been considered in manipulative scenarios. We propose a reconfigurable and adaptive decentralized coordination framework for heterogeneous multiple & multi-DOF robot systems. Agent coordination is held via two types of information exchange: (i) at an implicit level, e.g., when robots are in contact with each other and can sense the contact, and (ii) at an explicit level, using symbols grounded to each embodiment, e.g., when one robot notifies one other about the existence of an object of interest in its vicinity.

#### 8.3.1.5. Strategie

Title: Statistically Efficient Structured Prediction for Computer Vision and Medical Imaging

Programm: FP7

Duration: January 2014 - December 2017

Coordinator: Inria

Inria contact: Matthew Blaschko

'Inference in medical imaging is an important step for disease diagnosis, tissue segmentation, alignment with an anatomical atlas, and a wide range of other applications. However, imperfections in imaging sensors, physical limitations of imaging technologies, and variation in the human population mean that statistical methods are essential for high performance. Statistical learning makes use of human provided ground truth to enable computers to automatically make predictions on future examples without human intervention. At the heart of statistical learning methods is risk minimization - the minimization of the expected loss on a previously unseen image. Textbook methods in statistical learning are not generally designed to minimize the expected loss for loss functions appropriate to medical imaging, which may be asymmetric and non-modular. Furthermore, these methods often do not have the capacity to model interdependencies in the prediction space, such as those arising from spatial priors, and constraints arising from the volumetric layout of human anatomy. We aim to develop new statistical learning methods that have these capabilities, to develop efficient learning algorithms, to apply them to a key task in medical imaging (tumor segmentation), and to prove their convergence to optimal predictors. To achieve this, we will leverage the structured prediction framework, which has shown impressive empirical results on a wide range

of learning tasks. While theoretical results giving learning rates are available for some algorithms, necessary and sufficient conditions for consistency are not known for structured prediction. We will consequently address this issue, which is of key importance for algorithms that will be applied to life critical applications, e.g. segmentation of brain tumors that will subsequently be targeted by radiation therapy or removed by surgery. Project components will address both theoretical and practical issues.'

## **8.4. International Initiatives**

### **8.4.1. Inria International Partners**

#### *8.4.1.1. Informal International Partners*

- University of Oxford – Collaborative research with Andrea Vedaldi. Collaboration Topic: Deep Learning for Texture Recognition.
- Google Research – Collaborative research with George Papandreou. Collaboration Topic: Deep Learning for Semantic Segmentation.
- Universitat Polytechnical de Catalunya – Collaborative research with Francesc Moreno. Collaboration Topic: Deep Learning for Image Descriptors.
- Ecole Polytechnique Federale de Lausanne (EPFL) – Collaborative research with Eduard Trulls. Collaboration Topic: Deep Learning for Image Descriptors.
- University of California at Los Angeles – Collaborative research with Alan Yuille. Collaboration Topic: Deep Learning for Semantic Segmentation.
- University of Massachusetts at Amherst – Collaborative research with Subhansu Maji. Collaboration Topic: Deep Learning for Texture Recognition.
- Ryerson University – Collaborative research with Kostas Derpanis. Collaboration Topic: Deep Learning for Learning Segmentation.
- Ecole Polytechnique de Montreal - Collaborative research with Samuel Kadoury. Collaboration Topic: Multi-atlas co-segmentation, co-registration.
- University of Pennsylvania - Collaborative research with Aristeidis Sotiras. Collaboration Topic: Higher Order Graphs in biomedical image analysis.

## **8.5. International Research Visitors**

### **8.5.1. Visits of International Scientists**

- Angst, Roland. Max Planck Center for Visual Computing and Communication, GE (April 2015)
- Professor Maragos, Petros: Technical University of Athens, GR (13-20 November 2015)

## M3DISIM Team

# 9. Partnerships and Cooperations

## 9.1. European Initiatives

### 9.1.1. FP7 & H2020 Projects

#### 9.1.1.1. VPH-Share

Title: Virtual Physiological Human: Sharing for Healthcare – A Research Environment

Programm: FP7

Duration: March 2011 - May 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/>

Inria contact: Dominique Chapelle

Abstract: VPH-Share (concluded in May 2015) aimed at developing the organisational fabric (the infostructure) and integrating the optimised services to expose and share data and knowledge, to jointly develop multiscale models for the composition of new VPH workflows, and to facilitate collaborations within the VPH community. Within this project, the M3DISIM team was in charge of developing some high-performance data assimilation software tools.

#### 9.1.1.2. VP2HF

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

Programm: FP7

Duration: October 2013 - September 2016

Coordinator: King's College London (UK)

See also: <http://vp2hf.eu/>

Inria contact: Dominique Chapelle

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.

## 9.2. International Initiatives

### 9.2.1. Participation In other International Programs

M3DISIM is the leading representative of Inria within the “Living Heart Project”, a research network coordinated by Dassault-Systèmes to foster collaborations on cardiac modeling between various academic and industrial partners.

## 9.3. International Research Visitors

### 9.3.1. Visits of International Scientists

#### 9.3.1.1. Internships

Alexandre Laurin [Simon Fraser Univ., Canada] Sébastien Imperiale [correspondant] Philippe Moireau Dominique Chapelle Gabriel Valdes Alonzo [Pontificia Univ. Católica de Chile] Radomir Chabiniok [correspondant] Dominique Chapelle

A. Laurin's doctoral internship (2 months) has taken place in the context of an ongoing collaboration between the Aerospace Physiology lab (Simon Fraser University, Vancouver, Canada) and Inria (M3DISIM and Reo teams), with the objective of initiating the modelling of seismocardiography (SCG) measurements. SCG consists in measuring displacements of the sternum and ribs generated by a heart beat using accelerometers placed on the thorax. In this context, linear elastodynamics equations are applicable to account for the transient propagation of motion from the heart to the sternum via the highly heterogeneous underlying materials (cartilage and bone). Specific care has been taken to solve the aforementioned equation in a realistic 3D geometry including the complete thoracic cage. Fully coupled simulations (beating heart with thorax deformation) are planned at the final stage of this modelling work. Following the completion of his PhD, A. Laurin has joined the team for a post-doc, which provides the setting for continuing and extending this work.

G. Valdes (Master's student at Pontificia Univ. Católica de Chile) has been awarded a Conicyt funding for a 3 months internship within our team. He has worked on a simplified dynamical model of venous return, allowing to account for the evolution of the preload – the pressure that induces the filling of the heart – under the effect of variations of cardiac output. This is crucial for simulating sequences of heartbeats in transient regimes, and one major motivation for this was to initiate the modeling of the dynamics of heart failure.

## PARIETAL Project-Team

# 9. Partnerships and Cooperations

## 9.1. Regional Initiatives

### 9.1.1. *iConnectom project*

**Participants:** Bertrand Thirion [Correspondant], Gaël Varoquaux, Elvis Dohmatob.

This is a Digiteo project (2014-2017).

Mapping brain functional connectivity from functional Magnetic Resonance Imaging (MRI) data has become a very active field of research. However, analysis tools are limited and many important tasks, such as the empirical definition of brain networks, remain difficult due to the lack of a good framework for the statistical modeling of these networks. We propose to develop population models of anatomical and functional connectivity data to improve the alignment of subjects brain structures of interest while inferring an average template of these structures. Based on this essential contribution, we will design new statistical inference procedures to compare the functional connections between conditions or populations and improve the sensitivity of connectivity analysis performed on noisy data. Finally, we will test and validate the methods on multiple datasets and distribute them to the brain imaging community.

### 9.1.2. *SUBSAMPLE Digiteo chair*

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

Parietal is associated with this Digiteo Chair by Dimitris Samaras, in which we will address the probabilistic structure learning of salient brain states (PhD of Alexandre Abraham, 2012-2015).

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

### 9.1.3. *Medilearn/braincodes Inria-MSR project*

**Participants:** Bertrand Thirion [Correspondant], Gaël Varoquaux, Andrés Hoyos Idrobo.



Neuroimaging is accumulating large functional MRI datasets that display –among artefacts and noise– brain activation patterns giving access to a meaningful representation of brain spatial organization. This ongoing accumulation is intensified via new large-scale international initiatives such as the *Human Connectome Project* ([www.humanconnectomeproject.org](http://www.humanconnectomeproject.org)), but also to existing open repositories of functional neuroimaging datasets (<https://openfmri.org/>) or <http://www.fmridc.org/>. These datasets represent a very significant resource for the community, but require new analytic approaches in order to be fully exploited. The MediLearn/BrainCodes project strives to provide a synthetic picture of the brain substrate of human cognition and its pathologies. In practice, this can be achieved by learning from large-scale datasets a brain atlas that summarizes adequately these functional activation maps drawing from a large number of protocols and subjects. Once learned, such an atlas is extremely useful to understand the large-scale functional organization of the brain: it is a tool for understanding *brain segregation*, the different encoding of many cognitive parameters into different brain regions, as well as *brain integration*, *i.e.* how remote brain regions co-activate across subjects and experiments.

## 9.2. National Initiatives

### 9.2.1. ANR

#### 9.2.1.1. BrainPedia project

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

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 loses 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.

#### 9.2.1.2. NiConnect project

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

- **Context:** The NiConnect project (2012-2016) arises from an increasing need of medical imaging tools to diagnose efficiently brain pathologies, such as neuro-degenerative and psychiatric diseases or lesions related to stroke. Brain imaging provides a non-invasive and widespread probe of various features of brain organization, that are then used to make an accurate diagnosis, assess brain rehabilitation, or make a prognostic on the chance of recovery of a patient. Among different measures extracted from brain imaging, functional connectivity is particularly attractive, as it readily probes the integrity of brain networks, considered as providing the most complete view on brain functional organization.
- **Challenges:** To turn methods research into popular tool widely usable by non specialists, the NiConnect project puts specific emphasis on producing high-quality open-source software. NiConnect addresses the many data analysis tasks that extract relevant information from resting-state fMRI datasets. Specifically, the scientific difficulties are *i)* conducting proper validation of the models and tools, and *ii)* providing statistically controlled information to neuroscientists or medical doctors. More importantly, these procedures should be robust enough to perform analysis on limited quality data, as acquiring data on diseased populations is challenging and artifacts can hardly be controlled in clinical settings.
- **Outcome of the project:** In the scope of computer science and statistics, NiConnect pushes forward algorithms and statistical models for brain functional connectivity. In particular, we are investigating structured and multi-task graphical models to learn high-dimensional multi-subject brain connectivity models, as well as spatially-informed sparse decompositions for segmenting structures from

brain imaging. With regards to neuroimaging methods development, NiConnect provides systematic comparisons and evaluations of connectivity biomarkers and a software library embedding best-performing state-of-the-art approaches. Finally, with regards to medical applications, the NiConnect project also plays a support role in on going medical studies and clinical trials on neurodegenerative diseases.

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

## 9.3. European Initiatives

### 9.3.1. FP7 & H2020 Projects

#### 9.3.1.1. HBP

Title: The Human Brain Project

Programm: FP7

Duration: October 2013 - April 2016

Coordinator: EPFL

Partners: See <https://www.humanbrainproject.eu/fr/discover/the-community/partners>

Inria contact: Olivier Faugeras

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 diseases and build revolutionary new computing technologies. Today, for the first time, modern ICT has brought these goals within sight. The goal of the Human Brain Project, part of the FET Flagship Programme, is to translate this vision into reality, using ICT as a catalyst for a global collaborative effort to understand the human brain and its diseases and ultimately to emulate its computational capabilities. The Human Brain Project will last ten years and will consist of a ramp-up phase (from month 1 to month 36) and subsequent operational phases.

This Grant Agreement covers the ramp-up phase. During this phase the strategic goals of the project will be to design, develop and deploy the first versions of six ICT platforms dedicated to Neuroinformatics, Brain Simulation, High Performance Computing, Medical Informatics, Neuromorphic Computing and Neurorobotics, and create a user community of research groups from within and outside the HBP, set up a European Institute for Theoretical Neuroscience, complete a set of pilot projects providing a first demonstration of the scientific value of the platforms and the Institute, develop the scientific and technological capabilities required by future versions of the platforms, implement a policy of Responsible Innovation, and a programme of transdisciplinary education, and develop a framework for collaboration that links the partners under strong scientific leadership and professional project management, providing a coherent European approach and ensuring effective alignment of regional, national and European research and programmes. The project work plan is organized in the form of thirteen subprojects, each dedicated to a specific area of activity. A significant part of the budget will be used for competitive calls to complement the collective skills of the Consortium with additional expertise.

## 9.4. International Initiatives

### 9.4.1. Inria International Labs

Inria@SiliconValley

Associate Team involved in the International Lab:

#### *9.4.1.1. MetaMRI*

Title: Machine learning for meta-analysis of functional neuroimaging data

International Partner (Institution - Laboratory - Researcher):

Stanford (United States) - Department of Psychology - Russ Poldrack

Start year: 2015

See also: <https://team.inria.fr/metamri>

Neuroimaging produces huge amounts of complex data that are used to better understand the relations between brain structure and function. Observing that the neuroimaging community is still largely missing appropriate tools to store and organize the knowledge related to the data, Parietal team and Poldrack's lab, have decided to join forces to set up a framework for functional brain image meta-analysis, i.e. a framework in which several datasets can be jointly analyzed in order to accumulate information on the functional specialization of brain regions. MetaMRI will build upon Poldrack's lab expertise in handling, sharing and analyzing multi-protocol data and Parietal's recent developments of machine learning libraries to develop a new generation of meta-analytic tools.

## **9.5. International Research Visitors**

### *9.5.1. Visits of International Scientists*

Danilo Bzdok (Forschungszentrum Jülich and University of Aachen) visited Parietal several months in 2015 (January- December), to develop collaborations on the use of machine learning techniques to model behavioral variables and find data-driven characterization of brain diseases.

#### *9.5.1.1. Internships*

- Jacob Schreiber (Univ. Washington), went for an internship (June-September) to develop fast methods for three-based regression with Scikit-Learn.
- Giorgio Patrini (Australian National University) developed some tools for online learning during his internship (July-November) in Scikit-Learn.
- Daniel Alcalá Lopez (Univ. Aachen) joined us for a three month internship to discover the use of machine learning for neuroimaging in psychiatry (June-September 2015).

## POPIX Team

# 9. Partnerships and Cooperations

## 9.1. European Initiatives

### 9.1.1. FP7 & H2020 Projects

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

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

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

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

Duration: 2010 - 2016

Project members: Uppsala Universitet, Sweden; University of Navarra, Spain; Universiteit Leiden, Netherlands; Université Paris Diderot, France; Università degli Studi di Pavia, Italy; UCB Pharma, Belgium; Simcyp, UK; Pfizer, UK; Optimata, Israel; Novo Nordisk, Denmark; Novartis, Switzerland; Merck Serono, Switzerland; Takeda, Switzerland; Mango Business Solutions, UK; Lixoft, France; Interface Europe, Belgium; Institut de Recherches Internationales Servier, France; Inria, France; GlaxoSmithKline Research and Development, UK; Freie Universität 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.

## 9.2. International Initiatives

### 9.2.1. Inria International Partners

#### 9.2.1.1. Informal International Partners

POPIX has a collaboration with the Faculty of Pharmacy of Manchester University (UK).

POPIX is Adjunct Professor at the Faculty of Pharmacy of Florida University (USA).

POPIX is Adjunct Professor at the Faculty of Pharmacy of Buffalo University (USA).

### 9.2.2. Participation In other International Programs

Indo French Centre for the promotion of advanced research (CEFIPRA): Marc Lavielle was invited to participate to the the IFCAM Workshop in Statistics in Bangalore (July 2015).

## INFINE Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

### 8.1.1. LiveGrid

**Participants:** Cedric Adjih, Emmanuel Baccelli.

Infine is one of the teams from Inria participating to LiveGrid: LiveGrid is a consortium of the main actors of industry, research organisations, local authorities and competitive cluster from the Paris-Saclay campus. The goal of LiveGrid is make the Paris-Saclay campus one of the leader regions of smart grids. Infine expertise is in infrastructure: testbeds, communication protocols, embedded open source OS.

## 8.2. National Initiatives

### 8.2.1. Equipex FIT

**Participants:** Cedric Adjih, Emmanuel Baccelli, Ichrak Amdouni, Alaeddine Weslati, Vincent Ladeveze.

Partners: Inria (Lille, Sophia-Antipolis, Grenoble), INSA, UPMC, Institut Telecom Paris, Institut TÃ©lÃ©com Evry, LSIIT Strasbourg.

FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It provides this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project gives french internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the future internet. FIT was one of 52 winning projects from the first wave of the French Ministry of Higher Education and Researchâ€™s "Ã©quipements dâ€™excellence" (Equipex) research grant program, in 2011.

One component of the FIT platform is the sets of IoT-LAB testbeds (see [site IoT-LAB](#)). These were motivated by the observation that the world is moving towards an "Internet of Things", in which most communication over networks will be between objects rather than people.

The Infine team is more specifically managing the FIT IoT-LAB site formerly at Rocquencourt, which recently moved to Saclay (on-going re-deployment), and is participating in the deployment of an additional IoT-lab testbed in Berlin (at Freie Universitaet Berlin).

The Infine team is actively collaborating with UPEC on wireless sensor network testbeds (and protocols): in 2015, the testbed from UPEC with 45 Arduino nodes has been [integrated with the FIT IoT-LAB testbed](#).

## 8.3. European Initiatives

### 8.3.1. FP7 & H2020 Projects

#### 8.3.1.1. AGILE (H2020 project)

**Participants:** Emmanuel Baccelli, Cedric Adjih.

Program: H2020 ICT-30-2015 Topic: Internet of Things and Platforms for Connected Smart Objects

Project acronym: AGILE

Project title: Adoptive Gateways for dIverse muLtipLe Environments

Duration: 2015-2017

Coordinator: Emmanuel Baccelli

Other partners: Canonical (UK), Eclipse IoT Foundation (IE), Mobistar (BE), Libelium (ES), Startupbootcamp IoT (SP), CREATE-NET (IT), iMinds (BE), Atos (SP), Rulemotion (UK), Jolocom (DE), Passau University (DE), Sky-Watch (DN), BioAssist (GR), Graz Technical University (AT), Eurotech (IT), IoTango (US).

Abstract:

The AGILE project is a 3-year H2020 project started in January 2016, which will deliver an integrated framework of open source tools and platforms that interoperate for enabling the delivery of adaptive, self-configurable and secure IoT elements (both software and hardware) that can be utilized in a variety of scenarios. Such tools target actors with heterogeneous skills, including entrepreneurs, researchers, and individuals, aiming to enable the realization of IoT applications respecting user privacy and data ownership.

### 8.3.2. Collaborations in European Programs, except FP7 & H2020

#### 8.3.2.1. EU CHIST-ERA MACACO

**Participants:** Aline Carneiro Viana, Emmanuel Baccelli, Eduardo Mucelli.

Program: EU CHIST-ERA, topic Context- and Content-Adaptive Communication Networks

Project acronym: MACACO

Project title: Mobile context-Adaptive Caching for Content-centric networking

Duration: 2013-2016

Coordinator: Aline Carneiro Viana

Other partners: INPT-ENSEEIH at University of Toulouse, University of Birmingham (UK), SUPSI (Switzerland), CNR (Italy) and Federal University of Minas Gerais (Brazil)

Abstract:

MACACO (Mobile context-Adaptive Caching for Content-centric networking) is a 3-year CHIST-ERA European Project addressing the topic Context- and Content-Adaptive Communication Networks. It is funded by ANR in France, SNSF in Switzerland, and ESPRC in UK. It focus on data offloading mechanisms that take advantage of context and content information. Our intuition is that if it is possible to extract and forecast the behaviour of mobile network users in the threedimensional space of time, location and interest (i.e. *what*, *when* and *where* users are pulling data from the network), it is possible to derive efficient data offloading protocols. Such protocols would pre-fetch the identified data and cache it at the network edge at an earlier time, preferably when the mobile network is less charged, or offers better quality of service. This project has officially started in November 2013. The first annual report will be delivered before January 25, 2015.

#### 8.3.2.2. ANR/BMBF SAFEST

**Participants:** Emmanuel Baccelli, Cedric Adjih, Oliver Hahn.

Program: ANR/BMBF French-German partnership within CSOSG Framework

Project acronym: SAFEST

Project title: Social Area Framework for Early Security Triggers

Duration: 2012-2015

Coordinators: Emmanuel Baccelli (France), Jochen Schiller (Germany)

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

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

reliable methods for area surveillance. The SAFEST project aims to analyse the social context of area surveillance and to develop a system that can fulfill this task, both in terms of technology as well as acceptance by the general public. The system will operate in distributed way, collect anonymised data, securely transfer this data to a central location for evaluation, and if necessary notify the operator and/or issue alerts directly to the general public. SAFEST addresses the following topics: (i) it proposes a solution for crisis management, addressing social, technical, and economic issues, (ii) it enhances the protection of the population against risks and dangers, including the evaluation of acceptance of said solution, and (iii) it addresses the protection of critical infrastructures by the means of a comprehensive technical solution. Project completed in 2015. One of its main result was the emergence of RIOT.

## 8.4. International Initiatives

### 8.4.1. Inria International Partners

#### 8.4.1.1. Declared Inria International Partners

1. On-going formal collaboration with Freie Universitaet Berlin around the long-term stay of Emmanuel Baccelli in Berlin, around the topics of the Internet of Things and Information-Centric Networking.
2. The Inria teams Infine and Eva are part of the "D2D Communication for LTE Advanced Cellular Network" , a project funded by the Indo-French Centre for the Promotion of Advanced Research (CEFIPRA). With industrial partners, and also with Indian partners, this project is focusing on the evolution of cellular networks towards 5G: this includes exploration of device-to-device (D2D) communication, and more generally IoT communication in a cellular context. Research directions include efficient access for IoT devices (massive numbers of devices with low volume communication); combination of random access protocols/error coding/physical layer ; efficient neighbor discovery, ldots.

#### 8.4.1.2. Informal International Partners

1. On-going collaboration with Hamburg University of Applied Science around RIOT.
2. Informal collaborations with UIUC and UMass.

### 8.4.2. Participation In other International Programs

#### 8.4.2.1. STIC AmSud UCOOL

**Participants:** Aline Carneiro Viana, Eduardo Mucelli.

Program: STIC AmSud

Project acronym: UCOOL

Project title: Understanding and predicting human demanded Content and mObiLity

Duration: 2013-2015

Coordinator: Aline Carneiro Viana

Other partners: National Laboratory for Scientific Computing (Brazil), Facultad de IngenierÃ- a, Universidad de Buenos Aires (Argentina), Universidad Tecnica Federico Santa Maria (Chile), Telecom Sud Paris, and Inria (with INFINE at Saclay and DANTE at Rhone-Alpes)

Abstract: The UCOOL (Understanding and predicting human demanded Content and mObiLity, <https://macaco.inria.fr/>) project is granted by STIC-AmSUD, it is a 2-year project, and has officially started in January 2014. The main goal of this project is to define solutions for the identification and modelling of correlations between the user mobility â describing changes in the user positioning and the current environment he/she is in â and the traffic demand he/she generates.

#### 8.4.2.2. PHC PESSOA 2015

**Participant:** Aline Carneiro Viana.

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PHC PESSOA 2015 with University of Coimbra (2015-2016).

Program: -FCT - Programa PESSOA

Project title: Routine-based Enhanced Connectivity under User Mobility

Duration: 2015-2016

Coordinator: Aline Carneiro Viana and João Paulo da Silva Machado Garcia Vilela (University of Coimbra)

Abstract: The main goal of this project is to improve WiFi connectivity of users under mobility. The steady growth of smart-phones usage has put cellular networks under great strain, justifying the need for WiFi offloading as a solution that transfers part of the demand on cellular networks to WiFi hotspots that are in many cases already available. However, this must be performed in a way that provides benefits to the cellular operator while ensuring users a similar level of connectivity that they would achieve with cellular networks, even under user mobility (e.g. walking, taking a bus/train, etc). In this work we aim at (1) developing prediction mechanisms for selection of best hotspots by users under mobility, and (2) develop lightweight security schemes to reduce the burden of the association/authentication process of WiFi networks, therefore making WiFi offloading an effective and secure alternative to the growing demand on cellular networks.

## 8.5. International Research Visitors

### 8.5.1. Visits of International Scientists

1. Artur Ziviani, National Laboratory for Scientific Computing (LNCC), Brazil, October 2015.
2. José Ignacio Alvarez-Hamelin, Facultad de Ingeniería, Universidad de Buenos Aires, Argentina, November 2015.
3. Joao P. Vilela, University of Coimbra, July 2015

### 8.5.2. Visits to International Teams

#### 8.5.2.1. Research stays abroad

**Emmanuel Baccelli** has been visiting Freie Universitaet (FU) Berlin in 2015, within the context of the SAFEST project. The closer collaboration enabled by this stay allowed the initial development of the RIOT community (<http://www.riot-os.org>), and the development of new activities around Information-centric networking in the Internet of Things.



## AVIZ Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

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

**Participants:** Petra Isenberg [correspondant], Jean-Daniel Fekete, Pierre Dragicevic, Pascal Goffin.

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 three partners: LSIIIT/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) and BIOEMERGENCE-IMAGIF, the “valorisation” department of CNRS Gif s/Yvette. Valorisation will take place in strong collaboration with UNISTRA VALO, the valorisation structure of Université de Strasbourg. The project started on October 1st, 2012, for 2 years. AVIZ is in charge of developing new visualisation tools adapted to the monitoring of the optimization process.

## 8.2. European Initiatives

### 8.2.1. FP7 & H2020 Projects

#### 8.2.1.1. CENDARI

Title: Collaborative European Digital/Archival Infrastructure

Programm: FP7

Duration: February 2012 - January 2016

Coordinator: Trinity College - Dublin

**Partners:**

Consortium of European Research Libraries (United Kingdom)  
 Koninklijke Bibliotheek (Netherlands)  
 Fondazione Ezio Franceschini Onlus (Italy)  
 Freie Universitaet Berlin (Germany)  
 King's College London (United Kingdom)  
 "matematicki Institutnu, Beograd" (Serbia)  
 Narodni Knihovna Ceske Republiky (Czech Republic)  
 Societa Internazionale Per Lo Studio Del Medioevo Latino-S.I.S.M.E.L.Associazione (Italy)  
 The Provost Fellows & Scholars of The College of The Holy and Undivided Trinity of Queen Elizabeth Near Dublin (Ireland)  
 Georg-August-Universitaet Goettingen Stiftung Oeffentlichen Rechts (Germany)  
 Universitaet Stuttgart (Germany)  
 The University of Birmingham (United Kingdom)  
 Universita Degli Studi di Cassino E Del Lazio Meridionale (Italy)

Inria contact: Jean-Daniel Fekete & Lauerent Romary

'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.'

### **8.2.2. Collaborations with Major European Organizations**

We collaborate with several larger European research organizations, such as:

Fraunhofer Institute, IGD (DE)

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

University of Stuttgart, Visualization Center (DE)

We are collaborating on the development of a comprehensive visualization publication dataset  
 Technical University of Vienna, Visualization Research Group (AT)

We are collaborating on a project to derive major visualization domain keywords and collaborating on projects and workshops related to the evaluation of visualization.

## **8.3. International Initiatives**

### **8.3.1. Inria International Partners**

#### *8.3.1.1. Declared Inria International Partners*

- We hosted a visiting PhD student as part of the Inria-Mitacs collaboration.
- AVIZ collaborates with several researchers from Microsoft Research Redmond, in particular on the topic of new interactions for information visualization and brain connectivity visualization.

#### *8.3.1.2. Informal International Partners*

- Arizona State University, USA
- University of Groningen, the Netherlands
- University of Granada, Spain
- New York University, USA
- Harvard University, USA
- Google, USA

## **8.4. International Research Visitors**

### **8.4.1. Visits of International Scientists**

- Teresa Onorati, PostDoc at the University of Madrid visited us for three months.

#### *8.4.1.1. Internships*

- Paul Lapides and Alice Thudt visited from the University of Calgary, Canada.

### **8.4.2. Visits to International Teams**

#### *8.4.2.1. Sabbatical programme*

Fekete Jean-Daniel

Date: Jan 2015 - Dec 2015

Institution: **NYU** (United States) and Harvard University (United States)

## DAHU Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### 8.1.1. ANR

Acronym: PRODAQ

Title: Proof systems for Data Queries

Coordinator: Sylvain Schmitz

Duration: January 2015 – September 2019

Abstract: The project aims at developing proof systems for data logics. It is at the interface between several research communities in database theory, infinite-state system verification and proof theory. The main thrust behind the project is the investigation of proof-theoretic tools for data logic, using in particular insights from substructural logics, and using counter systems as a means to obtain algorithms and complexity results.

## 8.2. European Initiatives

### 8.2.1. MEALS

Title: Mobility between Europe and Argentina applying Logics to Systems

Programm: FP7

Duration: October 2011 - September 2015

Coordinator: Université de la sarre

Partners:

Imperial College of Science, Technology and Medicine (United Kingdom)

Rheinisch-Westfaelische Technische Hochschule Aachen (Germany)

Technische Universiteit Eindhoven (Netherlands)

Technische Universitaet Dresden (Germany)

University of Leicester (United Kingdom)

Universitaet Desarlandes (Germany)

Inria contact: Castuscia Palamidessi

Computing systems are getting ever more ubiquitous, making us dependent on their proper functioning. Therefore we require that they are correct (i.e. they conform their intended behavior), safe (i.e. its operation does not have catastrophic consequences), reliable, available to provide the intended service, and secure (i.e., no user without appropriate clearance can access or modify protected data). Guarantees for such characteristics rely on rigid specification and analysis techniques for both the required system functionality as well as its behavior. Formal methods provide a mathematical approach to model, understand, and analyze systems, especially at early development stages. 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). The MEALS project includes five tightly interconnected thematic work packages. They focus on quantitative analysis of concurrent program behaviour (WP1), reasoning tasks for specification and verification (WP2), security and information

flow properties (WP3), synthesis in model-based systems engineering (WP4) and foundations for the elaboration and analysis of requirements specifications (WP5). The crosscutting concern of all these work packages is the development of formal techniques for the specification, verification and synthesis of dependable ubiquitous computing systems. Five carefully planned MEALS gatherings and workshops give the project an effective structure for knowledge transfer, community building, and result dissemination, aimed at a sustained transcontinental collaboration.

### **8.3. International Research Visitors**

#### ***8.3.1. Visits of International Scientists***

Victor Vianu, June 1st till December 31st, UC San diego

#### ***8.3.2. Visits to International Teams***

##### ***8.3.2.1. Research stays abroad***

Sylvain Schmitz visited the University of Warwick for six months thanks to a grant by the Leverhulme Trust, from February 1st to July 31st, 2015.

## EX-SITU Team

# 9. Partnerships and Cooperations

## 9.1. Regional Initiatives

### 9.1.1. *DigiPods – Remote Collaborative Interaction among Heterogeneous Visualization Platforms*

Type: CESAME equipment grant

Funding: Région Île-de-France

Duration: 2012-2015

Coordinator: Stéphane Huot

Partners: Digiteo/FCS Campus Paris-Saclay, Univ. Paris-Sud, Inria, CNRS, CEA, Telecom Paris-Tech

Abstract: The goal is to design new interactive equipment 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), we are creating new devices to facilitate co-located or remote interaction and collaboration: telepresence robots and Digicarts, mobile hubs that gather interaction and communication devices. This equipment will be used by Human-Computer Interaction researchers to explore the visualization and manipulation of large datasets, interaction in virtual reality, and remote collaboration among heterogeneous platforms. Researchers and professionals in other fields will also be able to use DigiPods to explore and manipulate complex datasets.

### 9.1.2. *DigiCarts – Remote Collaborative Interaction Devices for Heterogeneous Visualization Platforms*

Type: Post-doctoral fellowship

Funding: Digiteo research network

Duration: 2013-2015

Coordinator: Stéphane Huot

Partners: Univ. Paris-Sud, Inria, CNRS, CEA, Telecom ParisTech

Abstract: This grant complements the DigiPods project with funding for a 18-month post-doctoral position focused on the design, implementation and evaluation of the DigiCart devices. This project funded Joe Malloch, a post-doctoral fellow who received his Ph.D. from McGill University.

### 9.1.3. *DigiZoom – Multiscale navigation: from mobile devices to collaborative wall-sized displays*

Type: Ph.D. grant

Funding: Digiteo network

Duration: 2012-2015

Coordinator: Olivier Chapuis

Partners: Univ. Paris-Sud, Inria, CNRS, Institut Mines-Telecom

Abstract: The goal of the project was to study multiscale navigation on a variety of devices, with an emphasis on large wall-sized displays in the context of the Digiscope project. This requires to properly operationalize the relevant factors in the various tasks that we seek to study. This work led to an award-winning publication at ACM CHI'14 [6], which introduces an abstract classification task to compare the performance of interaction techniques for navigating and manipulating content. This project funded Can Liu, a joint PhD student between the VIA group at Institut Mines-Telecom and InSitu who defended her thesis [10] in december, 2015.

#### **9.1.4. MultiVis – Novel Interaction Models for Multi-surface Visualization**

Type: Ph.D. grant

Funding: DigiCosme Labex

Duration: 2014-2017

Coordinator: James Eagan (Institut Mines Telecom)

Partners: Univ. Paris-Sud, Inria, CNRS, Institut Mines-Telecom

Inria contact: Michel Beaudouin-Lafon

Abstract: The goal of this project is to design, evaluate, and implement novel interaction models that help users appropriate multiple computational surfaces in the sense-making process. Our initial approach is to operationalize and extend the instrumental interaction model to specifically accommodate the specific needs of the sense-making process for information visualization. This project funds Marc-Emmanuel Perrin, a joint PhD student between the VIA group at Institut Mines-Telecom and ExSitu.

#### **9.1.5. MoveIT – Modeling the Speed/Accuracy Trade-Off of Human Aimed Movement with the Tools of Information Theory**

Type: Ph.D. grant

Funding: DigiCosme Labex

Duration: 2015-2018

Coordinator: Olivier Rioul (Institut Mines Telecom)

Partners: Univ. Paris-Sud, Inria, CNRS, Institut Mines-Telecom

Inria contact: Michel Beaudouin-Lafon

Abstract: The goal of this project is to conduct fundamental studies of aimed movements based on information theory. The project studies the interaction phenomena involved in pointing, in order to discover novel, more effective pointing techniques. This project funds Wanyu Liu, a joint Ph.D. student between the COMELEC and VIA groups at Institut Mines Telecom and ExSitu.

#### **9.1.6. SensoMotorCVE – Sensor-motor Interface for Collaborative Virtual Environments with Heterogeneous Devices: Application to Industrial Design**

Type: Ph.D. grant

Funding: DigiCosme Labex

Duration: 2014-2017

Coordinator: Patrick Bourdot (LIMSI-CNRS)

Partners: Univ. Paris-Sud, Inria, CNRS

Inria contact: Cédric Fleury

Abstract: In the context of collaborative virtual environments, the goal of this project is to develop a sensorimotor interface model for CAD data manipulation that supports heterogeneous interactive systems such as wall-sized displays or immersive virtual reality rooms. This project funds Yujiro Okuya, a joint Ph.D. student between the VENISE group at LIMSI and ExSitu.

### 9.1.7. *La Grande Vitrine des Choses*

Type: Art-science grant

Funding: IDEX Paris-Saclay

Duration: 2015-2016

Coordinators: Michel Beaudouin-Lafon & Wendy Mackay

Partners: Univ. Paris-Sud, Inria, CNRS, Theater group  $n + 1$

Abstract: Art-science project funded by "La Diagonale Paris-Saclay" to create, in collaboration with the theater group "n+1", an interactive store front in the form of an advent calendar, where users must discover which gestures to perform in order make an animated character open the next window. This installation raises the question of who is controlling whom: Participants think that their gestures directly control the character, but the system actually uses shaping techniques from experimental psychology that encourage users to make successive approximations to the correct gesture. The installation will be active during the month of December, 2016 in the Evry shopping mall, next to the Agora Theater. A prototype will also be shown during the Fête de la Science on the Plateau de Saclay in October, 2016.

## 9.2. National Initiatives

### 9.2.1. ANR

#### 9.2.1.1. *DRAO – Dessin Réaliste Assisté par Ordinateur*

Type: Jeunes Chercheuses - Jeunes Chercheurs

Duration: 2012-2015

Coordinator: Adrien Bousseau (Inria Sophia Antipolis)

Partners: Inria Saclay, Inria Sophia Antipolis

ExSitu contacts: Theophanis Tsandilas, Wendy Mackay

Abstract: The goal of the project was to facilitate and accelerate drawing for amateurs as well as for expert designers and illustrators (<https://www-sop.inria.fr/members/Adrien.Bousseau/drao>). The project explored the following research directions: (1) understanding how professionals draw, (2) automating parts of the drawing process, and (3) teaching people to draw.

### 9.2.2. *Investissements d'Avenir*

#### 9.2.2.1. *Digiscope - Collaborative Interaction with Complex Data and Computation*

Type: EQUIPEX (Equipement d'Excellence)

Duration: 2011-2020

Coordinator: Michel Beaudouin-Lafon

Partners: FCS Paris-Saclay (coordinator), Université Paris-Sud, CNRS, CEA, Inria, Institut Mines-Telecom, 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

Abstract: The goal of the project is to create ten high-end interactive rooms interconnected by high-speed networks and audio-video facilities to support 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. Digiscope includes the existing WILD room, and funded the WILDER room. ExSitu contributes its expertise in the design and evaluation of advanced interaction techniques and the development of distributed software architectures for interactive systems. At the end of 2015, nine of the ten rooms are operational, and the telepresence network is being developed.



### 9.2.3. Institut Universitaire de France

#### 9.2.3.1. The Instrumental Paradigm

Type: IUF senior fellowship

Duration: 2011-2016

Principal investigator: Michel Beaudouin-Lafon

Abstract: Tools or instruments are a natural way to interact with the real world, and can serve as a powerful metaphor to interact with on-line information. An instrument reifies interaction: it turns an interaction into a meaningful object for users, designers and developers. We envision a future where large, monolithic and closed applications are replaced by a rich ecology of instruments and information containers that can interoperate, giving users the power to shape their own environments. Our work on multisurface interaction [2] and Webstrates [18] illustrate this approach.

## 9.3. European Initiatives

### 9.3.1. CREATIV

Type: IDEAS

Instrument: ERC Advanced Grant

Duration: June 2013 - May 2018

Coordinator: Wendy Mackay

Partner: Inria (France)

Inria contact: Wendy Mackay

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

### 9.3.2. Collaborations with Major European Organizations

*EIT Digital 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 Twente (Netherlands), U. College London (UK), U. Trento (Italy). InSitu participates in the Human-Computer Interaction and Design (HCID) major of the EIT Digital European Master School. Paris-Sud is one the sites for the first year of this Master Program, and host one of the specialties for second-year students. Students in this program receive a double degree after studying in two countries. [https://www.dep-informatique.u-psud.fr/en/formation/lmd/M1\\_HCID](https://www.dep-informatique.u-psud.fr/en/formation/lmd/M1_HCID).

## 9.4. International Initiatives

### 9.4.1. Inria Associate Teams not involved in an Inria International Labs

The MidWay Equipe Associée, *Musical Interaction Design Workbench And technology*, was created in collaboration with the Input Devices and Music Interaction Technology (IDML) at the Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT) at McGill University. The Principle investigator from Inria, Stéphane Huot, was promoted to a Research Director position at Inria Lille, so the projet is now based there, but members of ExSitu have continued to collaborate on the project. The NIME paper on evaluation is a first result from this collaboration [14].

## **9.4.2. Inria International Partners**

### *9.4.2.1. Informal International Partners*

We are collaborating with Clemens Klokrose from University of Aarhus, Denmark, on our exploration of information substrates. This resulted in Webstrates [18], which received a best paper award at ACM UIST' 15.

We are working with Shumin Zhai from Google in Mountain View, California, on our project on “expressive keyboards”, which allows users to produce expressive output from “shapewriting” on soft keyboards.

We are working with Professor Bjoern Hartmann from U.C. Berkeley and will be starting an Inria Equipe Associée, called DECIBel, in 2016.

We are working with Professor Jürgen Steimele from the Max Planck Institute for Informatics and Saarland University on paper electronics and have recently recruited one of his students as a Ph.D. candidate, Michael Wesseley.

We are working with Marco Gilles, Rebecca Fiebrink and Atsu Tanaka of Goldsmith's college in London, U.K. on Human-Centred Machine Learning, and will run a workshop together in 2016.

We are working with Kim Halkov and Peter Dalsgaard from Aarhus University, on blended interaction spaces.

## **9.5. International Research Visitors**

### *9.5.1. Visits of International Scientists*

- Joanna McGrenere, Professor at the University of British Columbia, Canada, from August 2015.
- Ana Bernardos, Universidad Politécnica de Madrid, Spain, from September to December 2015.

## ILDA Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

**ScaleGest. Surface Gestures for Advanced Graphical Interfaces: Which Gesture for What.** (2014-2017) Funded by Digiteo. In collaboration with Telecom ParisTech: **109Keuros**. Participants: Caroline Appert (PI), Rafael Morales Gonzalez, Emmanuel Pietriga.

The project aims at designing gesture-based interaction for expert users who navigate and manipulate large datasets. In the context of advanced graphical applications, the number of gestures should be large-enough to cover the set of controls (*i.e.*, commands and parameter settings) but remain simple-enough to avoid exceeding human abilities. Making gesture-based interaction scale with graphical applications' growing complexity can be achieved only by understanding the foundational aspects of this input modality. This project is about characterizing and structuring both the space of application controls and the space of surface gestures in order to establish guidelines for appropriate control-gesture mappings. It is also about the definition of a sound and systematic evaluation methodology that will serve as a reference benchmark for evaluating these mappings. The resulting control-gesture mappings are demonstrated in the specific application domains of cartography and astronomy.

## 8.2. National Initiatives

### 8.2.1. ANR

**MapMuxing - Multi-dimensional Map Multiplexing.** (2014-2018) Funded by the French National Research Agency (ANR). In collaboration with IGN (Institut National de l'Information Géographique et Forestière): **208Keuros/499Keuros**. Participants: Emmanuel Pietriga (PI), Caroline Appert, Olivier Chapuis, María-Jesús Lobo. <http://mapmuxing.ign.fr>

The project explores novel ways of combining different maps and data layers into a single cartographic representation, and investigates novel interaction techniques for navigating in it. The project aims at going beyond the traditional pan & zoom and overview+detail interface schemes, and at designing and evaluating novel cartographic visualizations that rely on high-quality generalization, *i.e.*, the simplification of geographic data to make it legible at a given map scale, and symbol specification.

### 8.2.2. Collaborations with other French Research Organizations

**CorTextViz.** (2015-2016) Funded by INRA (Institut National de la Recherche Agronomique). In collaboration with project-team Aviz at Inria Saclay (Jean-Daniel Fekete) and INRA (Jean-Philippe Cointet, Guy Riba). Interactive visualization of medium-scale multi-level networks, supporting data storytelling on wall displays. Participants: Emmanuel Pietriga (PI), André Spritzer.

## 8.3. European Initiatives

### 8.3.1. Collaborations with Major European Organizations

European Southern Observatory (ESO)

ALMA Operations Monitoring and Control - design and implementation of state-of-the-art interactive visualization components for the operations monitoring and control software that runs the ALMA radio-observatory in Chile.

Deutsches Elektronen-Synchrotron (DESY)

Scientific consulting on the design and implementation of user interfaces for array operations monitoring and control for the Cherenkov Telescope Array (CTA) project, to be built in the Canary Islands (Spain) and in the Atacama desert (Chile).

## **8.4. International Initiatives**

### **8.4.1. Inria International Labs**

Inria Chile / CIRIC. Since 2012, Emmanuel Pietriga is the scientific leader of the Massive Data team at Inria Chile, working on projects in collaboration with the ALMA radio-telescope and the Millenium Institute of Astrophysics.

### **8.4.2. Inria International Partners**

#### *8.4.2.1. Informal International Partners*

Japan Advanced Institute of Science and Technology (JAIST): René Vestergaard on the interactive visualization of complex networks in molecular biology.

Microsoft Research: Nathalie Henry Riche and Bongshin Lee on defining the value of interaction on complex visualization systems. Participants: Anastasia Bezerianos.

Northwestern University: Steven Franconeri and Steve Haroz on understanding the impact of animations on interactive visual exploration. Participants: Anastasia Bezerianos.

University of Konstanz: Daniel Keim and Johannes Fuchs on mapping out the design space for visualization glyphs. Participants: Anastasia Bezerianos.

Universidad Carlos III de Madrid: Teresa Onorati and Paloma Diaz on the visualization of tweet feeds related to crisis events using a wall display, so as to help crisis monitoring and management. Participants: Anastasia Bezerianos, Emmanuel Pietriga.

### **8.4.3. Participation In other International Programs**

Program MIT-France, Hae-Jin Song, summer 2015 (3-month senior student internship).

## **8.5. International Research Visitors**

Steve Feiner, Professor of Computer Science, head of the Computer Graphics and User Interfaces Lab at Columbia University (March 2015).

Deb Agarwal and David Brown, LBNL Computational Research Division, University of California at Berkeley (June 2015).

## OAK Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### 8.1.1. ANR

**Content Management Techniques for Fact-Checking: Models, Algorithms, and Tools (ContentCheck)** is a 4-year project starting in January 2016, supported by ANR under DEFI 7 - Société de l'information et de la communication. The project is coordinated by Ioana Manolescu; Bogdan Cautis and Michaël Thomazo also participate. Other partners are U. Rennes 1, INSA Lyon, Le Monde's fact-checking team, and the LIMSI lab of Université Paris Sud. The project aims at establishing fact-checking as a data management problem, and endow it with the appropriate fundamental models, algorithm and tools, validated in interaction with the journalists.

**Apprentissage Adaptatif pour le Crowdsourcing Intelligent et l'Accès à l'Information (ALICIA)** is a 4-year project, started in February 2014, supported by the ANR CONTINT call. The project is coordinated by Bogdan Cautis, with Nicole Bidoit, and Ioana Manolescu; other partners include LIG (Grenoble) and the Vodkaster company. Its goal is to study models, techniques, and the practical deployment of adaptive learning techniques in user-centric applications, such as social networks and crowdsourcing.

**Cloud-Based Organizational Design (CBOD)** is a 4-year ANR started in 2014, coordinated by prof. Ahmed Bounfour from UNIV. PARIS-SUD. Its goal is to study and model the ways in which cloud computing impacts the behavior and operation of companies and organizations, with a particular focus on the cloud-based management of data, a crucial asset in many companies.

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

### 8.1.2. 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.

**CloudSelect** is a three-years project started in October 2015. It is financed by the *Institut de la Société Numérique (ISN)* of the IDEX Paris-Saclay; it funds the PhD scholarship of S. Cebiric. The project is a collaboration with A. Bounfour from the economics department of Université Paris Sud. The project aims at exploring technical and business-oriented aspects of data mobility across cloud services, and from the cloud to outside the cloud.

### 8.1.3. Others

**ODIN** is a four-year project started in 2014, funded by the Direction Générale de l'Armement, between the SemSoft company, IRISA Rennes and Inria Saclay (OAK). The project aims to develop a complete framework for analytics on Web data, in particular taking into account uncertainty, based on Semantic Web technologies such as RDF.

**Google Award** I. Manolescu has received a Google Award in collaboration with X. Tannier from LIMSI. The award is given within a call specifically dedicated to computing tools for computational journalism. The project given the award focuses on "Event Thread Extraction for Viewpoint Analysis".

## 8.2. International Initiatives

### 8.2.1. Inria International Labs

#### **Inria@SiliconValley**

Associate Team involved in the International Lab:

#### 8.2.1.1. OAKSAD

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

International Partner (Institution - Laboratory - Researcher):

University of California, San Diego (United States) - Computer Science and Engineering (CSE) - Alin Deutsch

Start year: 2013

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. Our work in 2015 has focused on scalable hybrid stores [9], [18]. The OAKSAD team ended with 2015 but we continue collaborating on this topic.

## 8.3. International Research Visitors

### 8.3.1. Visits of International Scientists

- Erietta Liarou, Harvard University, May 2015
- Helena Galhardas, University of Lisbon, March 2015
- Paolo Papotti, Qatar Computing Research Institute, February 2015
- Puya - Hossein Vahabi, Yahoo Labs, January 2015
- Yanlei Diao, University of Massachusetts Amherst, January 2015

### 8.3.2. Visits to International Teams

#### 8.3.2.1. Sabbatical programme

Bogdan Cautis went on a sabbatical to Hong Kong starting in September 2015, for a duration of one year.