RESEARCH CENTER
Sophia Antipolis - Méditerranée

FIELD

Activity Report 2019

Section Partnerships and Cooperations

Edition: 2020-03-21

ABS Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

– Frédéric Cazals is endowed chair within the 3IA Côte d'Azur (http://3ia.univ-cotedazur.fr/), within the focus area *Computational Biology and Bio-Inspired AI.*

6.2. International Research Visitors

6.2.1. Visits of International Scientists

6.2.1.1. Internships

- Internship of Maria Guramare, Harvard University, Cambridge, Massachusetts. Supervision: Frédéric Cazals and Dorian Mazauric. *Shortest Paths under Constraints Problem with Application for Structural Alignments.*
- Internship of Guilherme Santa Cruz, Polytech Nice. Supervision: Frédéric Cazals and Dorian Mazauric. *New method for assessing protein-phenotype relevance interpolating gene expression and biological networks*.
- Internship of Gabriel Djebbar, École Polytechnique de l'Université Nice Sophia Antipolis. Filière Sciences Informatiques, deuxième année du cursus ingénieur (niveau Master 1). Supervision: Frédéric Havet and Dorian Mazauric. *Graph Coloring Games with application on Algorithmic Geometry.*
- Projet de fin d'études de Youssef Benjelloun et Quentin Sautel, École Polytechnique de l'Université Nice Sophia Antipolis. Filière Mathématiques Appliquées et Modélisation, deuxième année du cursus ingénieur (niveau Master 1). Supervision: Dorian Mazauric. *Algorithmes pour le calcul de motif commun d'un ensemble de conformations d'une protéine.*

ACUMES Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- **Project OPERA** (2019-2021): Adaptive planar optics
  This project is composed of Inria teams NACHOS, ACUMES and HIEPACS, CNRS CRHEA lab. and company NAPA. Its objective is the characterization and design of new meta-surfaces for optics (opera web site).

8.2. European Initiatives

8.2.1. Collaborations in European Programs, Except FP7 & H2020

Program: COST

Project acronym: CA18232

Project title: Mathematical models for interacting dynamics on networks

Duration: October 2019 - September 2013

Coordinator: University of Ljubljana (Prof. Marjeta Kramar Fijavz)

Other partners: see https://www.cost.eu/actions/CA18232/#tabslName:parties

Abstract: Many physical, biological, chemical, financial or even social phenomena can be described by dynamical systems. It is quite common that the dynamics arises as a compound effect of the interaction between sub-systems in which case we speak about coupled systems. This Action shall study such interactions in particular cases from three points of view:

- the abstract approach to the theory behind these systems,
- applications of the abstract theory to coupled structures like networks, neighbouring domains divided by permeable membranes, possibly non-homogeneous simplicial complexes, etc.,
- modelling real-life situations within this framework.

The purpose of this Action is to bring together leading groups in Europe working on a range of issues connected with modelling and analysing mathematical models for dynamical systems on networks. It aims to develop a semigroup approach to various (non-)linear dynamical systems on networks as well as numerical methods based on modern variational methods and applying them to road traffic, biological systems, and further real-life models. The Action also explores the possibility of estimating solutions and long time behaviour of these systems by collecting basic combinatorial information about underlying networks.

8.3. International Initiatives

8.3.1. PHC Utique

Program: Program Hubert Curien PHC Utique (Tunisia)

Project acronym: NAMReD

Project title: Novel Algorithms and Models for Data Reconstruction

Duration: January 2018 - December 2020

Coordinator: A. Habbal and M. Kallel (Univ. Tunis al Manar)

Abstract: The project goal is the design of new and efficient algorithms tailored for data reconstruction involving ill-posed problems. We rely on an original use of game theory and p-Kirchhoff methods. We apply these approaches for missing data recovery and image restoration.

8.3.2. PHC Procope

Program: Program Hubert Curien Procope (Germany)

Project title: Non-local conservation laws for engineering applications

Duration: January 2019 - December 2020

Coordinator: P. Goatin and S. Göttlich (Univ. Mannheim)

Abstract: This project tackles theoretical and numerical issues arising in the mathematical study of conservation laws with non-local flux functions. These equations appear in a variety of applications, ranging from traffic flows to industrial processes and biology, and are intended to model macroscopically the action of non-local interactions occurring at the microscopic level. The team, bi-located in France and Germany, has complementary skills covering the analysis, numerical approximation and optimization of non-linear hyperbolic systems of conservation laws, and their application to the modeling of vehicular and pedestrian traffic flows, manufacturing systems and other industrial problems. Based on the members expertise and on the preliminary results obtained by both teams, the project will focus on the following interconnected aspects: The treatment of boundary conditions, both from the analytical and the numerical point of views, in order to provide a sound basis to address specific problems arising in the applications. The development of efficient, high-order finite volume numerical schemes for the computation of approximate solutions of non-local equations. The investigation of optimal control problems with corresponding optimality systems and the design of appropriate and adaptive optimization algorithms. Targeted applications include vehicular traffic (mainly in connection with vehicle-to-vehicle communication and consumption/pollution estimation), crowd motion (in connection with safe building evacuation procedures), and manufacturing systems (intelligent production). The impact of the project is therefore twofold: while addressing major mathematical advances in the theory and numerical approximation of highly non-standard problems, it puts the basis for innovative tools to handle modern applications in engineering sciences.

8.3.3. Inria International Labs

Inria Chile

Associate Team involved in the International Lab:

8.3.3.1. NOLOCO

Title: Efficient numerical schemes for non-local transport phenomena

International Partner (Institution - Laboratory - Researcher):

Universidad del Bio-Bio (Chile) - Luis Miguel Villada Osorio

Start year: 2018

See also: https://team.inria.fr/acumes/assoc-team/noloco/

This project tackles theoretical and numerical issues arising in the mathematical study of conservation laws with non-local flux functions. These equations include in a variety of applications, ranging from traffic flows to industrial processes and biology, and are intended to model macroscopically the action of non-local interactions occurring at the microscopic level.

The team, bi-located in France and Chile, has complementary skills covering the analysis, numerical approximation and optimization of non-linear hyperbolic systems of conservation laws, and their application to the modeling of vehicular and pedestrian traffic flows, sedimentation and other industrial problems.

Based on the members' expertise and on the preliminary results obtained by the team, the project will focus on the following aspects:

- The development of efficient, high-order finite volume numerical schemes for the computation of approximate solutions of non-local equations.
- The sensitivity analysis of the solutions on model parameters or initial conditions.

The impact of the project is therefore twofold: while addressing major mathematical advances in the theory and numerical approximation of highly non-standard problems, it puts the basis for innovative tools to handle modern applications in engineering sciences.

8.3.4. Inria International Partners

8.3.4.1. ORESTE

Title: Optimal REroute Strategies for Traffic managEment

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (United States) - Electrical Engineering and Computer Science (EECS) (EECS) - Alexandre M. Bayen

Duration: 2018 - 2022

Start year: 2018

See also: https://team.inria.fr/acumes/assoc-team/oreste

The rapidly changing transportation ecosystem opens new challenges in traffic modeling and optimization approaches. We will focus in particular on the two following aspects:

Route choice apps impact. The vast use of personal route choice systems through phone applications or other devices is modifying the traditional flow of networks, requiring new models for accounting of the guidance impact. Indeed, routing apps have changed traffic patterns in the US and Europe, leading to new congestion patterns where previously no traffic was observed. Over the last decade, GPS enabled smart phones and connected personal navigation devices have disrupted the mobility landscape. Initially, the availability of traffic information led to better guidance of a small portion of motorists in the system. But as the majority of the driving public started to use apps, the systematic broadcasting of "selfish" best routes led to the worsening of traffic in numerous places, ultimately leading to the first lawsuit against one specific company in particular (Waze) accused to be the cause of these problems. This is just the beginning of an evolution, which, if not controlled and regulated, will progressively asphyxiate urban landscapes (already nearly hundreds of occurrences of this phenomenon are noticed by the popular media, which indicates the presence of probably thousands of such issues in the US alone). Traffic managers are typically not equipped to fix these problems, and typically do not fund this research, as in order to be able to regulate and fix the problem, fundamental science needs to be advanced, modeling and game theory in particular, so remediation can happen (for which the traffic managers are equipped). In this project, we will mainly focus on the development and study of new macroscopic dynamical models to describe the aforementioned phenomena, and we will explore control strategies to mitigate their impact.

Autonomous vehicles. Besides, the foreseen deployment of connected and autonomous vehicles (CAVs) opens new perspectives both in traffic modeling and control. Indeed, CAVs are expected to modify the classical macroscopic traffic dynamics due to their peculiar motion laws, which are more uniform than human drivers' and follow different rules. Besides, due to their extended information on neighboring traffic conditions, the resulting dynamics would have a non-local character, justifying the use of rapidly developing non-local models. In any case, the different behavior of autonomous vehicles requires the design of new multi-class models capable of accounting for different vehicle classes characteristics and mutual interactions. Moreover, CAVs could be used as endogenous variable speed limiters, thus providing new action points to control traffic flow. Preliminary results show that the presence of few controlled vehicles can positively affect traffic conditions. In this setting, the interaction of AVs with the surrounding traffic can be described by strongly coupled PDE-ODE systems, which have been largely studied by the ACUMES team. Yet, the study of CAVs impact in realistic situations requires further research, in particular towards model validation, for which the Berkeley team will provide the necessary data.

8.3.4.2. Informal International Partners

University of Milano Bicocca, Mathematics and Applications (M. Garavello: https://sites.google.com/site/maurogaravello/)

University of Rutgers - Camden, Department of Mathematical Science (B. Piccoli: https://piccoli.camden.rutgers.edu/)

Argonne National Laboratory, Mathematics and Computer Science Division (Jonathan Ozik: https://www.anl.gov/profile/jonathan-ozik, Stefan Wild: https://www.anl.gov/profile/stefan-m-wild)

Virginia Polytechnic Institute and State University (Robert B. Gramacy: https://www.stat.vt.edu/people/stat-faculty/gramacy-robert.html)

University of Texas Arlington (S. Roy, https://mentis.uta.edu/explore/profile/souvik-roy)

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- J. Friedrich (January, June-July, November 2019, Univ. Mannheim, Germany): non-local traffic flow models.
- J. Kotz (November 2019, Univ. Mannheim, Germany): augmented macroscopic traffic flow models at junctions.
- L.M. Villada (November 2019, University of Bio-Bio): finite volume schemes for non-local systems of conservation laws.
- R. Ordonez (November-December 2019, Univ. Concepcion, Chile): finite volume schemes for non-local systems of conservation laws.
- R. Bürger (December 2019, Univ. Concepcion, Chile): finite volume schemes for non-local systems of conservation laws.
- M. Kallel (December 2019, Univ. Tunis al Manar, Tunisia): Game theory for inverse problems.

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

- F.A. Chiarello visited Mannheim University (S. Göttlich) for 3 months in March-May 2019.

AROMATH Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 & H2020 Projects

7.1.1.1. ARCADES

Program: Marie Skłodowska-Curie ETN

Project acronym: ARCADES

Project title: Algebraic Representations in Computer-Aided Design for complEx Shapes

Duration: January 2016 - December 2019

Coordinator: I.Z. Emiris (NKUA, Athens, Greece, and ATHENA Research Innovation Center)

Scientist-in-charge at Inria: L. Busé

Other partners: U. Barcelona (Spain), Inria Sophia Antipolis (France), J. Kepler University, Linz (Austria), SINTEF Institute, Oslo (Norway), U. Strathclyde, Glascow (UK), Technische U. Wien (Austria), Evolute GmBH, Vienna (Austria).

Webpage: http://arcades-network.eu/

Abstract: ARCADES aims at disrupting the traditional paradigm in Computer-Aided Design (CAD) by exploiting cutting-edge research in mathematics and algorithm design. Geometry is now a critical tool in a large number of key applications; somewhat surprisingly, however, several approaches of the CAD industry are outdated, and 3D geometry processing is becoming increasingly the weak link. This is alarming in sectors where CAD faces new challenges arising from fast point acquisition, big data, and mobile computing, but also in robotics, simulation, animation, fabrication and manufacturing, where CAD strives to address crucial societal and market needs. The challenge taken up by ARCADES is to invert the trend of CAD industry lagging behind mathematical breakthroughs and to build the next generation of CAD software based on strong foundations from algebraic geometry, differential geometry, scientific computing, and algorithm design. Our game-changing methods lead to real-time modelers for architectural geometry and visualisation, to isogeometric and design-through-analysis software for shape optimisation, and marine design and hydrodynamics, and to tools for motion design, robot kinematics, path planning, and control of machining tools.

7.1.1.2. POEMA

Program: Marie Skłodowska-Curie ITN

Project acronym: POEMA

Project title: Polynomial Optimization, Efficiency through Moments and Algebra

Duration: January 2019 - December 2022 (48 months)

Coordinator: B. Mourrain (Aromath, Inria Sophia Antipolis)

Other partners: LAAS - CNRS, Toulouse (France), Sorbonne Université, Paris (France), Centrum Wiskunde & Informatica, Amsterdam (The Netherlands), Stichting Katholieke Universiteit Brabant, Tilburd (The Netherlands), Universität Konstanz (Germany), Università degli Studi di Firenze (Italy), University of Birmingham (United Kingdom), Friedrich Alexander University Erlangen-Nuremberg (Germany), Universitet I Tromsø (Norway), ARTELYS SAS, Paris (France).

Webpage: http://poema-network.eu/

Abstract: Non-linear optimization problems are present in many real-life applications and in scientific areas such as operations research, control engineering, physics, information processing, economy, biology, etc. However, efficient computational procedures, that can provide the guaranteed global optimum, are lacking for them. The project will develop new polynomial optimization methods, combining moment relaxation procedures with computational algebraic tools to address this type of problems. Recent advances in mathematical programming have shown that the polynomial optimization problems can be approximated by sequences of Semi-Definite Programming problems. This approach provides a powerful way to compute global solutions of non-linear optimization problems and to guarantee the quality of computational results. On the other hand, advanced algebraic algorithms to compute all the solutions of polynomial systems, with efficient implementations for exact and approximate solutions, were developed in the past twenty years. The network combines the expertise of active European teams working in these two domains to address important challenges in polynomial optimization and to show the impact of this research on practical applications.

POEMA aims to train scientists at the interplay of algebra, geometry and computer science for polynomial optimization problems and to foster scientific and technological advances, stimulating interdisciplinary and intersectoriality knowledge exchange between algebraists, geometers, computer scientists and industrial actors facing real-life optimization problems.

7.1.1.3. GRAPES

Program: Marie Skłodowska-Curie ETN

Project acronym: GRAPES

Project title: Learning, Processing and Optimising Shapes

Duration: December 2019 - November 2023

Coordinator: I.Z. Emiris (NKUA, Athens, and ATHENA Research Center, Greece)

Scientist-in-charge at Inria: L. Busé

Other partners: U. Barcelona (Spain), Inria Sophia-Antipolis (France), J. Kepler University, Linz (Austria), SINTEF Institute, Oslo (Norway), U. Strathclyde, Glascow (UK), RWTH Aachen (Germany), U. Svizzera Italiana (Switzerland), U. Tor Vergata (Italy), Vilnius U. (Lithuania), GeometryFactory SARL (France).

Webpage: http://grapes-network.eu/

Abstract: GRAPES aims at advancing the state of the art in Mathematics, Computer-Aided Design, and Machine Learning in order to promote game changing approaches for generating, optimising, and learning 3D shapes, along with a multisectoral training for young researchers. Recent advances in the above domains have solved numerous tasks concerning multimedia and 2D data. However, automation of 3D geometry processing and analysis lags severely behind, despite their importance in science, technology and everyday life, and the well-understood underlying mathematical principles. GRAPES spans the spectrum from Computational Mathematics, Numerical Analysis, and Algorithm Design, up to Geometric Modelling, Shape Optimisation, and Deep Learning. This allows the 15 PhD candidates to follow either a theoretical or an applied track and to gain knowledge from both research and innovation through a nexus of intersectoral secondments and Network-wide workshops. Horizontally, our results lead to open-source, prototype implementations, software integrated into commercial libraries as well as open benchmark datasets. These are indispensable for dissemination and training but also to promote innovation and technology transfer. Innovation relies on the active participation of SMEs, either as a beneficiary hosting an ESR or as associate partners hosting secondments. Concrete applications include simulation and fabrication, hydrodynamics and marine design, manufacturing and 3D printing, retrieval and mining, reconstruction and visualisation, urban planning and autonomous driving.

7.2. International Initiatives

7.2.1. Participation in Other International Programs

7.2.1.1. PHC Alliance

- Program: PHC Alliance
- Project title: High-order methods for computational design and data-driven engineering
- Duration: 01/2020–12/2021
- Coordinator: Angelos Mantzaflaris
- Other partners: Swansea University, UK
- Abstract: The aim of this project is to develop a mathematical framework for the integration of geometric modeling and simulation using spline-based finite elements of high degree of smoothness. High-order methods are known to provide a robust and efficient methodology to tackle complex challenges in multi-physics simulations, shape optimization, and the analysis of large-scale datasets arising in data-driven engineering and design. However, the analysis and design of high-order methods is a daunting task requiring a concurrent effort from diverse fields such as applied algebraic geometry, approximation theory and splines, topological data analysis, and computational mathematics. Our strategic vision is to create a research team combining a uniquely broad research expertise in these areas by establishing a link between the team AROMATH at Inria Sophia-Antipolis and Swansea University.

7.2.1.2. NSFC

- Program: NSFC
- Project title: “Research on theory and method of time-varying parameterization for dynamic isogeometric analysis”,
- Duration: 2018-2021.
- Collaboration project with Gang Xu, Hangzhou Dianzi University, China.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

Gang Xu, Hangzhou Dianzi University, China, visited AROMATH team (9 - 20 Oct.) to work on Isogeometric Analysis and Geometric Modeling.

Ibrahim Adamou, Univ. Dan Dicko Dankoulodo de Maradi, Niger, visited B. Mourrain (28 Oct. - 21 Dec.) to work on medial axes of curve arcs.

7.3.1.1. Internships

Martin Jalard (L3, Ecole normale supérieure de Rennes) for his *introduction to research* internship explored during 6 weeks (May 13th to June 21st) the application of Norton’s lemma to the computation of isotypic decompositions.

7.3.2. Visits to International Teams

7.3.2.1. Research Stays Abroad

Evelyne Hubert was awarded a Simons fellowship within the program *Geometry, compatibility and structure preservation in computational differential equations*, from July to December 2019, at the Isaac Newton Institute in Cambridge (UK).

For the month of April, Evelyne Hubert was a guest professor a the University of the Arctic for *Pure Mathematics in Norway*.

Angelos Mantzaflaris visited in April the Computational Foundry, Swansea University, UK in the frame of the College of Science International Visitor Scheme.

ATHENA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ADT

8.1.1.1. ADT BCI-Browser

Participants: Théodore Papadopoulo, Maureen Clerc.

Duration: 1 year

Most often, BCI techniques are demonstrated in simple toy applications made. The only "few" real BCI applications are specific developments and are not used much as they lack of functionality, maintenance, ... The goal of this development contract is to demonstrate a new approach to BCI, in which BCI interactions are integrated in existing applications. Ideally, the original software is not modified and not even recompiled. It is modified by providing either modified GUI libraries or providing extensions as plugins. As a proof of concept, we aim at modifying C++/Qt applications with a focus on web browsing, by redefining some of its basic interactions (mouse clicks, keyboard, ...) using some BCI components. In this manner, it might be possible to drive standard and state-of-the-art application using BCI and at a limited maintenance cost.

This contract is part of the AMDT initiative.

8.1.1.2. ADT OpenMEEG

Participants: Théodore Papadopoulo, Maureen Clerc, Kostiantyn Maksymenko, Alexandre Gramfort [PARIETAL], Joan Massich [PARIETAL].

Duration: *24 months.*

The OpenMEEG ADT aims at improving OpenMEEG along 3 main directions:

1. Offer a user interface for the creation and verification of head models most importantly for a simpler management of non-nested head models.
2. Improve the Python interface (extension and reliability). This will also be useful to develop new research axes (in connection with point 3).
3. Enrich the available operators and refactor the code to offer new possibilities in OpenMEEG and reduce the cost of maintenance.

In addition to the expected gains in code maintenance, these improvements will allow a number of new – more sophisticated – applications as well as open OpenMEEG to a larger audience with a simplified interface for classical use-cases.

This contract is part of the AMDT initiative.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. ERC AdG CoBCoM

Program: H2020-EU.1.1. (ERC-ADG-2015 - ERC Advanced Grant)

Project acronym: CoBCoM - **ID:** 694665

Project title: *Computational Brain Connectivity Mapping*

Start date: 2016-09-01, End date: 2021-08-31

P.I. : R. Deriche

Partners: ATHENA project-team

Abstract:

One third of the burden of all the diseases in Europe is due to problems caused by diseases affecting brain. Although exceptional progress has been obtained for exploring it during the past decades, **the brain is still terra-incognita** and calls for specific research efforts to better understand its architecture and functioning.

COBCOM is our response to this great challenge of modern science with the overall goal to **develop a joint Dynamical Structural-Functional Brain Connectivity Network (**DSF-BCN**)** solidly grounded on advanced and integrated methods for diffusion Magnetic Resonance Imaging (dMRI) and Electro & Magneto-Encephalography (EEG & MEG).

To take up this grand challenge and achieve new frontiers for brain connectivity mapping, we will develop a new generation of computational models and methods for identifying and characterizing the structural and functional connectivities that will be at the heart of the DSF-BCN. Our strategy is to break with the tradition to incrementally and separately contributing to structure or function and develop **a global approach involving strong interactions between structural and functional connectivities.** To solve the limited view of the brain provided just by one imaging modality, our models will be developed under a rigorous computational framework integrating complementary non invasive imaging modalities: dMRI, EEG and MEG.

COBCOM will push far forward the state-of-the-art in these modalities, developing **innovative models and ground-breaking processing tools** to provide in-fine a joint DSF-BCN solidly grounded on a detailed mapping of the brain connectivity, both in space and time.

Capitalizing on the strengths of dMRI, MEG & EEG methodologies and building on the **bio-physical and mathematical foundations** of our new generation of computational models, COBCOM will be applied to high-impact diseases, and its **ground-breaking computational nature and added clinical value** will open new perspectives in neuroimaging.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

- Sherbrooke University, CA (M. Descoteaux)
- CMRR, University of Minnesota, USA (C. Lenglet)
- Verona University, It (G. Menegaz)
- Department of CISE, the University of Florida, Gainesville, USA (B. C. Vemuri)
- Centre for Medical Image Computing (CMIC), Dept. Computer Science, UCL, UK (D. Alexander)
- SBIA, University of Pennsylvania Medical School, USA (R. Verma).
- EEMagine company on EEG/MEG hardware.

8.3.2. Participation in Other International Programs

- University Houari Boumedienne (USTHB, Algiers) (L. Boumghar) and University of Boumerdes, (D. Cherifi), Algeria.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Pr Gloria Menegaz, Department of Computer Science, University of Verona (March 23 - Sept 20, 2019)

8.4.1.1. Internships

- Imogen Den otter-Moore - Queen's University, Kingston, Canada, From early May to late July, 2019
- Federica Cruciani - Department of Computer Science, University of Verona (March 1 - June 30, 2019)
- Enes Albay - Ph.D. student in Computer Engineering (Cont.), Istanbul Technical University, From Nov. 4, 2019 to Oct. 3, 2020.

BIOCORE Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. National programmes

- **ANR-Phycover:** The overall objective of the PHYCOVER project (2014-2018) is to identify a modular wastewater treatment process for the production of biogas. The method combines three modules. First, a high-rate algal pond is dedicated to the treatment of municipal wastewater. Then, an anaerobic digester capable of co-digesting biomass products (and others organic matter resources) to significantly reduce biological and chemical contaminants while producing a sustainable energy as biogas is analysed. A final module transforms the residual carbon, nitrogen and phosphorus into high-value microalgae dedicated to aquaculture and green chemistry.
- **ITE-OPALE:** The goal of the Institut de la Transition Énergétique - OPALE project (2016-2019) is to increase the lipid content of microalgae by specific selection pressure. The project relies on the strain already selected during the Facteur 4 project, whose productivity was 4 times higher than the wild type. We expect to still increase strain performances up to 10 times the productivity of the wild type. This project was unexpectedly arrested by the funding agency on April 2019.
- **ADEME Phytorecolt:** The goal of this project (2017-2019) is to develop an automated and optimized procedure for microalgae harvesting. A project coordinated by H. Bonnefond.
- **ANR-ICycle:** This project (2016-2020) aims at understanding the communication pathways between the cell division cycle and the circadian clock, using mathematical modeling and control theory to construct and implement two coupled synthetic biological oscillators. Project coordinated by M. Chaves.
- **ANR - Maximic:** The goal of the project (2017-2021) is to design and implement control strategies in a bacterium for producing at maximal rate a high value product. It is coordinated by H. de Jong (IBIS Grenoble), and involves members of Biocore and McTao.
- **Plan Cancer - Imodrez:** The objective of this project (2018-2021) is to understand cancer drug response heterogeneity using tumor single-cell dynamics and developing mathematical models and computational approaches. A project coordinated by J. Roux (IRCAN) and funded by Inserm - Plan Cancer.
- **SIGNALIFE:** Biocore is part of this Labex (scientific cluster of excellence) whose objective is to build a network for innovation on Signal Transduction Pathways in life Sciences, and is hosted by the University of Nice Sophia Antipolis.
- **UMT FIORIMED:** FioriMed is a Mixed Technology Unit created in January 2015 to strengthen the production and dissemination of innovation to the benefit of ornamental horticulture. Horticultural greenhouses are seen as a "laboratory" for the actual implementation of agroecology concepts with the possibility of generic outcomes being transfered to other production systems. The main partners of UMT FioriMed are ASTREDHOR (National Institute of Horticulture) and the ISA Joint Research Unit of INRA-CNRS-Univ. Nice.
- **EcoPhyto - CeraTIS Corse:** “Territorial management of the Mediterranean fruit fly in Corsica by the Sterile Insect Technique” (2020-2022). This project is based on a pilot field experiment of sterile male releases and it integrates population dynamics and socio-economic approaches.
- **EcoPhyto - INTERLUDE:** “Territorial innovations to reduce phytoparmaceutical products for the sustainable production of vegetable crops” (2020-2022). BIOCORE members participate in a case study that focuses on the agroecological management of soil pests and pathogens in Provence.

9.1.2. Inria funding

- **Inria Project Lab, Algae** *in silico***:** (2014-2019) The Algae in silico Inria Project Lab, funded by Inria and coordinated by O. Bernard, focuses on the expertise and knowledge of biologists, applied mathematicians and computer scientists to propose an innovative numerical model of microalgal culturing devices. The latest developments in metabolic modeling, hydrodynamic modeling and process control are joined to propose a new generation of advanced simulators in a realistic outdoor environment. The project gathers 5 Inria project teams and 3 external teams.
- **Inria Project Lab, Cosy:** (2017-...) This proposal aims at exploiting the potential of state-of-art biological modeling, control techniques, synthetic biology and experimental equipment to achieve a paradigm shift in control of microbial communities. We will investigate, design, build and apply an automated computer-driven feedback system for control of synthetic microbial communities, not just accounting for but rather leveraging population heterogeneity in the optimal accomplishment of a population-level task. The development of methodologies of general applicability will be driven by and applied to two different applications closely connected with real-world problems in the biomedical and biotechnological industry. The consortium is composed of the four Inria project-teams IBIS, BIOCORE, COMMANDS, VALSE, INBIO, as well as the external partners BIOP (Université Grenoble Alpes, including members of IBIS), MaIAge (INRA), and YoukLAB (TU Delft).

9.1.3. INRA funding

- **MoGeR:** “From knowledge to modeling: towards a user-friendly simulation tool to test crop resistance management scenarios in the Phoma-oilseed rape case study”, INRA Metaprogramme SMaCH, 2017–2019. This is a follow-up of the K-Masstec project, which focused on sustainable strategies for the deployment of genetic resistance in the field, based on molecular knowledge on avirulence genes.
- **ABCD:** INRA SPE is funding the project ABCD "Augmentative Biological Control; optimizing natural ennemies Deployment" (2017-2019) in which Biocore is a partner with INRA Sophia Antipolis.
- **IMMUnE:** INRA SPE is funding the project IMMUnE "Immunité et Modélisation Mathématique pour Unifier l’Epidémiologie" (2019-2021), headed by F. Hamelin (Agrocampus Ouest), in which BIOCORE is a partner.

9.1.4. Networks

- **ModStatSAP:** The objective of this INRA network is to federate researchers in applied mathematics and statistics and to promote mathematical and statistical modeling studies in crop and animal health. S. Touzeau is a member of the scientific committee.
- **Seminar:** BIOCORE organizes a regular seminar “Modeling and control of ecosystems” at the station zoologique of Villefranche-sur-Mer, at INRA-ISA or at Inria.

9.2. European Initiatives

9.2.1. Collaborations in European Programs, Except FP7 & H2020

Program: **PHC-Pessoa** Partenariat Hubert Curien with Portugal, managed by Campus France

Project acronym: **LTSB**

Project title: Logic Tools for Systems Biology

Duration: 01/2019 - 12/2019

Coordinator: M. Chaves

Other partners: M.A. Martins, University of Aveiro

Abstract: This project aims at developing Boolean, piecewise linear and other hybrid tools for analysis of biological networks.

9.2.2. Collaborations with Major European Organizations

Imperial college, Department of Chemical engineering (UK),

Modelling and optimization of microalgal based processes.

University of Padova, Italy.

Modelling and control of microalgal production at industrial scale.

9.3. International Initiatives

9.3.1. Inria International Labs

Inria Chile

Associate Team involved in the International Lab:

9.3.1.1. GREENCORE

Title: Modelling and control for energy producing bioprocesses

International Partners (Institution - Laboratory - Researcher):

PUCV (Chile) - Escuela de Ingenieria Bioquimica (EIB) - David Jeison

UTFSM (Chile) - Departamento de Matematica - Pedro Gajardo

Univ. Chile (Chile) - Centro de modelacion matematica - Hector Ramirez

Inria coordinator: O. Bernard

Start year: 2014

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

The worldwide increasing energy needs together with the ongoing demand for CO2 neutral fuels represent a renewed strong driving force for the production of energy derived from biological resources. In this scenario, the culture of oleaginous microalgae for biofuel and the anaerobic digestion to turn wastes into methane may offer an appealing solution. The main objective of our proposal is to join our expertise and tools, regarding these bioprocesses, in order to implement models and control strategies aiming to manage and finally optimize these key bioprocesses of industrial importance. By joining our expertise and experimental set-up, we want to demonstrate that closed loop control laws can significantly increase the productivity, ensure the bioprocess stability and decrease the environmental footprint of these systems. This project gathers experts in control theory and optimization (BIOCORE, UTFSM) together with experts in bioprocesses (PUCV and CMM) and software development.

International Laboratory for Research in Computer Science and Applied Mathematics

Associate Team involved in the International Lab:

9.3.1.2. EPITAG

Title: Epidemiological Modelling and Control for Tropical Agriculture

International Partner (Institution - Laboratory - Researcher):

Université de Douala (Cameroon) - Département de Mathématique et Informatique - Samuel Bowong

Inria coordinator: S. Touzeau

Start year: 2017

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

EPITAG gathers French and Cameroonian researchers, with a background in dynamical systems and control and with an interest in crop diseases. Crop pests and pathogens are responsible for considerable yield losses and represent a threat to food security. Their control is hence a major issue, especially in Cameroon, where agriculture is an important sector in terms of revenues and employment. To help design efficient strategies for integrated pest management, mathematical models are particularly relevant. Our main objective is to study the epidemiology and management of tropical crop diseases, with a focus on Cameroon and Sub-Saharan Africa. Our approach consists in developing and analysing dynamical models describing plant-parasite interactions, in order to better understand, predict and control the evolution of damages in crops. To ensure the relevance of our models, field experts and stakeholders need to be closely associated. We will focus on pest and pathogens that affect major staple food and cash crops, such as cocoa plant mirids, plantain and banana plant-parasitic nematodes, coffee berry borers, coffee leaf rust, maize stalk borers, cabbage diamondback moths, papaya mealybugs, etc. To tackle these issues, we jointly supervise master and PhD students.

9.3.2. Inria International Partners

- NTNU (Norwegian University of Science and Technology), Trondheim, Norway. The project involves turning wastes into bioenergy with anaerobic digestion. O. Bernard spent a one year sabbatical at NTNU in the Enersene group working on renewable energy.

9.3.3. Participation in Other International Programs

- Univ. Ben Gurion : Microalgal Biotechnology Lab (Israel), Member of the ESSEM COST Action ES1408 European network for algal-bioproducts (EUALGAE). Modelling of photosynthesis.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

Daniel Figueiredo, University of Aveiro, Portugal, 02-06 Sep. 2019. Visit in the context of PHC-Pessoa project to work on the development of logical tools for systems biology.

Israël Tankam Chedjou, University of Yaoundé 1, Cameroon, Feb.-Jun. 2019. Visit in the context of the EPITAG associate team.

Yves Fotso Fotso, University of Dschang, Cameroon, Mar.-Jul. 2019. Visit in the context of the EPITAG associate team.

Clotilde Djuikem, University of Douala, Cameroon, Mar.-Jul. 2019. Visit in the context of the EPITAG associate team.

9.4.2. Visits to International Teams

9.4.2.1. Sabbatical programme

O. Bernard spent a one year sabbatical at NTNU (Norwegian University of Science and Technology), Trondheim, Norway. He worked on a project to turn wastes into bioenergy with anaerobic digestion.

9.5. Project-team seminar

BIOCORE organized a 3-day seminar in September at Peyresq (Alpes-de-Haute-Provence). On this occasion, every member of the project-team presented his/her recent results and brainstorming sessions were organized.

BIOVISION Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

9.1.1.1. Trajectory

Title: Encoding and predicting motion trajectories in early visual networks

Programme: ANR

Duration: October 2015 - September 2020

Coordinator: Invibe Team, Institut des Neurosciences de la Timone, Frédéric Chavane,

Partners:

Institut de Neurosciences de la Timone (CNRS and Aix-Marseille Université, France)

Institut de la Vision (IdV), Paris, France

Universidad Tecnico Federico Santa María (Electronics Engineering Department, Valparaíso, Chile)

Inria contact: Bruno Cessac

Global motion processing is a major computational task of biological visual systems. When an object moves across the visual field, the sequence of visited positions is strongly correlated in space and time, forming a trajectory. These correlated images generate a sequence of local activation of the feed-forward stream. Local properties such as position, direction and orientation can be extracted at each time step by a feed-forward cascade of linear filters and static non-linearities. However such local, piecewise, analysis ignores the recent history of motion and faces several difficulties, such as systematic delays, ambiguous information processing (e.g., aperture and correspondence problems) high sensitivity to noise and segmentation problems when several objects are present. Indeed, two main aspects of visual processing have been largely ignored by the dominant, classical feed-forward scheme. First, natural inputs are often ambiguous, dynamic and non-stationary as, e.g., objects moving along complex trajectories. To process them, the visual system must segment them from the scene, estimate their position and direction over time and predict their future location and velocity. Second, each of these processing steps, from the retina to the highest cortical areas, is implemented by an intricate interplay of feed-forward, feedback and horizontal interactions. Thus, at each stage, a moving object will not only be processed locally, but also generate a lateral propagation of information. Despite decades of motion processing research, it is still unclear how the early visual system processes motion trajectories. We, among others, have proposed that anisotropic diffusion of motion information in retinotopic maps can contribute resolving many of these difficulties. Under this perspective, motion integration, anticipation and prediction would be jointly achieved through the interactions between feed-forward, lateral and feedback propagations within a common spatial reference frame, the retinotopic maps. Addressing this question is particularly challenging, as it requires to probe these sequences of events at multi-scale (from individual cells to large networks) and multiple stages (retina, primary visual cortex (V1)). “TRAJECTORY” proposes such an integrated approach. Using state-of-the-art micro- and mesoscopic recording techniques combined with modeling approaches, we aim at dissecting, for the first time, the population responses at two key stages of visual motion encoding: the retina and V1. Preliminary experiments and previous computational studies demonstrate the feasibility of our work. We plan three coordinated physiology and modeling work-packages aimed to explore two crucial early visual stages in order to answer the following questions: How is a translating bar

represented and encoded within a hierarchy of visual networks and for which condition does it elicit anticipatory responses? How is visual processing shaped by the recent history of motion along a more or less predictable trajectory? How much processing happens in V1 as opposed to simply reflecting transformations occurring already in the retina? The project is timely because partners master new tools such as multi-electrode arrays and voltage-sensitive dye imaging for investigating the dynamics of neuronal populations covering a large segment of the motion trajectory, both in retina and V1. Second, it is strategic: motion trajectories are a fundamental aspect of visual processing that is also a technological obstacle in computer vision and neuroprostheses design. Third, this project is unique by proposing to jointly investigate retinal and V1 levels within a single experimental and theoretical framework. Lastly, it is mature being grounded on (i) preliminary data paving the way of the three different aims and (ii) a history of strong interactions between the different groups that have decided to join their efforts.

9.2. European Initiatives

9.2.1. Collaborations in European Programs, Except FP7 & H2020

- Program: Leverhulme Trust
- Project acronym:
- Project title: A novel approach to functional classification of retinal ganglion cells
- Duration: 2017-2020
- Coordinator: Evelyne Sernagor, Institute of Neuroscience (ION), Newcastle, UK
- Inria contact: Bruno Cessac
- Other partners:

  Melissa Bateson Institute of Neuroscience (ION), Newcastle, UK

  Matthias Hennig Institute for Adaptive and Neural Computation (ANC, School of Informatics University of Edinburgh, UK)

  Gerrit HilgenInstitute of Neuroscience (ION), Newcastle, UK
- Abstract: Vision begins with photoreceptors converting light from different parts of the visual scene into electrical signals, compressing our visual world into a parsimonious code of impulses at the retinal output level, the retinal ganglion cells (RGCs). This information is sent to the brain via only $\approx$1m RGCs (45,000 in mouse). Amazingly, the brain can recreate images from interpreting these "barcodes" or trains of impulses. This ability is partly due to the astonishing functional diversity of RGCs, each interpreting a different feature of the visual scene. It is all these parallel streams of information that impart the complexity of visual scenes to our brain visual areas. At present, at least 30 RGC subtypes have been identified. Classification is typically based on common anatomical features, or on basic functions (e.g. whether cells respond to the onset or offset of the light, or whether they are sensitive to motion direction) and it has recently progressed to include molecular markers. Recent studies have successfully characterised common physiological properties between RGCs sharing gene expression, suggesting that their molecular signature may indeed be a good indicator of function. However, according to mouse genetics repositories (e.g., the Allen Brain Project) many genes are expressed in subpopulations of RGCs for which we have no phenotype yet. Genes that are expressed in most RGCs probably do not reflect specific functional populations, but some other genes are expressed only in sparse RGC groups. Each gene-specific class exhibits a distinct spatial mosaic pattern across the retina, suggesting that the cells belong to a common group. Many classes, even sparse, exhibit asymmetric distributions across the retina, e.g., with larger numbers on the ventral or dorsal side, suggesting specific roles in ecological vision, e.g., specialised in detecting moving objects in the sky (ventral) or on the ground (dorsal).

  We propose to develop a multidisciplinary approach to functionally phenotype new RGC subclasses sharing gene expression. Rather than inferring knowledge about the entire population from studying

individual cells, we will take a global approach based on large-scale, high-density pan-retinal recordings, pharmacogenetics (allowing us to selectively silence defined cell populations at will) and high-resolution imaging combined with computational approaches and behaviour. This novel approach necessitates collaboration between retinal neurophysiologists, animal behaviour specialists (Newcastle) and modellers (Inria) who specialise in visual processing and have sophisticated mathematical tools and software to handle and interpret the encoding of visual information at the pan-retinal level.

9.3. International Initiatives

9.3.1. Inria International Labs

Inria Chile

Associate Team involved in the International Lab:

9.3.1.1. MAGMA

Title: Modelling And understandinG Motion Anticipation in the retina

International Partner (Institution - Laboratory - Researcher):

Universidad Técnica Federico Santa Marı´a, Valparaiso (Chile) - Department of Electric Engineering - Maria-José Escobar

Start year: 2019

See also: https://team.inria.fr/biovision/associated-team-magma/.

Motion processing represents a fundamental visual computation ruling many visuomotor features such as motion anticipation which compensates the transmission delays between retina and cortex, and is fundamental for survival. We want to strengthen an existing collaborative network between the Universidad de Valparaiso in Chile and the Biovision team, gathering together skills related with physiological recording in the retina, data analysis numerical platforms and theoretical tools to implement functional and biophysical models aiming at understanding the mechanisms underlying anticipatory response and the predictive coding observed in the mammalian retina, with a special emphasis on the role of lateral connectivity (amacrine cells and gap junctions).

9.4. International Research Visitors

9.4.1. Visits of International Scientists

Helene Schreyer (University of Göttingen, Germany)

Dr Cyril Eleftheriou (IIT, Genova)

R. Cofré (Universidad Valparaíso, Chile).

9.4.1.1. Internships

- **September-November 2019 (M1).** Ignacio Ampuero, Université de Valparaiso.
- **March-August 2019 (M1).** Min-Toan Nguyen, Cycle Ingénieur Polytechnicien 3A. (co-direction with A. Muzy (I3S) et P. Reynaud-Bourret (LJAD)).
- **March-May 2019 (M1)** Safia Mensor, Master Mod4NeuCog (co-direction with A. Guyon (IPMC)) [35].
- **March-May 2019 (M1) et September 2019 - February 2020 (M2)** Simone Ebert, Master Mod4NeuCog (Co-direction with O. Marre Institut de la Vision (IdV), Paris, France et R. Veltz (Mathneuro)).
- **March-August 2019 (M2)** Téva Andreoletti, ENSEA Cergy.

CAMIN Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Occitanie Region finances half of the PhD thesis salary of Lucie William.
- Occitanie Region gave a grant to CAMIN for the PhD thesis of XinYue Lu (PILE-CIFRE) - 10.000 euros.

8.2. National Initiatives

- Inria ADT STIMBIO

  Participants : Christine Azevedo, Daniel Simon, Ronan Le Guillou, Benoît Sijobert.

  A 1-year engineer (R. LeGuillou) was funded by Inria ADT on the development of an architecture dedicated to FES-cycling platform.
- I-SITE MUSE COMPANIES AND CAMPUS grant - SPINSTIM project

  Collaboration with academic local partners (CHU, IES) and NEURINNOV company on the spinal stimulation for bladder and bowel functions restoration. This is linked to an ongoing collaboration with Oslo University (Norway).
- LABEX NUMEV - MEDITAPARK project Collaboration with Montpellier Hospital (Neurology service) and the Montpellier Mindfulness Center to analyze the impact of meditation on upper limb tremor.
- EDF Foundation - CYCLOSEF project

  Collaboration with La Châtaigneraie Hospital on FES-assisted cycling. Financial support for a study on FES-cycling training method and performance otimization on individuals with complete spinal cord injury.
- I-SITE MUSE - EXPLORE

  Support for the visit of Henrique Resende (UFMG, Brazil) and Emersion Fachin (UNB, Brazil) as guest researchers from December to February 2019. Completed with a LIRMM laboratory financial aid.
- I-SITE MUSE - EXPLORE

  Support for the visit of François Bonnetblanc at the Karolinska institute Hospital, Neurosurgery and Neurology Department
- ANR Grasp-It (2019-2023) - Leader LORIA, Nancy.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

CAMIN team is leader of a EIT Health project "AGILIS" on Grasping rehabilitation in individuals with quadriplegia (http://www.lirmm.fr/camin/agilis-project/).

8.4. International Initiatives

8.4.1. Inria Associate Teams Not Involved in an Inria International Labs

8.4.1.1. CACAO

Title: Lower limb electrical stimulation for function restoration

International Partner (Institution - Laboratory - Researcher):

UNB (Brazil) Physiology Faculty - FACHIN-MARTINS Emerson

Start year: 2019

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

The CACAO team has developed an expertise in the application of electrical stimulation for assisting seat-to-seat transfers and pedaling for people with paraplegia. The team shared a unique experience in 2016 by participating in the first Cybathlon techno-sports games with a Brazilian driver and a French driver in the assisted bicycle race. The team wishes to continue the work by optimizing the quality of pedaling to participate in the Cybathlon 2020 and extending the technique for the rehabilitation of patients with hemiplegia in a rehabilitation context.

8.4.1.2. Informal International Partners

We have an ongoing informal collaboration with Andrew Murray (DIMLAB, Dayton University) on the design of complex mechanisms in the context of cycling (trike design) and grasping (orthosis design).

8.5. International Research Visitors

Henrique Resende (UFMG, Brazil) and Emerson Fachin (UNB, Brazil) spent 3 months in CAMIN team from December 2018 to February 2019 to work on FES-cycling project (I-SITE MUSE Explore program and LIRMM support).

8.5.1. Internships

Camilo Silva is achieving a 6-months ERASMUS internship in the team on motion recognition using Deep Learning techniques.

CASTOR Project-Team

5. Partnerships and Cooperations

5.1. National Initiatives

5.1.1. ANR Sistem

Member of the ANR SISTEM, Oct. 2019 - Sept. 2023 coordinated by the M2P2 Institute of Aix-Marseille Univ. "SImulations with high-order schemes of tranSport and TurbulencE in tokaMak" programme Modeles numeriques 2019

- Participants: Francesca Rapetti, Blaise Faugeras, Didier Auroux, Jacques Blum, Cédric Boulbe

Contact: F. Rapetti

5.2. European Initiatives

5.2.1. FP7 & H2020 Projects

EuroFusion Consortium

CASTOR participates to the following EuroFusion consortium projects :

EUROfusion WPCD (Working Package Code Development):

- EWE-2: Enabling Workflow Exploitation Area - Enabling the exploitation of the equilibrium reconstruction and MHD stability workflow (participation)
- WDEV-2: Workflow Development Area - Free boundary equilibrium and feedback control (participation and coordination)

EuroFusion Enabling Research CfP-AWP19-ENR-01, Strengthening the non-linear MHD code JOREK for application to key questions of the fusion roadmap.

EUROfusion WPSA(Work Package JT-60SA) 2018-2010

5.3. International Initiatives

5.3.1. Informal International Partners

The team collaborates with TUC (Technical University of Crete, Prof. Argyris Delis) on the modelling of acoustic streaming phenomena. In this framework, Argyris Delis has visited the Castor team in November 2019.

CHORALE Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. SPHERE ADT Inria project, 2019-20

Participants: Philippe Martinet, Patrick Rives, Renato Martins. The project SPHERE is an Inria ADT coordinated by Philippe Martinet. The aim is to put in place the PERCEPTION360 framework embedded inside the vehicle ICAV in order to map, localize and navigate autonomously in urban areas. It funds an Inria expert engineer position in CHORALE (John Thomas, 12/19-05/20) focusing on instrumentation, control and software development around the autonomous vehicle ICAV.

8.1.2. E-WHEELED ATT Inria project, 2019-21

Participants: Philippe Martinet. The project E-WHEELED is an Inria ATT coordinated by Philippe Martinet. The aim is to provide mobility to things by implementing connectivity techniques. It makes available an Inria expert engineer (Nicolas Chleq) in CHORALE in order to demonstrate the Proof of Concept using a small size demonstrator.

8.1.3. Local initiatives

CHORALE is in touch with local government CASA (Communauté d'Agglomération de Sophia Antipolis) in order to have access to the experimental site dedicated to Autonomous Vehicle demonstration. The first demonstration of autonomous driving has been done mid December. This site will be inaugurated during spring 2020.
Contacts with local companies involved in connected and autonomous driving have been made (including Renault Software Lab and Hitachi). CHORALE has participated to the GetTogether meetings organized by the local initiative SmartVehicles06.

8.2. National Initiatives

8.2.1. ANR Platinum (14-19)

The ANR Platinum (ended in november 2019), led locally by P. Rives, aims to develop methods and algorithms to map an urban environment, enrich it and automatically update it using visual sensors that communicate and are embedded by system users. The consortium is made of 4 academic partners: LITIS, Le2I (VIBOT), Inria-LAGADIC (CHORALE) et IGN-MATIS. One Phd (Mohammed Boussaha) is working on semantization of urban scenes.

8.2.2. ANR Mobi-Deep (17-22)

The ANR MOBI-Deep project, led locally by P. Rives (then P. Martinet since December 2019) aims to develop technologies that enable (or help) autonomous navigation in open and unknown environments using low-cost sensors such as digital cameras. The consortium is made of 2 academic partners: GREYC, Inria-LAGADIC (CHORALE), one association INJA and 3 industrial partners SAFRAN, SAFRAN Electronic & Defence and NAVOCAP. Philippe Martinet took the coordination of the project in December 2019. One master student (Wanting Jin) has worked (6 months) on proactive navigation, and one post-doc (Renato Martins) has been recruted in April 2019 for two years to work on End to End deep learning navigation.

8.2.3. ANR CLARA (19-22)

The ANR CLARA project, led and coordinated by G. Allibert, is focused in autonomous navigation of an aerial drone, equipped with 360-degree cameras, evolving in a forest to provide 3D mapping using deep learning techniques. The consortium is made of 3 academic partners: I3S/Inria CHORALE, LITIS, ViBot. One PhD student (Ihab Mohamed) is working on autonomous navigation using MPPI technics and one master (Haozhou Zhang) has investigated Optical Flow Estimation in Spherical Images.

8.2.4. Collaboration with LS2N-ARMEN

Philippe Martinet as a strong collaboration with the ARMEN team at LS2N. This mainly concerns autonomous parking maneuvers (with Olivier Kermorgant and Salvador Dominguez; we had a phd student), platoon control and observers (with Olivier Kermorgant and Salvador Dominguez; we had 1 post-doc), high speed visual servoing (with Olivier Kermorgant; we have one phd student), collaborative SLAM (with Olivier Kermorgant; we had one phd student), and Control based design (Sébastien Briot; we had one phd student and have one postdoc). These collaborations are mainly funded by ANR projects (initialized and/or prepared when I was in Nantes).

8.2.4.1. ANR Valet (15-19)

The ANR VALET (coordinated by F. Nashashibi from Inria RITS) proposes the development of an automatic redistribution system for sharing vehicles in urban environments. The principle is based on the creation of automated vehicle platoons guided by manually driven vehicles. The collected vehicles are transported to a charging centre or to a car park; here, each vehicle is assigned a parking space to which it must go and then in which it must park fully autonomously. Throughout the movement of platoons and vehicles, they must interact with other road users, including vehicle-type obstacles and pedestrians. The consortium is made of 2 academic partners: Inria (RITS, Chroma, Prima) and Ircyyn (LS2N) Ecole Centrale de Nantes and the AKKA company. One phD student (David Perez Morales) has worked on autonomous parking. One post doc (Ahmed Khalifa) has worked on observer and control design for platoon applications. CHORALE is working inside Hianic via the collaboration with ARMEN.

8.2.4.2. ANR Hianic (18-21)

The HIANIC project (coordinated by A. Spalanzani from Inria CHROMA) proposes to endow autonomous vehicles with smart behaviors (cooperation, negotiation, socially acceptable movements) that better suit complex shared space situations. It integrates models of human behaviors (pedestrian, crowds and passengers), social rules, as well as smart navigation strategies that will manage interdependent behaviors of road users and of cybercars. The consortium is made of 3 academic partners: Inria (RITS, Chroma, Pervasive Interaction teams), Lig Laboratory (Magma team) and LS2N laboratory (ARMEN and PACCE teams). CHORALE is working inside Hianic via the collaboration with CHROMA and ARMEN. One phd student (Maria Kabtoul) is working on proactive navigation of a vehicle among the crowd.

8.2.4.3. ANR SESAME (19-22)

The ANR SESAME (coordinated by S. Briot from LS2N ARMEN) aims to study singularities and stability of sensor-based controllers The consortium is made of 3 academic partners: LS2N (ARMEN and OGRE), Inria (RAINBOW), LIP6 (POLSYS). One master student (John Thomas) has worked on the design of controller based on the concept of hidden robot. One post doc (Abhilash Nayak) is working of the determination of singularities. CHORALE is working inside SESAME via the collaboration with ARMEN.

8.2.5. Collaboration with VIBOT

Guillaume Allibert has a strong collaboration with Pr Cédric Demonceaux from the ERL VIBOT. This mainly concerns activities around perception for robotics. Specifically, we are interested in how to integrate model-based knowledge into deep learning approaches. Two Master students have been involved in 2019: Haozhou Zhang (Optical Flow Estimation In Spherical Images) and Yanis Marchand (New Convolution for Spherical Images Using Depth Information).

8.2.6. Collaboration with RAINBOW Inria Team

Paolo Salaris has a strong collaboration with the RAINBOW Inria team about the research field on active sensing control for robotic platforms where the objective is to determine the robot trajectories that maximise the amount of information coming from sensors. In this activity was involved 1 PostDoc (2017-2019) and recently 1 Master student. This collaboration gave raise to 1 journal and 3 conference papers (one of them under review in the procedeeing of ICRA 2020).

8.3. FP7 & H2020 Projects

Program: H2020

Project acronym: CROWDBOT

Project title: Safe Navigation of Robots in Dense Human Crowds

Duration: Jan 2018 - Jun 2021

Coordinator: Julien Pettré

Other partners: ETHZ (Switzerland), EPFL (Switzerland), UCL (UK), RWTH (Germany), Softbank (France), Locomotec (Germany)

Abstract: CrowdBot will enable mobile robots to navigate autonomously and assist humans in crowded areas. Today's robots are programmed to stop when a human, or any obstacle is too close, to avoid coming into contact while moving. This prevents robots from entering densely frequented areas and performing effectively in these high dynamic environments. CrowdBot aims to fill in the gap in knowledge on close interactions between robots and humans during navigation tasks.

8.4. International Initiatives

8.4.1. Collaboration with Universidade Federal de Minas Gerais, San Paolo

Patrick Rives and Renato Martins have strong collaborations with two research groups at Universidade Federal de Minas Gerais (UFMG), Brazil. The research topics of CHORALE have a large coverage and share common interests with ongoing projects at these groups.

In this context, Patrick Rives spent two months (Nov-Dec 2018) on a Chair Position at UFMG conjointly funded by Le Ministère des Affaires étrangères (France) and UFMG (Brazil). During his stay, he worked with Prof. Alessandro Correa Victorino in the domain of advanced perception for autonomous vehicles.

One objective of his visit was to initiate a long-term scientific collaboration between UFMG and Inria, based on scientific internships of researchers and PhD students (co-tutelle). Originally, this collaboration should be funded by the CAPES-COFECUB International Program. Unfortunately, due to the political changes in Brazil, this project of collaboration is still pending.

Renato Martins, for his part, is a former postdoctoral researcher in the Computer Vision and Robotics Laboratory - VeRLab (UFMG), where he is currently an external collaborator. He actively collaborates on computer vision, perception and robotic vision with Prof. Erikson R. Nascimento, whose research interests and expertise spans from Computer Vision to Computer Graphics.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

Universidade Federal de Minas Gerais (UFMG), Brazil
Jaume I University (UJI), Spain
National University of Singapore, Singapore (Marcelo H. Ang)
Universidade de Sao Paulo, Brazil

8.5. Visits of International Scientists

Enric Cervera Associated Professor at the Jaume I University (SPAIN). He is working in visual servoing application. During his stay (May-July 2019) as invited professor, he has worked on 360 degree view visual perception for autonomous navigation.

8.5.1. Visits to International Teams

8.5.1.1. Research Stays Abroad

Patrick Rives spent two months (Nov-Dec 2018) on a Chair Position at UFMG conjointly funded by Le Ministère des Affaires étrangères (France) and UFMG (Brazil).

COATI Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. SNIF, 2018-2021

Participants: David Coudert, Frédéric Giroire, Nicolas Nisse, Stéphane Pérennes.

Program: Innovation project of IDEX UCA[JEDI].

Project acronym: SNIF

Project title: Scientific Networks and IDEX Funding

Duration: September 2018 - August 2021

Coordinator: Patrick Musso

Other partners: GREDEG, SKEMA, I3S (SigNet) and Inria (COATI), all from UCA.

Abstract: Scientific collaboration networks play a crucial role in modern science. This simple idea underlies a variety of initiatives aiming to promote scientific collaborations between different research teams, universities, countries and disciplines. The recent French IDEX experience is one of them. By fostering competition between universities and granting few of them with a relatively small amount of additional resources (as compare to their global budget), public authorities aim to encourage them to deeply reshape the way academic activities are organized in order to significantly increase the quality of their research, educational programs and innovative activities. The development of new collaboration networks is one of the factors at the heart of this global reorganization. Promoting new international and/or interdisciplinary collaborations is supposed to increase researchers' productivity and industry partnerships. This project aims to question the validity of this line of thought.

9.2. National Initiatives

9.2.1. DGA/Inria Brainside, 2019-2023

Participants: Francesco d'Amore, Emanuele Natale.

Program: DGA/Inria

Project acronym: Brainside

Project title: Algorithms for simplifying neural networks

Duration: October 2019 - March 2023

Coordinator: Emanuele Natale

Other partners: Inria Paris, EP GANG

Abstract: The widespread use of neural networks on devices with computationally-low capabilities, demands for lightweight and energy-efficient networks. Despite such need, and despite the strategies employed to prevent overfitting by removing a substantial part of their edges, the question of how to reduce their size in terms of the number of neurons appears largely unexplored. The aim of the project is to investigate algorithmic procedures to reduce the size of neural networks, in order to improve the speed with which they can be evaluated and to shed light on how much information about the computational problem at hand can be encoded within neural networks of small size.

9.2.2. ANR-17-CE22-0016 MultiMod, 2018-2022

Participants: Mohammed Amine Ait Ouahmed, Ali Al Zoobi, David Coudert, Nicolas Nisse, Michel Syska.

Program: ANR

Project acronym: MultiMod

Project title: Scalable routing in Multi Modal transportation networks

Duration: January 2018 - December 2022

Coordinator: David Coudert

Other partners: Inria Paris, EP GANG; team CeP, I3S laboratory; SME Instant-System; SME Benomad

Abstract: The MultiMod project addresses key algorithmic challenges to enable the fast computation of personalized itineraries in large-scale multi-modal public transportation (PT) networks (bus, tram, metro, bicycle, etc.) combined with dynamic car-pooling. We will use real-time data to propose itineraries with close to real travel-time, and handle user-constraints to propose personalized itineraries. Our main challenge is to overcome the scalability of existing solutions in terms of query processing time and data-structures space requirements, while including unplanned transportation means (car-pooling), real-time data, and personalized user constraints. The combination of car-pooling and PT network will open-up areas with low PT coverage enable faster itineraries and so foster the adoption of car-pooling. We envision that the outcome of this project will dramatically enhanced the mobility and daily life of citizens in urban areas.

Web: https://project.inria.fr/multimod/

9.2.3. PICS DISCO

Program: PICS

Project acronym: DISCO

Project title: DIsjoint Structures and Coverings in Oriented graphs

Duration: January 2018 -December 2020.

Coordinator: Stéphane Bessy (LIRMM)

Other partners: CNRS LIRMM (Montpellier), Syddansk universitet (Odense, Danemark)

Abstract: Directed graphs (digraphs) are much less understood than undirected graphs. Many, seemingly very simple questions remain unsolved for digraphs while the analogous problem for undirected graphs is trivial. At the same time digraphs are a very important modelling tool for practical applications and so a better undestanding of their structure is important. The purpose of DISCO is to advance knowledge on fundamental problems on digraphs, including splitting a digraph into smaller pieces with given properties, problems regarding disjoint paths and trees, finding small certificates for given properties, such as strong spanning subdigraphs with few arcs. The later is important for speeding up certain algorithms.

Through a concerted effort we expect to obtain important results which will lead to a better undestanding of fundamental questions about the structure of digraphs. The participants will meet regularly both in France and in Denmark to work on carefully selected problems.

9.2.4. GDR Actions

9.2.4.1. GDR RSD, ongoing (since 2006)

Members of COATI are involved in the working group RESCOM (*Réseaux de communications*) of GDR RSD, CNRS (http://gdr-rsd.cnrs.fr/pole_rescom). In particular, David Coudert is co-chair of this working group since 2017.

We are also involved in the working group "Energy" of GDR RSD (http://gdr-rsd.cnrs.fr/action_green). In particular, Frédéric Giroire is co-hair of this working group.

9.2.4.2. GDR IM, ongoing (since 2006)

Members of COATI are involved in the working group "Graphes" of GDR IM, CNRS. (http://gtgraphes.labri.fr/). In particular, Frédéric Havet is member of the steering committee.

9.2.4.3. GDR MADICS, ongoing (since 2017)

Members of COATI are involved in the working group GRAMINEES (GRaph data Mining in Natural, Ecological and Environnemental Sciences) of GDR MADICS (Masses de Données, Informations et Connaissances en Sciences). (http://www.madics.fr/actions/actions-en-cours/gramineees/).

9.3. International Initiatives

9.3.1. Inria Associate Teams Not Involved in an Inria International Labs

9.3.1.1. EfDyNet

Title: Efficient Dynamic Resource Allocation in Networks

International Partner (Institution - Laboratory - Researcher):

Concordia University (Canada) - Department of Electrical Engineering - Brigitte Jaumard

Start year: 2019

See also: https://team.inria.fr/coati/projects/efdynet/

Networks are evolving rapidly in two directions. On the one hand, new network technologies are developed for different layers, and in particular flexible optical technologies (enabling to allocate a fraction of the optical spectrum rather than a fixed wavelength), Software Defined Networks, and Network Function Virtualization. On the other hand, the traffic patterns evolve and become less predictable due to the increase of cloud and mobile traffic. In this context, there are new possibilities and needs for dynamic resource allocations. We will study this problem mainly in two directions: network reconfiguration and the allocation of virtualized resources. The associated team will build on an already fruitful collaboration between COATI and Concordia. The two teams address design and management optimization problems in networks (WDM, wireless, SDN) with complementary tools and expertise.

9.3.2. Inria International Partners

9.3.2.1. Informal International Partners

Apart from formal collaboration COATI members maintain strong connections with the following international teams, with regular visits of both sides.

Universidade Federal do Ceará (Fortaleza, Brazil), ParGO team;

Universidade Estadual do Ceará (Fortaleza, Brazil), Prof. Leonardo Sampaio;

Univ. of Southern Denmark (Odense, Denmark), Prof. Jørgen Bang-Jensen.

9.3.3. Participation in Other International Programs

9.3.3.1. International Initiatives

GALOP

Program: STICAmSud

Title: Graphs ALgorithms for Optimization Problems

International Partners (Institution - Laboratory - Researcher):

Universidad Diego Portales (Chile) - Facultad de Ingeniería y Ciencias - Karol Suchan

Universidade Federal do Ceará (Brazil) - ParGo team - Julio Araujo

Duration: 2019 - 2020

Start year: 2019

See also: https://team.inria.fr/coati/projects/sticamsud-galop/
This project aims at allowing to continue the fruitful and long-standing collaboration between Inria and UFC and between Inria and UAI. Another goal is to reinforce the collaboration between UFC and UAI that has been recently initiated. Our goal is to study the Computational Complexity of several important problems arising in networks (routing, resources assignment...). In particular, we will focus on the computation of metric or structural properties and parameters of large networks (e.g., transportation and social networks...). We plan to design efficient exact algorithms for solving these problems or to theoretically prove that such algorithms cannot exist. In the latter case, we will then design approximation algorithms, or prove that none exists. In all cases, we aim at implementing our algorithms and use them on real-world instances such as large road networks or huge social networks.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Hossein Baktash: Sharif Institute of Technology, Tehran, Iran. July 15 - September 15, 2019.
- Joergen Bang-Jensen: Southern Denmark University, Odense, Denmark, January 7-11 2019.
- Brigitte Jaumard: Concordia University, Montréal, Québec, Canada. June 17-28 and December 7-21, 2019.
- Malgorzata Sulkowska: Faculty of Fundamental Problems of Technology, Wroclaw University of Science and Technology, Wroclaw, Poland. September 23-27th, 2019.
- Karol Suchan: Universidad Diego Portales, Santiago, Chile. December 8-22th, 2019.
- Julio-Cesar Silva Araújo: Universidad do Ceara, Fortaleza, Brazil. December 5-28th, 2019.
- Karol Maia de Oliveira: Universidad do Ceara, Fortaleza, Brazil. December 5-28th, 2019.
- Claudia Linhares Sales: Universidad do Ceara, Fortaleza, Brazil. December 5-28th, 2019.
- Leonardo Sampaio Rocha: Universidad do Ceara, Fortaleza, Brazil. until June 2019.
- Xavier Defago: Tokyo Institute of Technology, Tokyo, Japan. January 7-11, 2019.
- Takako Kodate: Tokyo Woman's Christian University, Tokyo, Japan. March 18-31, 2019.

9.4.2. Visits to International Teams

9.4.2.1. Research Stays Abroad

- Julien Bensmail :
  Indian Statistical Institute, Kolkata, India. January 26-February 9, 2019.
  Universidade Federal do Ceará, Fortaleza, Brazil. May 4-May 17, 2019.
  Xidian University, Xi'an, China. August 31-September 14, 2019.
  Northwestern Polytechnical University, Xi'an, China. October 19-November 2, 2019.
- David Coudert :
  Concordia University, Montréal, Québec, Canada. July 12-27, 2019.
- Adrien Gausseran :
  Concordia University, Montréal, Québec, Canada. September 2 - December 2, 2019.
- Frédéric Giroire :
  Concordia University, Montréal, Québec, Canada. October 8-18th, 2019.
- Joanna Moulierac :
  Concordia University, Montréal, Québec, Canada. October 8-18th, 2019.
- Emanuele Natale :
  Max Planck Institute for Informatics, Sarrebruck, Germany. January 19 - February 28, 2019.
  University of Melbourne, Melbourne, Australia & University of Otago, Dunedin, New Zealand. October 1-30, 2019.
  University of Rome Tor Vergata, Rome, Italy. 1 November 2019 - 31 January 2020.
- Nicolas Nisse :
  Univ. Federal do Ceara, Fortaleza, Brazil, May 4-18th, 2019.
  Xidiang University, Xi'an, China. September 1-15th, 2019.

COFFEE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

The team is involved in the IDEX project UCA-JEDI.

7.2. National Initiatives

7.2.1. ANR

- ANR CHARMS (Quantitative Reservoir Models for Complex Hydrothermal Systems), Roland Masson and Konstantin Brenner: december 2016 - december 2020, partners BRGM (leader), LJAD-Inria, Storengy, MdS, LJLL.
- ANR JCJC PRECIS (Effect of a shock wave on a structure with contact using mesh refinement and parallelism), Laurent Monasse: april 2018 - april 2021, partners Inria (leader), Ecole des Ponts, CEA, Université Paris-Est.

7.2.2. National and European networks

- GdR MANU.

  The research group MANU has activities centered around scientific computing, design of new numerical schemes and mathematical modelling (upscaling, homogenization, sensitivity studies, inverse problems,...). Its goal is to coordinate research in this area, as well as to promote the emergence of focused groups around specific projects
- S. Junca is involved in GdR 3437 DYNOLIN “Dynamique non linéaire” and GdR MecaWave.
- LJAD-Inria and BRGM are the French partners of the Norvergian, German French project InSPiRE "International Open Source Simulation Software Partnership in Research and Education” which has just been accepted by the Research Council of Norway with the code ComPASS as one of the softwares of this project together with Dune, Dumux and OPM.

7.3. International Initiatives

7.3.1. Inria Associate Teams Not Involved in an Inria International Labs

7.3.1.1. HDTHM

Title: Mathematical and numerical methods for thermo-hydro-mechanical models in porous media with discontinuities

International Partner (Institution - Laboratory - Researcher):

Monash University (Australia) - School of Mathematics - Jérome Droniou

Start year: 2019

See also: https://math.unice.fr/~massonr/HDTHM/HDTHM.html

The objective of this project is to extend a recent successful joint work between the two project leaders into a tight collaboration between the Monash and the Coffee teams involving several permanent members and students. The present project focuses on challenging directions of research related to the numerical simulation of thermo-hydro-mechanical models in fractured porous media that take advantage of the complementarity of both teams’ expertise as well as of the recent arrival of Laurent Monasse in the Coffee team. It is an opportunity to extend our collaborations with the Coffee team industrial partners in geosciences as well as to submit in common a research project to the Australian Research Council toward the end of the project.

7.3.2. Inria International Partners

The team has many interactions abroad: UFRJ, Ut Austin, India, Geneva, ICL,...

7.3.3. Participation in Other International Programs

Coffee is member of the Interdisciplinary Union of Porous Media Research at the University of Stuttgart (NUPUS).

Principal areas of research cooperation to be pursued under this program include free flow and porous medla flow interaction, fracture and fluid flow interactlon, fluid-solid phase change interaction, and simulation methods and tools.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

The team has welcomed Paulo Amorim, from UFRJ, for research on the modeling of self-organization in f population dynamics, Corrado Mascia, from La Sapienza, on the analysis of hyperbolic systems and Martin Gander, from Univ. Geneva, for research on domain decomposition methods.

DATASHAPE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Mini course on “Sheaf Theory and Topological Data Analysis” taught by Rodrigo Cordoniu (Nice University) at Inria Sophia Antipolis — 8 weeks, 2h per week, Feb 2019 to Apr 2019.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. ANR ASPAG

Participant: Marc Glisse.

- Acronym : ASPAG.

- Type : ANR blanc.

- Title : Analysis and Probabilistic Simulations of Geometric Algorithms.

- Coordinator : Olivier Devillers (équipe Inria Gamble).

- Duration : 4 years from January 2018 to December 2021.

- Others Partners: Inria Gamble, LPSM, LABRI, Université de Rouen, IECL, Université du Littoral Côte d’Opale, Telecom ParisTech, Université Paris X (Modal’X), LAMA, Université de Poitiers, Université de Bourgogne.

- Abstract:

The analysis and processing of geometric data has become routine in a variety of human activities ranging from computer-aided design in manufacturing to the tracking of animal trajectories in ecology or geographic information systems in GPS navigation devices. Geometric algorithms and probabilistic geometric models are crucial to the treatment of all this geometric data, yet the current available knowledge is in various ways much too limited: many models are far from matching real data, and the analyses are not always relevant in practical contexts. One of the reasons for this state of affairs is that the breadth of expertise required is spread among different scientific communities (computational geometry, analysis of algorithms and stochastic geometry) that historically had very little interaction. The Aspag project brings together experts of these communities to address the problem of geometric data. We will more specifically work on the following three interdependent directions.

(1) Dependent point sets: One of the main issues of most models is the core assumption that the data points are independent and follow the same underlying distribution. Although this may be relevant in some contexts, the independence assumption is too strong for many applications.

(2) Simulation of geometric structures: The phenomena studied in (1) involve intricate random geometric structures subject to new models or constraints. A natural first step would be to build up our understanding and identify plausible conjectures through simulation. Perhaps surprisingly, the tools for an effective simulation of such complex geometric systems still need to be developed.

(3) Understanding geometric algorithms: the analysis of algorithm is an essential step in assessing the strengths and weaknesses of algorithmic principles, and is crucial to guide the choices made when designing a complex data processing pipeline. Any analysis must strike a balance between realism and tractability; the current analyses of many geometric algorithms are notoriously unrealistic. Aside from the purely scientific objectives, one of the main goals of Aspag is to bring the communities closer in the long term. As a consequence, the funding of the project is crucial to ensure that the members of the consortium will be able to interact on a very regular basis, a necessary condition for significant progress on the above challenges.

- See also: https://members.loria.fr/Olivier.Devillers/aspag/

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- Arijit Ghosh, Indian Statistical Institute, Kolkata, India (September 2019)
- Ramsay Dyer Berkeley Publishing (September 2019)
- Mathijs Wintraecken, IST Austria (September and October 2019)

7.3.1.1. Internships

- Alex Delalande, Centrale-Supelec, (May-October 2019).

7.3.1.2. Research Stays Abroad

- Martin Royer, Fujitsu Laboratories, Tokyo, 2 months.

DIANA Project-Team

8. Partnerships and Cooperations

8.1. Inria Internal Funding

8.1.1. IPL Betternet

Participants: Giuilio Grassi, Imane Taibi, Chadi Barakat.
The DIANA team is part of the Inria Project Lab BetterNet (http://project.inria.fr/betternet/). Within this lab, Inria is funding the PhD of Imane Taibi who is hosted by the Dionysos team in Rennes and is co-supervied by Chadi Barakat from the DIANA project-team and Gerardo Rubino and Yassine Hadjadj-Aoul from the DIONYSOS project-team. The PhD of Imane Taibi started on the 1st of November 2017. Further in 2018, Inria funded a PostDoc position to supervise the experiments planned within the IPL and develop the data analysis part. This PostDoc position is occupied by Giulio Grassi who is co-supervised by Chadi Barakat from the Diana project-team and Renata Teixeira from the MIMOVE project-team. Giulio Grassi started on October 1st, 2018 and is currently located in Paris.

8.2. Regional Initiatives

8.2.1. ElectroSmart

Participants: Arnaud Legout, Mondi Ravi, David Migliacci, Abdelhakim Akodadi, Yanis Boussad.

The ElectroSmart project benefits form the following fundings:

- a 39 months engineering position from the UCN@Sophia Labex for the 2016-2019 period (Ravi Mondi was hired on this position)
- 30KEuros from Academy 1 of UCAJedi
- a two years engineering position from an Inria ADT for 2017/2019 (Abdelhakim Akodadi)
- a 18 months business developer from Inria ATT for june 2017-june 2019 (David Migliacci)
- a 3 years 2017/2020 Ph.D. thesis from Academy 1 of UCAJedi (Yanis Boussad)
- 12 months business developper from Inria ATT for june 2019 - mai 2020 (David Migliacci)
- 12 months engineer from Inria ATT for june 2019 - mai 2020 (Mondi Ravi)

8.2.2. D2D Indoor

Participants: Chadi Barakat, Zeineb Guizani.
This project is joint with the NFCOM startup in Nice, specialized in the development of new services for mobile phones. The project aims at leveraging mobile to mobile communications for offloading the cellular infrastructure, and targets a solution based on algorithms previously developed in the DIANA project-team (BitHoc and HBSD) to achieve networking in a sparse scenario following the multi-hop communication principle. The project got a funding for one year engineer from the Labex UCN@SOPHIA. Zeineb Guizani has worked on this project from July 2018 to May 2019 and has proposed an architecture based on NDN-opp to support such communications.

8.3. National Initiatives

8.3.1. ANR

- **ANR JCJC DET4ALL** (2019-2021): Modern factories and industrial system massively rely on cyber physical systems with digital communications (e.g., to allow collaborative robots, for data analytics...). However, industrial networks are still mostly managed and conceived as collections of independent communicating units instead of one unified piece of software.

  The reason why the shift of paradigm did not occur yet to industrial digital communication networks is because industrial processes generally impose strong determinism and real-time constraints. As a result, industrial networks have a propensity of being physically segregated to contain potential malfunctions and simplify conception.

  With the DET4ALL project, we will apply the concept of network programmability to the world of industrial communicating systems. To that aim, we will construct and prove the essential building blocks that will allow to virtualise industrial networks:

  – algorithms to automatically provision the various components constituting industrial networks;

  – Domain Specific Languages (DSLs) to specify real-time communication schemes;

  – mechanisms to update on-the-fly the production infrastructures without service degradation.

  The impact of the DET4ALL project goes beyond technological advances; it will also bring a new vision on what production tools can become, namely agile systems in perpetual evolution.
- **ANR FIT** (2011-2019): FIT (Future Internet of Things) aims at developing an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet. FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's Equipements of Excellence (Equipex) research grant programme. The project will benefit from a 5.8 million euro grant from the French government. Other partners are UPMC, IT, Strasbourg University and CNRS. The project was extended for one year and will end in december 2019. See also http://fit-equipex.fr/.
- **ANR BottleNet** (2016-2019): BottleNet aims to deliver methods, algorithms, and software systems to measure Internet Quality of Experience (QoE) and diagnose the root cause of poor Internet QoE. This goal calls for tools that run directly at users' devices. The plan is to collect network and application performance metrics directly at users' devices and correlate it with user perception to model Internet QoE, and to correlate measurements across users and devices to diagnose poor Internet QoE. This data-driven approach is essential to address the challenging problem of modeling user perception and of diagnosing sources of bottlenecks in complex Internet services. ANR BottleNet will lead to new solutions to assist users, network and service operators as well as regulators in understanding Internet QoE and the sources of performance bottleneck.

8.4. European Initiatives

8.4.1. FP7 & H2020 Projects

- Program: FP7 FIRE programme
- Project acronym: Fed4Fire+
- Project title: Federation for FIRE Plus

- Duration: January 2017 - December 2021
- Coordinator: iMinds (Belgium)
- Other partners: 20 european partners including IMEC (Belgium), UPMC (Fr), Fraunhofer (Germany), TUB (Germany), etc.
- Web site: http://www.fed4fire.eu/
- Abstract: The Fed4FIRE+ project has the objective to run and further improve Fed4FIRE as best-in-town federation of experimentation facilities for the Future Internet Research and Experimentation initiative. Federating a heterogeneous set of facilities covering technologies ranging from wireless, wired, cloud services and open flow, and making them accessible through common frameworks and tools suddenly opens new possibilities, supporting a broad range of experimenter communities covering a wide variety of Internet infrastructures, services and applications. Fed4FIRE+ will continuously upgrade and improve the facilities and include technical innovations, focused towards increased user satisfaction (user-friendly tools, privacy-oriented data management, testbed SLA and reputation, experiment reproducibility, service-level experiment orchestration, federation ontologies, etc.). It will open this federation to the whole FIRE community and beyond, for experimentation by industry and research organisations, through the organization of Open Calls and Open Access mechanisms. The project will also establish a flexible, demand-driven framework which allows test facilities to join during the course of its lifetime by defining a set of entry requirements for new facilities to join and to comply with the federation. FIRE Experimental Facilities generate an ever increasing amount of research data that provides the foundation for new knowledge and insight into the behaviour of FI systems. Fed4FIRE+ will participate in the Pilot on Open Research Data in Horizon 2020 to offer open access to its scientific results, to the relevant scientific data and to data generated throughout the project's lifetime. Fed4FIRE+ will finally build on the existing community of experimenters, testbeds and tool developers and bring them together regularly (two times a year) in engineering conferences to have maximal interaction between the different stakeholders involved.

8.5. International Initiatives

8.5.1. Inria Associate Teams Involved in an Inria International Lab

8.5.1.1. DrIVE

Title: DrIVE: Distributed Intelligent Vehicular Environment - Enabling ITS through programmable networks

Inria International Lab: **Inria@SiliconValley**

International Partners (Institution - Laboratory - Researcher):

UniCamp (Brazil) - Department of Computer Engineering and Industrial Automation - Mateus Augusto Silva Santos

UNICAMP (Brazil) - Department of Computer Engineering and Industrial Automation - Christian Esteve Rothenberg

UC Santa Cruz (USA) - Department of Computer Science and Engineering- Katia Obraczka

Start year: 2018

See also: https://team.inria.fr/diana/drive-associated-team/

Transportation systems are part of our society's critical infrastructure and are expected to experience transformative changes as the Internet revolution unfolds. The automotive industry is a notable example: it has been undergoing disruptive transformations as vehicles transition from traditional unassisted driving to fully automated driving, and eventually to the self-driving model. Communication technology advancements such as support for vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communication have been one of the key enablers of next generation transportation services,

also known as Intelligent Transport Systems (ITS). However, ITS services and applications pose significant challenges to the underlying communication and network infrastructure due to their stringent low latency, reliability, scalability, and geographic decentralization requirements. The DrIVE associated team proposal aims at addressing such challenges by: (1) developing a programmable network control plane that will dynamically adjust to current environment conditions and network characteristics to support ITS' scalability, quality of service (QoS), and decentralization requirements, and (2) applying the proposed distributed network control plane framework to ITS applications, such as road hazard warning, autonomous- and self-driving vehicles, and passenger-centric services (e.g., infotainment and video streaming).

8.6. International Research Visitors

8.6.1. Visits of International Scientists

Mark Crovella, Professor at Boston University, visited us in March 2019 and gave a talk at Forum Numerica of Université Côte d'Azur. Mark is currently collaborating with Chadi Barakat on network-wide anomaly detection within the IPL BetterNet.

8.6.2. Internships

Houssam Elbouanani

Date: from March 2019 to August 2019

Institution: Ubinet Master 2 program at Université Côte D'Azur

Supervisors: Chadi Barakat and Guillaume Urvoy-Keller

Subject: Measurement as a Service in modern Data Centers

Anas Errahali

Date: from March 2019 to August 2019

Institution: Ubinet Master 2 program at Université Côte D'Azur

Supervisosr: Walid Dabbous and Thierry Turletti

Subject: Enhancing geolocation accuracy in LoRa Low Power Wide Area Networks

Youssef Rachid

Date: from March 2019 to August 2019

Institution: Ubinet Master 2 program at Université Côte D'Azur

Supervisor: Arnaud Legout

Subject: Exploring bias in the YouTube recommendation system.

Tareq Si Salem

Date: from March 2019 to August 2019

Institution: Ubinet Master 2 program at Université Côte D'Azur

Supervisor: Arnaud Legout

Subject: Identifying exposure profiles of Electrosmart users.

8.6.3. Visits to International Teams

Mohamed Naoufal Mahfoudi spent six months (october 2018, March 2019) PhD internship in University of California at San Diego in Professor Xinyu Zhang team. During this period he worked on a new passive localization system based on deep learning.

Tingting Yuan spent a 3-week visit at UNICAMP, Brazil, in the context of the DrIVE associated team (Oct 21 – Nov 8, 2019).

ECUADOR Project-Team (section vide)

EPIONE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Marco Lorenzi is principal investigator of the project Big Data for Brain Research, funded during 2017-20 by the Départment des Alpes Maritimes.
- Marco Lorenzi is principal investigator of the project MetaImaGen, funded by Idex Jedi UCA (2018-2020, 37k€).
- Maxime Sermesant is principal investigator of the project "The Digital Heart" and the innovation action "Digital Heart Phantom" with General Electrics, funded by Idex UCA Jedi. These projects gather the local cardiac research in academia, clinics and industry.
- Hervé Delingette is the principal investigator of the LungMark project funded by Idex Jedi UCA (2018-2021).
- Hervé Delingette is the principal investigator of the CIMPLE project, funded by Idex Jedi UCA (2018-2021), the region PACA and Oticon Medical. The region PACA and Oticon Medical are co-funding the Phd of Zihao Wang.
- N. Ayache and P. Robert are principal investigators of the project MNC3 (Médecine Numérique, Cerveau, Cognition, Comportement) funded by Idex Jedi UCA (2017-2021, 450k€). M. Lorenzi (Inria) actively participates to the supervision of this project with the help of V. Manera (ICP).

8.2. National Initiatives

8.2.1. Consulting for Industry

- Marco Lorenzi is a scientific consultant for the company MyDataModels (Sophia Antipolis), and for the company Flexper (Sophia Antipolis.)
- Maxime Sermesant is a scientific consultant for the company inHEART (Bordeaux)
- Nicholas Ayache is a scientific consultant for the company Mauna Kea Technologies (Paris).

8.2.2. Institute 3IA Côte d'Azur

The 3IA Côte d'Azurhttp://univ-cotedazur.fr/institutes/3IA/home is one of the four "Interdisciplinary Institutes of Artificial Intelligence" that were created in France in 2019. Its ambition is to create an innovative ecosystem that is influential at the local, national and international levels, and a focal point of excellence for research, education and the world of AI.

Epione is heavily involved in this institute since its 5 permanents researchers (N. Ayache, H. Delingette, M. Lorenzi, M. Sermesant and X.Pennec) are chair holders in this institute, and N. Ayache is its scientific director.

8.2.3. Collaboration with national hospitals

The Epione-project team collaborates with the following 3 French IHU (University Hospital Institute): the IHU-Strasbourg (Pr J. Marescaux and L. Soler) on image-guided surgery, the IHU-Bordeaux (Pr M. Haïssaguere and Pr P. Jaïs) on cardiac imaging and modeling and the IHU-Pitié Salpétrière (Dr. O. Colliot and S. Durrleman) on neuroimaging.

We also have long term collaborations with the CHU Nice and Centre Antoine Lacassagne in Nice.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. ERC ECSTATIC

Title: Electrostructural Tomography – Towards Multiparametric Imaging of Cardiac Electrical Disorders

Programm: H2020

Type: ERC

Duration: 2017 - 2022

Coordinator: U. Bordeaux

Inria contact: Maxime Sermesant

Cardiac electrical diseases are directly responsible for sudden cardiac death, heart failure and stroke. They result from a complex interplay between myocardial electrical activation and structural heterogeneity. Current diagnostic strategy based on separate electrocardiographic and imaging assessment is unable to grasp both these aspects. Improvements in personalized diagnostics are urgently needed as existing curative or preventive therapies (catheter ablation, multisite pacing, and implantable defibrillators) cannot be offered until patients are correctly recognized.

ECSTATIC aims at achieving a major advance in the way cardiac electrical diseases are characterized and thus diagnosed and treated, through the development of a novel non-invasive modality (Electrostructural Tomography), combining magnetic resonance imaging (MRI) and non-invasive cardiac mapping (NIM) technologies.

The approach will consist of: (1) hybridising NIM and MRI technologies to enable the joint acquisition of magnetic resonance images of the heart and torso and of a large array of body surface potentials within a single environment; (2) personalising the inverse problem of electrocardiography based on MRI characteristics within the heart and torso, to enable accurate reconstruction of cardiac electrophysiological maps from body surface potentials within the 3D cardiac tissue; and (3) developing a novel disease characterisation framework based on registered non-invasive imaging and electrophysiological data, and propose novel diagnostic and prognostic markers.

This project will dramatically impact the tailored management of cardiac electrical disorders, with applications for diagnosis, risk stratification/patient selection and guidance of pacing and catheter ablation therapies. It will bridge two medical fields (cardiac electrophysiology and imaging), thereby creating a new research area and a novel semiology with the potential to modify the existing classification of cardiac electrical diseases.

8.3.1.2. ERC G-statistics

Title: Biophysical Modeling and Analysis of Dynamic Medical Images

Programme: FP7

Type: ERC

Period: 2018-2023

Coordinator: Inria

PI: Xavier Pennec

G-Statistics aims at exploring the foundations of statistics on non-linear spaces with applications in the Life Siences. Invariance under gauge transformation groups provides the natural structure explaining the laws of physics. In life sciences, new mathematical tools are needed to estimate approximate invariance and establish general but approximate laws. Rephrasing Poincaré: a geometry cannot be more true than another, it may just be more convenient, and statisticians must find the most

convenient one for their data. At the crossing of geometry and statistics, G-Statistics aims at grounding the mathematical foundations of geometric statistics and to exemplify their impact on selected applications in the life sciences.

So far, mainly Riemannian manifolds and negatively curved metric spaces have been studied. Other geometric structures like quotient spaces, stratified spaces or affine connection spaces naturally arise in applications. G-Statistics will explore ways to unify statistical estimation theories, explaining how the statistical estimations diverges from the Euclidean case in the presence of curvature, singularities, stratification. Beyond classical manifolds, particular emphasis will be put on flags of subspaces in manifolds as they appear to be natural mathematical object to encode hierarchically embedded approximation spaces.

In order to establish geometric statistics as an effective discipline, G-Statistics will propose new mathematical structures and characterizations of their properties. It will also implement novel generic algorithms and illustrate the impact of some of their efficient specializations on selected applications in life sciences. Surveying the manifolds of anatomical shapes and forecasting their evolution from databases of medical images is a key problem in computational anatomy requiring dimension reduction in non-linear spaces and Lie groups. By inventing radically new principled estimations methods, we aim at illustrating the power of the methodology and strengthening the "unreasonable effectiveness of mathematics" for life sciences.

8.3.2. Collaborations in European Programs, Except FP7 & H2020

Program: ERA CoSysMed

Project acronym: SysAFib

Project title: Systems medicine for diagnosis and stratification of atrial fibrillation

Duration: Mai 2016 - Mai 2019

Coordinator: Simula, Norway

Inria contact: Maxime Sermesant

Other partners: Inria, Helmholtz Zentrum München, Oslo University Hospital, Maastricht University, CardioCentro Ticino/CCMC

Abstract: Atrial fibrillation (AF) sharply increases the risk of stroke and is associated with a number of other severe complications, including heart failure. The SysAFib project aims to combine advanced data analysis and computer simulations with classical clinical approaches to create a decision support tool for treating AF. Diverse data sources, such as the individual patient's medical history, clinical measurements and genetic data will be combined into a single tool for optimizing and personalizing AF therapy. SysAFib's ultimate goal is to deliver the right treatment to the right patient at the right time, stopping AF in its tracks and ending the need for repeat invasive procedures.

8.4. International Initiatives

8.4.1. Inria International Labs

Inria@SiliconValley
Associate Team involved in the International Lab:

8.4.1.1. GeomStats

Title: Geometric Statistics in Computational Anatomy: Non-linear Subspace Learning Beyond the Riemannian Structure

International Partner (Institution - Laboratory - Researcher):

Stanford (United States) - Department of Statistics - Susan Holmes

Start year: 2018

See also: http://www-sop.inria.fr/asclepios/projects/GeomStats/

The scientific goal of the associated team is to develop the field of geometric statistics with key applications in computational anatomy. Computational anatomy is an emerging discipline at the interface of geometry, statistics, image analysis and medicine that aims at analysing and modelling the biological variability of the organs shapes at the population level. An important application in neuroimaging is the spatial normalization of subjects that is necessary to compare anatomies and functions through images in populations with different clinical conditions. Following the developments of the last 3 years of the associated team GeomStat, the new research directions have been broken into three axes. The first axis aims at continuing the progresses in theoretical and applied Geometric statistics, with a first theme studying the impact of curvature on the estimation with a finite sample, and a second axis extending the current work on Barycentric Subspace Analysis (BSA), notably with algorithms. The second axis aims at developing a hierarchical atlas of the brain anatomy based on the stratification of the space of image orbits under diffeomorphisms. The third axis explores three important applications of low-dimensional subspace learning in manifolds using BSA in neuroscience: the approximation of EEG signals for brain-computer interfaces (BCI); the acceleration and robustification of Tensor Distribution Functions (TDF) estimation in diffusion images; and the efficient inference in spaces of rank-deficient symmetric matrices for imaging-genetics from multi-centric databases.

8.4.2. Inria Associate Teams Not Involved in an Inria International Labs

8.4.2.1. PERSOCARDIOLEARN

Title: Personalization of Cardiac Models using Experimental Data and Machine Learning

International Partner (Institution - Laboratory - Researcher):

University of Toronto (Canada) - Sunnybrook Research Institute - Mihaela Pop

Start year: 2017

See also: https://team.inria.fr/asclepios/research/associated-team-persocardiolearn/

Multi-scale computer modelling is a powerful tool that could be used to simulate in silico cardiac electrical activity and biomechanical function of individual heart. Imaging and 3D heart models built from images can help us understand the basis of structurally-diseased hearts at organ level and to predict in silico the changes in electro-mechanical function as a consequence of muscle remodelling in pathologic state (e.g. chronic infarction, a major cause of death). We hypothesize that MRI-based predictive models can help us identify new opportunities to intervene or to predict the outcome of ablation therapy, which currently has low clinical success. However, these predictive models need to be validated and thoroughly tested in preclinical experiments prior to their integration into the clinical stage. Hence, the next logical step for our joint Inria-SB efforts is to expand our experimental-theoretical framework and to personalize fast 3D heart models from in vivo MR-EP data. This translational step involves numerous challenging tasks from the modelling perspective since the in vivo imaging and physiological signals are rather noisy and obtained at a poor spatial resolution, potentially leading to erroneous customization of mathematical model parameters. However, this collaboration employs a rare combination of experiments and modelling specialists. Moreover, the originality of the proposed approach is to build upon machine-learning techniques rather than on data assimilation methods that are more explored in the literature but have inherent limitations (robustness to noise, local minima. . .).

8.4.3. Inria International Partners

8.4.3.1. Informal International Partners

8.4.3.1.1. University College London (UCL), London, UK

Marco Lorenzi is collaborator of the Translational Imaging Group of UCL, and with the UCL Institute od Ophtalmology. His collaboration is around the topic of spatio-temporal analysis of medical images, with special focus on brain imaging analysis and biomarker development. He is also collaborating with the "Progression Over Neurodegenerative Disorders" (POND) group (Prof. Daniel Alexander) for developing new computational models and techniques for learning characteristic patterns of disease progression using large longitudinal clinical data sets, with special focus on dementias.

8.4.3.1.2. Imaging Genetics Center (IGC), University of Southern California (USC), CA, USA

Marco Lorenzi is currently collaborator of IGC for the investigation of the complex relationship between brain atrophy and genetics in Alzheimer's disease, in particular for demonstrating the effectiveness of multivariate statistical models in providing a meaningful description of the relationship between genotype and brain phenotype.

8.4.3.1.3. St Thomas' Hospital, King's College London, United Kingdom

Maxime Sermesant is a visiting lecturer in the Division of Imaging Sciences and Biomedical Engineering, St Thomas' Hospital, King's College London lead by Pr Reza Razavi. The XMR facility within this hospital is a unique opportunity to validate and exploit the cardiovascular modelling work.

8.4.3.1.4. Other International Hospitals

Collaborations with several other European hospitals have been established through the European projects VP2HF, MD PAEDIGREE, SysAFib and with BarcelonaBeta research centre for Alzheimer.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Dr. Gabriel Ziegler (German Center for Neurodegenerative Disorder, DE) visited the group from Oct 14th to Oct 18t.
- Guillaume Lajoinie (Physics of Fluid laboratory, University of Twente, NL) visited the team from April until October 2019.
- Wilhelm Wimmer (Center ARTORG, University of Bern, CH) visited the team from Nov. 2018 until Oct. 2019.
- Pr. Dmitri Alekseevky (The Institute for Information Transmission Problems, Moscow) visited the Geometric Statistics group from february 6 to 13 2019.

8.5.1.1. Internships

- Buntheng LY, Master student at the University Claude Bernard Lyon 1, visited the Epione team from March to September 2019 to work with Maxime Sermesant on Machine Learning methods for the prediction of Sudden Cardiac Death.
- YingYu Yang, Master student at Ecole Polytechnique, visited the Epione team from April to September 2019 to work with Maxime Sermesant on Machine Learning and Pulmonary hypertension.
- Gaetan Desrues, Master student at University of Bordeaux, visited the Epione team from March to September 2019 to work with Maxime Sermesant on hyper-reduction of cardiac models using poly-affine deformation.
- Paul Blanc Durand, Master student at University Paris-Est Créteuil, visited the Epione team from April to October 2019 to work with Hervé Delingette on Mesh-based Registration of lung CT scans between inhale and exhale phases.
- Bastien Manach-Perennou, Master student at Ecole Central Supélec, visited the Epione team from September to January 2019 to work with Xavier Pennec on Registration synchronisation.
- Julien Moreira, Master student from University Côte d'Azur, visited the Epione team from April to June 2019 to work with Marco Lorenzi on the analysis of apathy and depression in the UK Biobank. The internship is within a collaboration with Centre de la Memoire de Nice.
- Yann Fraboni visited the Epione team from December 2019 to work with Marco Lorenzi on the analysis of bias of federated learning methods in distributed application. The internship is within a collaboration with Accenture Labs of Sophia Antipolis.

FACTAS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- The team co-advises a PhD (G. Bose) with the CMA team of LEAT (http://leat.unice.fr/pages/activites/cma.html) funded by the Labex UCN@Sophia on the co-conception of Antennas and Filters.
- The team participates in the project ToMaT, "Multiscale Tomography: imaging and modeling ancient materials, technical traditions and transfers", funded by the Idex UCA^{Jedi} ("programme structurant Matière, Lumière, Interactions"). This project brings together researchers in archaeological, physical, and mathematical sciences, with the purpose of modeling and detecting low level signals in 3-D images of ancient potteries. The other concerned scientists are from CEPAM-CNRS-UCA (project coordinator: Didier Binder), Nice http://www.cepam.cnrs.fr, the team Morpheme, CNRS-I3S-Inria http://www.inria.fr/equipes/morpheme, and IPANEMA, CNRS, Ministère de la Culture et de la Communication, Université Versailles Saint Quentin http://ipanema.cnrs.fr/. Since March 2018, they co-advise together the post-doctoral research of Vanna Lisa Coli, see Section 6.6 , and this year the internship training of Pat Vatiwutipong.

8.2. National Initiatives

8.2.1. ANR MagLune

The ANR project MagLune (Magnétisme de la Lune) was active from July 2014 to August 2019. It involved the Cerege (Centre de Recherche et d'Enseignement de Géosciences de l'Environnement, joint laboratory between Université Aix-Marseille, CNRS and IRD), the IPGP (Institut de Physique du Globe de Paris) and ISTerre (Institut des Sciences de la Terre). Associated with Cerege were Inria (Apics, then Factas team) and Irphe (Institut de Recherche sur les Phénomènes Hors Équilibre, joint laboratory between Université Aix-Marseille, CNRS and École Centrale de Marseille). The goal of this project (led by geologists) was to understand the past magnetic activity of the Moon, especially to answer the question whether it had a dynamo in the past and which mechanisms were at work to generate it. Factas participated in the project by providing mathematical tools and algorithms to recover the remanent magnetization of rock samples from the moon on the basis of measurements of the magnetic field it generates. The techniques described in Section 6.1 were instrumental for this purpose.

8.2.2. ANR Repka

ANR-18-CE40-0035, "REProducing Kernels in Analysis and beyond", starting April 2019 (for 48 months).

Led by Aix-Marseille Univ. (IMM), involving Factas team, together with Bordeaux (IMB), Paris-Est, Toulouse Universities.

The project consists of several interrelated tasks dealing with topical problems in modern complex analysis, operator theory and their important applications to other fields of mathematics including approximation theory, probability, and control theory. The project is centered around the notion of the so-called reproducing kernel of a Hilbert space of holomorphic functions. Reproducing kernels are very powerful objects playing an important role in numerous domains such as determinantal point processes, signal theory, Sturm-Liouville and Schrödinger equations.

This project supports the PhD of M. Nemaire within Factas, co-advised by IMB partners.

8.3. European Initiatives

8.3.1. Collaborations with Major European Organizations

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

System identification deals with the derivation, estimation and validation of mathematical models of dynamical phenomena from experimental data.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

Following two Inria Associate teams (2013-2018) and a MIT-France seed funding (2014-2018), the team has a strong and regular collaboration with the Earth and Planetary Sciences department at Massachusetts Institute of Technology (Cambridge, MA, USA) and with the Mathematics department of Vanderbilt University (Nashville, TN, USA) on inverse problems for magnetic microscopy applied to the analysis of ancient rock magnetism.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

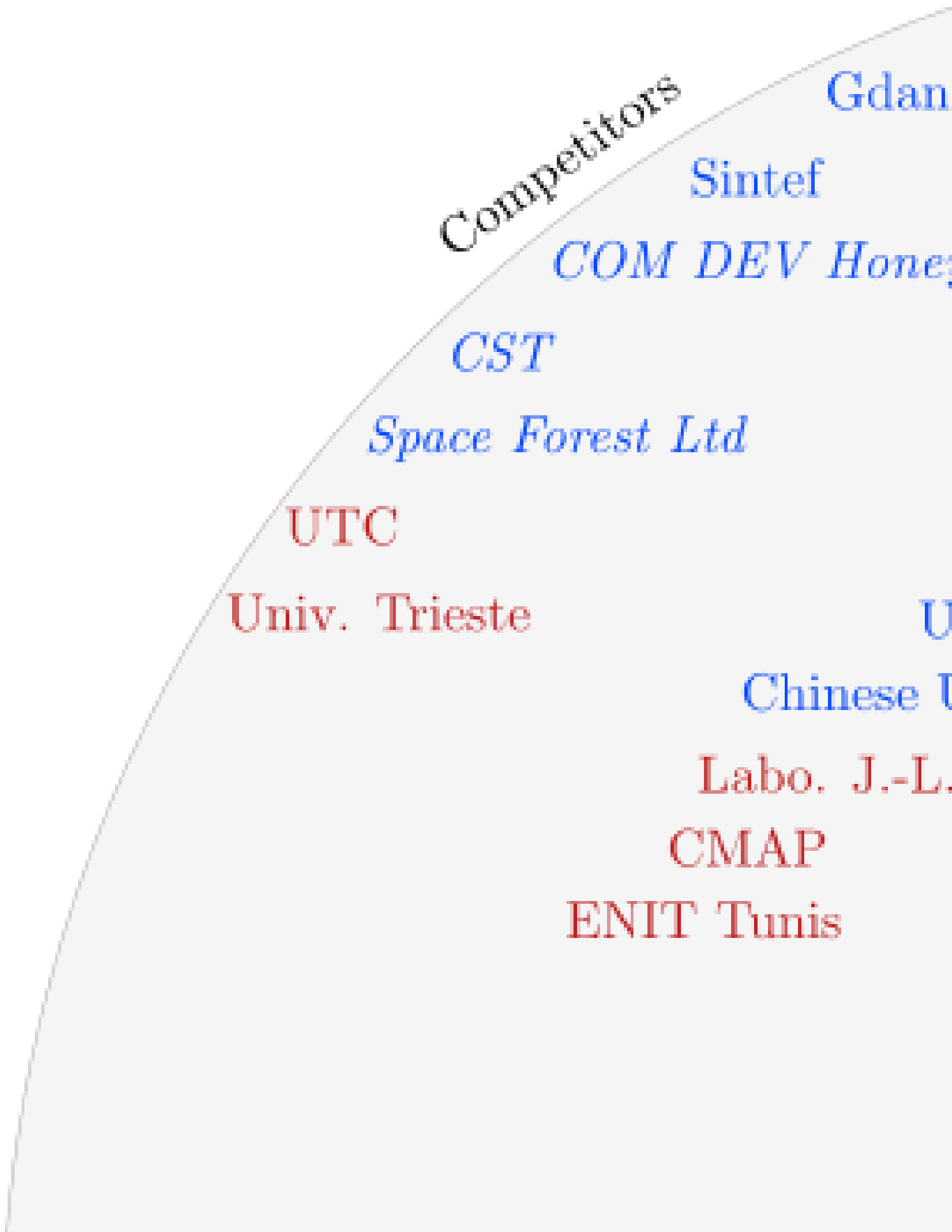
- Smain Amari (Royal Military College of Canada, Kingston, Canada), February 4-9.
- Jonathan Partington (Univ. of Leeds, England), February 4-7.
- Dmitry Ponomarev (T.U. Vienna, Vienna, Austria), June 24.
- Élodie Pozzi (St Louis Univ., St Louis, Missouri, USA), Brett Wick (Washington Univ., St Louis, Missouri, USA), January 9-10.
- Yves Rolain (Vrije Universiteit Brussel, VUB, Brussels, Belgium), February 5-7.
- Maxim Yattselev (University of Indianapolis, Purdue University at Indianapolis, USA), June 29-July 1.

8.5.1.1. Internships

- Paul Asensio, École Centrale Lyon, *Study of silent current sources in electroencephalography (EEG) and magnetoencephalography (MEG)*; advisors: L. Baratchart, J. Leblond.
- Masimba Nemaire, MathMods Master, *Study of silent current sources in EEG and MEG*; advisors: L. Baratchart, J. Leblond.
- Tuong Vy Nguyen Hoang, *Mathematical Circuit Modeling for Antennas*; advisors: F. Seyfert, M. Olivi.
- Pat Vatiwutipong, MathMods Master, *Properties of the d-Radon transform and applications to imaging issues in archaeology*; advisors: V. L. Coli, J. Leblond.

8.6. List of international and industrial partners

Figure 10 sums up who are our main collaborators, users and competitors.


Competitors
Gdan
Sintef
COM DEV Hone
CST
Space Forest Ltd
UTC
Univ. Trieste
U
Chinese U
Labo. J.-L.
CMAP
ENIT Tunis

FOCUS Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

- DCore (Causal debugging for concurrent systems) is a 4-years ANR project that started on March 2019. The overall objective of the project is to develop a semantically well-founded, novel form of concurrent debugging, which we call "causal debugging". Causal debugging will comprise and integrate two main engines: (i) a reversible execution engine that allows programmers to backtrack and replay a concurrent or distributed program execution and (ii) a causal analysis engine that allows programmers to analyze concurrent executions to understand why some desired program properties could be violated. Main persons involved: Lanese, Medic.
- REPAS (Reliable and Privacy-Aware Software Systems via Bisimulation Metrics) is an ANR Project that started on October 2016 and that will finish on October 2020. The project aims at investigating quantitative notions and tools for proving program correctness and protecting privacy. In particular, the focus will be put on bisimulation metrics, which are the natural extension of bisimulation to quantitative systems. As a key application, we will develop a mechanism to protect the privacy of users when their location traces are collected. Main persons involved: Dal Lago, Gavazzo, Sangiorgi.
- COCAHOLA (Cost models for Complexity Analyses of Higher-Order Languages) is an ANR Project that started on October 2016 and that finished on October 2019. The project aims at developing complexity analyses of higher-order computations. The focus is not on analyzing fixed programs, but whole programming languages. The aim is the identification of adequate units of measurement for time and space, i.e. what are called *reasonable* cost models. Main persons involved: Dal Lago, Martini.
- PROGRAMme ("What is a program? Historical and philosophical perspectives"), is an ANR project started on October 2017 and that will finish on October 2022; PI: Liesbeth De Mol (CNRS/Université de Lille3). The aim of this project is to develop a coherent analysis and pluralistic understanding of "computer program" and its implications to theory and practice. Main person involved: Martini.

9.2. European Initiatives

9.2.1. FP7 & H2020 Projects

- BEHAPI (Behavioural Application Program Interfaces) is an European Project H2020-MSCA-RISE-2017, running in the period March 2018 - February 2022. The topic of the project is behavioural types, as a suite of technologies that formalise the intended usage of API interfaces. Indeed, currently APIs are typically flat structures, i.e. sets of service/method signatures specifying the expected service parameters and the kind of results one should expect in return. However, correct API usage also requires the individual services to be invoked in a specific order. Despite its importance, the latter information is either often omitted, or stated informally via textual descriptions. The expected benefits of behavioural types include guarantees such as service compliance, deadlock freedom, dynamic adaptation in the presence of failure, load balancing etc. The project aims to bring the existing prototype tools based on these technologies to mainstream programming languages and development frameworks used in industry.
- ICT COST Action IC1405 (Reversible computation - extending horizons of computing). Initiated at the end of April 2015 and with a 4-year duration, this COST Action studies reversible computation and its potential applications, which include circuits, low-power computing, simulation, biological modeling, reliability and debugging. Reversible computation is an emerging paradigm that extends the standard forwards-only mode of computation with the ability to execute in reverse, so that computation can run backwards as naturally as it can go forwards.

  Main persons involved: Lanese (vice-chair of the action).

9.2.2. Collaborations with Major European Organizations

We list here the cooperations and contacts with other groups, without repeating those already listed in previous sections.

- ENS Lyon (on concurrency models and resource control). Contact person(s) in Focus: Dal Lago, Martini, Sangiorgi. Some visit exchanges during the year, in both directions. A joint PhD (Adrien Durier).
- University of Innsbruck (on termination and complexity analysis of probabilistic programs). Contact person(s) in Focus: Avanzini. Some short visits during the year.
- University of Southern Denmark (on service-oriented computing). Contact person(s) in Focus: Gabbrielli, Lanese, Zavattaro.
- Universitat Politecnica de Valencia, Spain (on reversibility for Erlang). Contact person(s) in Focus: Lanese. Some visit exchanges during the year, in both directions.
- Laboratoire d'Informatique, Université Paris Nord, Villetaneuse (on implicit computational complexity). Contact person(s) in Focus: Dal Lago, Martini.
- Institut de Mathématiques de Luminy, Marseille (on lambda-calculi, linear logic and semantics). Contact person(s) in Focus: Dal Lago, Martini.
- Team PPS, IRIF Lab, University of Paris-Diderot Paris 7 (on logics for processes, resource control). Contact person(s) in Focus: Dal Lago, Martini, Sangiorgi. Some short visits in both directions during the year.
- IRILL Lab, Paris (on models for the representation of dependencies in distributed package based software distributions). Contact person(s) in Focus: Gabbrielli, Zavattaro. Some short visits in both directions during the year.
- IMDEA Software, Madrid (G. Barthe) (on implicit computational complexity for cryptography). Contact person(s) in Focus: Dal Lago. Some visits during the year.

9.3. International Initiatives

9.3.1. Inria Associate Teams Not Involved in an Inria International Lab

9.3.1.1. CRECOGI

Title: Concurrent, Resourceful and Effectful Computation by Geometry of Interaction

International Partner (Institution - Laboratory - Researcher):

Kyoto (Japan) - Research Institute for Mathematical Sciences - Naohiko Hoshino

Start year: 2018

See also: http://crecogi.cs.unibo.it

The field of denotational semantics has successfully produced useful compositional reasoning principles for program correctness, such as program logics, fixed-point induction, logical relations, etc. The limit of denotational semantics was however that it applies only to high-level languages and to extensional properties. The situation has changed after the introduction of game semantics and the geometry of interaction (GoI), in which the meaning of programs is formalized in terms of movements of tokens, through which programs "talk to" or "play against" each other, thus having an operational flavour which renders them suitable as target language for compilers. The majority of the literature on GoI and games only considers sequential functional languages. Moreover, computational effects (e.g. state or I/O) are rarely taken into account, meaning that they are far from being applicable to an industrial scenario. This project's objective is to develop a semantic framework for concurrent, resourceful, and effectful computation, with particular emphasis on probabilistic and quantum effects. This is justified by the greater and greater interest which is spreading around these two computation paradigms, motivated by applications to AI and by the efficiency quantum parallelism induces.

9.3.2. Participation in Other International Programs

Focus has taken part in the creation of the Microservices Community (http://microservices.sdu.dk/), an international community interested in the software paradigm of Microservices. Main aims of the community are: i) sharing knowledge and fostering collaborations about microservices among research institutions, private companies, universities, and public organisations (like municipalities); ii) discussing open issues and solutions from different points of view, to create foundations for both innovation and basic research.

U. Dal Lago is "Partner Investigator" in the project "Verification and analysis of quantum programs", whose Chief Investigator is Prof Yuan Feng, University of Technology Sydney. The project is funded by the Australian Research Council.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

The following researchers have visited Focus for short periods; we list them together with the title of the talk they have given during their stay, or the topic discussed during their stay.

- Ornela Dardha (University of Glasgow) and Laura Bocchi (University of Kent): collaboration within BehAPI RISE H2020 project, September 2019.
- Guilhem Jaber (University of Nantes): "Game semantics for higher-order functions with state", December 2019.
- Naohiko Hoshino, April 2019 and October 2019.
- Gilles Barthe, May 2019.
- Boaz Barak, July 2019.
- Francesco Dagnino, "Generalizing Inference Systems by Corules", November 2019.

9.4.1.1. Sabbatical programme

Simone Martini has been Fellow at the Collegium - Lyon Institute for Advanced Studies, since September 2018 and until June 2019 https://collegium.universite-lyon.fr.

9.4.1.2. Research Stays Abroad

- Ugo Dal Lago has spent overall a few weeks in Japan: RIMS (Kyoto) and NII (Tokyo), as part of ongoing collaborations with Naohiko Hoshino and Shin-ya Katsumata.
- Ivan Lanese has visited Xibis Limited and University of Leicester, UK (in particular Irek Ulidowski and Emilio Tuosto) from 3/7/2019 to 2/8/2019, to work on choreographies, and the University of Torun, Poland (in particular Lukasz Mikulski and Kamila Barylska), from 13/8/2019 to 29/8/2019, to work on reversible Petri nets.
- Cosimo Laneve and Gianluigi Zavattaro have spent overall a few weeks in Malta visit to Prof. Adrian Francalanza at the University of Malta within the BehAPI RISE H2020 project.
- Michael Lodi has visited Prof. Tim Bell and the Computer Science Education Research Group at the Department of Computer Science and Software Engineering, University of Canterbury, Christchurch, New Zealand, from 26th of October 2018 to 17th of April 2019, as part of his Ph.D. course.

GRAPHDECO Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. EpicNPoc

Participants: Bastien Wailly, Adrien Bousseau.

EpicNPoc is a startup working on user interface design for the car industry. Together with two InriaTech engineers, we developed a small proof-of-concept that adapts our drawing recognition technology [9] to their needs. We first adapted our drawing synthesis algorithms to generate artificial sketches of user interface widgets, which include typical distortions and inaccuracies present in real sketches. The two engineers from InriaTech then used this technology to generate a large dataset of drawings, and to train a deep neural network to recognize the widgets in real drawings. The two engineers also integrated the trained network into a real-time system that recognizes widgets as they are drawn on a white board. We advised the engineers in their choice of a deep network architecture and on how to train this network to work on drawings. The result of this collaboration helped EpicNPoc appreciate the robustness of this technology, as well as to evaluate remaining challenges, such as convert the recognized widgets into working user-interface source code.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. D^3: Drawing Interpretation for 3D Design

Participants: Yulia Gryaditskaya, Tibor Stanko, Bastien Wailly, David Jourdan, Adrien Bousseau, Felix Hähnlein.

Line drawing is a fundamental tool for designers to quickly visualize 3D concepts. The goal of this ERC project is to develop algorithms capable of understanding design drawings. The first 30 months of the project allowed us to make significant progress in our understanding of how designers draw, and to propose preliminary solutions to the challenge of reconstructing 3D shapes from design drawings.

To better understand design sketching, we have collected a dataset of more than 400 professional design sketches [17]. We manually labeled the drawing techniques used in each sketch, and we registered all sketches to reference 3D models. Analyzing this data revealed systematic strategies employed by designers to convey 3D shapes, which will inspire the development of novel algorithms for drawing interpretation. In addition, our annotated sketches and associated 3D models form a challenging benchmark to test existing methods.

We proposed several methods to recover 3D information from drawings. A first family of method employs deep learning to predict what 3D shape is represented in a drawing. We applied this strategy in the context of architectural design, where we reconstruct 3D building by recognizing their constituent components (building mass, facade, window). We also presented an interactive system that allows users to create 3D objects by drawing from multiple viewpoints [14]. The second family of methods leverages geometric properties of the lines drawn to optimize the 3D reconstruction. In particular, we exploited properties of developable surfaces to reconstruct sketches of fashion items.

A long-term goal of our research is to evaluate the physical validity of a concept directly from a drawing. We obtained promising results towards this goal for the particular case of mechanical objects. We proposed an interactive system where users design the shape and motion of an articulated object, and our method automatically synthesize a mechanism that animates the object while avoiding collisions [18]. The geometry synthesized by our method is ready to be fabricated for rapid prototyping.

8.2.1.2. ERC FunGraph

Participants: George Drettakis, Thomas Leimkühler, Sébastien Morgenthaler, Rada Deeb, Stavros Diolatzis, Siddhant Prakash, Simon Rodriguez, Julien Philip.

The ERC Advanced Grant FunGraph proposes a new methodology by introducing the concepts of rendering and input uncertainty. We define output or rendering uncertainty as the expected error of a rendering solution over the parameters and algorithmic components used with respect to an ideal image, and input uncertainty as the expected error of the content over the different parameters involved in its generation, compared to an ideal scene being represented. Here the ideal scene is a perfectly accurate model of the real world, i.e., its geometry, materials and lights; the ideal image is an infinite resolution, high-dynamic range image of this scene.

By introducing methods to estimate rendering uncertainty we will quantify the expected error of previously incompatible rendering components with a unique methodology for accurate, approximate and image-based renderers. This will allow FunGraph to define unified rendering algorithms that can exploit the advantages of these very different approaches in a single algorithmic framework, providing a fundamentally different approach to rendering. A key component of these solutions is the use of captured content: we will develop methods to estimate input uncertainty and to propagate it to the unified rendering algorithms, allowing this content to be exploited by all rendering approaches.

The goal of FunGraph is to fundamentally transform computer graphics rendering, by providing a solid theoretical framework based on uncertainty to develop a new generation of rendering algorithms. These algorithms will fully exploit the spectacular – but previously disparate and disjoint – advances in rendering, and benefit from the enormous wealth offered by constantly improving captured input content.

8.2.1.3. Emotive

Participants: Julien Philip, Sebastiàn Vizcay, George Drettakis.

https://emotiveproject.eu/

Type: COOPERATION (ICT)

Instrument: Reseach Innovation Action

Objectif: Virtual Heritage

Duration: November 2016 - October 2019

Coordinator: EXUS SA (UK)

Partner: Diginext (FR), ATHENA (GR), Noho (IRL), U Glasgow (UK), U York (UK)

Inria contact: George Drettakis

Abstract: Storytelling applies to nearly everything we do. Everybody uses stories, from educators to marketers and from politicians to journalists to inform, persuade, entertain, motivate or inspire. In the cultural heritage sector, however, narrative tends to be used narrowly, as a method to communicate to the public the findings and research conducted by the domain experts of a cultural site or collection. The principal objective of the EMOTIVE project is to research, design, develop and evaluate methods and tools that can support the cultural and creative industries in creating Virtual Museums which draw on the power of 'emotive storytelling'. This means storytelling that can engage visitors, trigger their emotions, connect them to other people around the world, and enhance their understanding, imagination and, ultimately, their experience of cultural sites and content. EMOTIVE did this by providing the means to authors of cultural products to create high-quality, interactive, personalized digital stories. The project was evaluated in December with very positive initial feedback.

GRAPHDECO contributed by developing novel image-based rendering techniques to help museum curators and archeologists provide more engaging experiences. We developed a mixed reality plugin for Unity that allows the use of IBR and we developed, in collaboration with ATHENA, a VR experience used in one of the EMOTIVE user experiences using a VIVE HMD. This demo was presented at a public event in November in Glasgow, and used by over 25 museum professionals with very positive feedback.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

We maintain close collaborations with international experts, including

- McGill (Canada) (A. Gruson)
- UBC (Canada), (A. Sheffer)
- TU Delft (NL) (M. Sypesteyn, J. W. Hoftijzer and S. Pont)
- EPFL (Switzerland) (W. Jakob)
- U Bern (Switzerland) (D. Bommes)
- University College London (UK) (G. Brostow, P. Hedman)
- NVIDIA Research (USA, Finland), (C. Wyman, P. Shirley, M. Aittala)
- Adobe Research (USA), (A. Hertzmann, S. Paris, M. Gharbi)
- UC Berkeley (USA) (A. Efros)
- Purdue University (USA) (D. Aliaga, G. Nishida)
- U Texas, Austin (USA), (E. Vouga)
- George Mason University (USA) (Y. Gingold)

8.3.1.2. Inria International Chairs

Fredo Durand, Massachusetts Institute of Technology (United States)

Duration: 2016 - 2020

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Justin Solomon (MIT) in March.
- Mikhail Bessmeltsev (University of Montreal) in June.
- Aaron Hertzmann (Adobe Research) in June.
- Pierre Benard (U. Bordeaux), Daniel Sykora (U. Prague) and TT Wong (Hong Kong Polytechnic) in June.
- Tobias Ritschel (MPI Saarbrucken), Hendrik Lensch (U. Tuebingen) and Yann Gousseau (Telecom Paris) in June.
- Peter Hedman (UCL), September and October.
- Guillaume Coordonnier (ETH Zurich) in October.
- Alyosha Efros (U. Berkeley)
- Holly Rushmeier (Yale) and Abhijeet Ghosh (Imperial College London) in November.
- Niloy Mitra (UCL), Adrien Gruson (McGill) and Michael Gharbi (Adobe) in November.

8.4.1.1. Internships

J. Philip at Adobe Research, June 1st- September 28th, 2019. San Francisco.

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

T. Stanko spent two weeks at University of Montreal to collaborate with Mikhail Bessmeltsev, and S. Rodriguez spent 5 weeks at NVIDIA research in Seattle (host C. Wyman).

GRAPHIK Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. CQFD (ANR PRC, Jan. 2019-Dec. 2022)

Participants: Jean-François Baget, Michel Leclère, Marie-Laure Mugnier, Federico Ulliana.

CQFD (Complex ontological Queries over Federated heterogeneous Data), coordinated by Federico Ulliana (GraphIK), involves participants from Inria Saclay (CEDAR team), Inria Paris (VALDA team), Inria Nord Europe (SPIRALS team), IRISA, LIG, LTCI, and LaBRI. The aim of this project is tackle two crucial challenges in OMQA (Ontology Mediated Query Answering), namely, heterogeneity, that is, the possibility to deal with multiple types of data-sources and database management systems, and federation, that is, the possibility of cross-querying a collection of heterogeneous datasources. By featuring 8 different partners in France, this project aims at consolidating a national community of researchers around the OMQA issue.

8.1.2. ICODA (Inria Project Lab, 2017-2021)

Participants: Jean-François Baget, Michel Chein, Marie-Laure Mugnier.

The iCODA project (Knowledge-mediated Content and Data Interactive Analytics—The case of data journalism), coordinated by Guillaume Gravier and Laurent Amsaleg (LINKMEDIA), takes together four Inria teams: LINKMEDIA, CEDAR, ILDA and GraphIK, as well as three press partners: Ouest France, Le Monde (les décodeurs) and AFP.

Taking data journalism as an emblematic use-case, the goal of the project is to develop the scientific and technological foundations for knowledge-mediated user-in-the-loop big data analytics jointly exploiting data and content, and to demonstrate the effectiveness of the approach in realistic, high-visibility use-cases.
https://project.inria.fr/icoda/

8.1.3. Docamex (CASDAR project, 2017-2020)

Participants: Patrice Buche, Madalina Croitoru, Jérôme Fortin, Clément Sipieter.

DOCaMEx (Développement de prOgiciels de Capitalisation et de Mobilisation du savoir-faire et de l'Expérience fromagers en filière valorisant leur terroir), let by CFTC (centre technique des fromages de Franche-Comté) involves 7 research units (including IATE and LIRMM), 8 technical centers and 3 dairy product schools. It represents five cheese-making chains (Comté, Reblochon, Emmental de Savoie, Salers, Cantal).

Traditional cheese making requires a lot of knowledge, expertise, and experience, which are usually acquired over a long time. This know-how is today mainly transmitted by apprenticeship and a concrete risk of knowledge forgetting is raised by the evolution of practices in the sector. The main goal of the project is to develop a new approach for expert knowledge elicitation and capitalization, and a dedicated software for decision making. The novel part of the decision making tool consists in the representation power and reasoning efficiency in the context of the logic used to describe the domain knowledge.
http://www.rmtfromagesdeterroirs.com/projets-de-r-et-d/docamex/

8.1.4. Convergence Institute #DigitAg (2017-2023)

Participants: Patrice Buche, Madalina Croitoru, Marie-Laure Mugnier, Rallou Thomopoulos, Federico Ulliana.

Located in Montpellier, #DigitAg (for Digital Agriculture) gathers 17 founding members: research institutes, including Inria, the University of Montpellier and higher-education institutes in agronomy, transfer structures and companies. Its objective is to support the development of digital agriculture. GraphIK is involved in this project on the issues of designing data and knowledge management systems adapted to agricultural information systems, and of developing methods for integrating different types of information and knowledge (generated from data, experts, models). A starting PhD thesis (Elie Najm) will investigate knowledge representation and reasoning for agro-ecological systems, in collaboration with the research laboratory UMR SYSTEM (Tropical and mediterranean cropping system functioning and management).
https://www.hdigitag.fr/en/

8.1.5. Vitamin (Méta-programme Did'It 2017-2018)

Participant: Rallou Thomopoulos.

The goal is to get a better understanding of factors influencing individuals in their transition to stop or reduce their animal product consumption. We use comprehensive individual interviews, questionnaires as well as diverse modelling techniques (mainly multi-agents & argumentation systems) to collect and analyse this topic. We develop agent-based models integrating argumentation systems about vegetarian transitions, at the long and short term. We have proposed a generic framework implemented in the GAMA platform allowing to explicitly represent exchanges of arguments between actors in the context of an opinion dynamic model. More precisely, we propose to formalize the inner attitude towards an opinion of each agent as an argumentation graph and give them the possibility to share arguments with other agents. The application to food choices allows studying the possible evolution of the vegetarian diet.
https://www.researchgate.net/project/VITAMIN-VegetarIan-Transition-Argument-ModellINg

8.1.6. Informal National Partners

We continue to work informally with the following partners:

- Pierre Bourhis (SPIRALS Inria team) and Sophie Tison (LINKS Inria team) Ontology-Mediated Query Answering [22].
- Michael Thomazo (VALDA Inria team) on Ontology-Mediated Query Answering [29].
- Jérôme Bonnet and Sarah Guiziou, from the Center for Structural Biochemistry of Montpellier (CBS), on the encoding of Boolean functions in biological systems [30]
- Srdjan Vesic (CRIL) on logical argumentation systems. In particular, Srdjan Vesic was a co-supervisor of Bruno Yun's PhD thesis, defended in July 2019 [33].
- Jean-Claude Léon (IMAGINE Inria team) on the development of an ontology-mediated query answering system applied to the field of CAD (Computer Aided Design).
- Slawek Staworko (LINKS Inria team) on data cleaning and argumentation techniques for repairing.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. NoAW (H2020, Oct. 2016-Sept. 2020)

Participants: Patrice Buche, Pierre Bisquert, Madalina Croitoru, Rallou Thomopoulos.

NoAW (No Agricultural Waste) is led by INRA-IATE. Driven by a "near zero-waste" society requirement, the goal of NoAW project is to generate innovative efficient approaches to convert growing agricultural waste issues into eco-efficient bio-based products opportunities with direct benefits for both environment, economy and EU consumer. To achieve this goal, the NoAW concept relies on developing holistic life cycle thinking able to support environmentally responsible R&D innovations on agro-waste conversion at different TRLs, in the light of regional and seasonal specificities, not forgetting risks emerging from circular management of agro-wastes (e.g. contaminants accumulation). GraphIK contributes on two aspects. On the one hand we participate in the annotation effort of knowledge bases (using the @Web tool). On the other hand we further investigate the interplay of argumentation with logically instantiated frameworks and its relation with social choice in the context of decision making.

http://cordis.europa.eu/project/rcn/203384_en.html

8.2.1.2. GLOPACK (H2020, June. 2018- July. 2022)

Participants: Patrice Buche, Pierre Bisquert, Madalina Croitoru.

GLOPACK is also led by INRA-IATE. It proposes a cutting-edge strategy addressing the technical and societal barriers to spread in our social system, innovative eco-efficient packaging able to reduce food environmental footprint. Focusing on accelerating the transition to a circular economy concept, GLOPACK aims to support users and consumers' access to innovative packaging solutions enabling the reduction and circular management of agro-food, including packaging, wastes. Validation of the solutions including compliance with legal requirements, economic feasibility and environmental impact will push forward the technologies tested and the related decision-making tool to TRL 7 for a rapid and easy market uptake contributing therefore to strengthen European companies' competitiveness in an always more globalised and connected world.
https://glopack2020.eu/

8.2.2. Collaborations in European Programs, Except FP7 & H2020

8.2.2.1. FoodMC (European COST action, 2016-2020)

Participants: Patrice Buche, Madalina Croitoru, Rallou Thomopoulos.

COST actions aim to develop European cooperation in science and technology. FoodMC (CA 15118) is a cost action on Mathematical and Computer Science Methods for Food Science and Industry. Rallou Thomopoulos is co-leader of this action for France, and member of the action Management Committee, and other members of GraphIK (Patrice Buche, Madalina Croitoru) are participants. The action is organised in four working groups, dealing respectively with the modelling of food products and food processes, modelling for eco-design of food processes, software tools for the food industry, and dissemination and knowledge transfer. http://www6.inra.fr/foodmc

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Carlos Saez, postdoctoral researcher at the Biomedical Data Science Lab of the ITACA Institute of the Universitat Politècnica de València (UPV, Spain) stayed one week (from 10/12/2019 to 14/12/2019) to work on data quality issues for machine learning techniques and how OBDA and argumentation could help improve the quality of data.

8.3.2. Visits to International Teams

8.3.2.1. Research Stays Abroad

Madalina Croitoru obtained a SICSA Distinguished Visitor Program Funding and stayed at the University of Aberdeen from the 1st of April 2019 to the 31st of May 2019. She worked with Professor Nir Oren on ethical decision making in a multi-agent setting.

HEPHAISTOS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

- the project **Craft** on collaborative cable-driven parallel robot has been funded by ANR. It involves LS2N (Nantes) and the Cetim. This project will start in 2019

8.1.1. FHU

- the team has been involved for the FHU *INOVPAIN : Innovative Solutions in Refractory Chronic Pain* that has been labeled in December 2016

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

We have numerous international collaborations but we mention here only the one with activities that go beyond joint theoretical or experimental works:

- University of Bologna, Italy: 2 joint PhD student, publications
- University Innsbruck, Austria: joint conference organization
- Fraunhofer IPA, Stuttgar, Germany: joint conference organization
- Duisburg-Essen University, Germany: joint conference organization
- University of New-Brunswick, Canada: 1 joint PhD student
- University Laval, Québeç Canada: joint book
- University of Tokyo, Japan: joint conference organization
- Tianjin University, China: joint book

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- W. Godoy, Pr. Univ Sao Paolo, from Dec 2019
- M. Tome, PhD student, Univ Sao Paolo, from Dec 2019
- I.D. Weber, Master student, Univ Sao Paolo, from Dec 2019
- M. Tuda, PhD student, Univ Sao Paolo, from Jun 2019 until July 2019
- H. Lins Vieira, PhD student, Univ Sao Paolo, from January until Aug 2019

8.4. Transfert

- J-P. Merlet is scientific advisor of the startup *Farmboy Labs* that is currently being created by our former PhD student L. Blanchet. The purpose of this startup is to propose cable-driven parallel robots for agriculture (monitoring, maintenance, weeding, ...). .

INDES Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Skini

Skini was used for the production of a musical piece as part of SACEM's "Music Factory" program in collaboration with the *CIRM* in Nice and the *Conservatory of Nice*. This piece was designed, and produced in May at the Nice Conservatory, by 12 years old pupils of the Nucéra secondary school in Nice after a dozen working sessions within the school. This production is followed by a similar project with 14 years old pupils as part of the "Cordé de la résussite" programme run by Inria with the objective of a musical production in spring 2020.

8.2. National Initiatives

8.2.1. ANR CISC

The CISC project (Certified IoT Secure Compilation) is funded by the ANR for 42 months, starting in April 2018. The goal of the CISC project is to provide strong security and privacy guarantees for IoT applications by means of a language to orchestrate IoT applicatoins from the microcontroller to the cloud. Tamara Rezk coordinates this project, and Manuel Serrano, Ilaria Castellani and Nataliia Bielova participate in the project. The partners of this project are Inria teams Celtique, Indes and Privatics, and Collège de France.

8.2.2. ANR PrivaWeb

The PrivaWeb project (Privacy Protection and ePrivacy Compliance for Web Users) is funded by the ANR JCJC program for 48 months, started in December 2018. PrivaWeb aims at developing new methods for detection of new Web tracking technologies and new tools to integrate in existing Web applications that seamlessly protect privacy of users.

Nataliia Bielova coordinates this project.

8.2.3. PIA ANSWER

The ANSWER project (Advanced aNd Secured Web Experience and seaRch) is funded by PIA program for 36 months, starting January 1, 2018. The aim of the ANSWER project is to develop the new version of the http://www.qwant.com search engine by introducing radical innovations in terms of search criteria as well as indexed content and users' privacy. The partners of this project include QWANT and Inria teams Wimmics, Indes, Neo and Diana.

8.3. Inria Internal Funding

8.3.1. IPL SPAI

SPAI (Security Program Analyses for the IoT) is an IPL (Inria Project Lab), with a duration of 4 years, started on April 2018. Members of the Antique, Celtique, Indes, Kairos, and Privatics Inria teams are involved in the SPAI IPL.

SPAI is concerned with the design of program analyses for a multitier language for the Internet of Things (IoT). The programming abstractions will allow us to reason about IoT systems from microcontrollers to the cloud. Relying on the Inria multitier language Hop.js semantics and the current Coq formalizations of JavaScript semantics, we plan to certify these analyses in order to guarantee the impossibility of security properties violations and implement security properties' enforcements by compilation.

8.3.2. AEx DATA4US

DATA4US is a joint project between two teams in Inria Sophia Antipolis and Inria Grenoble - Rhône-Alpes that tackles these interdisciplinary challenges by establishing collaborations with researchers in Law. Members are Nataliia Bielova (INDES) and Cedric Lauradoux (Privatics).

DATA4US will propose a new architecture for exercising access rights that will explain the users whether their data has been legally collected and eventually help contact DPAs for further investigations.

8.3.3. ADT FingerKit

In the context of the Inria ADT call, we are involved in a *FingerKit: a Cloud Platform to Study Browser Fingerprints at Large*, lead by Walter Rudametkin from the Spirals project-team. The funding for a two year engineering position for the 2018-2020 period was obtained and an engineer is hired in Spirals project-team. Nataliia Bielova is part of this project.

8.4. European Initiatives

8.4.1. H2020 Sparta

SPARTA (Strategic Programs for Advanced Research and Technology in Europe) is a novel cybersecurity competence network, with the objective to collaboratively develop and implement top-tier research and innovation actions. Strongly guided by concrete challenges forming an ambitious Cybersecurity Research & Innovation Roadmap, SPARTA will tackle hard innovation challenges, leading the way in building transformative capabilities and forming a world-leading cybersecurity competence network across the EU. Four initial research and innovation programs will push the boundaries to deliver advanced solutions to cover emerging issues, with applications from basic human needs to economic activities, technologies, and sovereignty.

See also: https://www.sparta.eu/

8.4.2. Collaborations in European Programs, Except FP7 & H2020

8.4.2.1. ICT Cost Action IC1405 on Reversible Computation

Program: ICT COST Action IC1405

Project title: Reversible computation - extending horizons of computing

Duration: November 2014 - April 2019

Coordinator: Irek Ulidowski, University of Leicester

Other partners: several research groups, belonging to 23 European countries.

Abstract: Reversible computation is an emerging paradigm that extends the standard mode of computation with the ability to execute in reverse. It aims to deliver novel computing devices and software, and to enhance traditional systems. The potential benefits include the design of reversible logic gates and circuits - leading to low-power computing and innovative hardware for green ICT, new conceptual frameworks and language abstractions, and software tools for reliable and recovery-oriented distributed systems. This was the first European network of excellence aimed at coordinating research on reversible computation.

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

8.4.2.2. Bilateral PICS project SuCCeSS

Program: CNRS Bilaterial PICS project

Project acronym: SuCCeSS

Project title: Security, Adaptability and time in Communication Centric Software Systems

Duration: June 2016 - June 2019

Coordinator: Cinzia Di Giusto, I3S, Sophia Antipolis

Partners: I3S, Inria, University of Groningen

Abstract: The project SuCCeSS was a CNRS-funded “Projet coopératif” (PICS 07313), involving two French teams in Sophia Antipolis (the MDSC team at the laboratory I3S, acting as coordinator, and the INDES team) and one Dutch team at the University of Groningen. The objective of the project was to study formal models for reliable distributed communication-centric software systems. The project focussed on analysis and validation techniques based on behavioural types, aimed at enforcing various properties (safety, liveness, security) of structured communications.

8.5. International Initiatives

8.5.1. Inria International Partners

8.5.1.1. Informal International Partners

- We are collaborating with Professor of Law, Frederik Zuiderveen Borgesius from the Radbound University Nijmegen and Amsterdam Law School (double affiliation). We are studying General Data Protection Regulation (GDPR) and ePrivacy Regulation and their application to Web tracking technologies.
- We have been collaborating with Prof. Benoit Baudry from KTH Royal Institute of Technology, Sweden and with Pierre Laperdrix from Stony Brook University on the survey of browser fingerprinting technologies.
- We are setting a new collaboration with Dr. Zinaida Benenson from University of Erlangen-Nuremberg, Germany, to study Human Factors in Privacy: in particular, to set up user studies to evaluate their perception and understanding of the cookie banners design and measure the influence of dark patterns on user decisions.
- We are setting a new collaboration with Prof. Martin Johns from TU Braunschweig, Germany, to work on cryptographic primitives to include proof of ownership in browser cookies that would facilitate the exercise of GDRP subject access rights. The is a joint collaboration with Cedric Lauradoux from Privatics.
- We are pursuing our collaboration on session types with Prof. Mariangiola Dezani Ciancaglini from the University of Torino and Prof. Paola Giannini from the University of Piemonte Orientale. This year, this collaboration was extended to Dr. Ross Horne from the University of Luxemburg. We also continue to collaborate with Dr. Jorge Pérez and his PhD student Mauricio Cano, from the University of Groningen, on the integration of session types with synchronous reactive programming.
- We are pursuing our collaboration on reactive programming and on higher contracts for security with Prof. Robby Findler from Northwestern University in Chicago.
- We are pursuing our collaboration with Prof. Marc Feeley from Univerisity of Montréal on the compilation of dynamic languages.

8.5.2. Participation in Other International Programs

8.5.2.1. International Initiatives

DAJA

Title: Detection strategies based on Software Metrics for Multitier JavaScript

International Partners (Institution - Laboratory - Researcher):

Universidad de Chile (Chile), Intelligent Software Construction laboratory (ISCLab) - Alexandre Bergel

Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina) Computer Science Departement - Santiago Vidal

Duration: 2018 - 2019

Start year: 2018

See also: https://daja-sticamsud.github.io/

JavaScript is the most popular object scripting programming language. It is extensively used conceived only for scripting, it is frequently used in large applications. The rapid adoption of JavaScript has outpaced the Software Engineering community to propose solutions to ensure a satisfactory code quality production. This situation has favored the production of poor quality JavaScript applications: we have found across JavaScript applications a large presence of dead-code (i.e., source code portion that is never used) and code duplications. These symptoms are known to lead to maintenance and performance degradation. Moreover, we have previously analyzed potential security threats to JavaScript applications produced by bad coding practices. The DAJA project will provide methodologies, techniques, and tools to ease the maintenance of software applications written in JavaScript while improving its security.

8.6. International Research Visitors

8.6.1. Visits of International Scientists

- We are collaborating with Cristiana Teixeira Santos from University Toulouse 1-Capitole. Cristiana is a postdoc in Data Protection Law with whom we have been analyzing legal requirements for GDPR consent, and cookie banners in particular. Cristiana has visited us two times in 2019 and will be hired as a postdoc for Inria AEx project DATA4US in 2020.
- As part of our ongoing collaboration on GDPR Subject Access Rights, Cedric Lauradoux has visited us several times in 2019, to expand our existing work [13] and establish new research directions. Cedris is a co-PI for Inria AEx project DATA4US.
- We are collaborating with Prof. Marc Feeley from University of Montréal. For the third consecutive year, M. Feeley has visited us for studying implementation of dynamic languages, and in particular we started a study of the efficient compilation of the Python programming language.
- We are collaborating with Prof. Andrei Sabelfeld from Chalmers University of Technology. A.Sabelfeld has visited us for one month in July 2019 for studying remote timing attackers in the context of IoT frameworks.
- Prof. Robby Findler and his PhD student Spencer Florence visited us in July, where we have organized a mini-workshop during a week, working with Prof. G. Berry and J. Krishnamurthy on the semantics and implementation of reactive languages.

8.6.1.1. Internships

- Nataliia Bielova has co-supervised Hicham Lesfari for 3 months together with Frederic Giroire from Inria Coati team.
- Nataliia Bielova has supervised the intern Michael Toth as a "relai-de-these" for 2 months.
- Ilaria Castellani and Tamara Rezk supervised the intern Carlo Prato for 6 months.
- Tamara Rezk supervised the ENS L3 internship of Maxime Legoupil for 7 weeks in June and July 2019.
- Tamara Rezk has co-supervised the ENS L3 internship of Clément Ogier in July 2019.
- Tamara Rezk supervised the internship of Adam Khayam for 6 months.
- Tamara Rezk supevised -as tutor- the internship of Ayoub Ider Aghbal in a company.

8.6.2. Visits to International Teams

For the third consecutive year, Manuel Serrano and Gérard Berry visited Prof. Robby Findler at University of Northeastern in Chicago. This time, Tamara Rezk joined the delegation that also visited Prof. Christos Dimoulas also working at Northeastern University. The Indes team and Findler's team have applied for the second time to the Inria Associated Team program.

Kairos Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Université Côte d'Azur Academy 1 and EUR DS4H

In the context of the local UCA-Jedi IDEX program and its RISE Academy, we were afforded a three years funding, including a postdoctoral position, for the "Smart IoT for Mobility" project. This project, lead by the LEAT UMR and Kairos, aims at building a formal language for the design of smart contracts in the context of a mobility project, in collaboration with Renault Software Labs and Symag, a subsidiary of BNP Paribas. This agreement was operational in preparing the larger ANR project SIM, that was accepted this year, while an even larger European project is under proposal.

9.1.2. PSPC-Region project ADAVEC

This project was recently accepted, and not yet started in practice. It associates Renault Software Labs with UCA (represented by our team), together with Avisto Telecom and EPICnPOC companies. The focus is on requirements and specification for Automated Driving Assistance, and more specially the transitions that need to be properly handled when control needs to be held back to the human driver.

9.2. National Initiatives

9.2.1. ANR Project SIM

The ANR SIM (Smart IoT for Mobility) is a PRCE project co-funded by ANR (AAPG 2019) and DGA for 42 months. The national coordinator is the LEAT (UMR CNRS) and the other partners are Renault Software Labs and Symag. The goal is to provide a formal meta-language to describe smart contracts that can be used in the context of an autonomous vehicles to provide services to the users. The services are related to the combined use of multi-model transportation systems by having a single smart contracts that can enforce all the intermediate transactions with all the actors involved (car manufacturing, parking lease, highway toll companies, insurances, bike rental companies).

9.2.2. Competitivity Clusters

The Kairos team is involved in the actions of the cluster SCS (Systèmes Communicants Sécurisés) and Frédéric MALLET is elected in the steering committee of SCS. One of the more prominent action is to build, in partnership with University Aix-Marseille, a Digital Innovation Hub, to open the access (with actions of transfer and valorization) to Digital Innovations for companies that would benefit from it, like public institutions (hospitals, human resources, employment institutions) or private companies that could use IoT for agriculture, tourism, smart infrastructures (harbours, buildings, cities).

9.2.3. CNRS GDRs

We are registered members of three GDR funded by CNRS : **SoC**^{2}, on topics of Hardware-software codesign and Non-Functional Property modeling for co-simulation; **LTP**, on verification and language design for reactive CPS systems; **GPL**, on software engineering and Domain-Specific Languages.

9.2.4. Inria Project Lab SPAI

This collaborative action, targeting *Security by Program Analysis for the IoT (SPAI)*, is headed by the Indes Project, and associated the Antique, Privatics and Celtique EPIs. See 7.15 for our contribution.

9.2.5. PAI ES3CAP

ES3CAP (Embedded Smart Safe Secure Computing Autonomous Platform) is a PIA (Programme d'Investissements d'Avenir) project. Its budget is of 22.2MEuros, over 36 months. The national coordinator is Kalray, and other partners include Safran, Renault, and MBDA. The objectives of the project are to:

- Build a hardware and software industry-grade solution for the development of computation-intensive critical application. The solution should cover the needs of industrial end users, and target multi/many-core hardware platforms. The solution will come with 3 to 6 usage profiles specific to various industries (automotive, aerospace, defence)
- Improve the technology readiness level of the proposed development flow from TRL4-5 (technology development) to TRL6-7, thus approaching as much as possible commercialization.
- Build an alternate, perennial ecosystem for critical real-time OSs and development tools for computer vision, data fusion and neural networks. The tools and components must be available on a prototyping and demonstration platform that is safe and secure.
- Capitalize on the convergence between the automotive and aerospace markets on subjects such as security, safety, decision making, and big data.

Our technical contributions to this project are described in 7.16 . This project partially finances Hugo Pompugnac's PhD and Jad Khatib's post-doc.

9.3. International Initiatives

9.3.1. Inria International Partners

9.3.1.1. IIP TuMuLT

Title: Trustworthy Modeling using Logical Time

International Partner (Institution - Laboratory - Researcher):

E.C.N.U. (Shanghai, China) - Departement of Software Engineering and Computer Science - Zhang Min

Duration: 2018 - 2022

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

- Modeling the Uncertain Environments of Cyber-Physical Systems: Logical Time is one of the main scientific foundation of the KAIROS Team. From the background in theory of concurrency, we are used to consider mainly discrete control systems that can guarantee a functional determinism independently of any implementation-specific timing variation. Addressing Cyber-Physical Systems and the Internet of Things means widening those assumptions to consider the external environment, typically involving uncertainty, as part of the design. This task explores the definition of sound extensions to logical time to capture both the physical continuous behavior and make an abstract characterization as a statistical approximation.
- SMT For Logical Time: While synchronous systems usually focus on finite state-based control systems, our abstraction of logical time relies on both Boolean algebra (for synchronous operations) and integer arithmetic (for synchronizing mechanisms), In that context, SMT is a promising solution to solve systems that combine several theories. We had first results on this aspect [SCP'17] but we still need to increase the subset of constraints that can be addressed efficiently as well as the performances of the solving tools.
- Spatio-Temporal Specification for Trustworthy Intelligent Transportation Systems: Focusing on Intelligent Transportation Systems as a subset of Cyber-Physical Systems, we encounter specific problems. This task would focus on extensions of our framework for a spatio-temporal logics based on logical time. This means a description of the location of infrastructures as well as the ability to build constraints that depend both on time (logic or physical) and locations (logical or physical).

- Symbolic approaches for models and analysis of Open systems: Methods for analyzing and guaranteeing the properties of critical and complex systems, including their data and time depend aspects, have strongly evolved with the emergence of efficient SAT and SMT engines. We are working on novel methods combining classical verification paradigms with SMT approaches to create symbolic and compositional verification methods and tool platforms [22], [27].

  Collaboration will come in the form of scientific short or middle term visits, student exchanges (master and PhD), and organization of events (workshops and conferences).

9.3.1.2. Informal International Partners

- Luigi Liquori has a steady collaboration with researchers from University of Udine and Turin, Italy.
- We keep close informal relations with the Universities of Kiel and Bamberg Germany, in the context of the Synchronous Reactive academic community. We all attended the yearly Synchron seminar, held this year in Aussois (together with researchers from Verimag and the Parkas and Spades Inria teams).
- Frédéric Mallet has a collaboration with Peter Olvecsky from University of Oslo. He was funded in 2019 by a program of the French Embassy in Norway called Asgard.

9.3.2. Participation in Other International Programs

- PHC Cai Yuan Pei: The partnership is a joint funding from Campus France and Chinese Scholarship Council (CSC) to fund short exchanges of permanent staffs and long exchanges of PhD students. A 2-week visit was carried out by Frédéric Mallet in 2019, while Xiaohong Chen is visiting France during 3 months starting in mid-November. The program is funded for three years and a PhD student (Zhang Juan) will visit our team during 16 months in 2020.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Xiaohong Chen, Assistant Professor at East China Normal University (Shanghai), from Nov 2019 to Feb 2020.
- Grygoriy Zholtkevych, Professor at V.N. Karazin Kharkiv National University (Ukraine), from Oct 2019 until Nov 2019.
- Peter Olvescky, Professor at University of Oslo, from November 24th to November 29th, 2019.
- Matteo Sereno, Professor, University of Turin, Italy, in May 2019.
- Thomas Ehrhard, University of Paris, in September 2019.

9.4.2. Visits to International Teams

9.4.2.1. Research Stays Abroad

- E. Madelaine spent 4 weeks visiting the Software Engineering an Computer Science department at ECNU Shanghai (2 weeks in May, 2 weeks in September), founded by the foreign expert program of ECNU; and 1 week visiting the Institute of Software of the Chinese Academy of Science (ISCAS, Beijing), funded by ISCAS.
- Marie-Agnès Peraldi Frati spent 10 days at Danang University in May 2019 in the context of the joined UCA/UD international DNIIT laboratory for student supervision and scientific meetings. The visit was funded by Mobility Contract Erasmus Mundus.
- Frédéric Mallet stayed three weeks in Shanghai in August 2019. He stayed one week in Hangzhou in September as part of a Chinese competition for oversea professors. He also stayed two weeks in Shanghai in November 2019 through the PHC Cai Yuan Pei program.

LEMON Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The MeDo project (lead by N. Chahinian) in which Carole Delenne participates is funded by Occitanie Region.

8.2. National Initiatives

Antoine Rousseau is member of the ANR project ANSWER (PI Céline Casenave), 2016-2020

Gwladys Toulemonde is head of a project (2019-2021) funded by INSU via the action MANU (MAthematical and NUmerical methods) of the LEFE program. This project, called Fraise, is focused on rainfall forcing by stochastic simulation for hydrological impact studies from dry periods to extreme events. The consortium involved in this project is larger than the Cerise one (14 researchers from 8 partners : AgroParisTech, CNRS, INRA, Inria, IRD, Université de Lyon 1, Université de Montpellier and the University of Venise in Italy).

Gwladys Toulemonde is member of the ANR project Gambas (PI Frédéric Mortier, Cirad), 2019-2023. The project GAMBAS focuses on joint species distribution models. These models can provide a better understanding and more accurate predictions of species distributions based on environmental variables while taking into account the effects of all other co-occurring species (e.g. competition).

Pascal Finaud-Guyot is member of the ANR project DEUFI (PI André Paquier, IRSTEA Lyon), 2019-2022

All the team is involved in the Inria ADT named SW2D-Lemon. This development project led to 2 coding sprints (of 2 weeks each) with the development team in Sophia. Thanks to this project, SW2D is now a C++ platform, with a dedicate GUI.

8.3. International Initiatives

Gwladys Toulemonde is member of the PHC Utique project (with Tunisia) AMANDE (PI Julie Carreau, IRD), 2019-2021. The project AMANDE focuses on stochastic and semi-parametric approaches combined to teledetection for the study of the water stress.

8.3.1. Inria International Labs

Inria Chile. Associate Team involved in the International Lab: NEMOLOCO

Title: NEw MOdeLing tOols for Coastal Oceanography

International Partner (Institution - Laboratory - Researcher): Pontificia Universidad Católica de Chile (Chile) - CIGIDEN - Rodrigo Cienfuegos

Start year: 2017

See also: https://team.inria.fr/lemon/en/

The NEMOLOCO project targets the improvement of models in the coastal zone. Expected contributions concern: 1) design and implementation of domain decomposition and coupling techniques for coastal modeling; 2) high resolution ocean simulation (including nesting) thanks to the software ROMS-CROCO, applied to biological tracers tracking.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

A research collaboration agreement was signed with LSIA, Fès University, Morocco in the framework of Yassine Bel-Ghaddar PhD thesis.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Carlo Gaetan from the University of Venise in Italy has been invited thanks to the Fraise project one week in april, 2019.

MATHNEURO Project-Team

6. Partnerships and Cooperations

6.1. European Initiatives

6.1.1. FP7 & H2020 Projects

6.1.1.1. HBP

Title: The Human Brain Project

Program: FP7

Duration: October 2013 - March 2016 (first part), then : April 2016 - March 2018 (second part) and then : April 2018 - March 2020 (third part)

Coordinator: EPFL

Partners:
see the webpage of the project.

Olivier Faugeras is leading the task T4.1.3 entitled “Meanfield and population models” of the Worpackage W4.1 “Bridging Scales”.

Inria contact: Olivier Faugeras (first part) and then : Romain Veltz (second and third part)

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.

6.2. International Initiatives

6.2.1. Inria Associate Teams Not Involved in an Inria International Labs

6.2.1.1. NeuroTransSF

Title: NeuroTransmitter cycle: A Slow-Fast modeling approach

PI for Inria MathNeuro: Mathieu Desroches

International Partner (Institution - Laboratory - Researcher):

Basque Center for Applied Mathematics (BCAM) (Spain) - Mathematical, Computational and Experimental Neuroscience (MCEN) Team - Serafim Rodrigues

Start year: 2019

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

This associated team project proposes to deepen the links between two young research groups, on strong Neuroscience thematics. This project aims to start from a joint work in which we could successfully model synaptic transmission delays for both excitatory and inhibitory synapses, matching experimental data, and to supplant it in two distinct directions. On the one hand, by modeling the endocytosis so as to obtain a complete mathematical formulation of the presynaptic neurotransmitter cycle, which will then be integrated within diverse neuron models (in particular interneurons) hence allowing a refined analysis of their excitability and short-term plasticity properties. On the other hand, by modeling the postsynaptic neurotransmitter cycle in link with long-term plasticity and memory. We will incorporate these new models of synapse in different types of neuronal networks and we will then study their excitability, plasticity and synchronisation properties in comparison with classical models. This project will benefit from strong experimental collaborations (UCL, Alicante) and it is coupled to the study of brain pathologies linked with synaptic dysfunctions, in particular certain early signs of Alzheimer's Disease. Our initiative also contains a training aspect with two PhD student involved as well as a series of mini-courses which we will propose to the partner institute on this research topic; we will also organise a "wrap-up" workshop in Sophia at the end of it. Finally, the project is embedded within a strategic tightening of our links with Spain with the objective of pushing towards the creation of a Southern-Europe network for Mathematical, Computational and Experimental Neuroscience, which will serve as a stepping stone in order to extend our influence beyond Europe.

6.2.2. Inria International Partners

6.2.2.1. Informal International Partners

VU Amsterdam (Netherlands), Faculty of Science, Mathematics: Daniele Avitabile

ENS Paris, Laboratoire de Neurosciences Cognitives: Boris Gutkin

University of the Balearic Islands (Spain), Dept of Applied Mathematics: Antonio Teruel

Polytechnic University of Catalunya (Spain), Dept of Applied Mathematics: Antoni Guillamon

6.3. International Research Visitors

6.3.1. Visits of International Scientists

Invitation of Nikola Popovic, University of Edinburgh (UK), April 2019

Invitation of Tomás Lázaro, Polytechnic University of Catalunya (Spain), May 2019

6.3.1.1. Internships

Ariane Delrocq (étudiante Ecole Polytechnique, Paris): April - July 2019

6.3.2. Visits to International Teams

Visit of Yuri Rodrigues and Romain Veltz to Cian O'Donnell (University of Bristol, UK) in December 2019

6.3.2.1. Research Stays Abroad

One-month research stay of Mathieu Desroches at BCAM (Bilbao, Spain) on an invited professor scholarship to work with Serafim Rodrigues, June-July 2019

MCTAO Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

Sub-Riemannian Geometry and Interactions (SRGI). Started 2015 (decision ANR-15-CE40-0018), duration: 4 years. L. Rifford is a member.

Intéractions Systèmes Dynamiques Équations d'Évolution et Contrôle (ISDEEC). Started 2016 (decision ANR-16-CE40-0013), duration: 4 years. L. Rifford is a member.

Maximic: optimal control of microbial cells by natural and synthetic strategies. Started 2017, duration: 4 years. J.-B. Caillau, L. Giraldi, J.-B. Pomet are members.

9.1.2. Others

Défi InfIniti CNRS project, Control and Optimality of Magnetic Microrobots, (PI L. Giraldi). Started 2017, duration: 2 years. This project involves colleagues from Paris Sorbonne Université S. Régnier and from University of Strasbourg C. Prud'Homme's.

PGMO grant (2017-2019) on "Algebro-geometric techniques with applications to global optimal control for Magnetic Resonance Imaging (MRI)". B. Bonnard, A. Nolot and J. Rouot participate in this project, the PI is O. Cots, from ENSEIHHT, Toulouse.

PGMO grant (2019-2021) on "Sampled-Data Control Systems and Applications" (PI B. Bonnard).

The McTAO team participates in the GdR MOA, a CNRS network on Mathematics of Optimization and Applications.

J.-B. Caillau is associate researcher of the CNRS team Parallel Algorithms & Optimization at ENSEEIHT, Univ. Toulouse.

9.2. International Research Visitors

9.2.1. Visits of International Scientists

Prof. Sorin Sabau (Tokai University) visited Inria during two weeks in May 2019. He gave a talk on "The calculus of variations on Finsler manifolds".

9.2.1.1. Research Stays Abroad

- Bernard Bonnard visited the University of Hawaii at Manoa, Mars 2019 (1 month, host: M. Chyba).

MORPHEME Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Labex Signalife

The MORPHEME team is member of the SIGNALIFE Laboratory of Excellence.

Florence Besse and Xavier Descombes are members of the Scientific Committee.

8.1.2. Idex UCA Jedi

Luca Calatroni is responsible of the project "Action 2, DEP attractivité du territoire du IDEX JEDI, Académie 2 'Systemes complexes'".

Xavier Descombes is co-PI of the MOORPHEUS project funded by the Academy 4 of IDEX-JEDI ("Modélisation computationnelle de la croissance et de l'organisation spatiale dynamique des organoides/tumoroides de prostate"), in collaboration with C3M.

Biological Image Super-resolution Enhanced with Tensor (Biset) supported by Académie 1 RISE. Participants : E. Debreuve, L. Blanc-Féraud, S. Schaub.

Multiscale Tomography : imaging and modelling ancient materials, technical traditions and transfers, (ToMaT), supported by Idex UCA JEDI structuring Project, Participants: L. Blanc-Féraud, Vanna-Lisa Coli, Juliette Leblond, Didier Binder, Louise Gomart, Serge Cohen.

The PhD grant of Clara Sanchez is funded by the IDEX EUR DS4H. Participants: E. Debreuve, C. Rovère (IPMC).

8.1.3. 3AI Côte d'Azur

Laure Blanc-Féraud and Grégoire Malandain are chair holders of the 3AI Côte d'Azur, in the "Computational Biology and Bio-Inspired AI" axis.

The PhD grant of Vasiliki Stergiopoulou is funded by the 3AI Côte d'Azur.

8.2. National Initiatives

8.2.1. ANR RNAGRIMP

Participants: Florence Besse [PI], Fabienne de Graeve, Xavier Descombes, Eric Debreuve, Somia Rahmoun.

Here, we propose to study the molecular bases underlying the assembly and regulation of RNA granules, using the highly conserved IMP-containing granules as a paradigm. Specifically, we propose to perform an unbiased genome-wide RNAi screen on Drosophila cultured cells to identify mutant conditions in which the organization and/or distribution of IMP-containing granules is altered. To quantitatively and statistically analyze mutant conditions, and to define precise and coherent classes of mutants, we will combine high throughput microscopy with the development of a computational pipeline optimized for automatic analysis and classification of images. The function of positive hits isolated in the screen will then be validated in vivo in Drosophila neurons using fly genetics and imaging techniques, and characterized at the molecular and cellular levels using biochemical assays, in vitro phase transition experiments and live-imaging. Finally, the functional conservation of identified regulators will be tested in zebrafish embryos combining gene inactivation and live-imaging techniques. This integrative study will provide the first comprehensive analysis of the functional network that regulates the properties of the conserved IMP RNA granules. Our characterization of the identified regulators in vivo in neuronal cells will be of particular significance in the light of recent evidence linking the progression of several degenerative human diseases to the accumulation of non-functional RNA/protein aggregates.

This 4-years project started january, 2016 and is leaded by F. Besse (iBV, Nice). Participants are iBV, institut de biologie Paris Seine (IBPS, Paris), and Morpheme.

8.2.2. ANR HMOVE

Participants: Xavier Descombes, Eric Debreuve, Somia Rahmoun.

Among the signaling molecules involved in animal morphogenesis are the Hedgehog (Hh) family proteins which act at distance to direct cell fate decisions in invertebrate and vertebrate tissues. To study the underlying process we will develop accurate tracking algorithm to compare trajectories of different Hh pools transportation in live animals. This will allow us to analyze the contribution of the different carriers in the establishment of the Hh gradient. Moreover, we will develop new methods to modify the spatio-temporal and dynamical properties of the extra-cellular Hh gradient and separate the contribution of the apical versus basal Hh pools. We will complete this study with a genome-wide screen to identify genes and related cellular processes responsible for Hh release. The particular interest of this collaboration lies in the combination of development of tracking algorithm to analyze Hh distribution and trajectories with extremely powerful genetics, ease of in vivo manipulation and lack of genetic redundancy of Drosophila.

This 4-years project started january, 2016 and is leaded by P. Thérond (iBV, Nice). Participants are iBV and Morpheme.

8.2.3. ANR Cell Whisper

Participant: Grégoire Malandain.

Successful embryogenesis requires the differentiation of the correct cell types, in defined numbers and in appropriate positions. In most cases, decisions taken by individual cells are instructed by signals emitted by their neighbours. A surprisingly small set of signalling pathways is used for this purpose. The FGF/Ras/ERK pathway is one of these and mutations in some of its individual components cause a class of human developmental syndromes, the RASopathies. Our current knowledge of this pathway is, however, mostly static. We lack an integrated understanding of its spatio-temporal dynamics and we can imperfectly explain its highly non-linear response to a graded increase in input stimulus.

This systems biology project combines advanced quantitative live imaging, pharmacological/optogenetics perturbations and computational modelling to address 3 major unanswered questions, each corresponding to a specific aim:

- Aim 1: What is the spatio-temporal dynamic of intracellular signal transduction in response to FGF?
- Aim 2: What is the molecular basis of the switch-like response to graded extracellular signals?
- Aim 3: Can the results be integrated into a predictive computational model of the pathway?

Through this approach, in a simplified model system, we hope to gain an integrated view of the pathway's dynamics.

This 4-years project started october the 1st, 2019 and is leaded by P. Lemaire (CRBM, Montpellier). Participants are CRBM (Montpellier), LIRMM (Montpellier), MOSAIC (Inria Grenoble) and Morpheme.

8.2.4. Inria Large-scale initiative Naviscope

Participant: Grégoire Malandain.

This action gathers the expertise of seven Inria research teams (Aviz, Beagle, Hybrid, Morpheme, Parietal, Serpico and Mosaic) and other groups (MaIAGE, INRA, Jouy-en-Josas and UMR 144, Institut Curie Paris) and aimed at developing original and cutting-edge visualization and navigation methods to assist scientists, enabling semi-automatic analysis, manipulation, and investigation of temporal series of multi-valued volumetric images, with a strong focus on live cell imaging and microscopy application domains. More precisely, the three following challenges will be addressed:

- Novel machine learning methods able to detect the main regions of interest, and automatic quantification of sparse sets of molecular interactions and cell processes during navigation to save memory and computational resources.

- Novel visualization methods able to encode 3D motion/deformation vectors and dynamics features with color/texture-based and non-sub-resolved representations, abstractions, and discretization, as used to show 2D motion and deformation vectors and patterns.
- Effective machine learning-driven navigation and interaction techniques for complex functional 3D+Time data enabling the analysis of sparse sets of localized intra-cellular events and cell processes (migration, division, etc.).

8.3. International Research Visitors

8.3.1. Visits of International Scientists

Alin Achim, professor at Bristol university, is an invited professor in Morpheme since september 2019 for a ten months period (Leverhulme grant).

NACHOS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR project

8.1.1.1. OPERA (Adpative planar optics)

Participants: Emmanuel Agullo [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Régis Duvigneau [ACUMES project-team], Mahmoud Elsawy, Patrice Genevet [CRHEA laboratory, Sophia Antipolis], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Stéphane Lanteri.

Type: ANR ASTRID Maturation

See also: http://www-sop.inria.fr/nachos/opera/

Duration: Avril 2019 - March 2022

Coordinator: Inria

Partner: CRHEA laboratory in Sophia Antipolis and NAPA Technologies in Archamps

Inria contact: Stéphane Lanteri

Abstract: In the OPERA project, we are investigating and optimizing the properties of planar photonic devices based on metasurfaces using numerical modelling. The scientific and technical activities that constitute the project work programme are organized around 4 main workpackages. The numerical characterization of the optical properties of planar devices based on metasurfaces, as well as their optimization are at the heart of the activities and objectives of two horizontal (transversal) workpackages. These numerical methodologies will be integrated into the DIOGENeS software framework that will eventually integrates (1) discontinuous Galerkin-type methods that have been tested over the past 10 years for the discretization of Maxwell equations in time and frequency regimes, mainly for applications in the microwave band, (2) parallel resolution algorithms for sparse linear systems based on the latest developments in numerical linear algebra, (3) modern optimization techniques based on learning and metamodeling methods and (4) software components adapted to modern high performance computing architectures. Two vertical workpackages complete this program. One of them aims to demonstrate the contributions of methodological developments and numerical tools resulting from transversal workpackages through their application to diffusion/radiation control by passive planar devices. The other, more prospective, concerns the study of basic building blocks for the realization of adaptive planar devices.

8.2. European Initiatives

8.2.1. H2020 Projects

8.2.1.1. PRACE 6IP

Title: PRACE Sixth Implementation Phase (PRACE-6IP) project

See also: https://cordis.europa.eu/project/id/823767

Duration: May 2019 - December 2021

Partners: see https://cordis.europa.eu/project/id/823767

Inria contact: Luc Giraud

PRACE, the Partnership for Advanced Computing is the permanent pan-European High Performance Computing service providing world-class systems for world-class science. Systems at the highest performance level (Tier-0) are deployed by Germany, France, Italy, Spain and Switzerland, providing researchers with more than 17 billion core hours of compute time. HPC experts from 25 member states enabled users from academia and industry to ascertain leadership and remain competitive in the Global Race. Currently PRACE is finalizing the transition to PRACE 2, the successor of the initial five year period. The objectives of PRACE-6IP are to build on and seamlessly continue the successes of PRACE and start new innovative and collaborative activities proposed by the consortium. These include: assisting the development of PRACE 2; strengthening the internationally recognised PRACE brand; continuing and extend advanced training which so far provided more than 36 400 person·training days; preparing strategies and best practices towards Exascale computing, work on forward-looking SW solutions; coordinating and enhancing the operation of the multi-tier HPC systems and services; and supporting users to exploit massively parallel systems and novel architectures. A high level Service Catalogue is provided. The proven project structure will be used to achieve each of the objectives in 7 dedicated work packages. The activities are designed to increase Europe's research and innovation potential especially through: seamless and efficient Tier-0 services and a pan-European HPC ecosystem including national capabilities; promoting take-up by industry and new communities and special offers to SMEs; assistance to PRACE 2 development; proposing strategies for deployment of leadership systems; collaborating with the ETP4HPC, CoEs and other European and international organisations on future architectures, training, application support and policies. This will be monitored through a set of KPIs.

8.2.1.2. EPEEC

Title: European joint effort toward a highly productive programming environment for heterogeneous exascale computing

Program: H2020

See also: https://epeec-project.eu

Duration: October 2018 - September 2021

Coordinator: Barcelona Supercomputing Center

Partner: Barcelona Supercomputing Center (Spain)

Coordinator: CEA

Partners:

Fraunhofer–Gesellschaft (Germany)

CINECA (Italy)

IMEC (Blegium)

INESC ID (Portugal)

Appentra Solutions (Spain)

Eta Scale (Sweden)

Uppsala University (Sweden)

Inria (France)

Cerfacs (France)

Inria contact: Stéphane Lanteri

EPEEC's main goal is to develop and deploy a production-ready parallel programming environment that turns upcoming overwhelmingly-heterogeneous exascale supercomputers into manageable platforms for domain application developers. The consortium will significantly advance and integrate existing state-of-the-art components based on European technology (programming models, runtime systems, and tools) with key features enabling 3 overarching objectives: high coding productivity,

high performance, and energy awareness. An automatic generator of compiler directives will provide outstanding coding productivity from the very beginning of the application developing/porting process. Developers will be able to leverage either shared memory or distributed-shared memory programming flavours, and code in their preferred language: C, Fortran, or C++. EPEEC will ensure the composability and interoperability of its programming models and runtimes, which will incorporate specific features to handle data-intensive and extreme-data applications. Enhanced leading-edge performance tools will offer integral profiling, performance prediction, and visualisation of traces. Five applications representative of different relevant scientific domains will serve as part of a strong inter-disciplinary co-design approach and as technology demonstrators. EPEEC exploits results from past FET projects that led to the cutting-edge software components it builds upon, and pursues influencing the most relevant parallel programming standardisation bodies.

8.3. International Initiatives

8.3.1. Participation in Other International Programs

8.3.1.1. International Initiatives

PHOTOM

Title: PHOTOvoltaic solar devices in Multiscale computational simulations

International Partners:

Center for Research in Mathematical Engineering, Universidad de Concepcion (Chile), Rodolfo Araya

Laboratório Nacional de Computação Científica (Brazil), Frédéric Valentin

Instito de Matemáticas, PUCV (Chile), Diego Paredes

Duration: 2018 - 2020

Start year: 2018

See also: http:////www.photom.lncc.br

The work consists of devising, analyzing and implementing new multiscale finite element methods, called Multiscale Hybrid-Mixed (MHM) method, for the Helmholtz and the Maxwell equations in the frequency domain. The physical coefficients involved in the models contain highly heterogeneous and/or high contrast features. The goal is to propose numerical algorithms to simulate wave propagation in complex geometries as found in photovoltaic devices, which are naturally prompt to be used in massively parallel computers. We demonstrate the well-posedness and establish the optimal convergence of the MHM methods. Also, the MHM methods are shown to induce a new face-based a posteriori error estimator to drive space adaptivity. An efficient parallel implementation of the new multiscale algorithm assesses theoretical results and is shown to scale on a petaflop parallel computer through academic and realistic two and three-dimensional solar cells problems.

8.3.1.2. Informal International Partners

Prof. Kurt Busch, Humboldt-Universität zu Berlin, Institut für Physik, Theoretical Optics & Photonics

8.3.1.3. Inria International Chairs

IIC VALENTIN Frédéric

Title: Innovative multiscale numerical algorithms for wave-matter interaction models at the nanoscale

International Partner (Institution - Laboratory - Researcher):

Laboratório Nacional de Computação Científica (Brazil), Frédéric Valentin

Duration: 2018 - 2022

Start year: 2018

See also: https://www.lncc.br/~valentin/

The project addresses complex three-dimensional nanoscale wave-matter interaction models, which are relevant to the nanophotonics and nanophononics fields, and aims at devising innovative multi-scale numerical methods, named Multiscale Hybrid-Mixed methods (MHM for short), to solve them with high accuracy and high performance.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- David Pardo (Basque Center for Applied Mathematics, Spain) at Inria, France, April 2-5, 2019.
- Christophe Geuzaine (University of Liège, Belgium) at Inria, France, April 29-30, 2019.
- Jean-Francois Remacle (Ecole Polytechnique de Louvain, Belgium) at Inria, France, April 29-30, 2019.
- Jay Gopalakrishnan (University of Portland, USA) at Inria, France, June 4-5, 2019.

NEO Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. MYDATA (Sept. 2018 - Nov. 2020)

Participant: Giovanni Neglia.

This is a research project in cooperation with two other labs (LJAD and GREDEG) from Univ Côte d'Azur to study how to achieve privacy through obfuscation. The project is funded by IDEX UCA$^{\text{JEDI}}$ Academy 1 on "Networks, Information and Digital society". It involves the participation of Vidhya Kannan.

9.2. National Initiatives

9.2.1. PIA ANSWER

Participants: Konstantin Avrachenkov, Abhishek Bose, Kishor Yashavant Patil.

Project Acronym: ANSWER

Project Title: Advanced aNd Secured Web Experience and seaRch

Coordinator: QWANT

Duration: 15 November 2017 – 31 December 2020

Others Partners: Inria Project-Teams WIMMICS, INDES, COFFEE

Abstract: ANSWER is a joint project between QWANT and Inria, funded by the French Government's initiative PIA "Programme d'Investissement d'Avenir".

The aim of the ANSWER project is to develop the new version of the search engine http://www.qwant.com by introducing radical innovations in terms of search criteria as well as indexed content and security. This initiative is a part of the Big Data Big Digital Challenges field, since a Web search engine deals with large volumes of heterogeneous and dynamic data.

Of the five characteristics of big data, the ANSWER project will focus more particularly on the aspects of Velocity in terms of near real-time processing of results, and Variety for the integration of new indicators (emotions, sociality, etc.) and meta-data. The Volume, Value and Veracity aspects will necessarily be addressed jointly with these first ones and will also be the subject of locks, especially on the topics of crawling and indexing.

This registration of the search engine in the Big Data domain will only be reinforced by developments in the Web such as the Web of data, and generally by the current trend to integrate the Web of increasingly diverse, rich and complex resources.

9.2.2. ANR MAESTRO5G

Participant: Eitan Altman.

Project Acronym: MAESTRO5G

Project Title: MAnagEment of Slices in The Radio access Of 5G networks

Coordinator: Orange Labs

Duration: February 2019 – January 2022

Others Partners: Nokia Bell Labs, Univ Avignon, Inria Project-Team AGORA, Sorbonne Univ, Telecom SudParis, CentraleSupélec.

Abstract: The project develops enablers for implementing and managing slices in the 5G radio access network, not only for the purpose of serving heterogeneous services, but also for dynamic sharing of infrastructure between operators. MAESTRO-5G develops a framework for resource allocation between slices and a business layer for multi-tenant slicing. It provides an orchestration framework based on Software Define Networking that manages resources and virtual functions for slices. A hardware demonstrator brings the slicing concept to reality and showcases the project's innovations.

9.3. European Initiatives

9.3.1. Collaborations in European Programs, Except FP7 & H2020

Participant: Konstantin Avrachenkov.

Program: EU COST

Project acronym: COSTNET

Project title: European Cooperation for Statistics of Network Data Science

Duration: May 2016 - April 2020

Coordinator: Ernst Wit (NL), Gesine Reinert (UK)

Other partners: see http://www.cost.eu/COST_Actions/ca/CA15109

Abstract: A major challenge in many modern economic, epidemiological, ecological and biological questions is to understand the randomness in the network structure of the entities they study: for example, the SARS epidemic showed how preventing epidemics relies on a keen understanding of random interactions in social networks, whereas progress in curing complex diseases is aided by a robust data-driven network approach to biology.

Although analysis of data on networks goes back to at least the 1930s, the importance of statistical network modelling for many areas of substantial science has only been recognized in the past decade. The USA is at the forefront of institutionalizing this field of science through various interdisciplinary projects and networks. Also in Europe there are excellent statistical network scientists, but until now cross-disciplinary collaboration has been slow.

This Action aims to facilitate interaction and collaboration between diverse groups of statistical network modellers, establishing a large and vibrant interconnected and inclusive community of network scientists. The aim of this interdisciplinary Action is two-fold. On the scientific level, the aim is to critically assess commonalities and opportunities for cross-fertilization of statistical network models in various applications, with a particular attention to scalability in the face of Big Data. On a meta-level, the aim is to create a broad community which includes researchers across the whole of Europe and at every stage in their scientific career and to facilitate contact with stakeholders.

9.4. International Initiatives

9.4.1. Inria Associate Teams Not Involved in an Inria International Labs

9.4.1.1. MALENA

Title: Machine Learning for Network Analytics

International Partner (Institution - Laboratory - Researcher):

Indian Institute of Technology Bombay (India) - Electrical Communication Engineering - Vivek Borkar

Start year: 2017

See also: http://www-sop.inria.fr/members/Konstantin.Avratchenkov/MALENA.html

In the past couple of decades network science has seen an explosive growth, enough to be identified as a discipline of its own, overlapping with engineering, physics, biology, economics and social sciences. Much effort has gone into modelling, performance measures, classification of emergent features and phenomena, etc, particularly in natural and social sciences. The algorithmic side, all important to engineers, has been recognised as a thrust area (e.g., two recent Nevanlinna Prize (J. Kleinberg 2006 and D. Spielman 2010) went to prominent researchers in the area of network analytics). Still, in our opinion the area is yet to mature and has a lot of uncharted territory. This is because networks provide a highly varied landscape, each flavour demanding different considerations (e.g., sparse vs dense graphs, Erdos-Renyi vs planted partition graphs, standard

graphs vs hypergraphs, etc). Even adopting existing methodologies to these novel situations is often a nontrivial exercise, not to mention many problems that cry out for entirely new algorithmic paradigms. It is in this context that we propose this project of developing algorithmic tools, drawing not only upon established as well as novel methodologies in machine learning and big data analytics, but going well beyond, e.g., into statistical physics tools.

9.4.1.2. THANES

Title: THeory and Application of NEtwork Science

International Partner (Institution - Laboratory - Researcher):

Universidade Federal do Rio de Janeiro (Brazil) - Computer Science Department - Daniel Ratton Figueiredo

Start year: 2017

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

This team is the follow-up of a joint Inria-UFRJ team (funded by FAPERJ in Rio de Janeiro, Brazil) with the same name and almost the same permanent researchers involved. During the first three years THANES has studied how services in Online Social Networks (OSNs) can be efficiently designed and managed. The joint research activity continued along the line of network science with a focus on network growth models, community detection, information spreading, and recommendation systems for online social networks. A new research axis on deep learning spawned during 2018.

9.4.2. Participation in Other International Programs

9.4.2.1. Indo-French Center of Applied Mathematics (IFCAM)

NEO is involved in the IFCAM with the MALENA project. See 9.4.1.1 .

9.5. International Research Visitors

9.5.1. Visits of International Scientists

9.5.1.1. Professors/Researchers

Mindaugas Bloznelis, Date: 2-7 Oct, Institution: Vilnius Univ (Lithuania)

Damiano Carra, Date: 17-26 Jun, Institution: Univ of Verona (Italy)

Mahmoud El Chamie, Date: 16-20 Dec, Institution: United Technologies Research Center, East Hartford (USA)

Lasse Leskela, Date: 8-19 April, Institution: Aalto Univ (Finland)

Nelly Litvak, Date: 20 May-2 Jun, Institution: Univ of Twente (Netherlands)

Vincenzo Mancuso, Date: 16-18 Jul , Institution: IMDEA Networks Institute (Spain)

Angelia Nedich, Date: 8-10 Dec, Institution: Arizona State Univ (USA)

Sreenath Ramanath, Date: 2-7 Jul, Institution: Lekha Wireless (India)

Daniel Sadoc Menasche, Date: 24-28 Jun, Institution: UFRJ (Brazil)

Neeraja Sahasrabudhe, Date: 9 May - 4 Jun and 16-20 Dec, Institution: IIT Bombay (India)

Matteo Sereno, Date: 15-17 July, Institution: Univ of Turin (Italy)

Georgy Shevlyakov, Date: 3-17 Nov, Institution: Peter the Great St. Petersburg Polytechnic Univ (Russia)

Gugan Thoppe, Date: 25 Nov - 6 Dec, Institution: IISc Bangalore (India)

Don Towsley, Date: 1-4 Apr, Institution: UMass Amherst (USA)

Kavitha Voleti Veeraruna, Date: 27 May - 8 Jun, Institution: IIT Bombay (India)

9.5.1.2. Postdoc/PhD Students

Tejas Bodas, Date: 12-22 Apr and 11-22 Jun, Postdoc at IIS Bangalore (India)

Mikhail Grigorev, Date: 2-31 Jan, PhD student at MFTI Moscow (Russia)

Eduardo Hargreaves, Date: 24-28 Jun, PhD student at UFRJ (Brazil)

Maksim Mironov, Date: 2-31 Jan and 24 Aug - 7 Sep, PhD student at MFTI Moscow (Russia)

Maksim Ryzhov, Date: 4 Apr - 3 May, PhD student at MFTI Moscow (Russia)

Anirudh Sabnis, Date: 1 Jul - 6 Oct, PhD student at UMass Amherst (USA)

9.5.2. Internships

Note: UCA is the Univ Côte d'Azur.

Younes Ben Mazziane, Date: 19 Nov-13 Dec, Institution: PFE Master Ubinet, UCA, Supervisors: S. Alouf and G. Neglia

Vidhya Kannan, Date: from Dec, Institution: UCA, Supervisor : G. Neglia

Carlos Eduardo Marciano, Date: 13 Sep-9 Dec, Institution: Master student at UFRJ, Brazil, Supervisor: G. Neglia

Kaiyun Pan, Date: 19 Nov-13 Dec, Institution: PFE Master Ubinet, UCA, Supervisor: G. Neglia

Quentin Petitjean, Date: 11 Jun-26 Jul, Institution: ENS Cachan, Supervisors: S. Alouf and A. Jean-Marie

Vilc Queupe Rufino, Date: 17-19 Jun, Institution: Master student at UFRJ, Brazil, Supervisor: D. Sadoc Menasche (UFRJ)

Varvara Samoili, Date: 11 Jan-10 Jul, Institution: Bodossaki Foundation, Supervisor: G. Neglia

Nicola Sebastianelli, Date: 1 Mar-31 Aug, Institution: Master Ubinet, UCA, Supervisor: G. Neglia

Adeel Siddiqui, Date: until Jan 2019, Institution: UCA, Supervisor : G. Neglia

Siemo Zhang, Date: 1 Sep-30 Nov, Institution: Master student at Univ of Twente, Netherlands, Supervisor: K. Avrachenkov

9.6. Visits to International Teams

9.6.1. Research Stays Abroad

Eitan Altman

- Date: 29 January - 4 February, 28 March - 6 April, 20 June - 10 July, 18 October - 4 December, Institution: Technion and Univ Tel-Aviv (Israel)

Konstantin Avrachenkov

- Date: 17-22 February, Institution: Friedrich-Alexander Univ (Germany)
- Date: 4-15 March, Institution: Petrozavodsk State Univ (Russia)
- Date: 26-28 October, Institution: IISc Bangalore (India)
- Date: 30 October - 2 November, Institution: IIT Bombay (India)
- Date: 24-26 November, Institution: Univ Twente (The Netherlands)

Maximilien Dreveton

- Date: 24 May - 9 June, Institution: Aalto Univ (Finland)

Alain Jean-Marie

Date: 17 October - 4 November, Institution: GERAD (Montréal, Canada)

Giovanni Neglia

- Date: 20-22 February, Institution: Univ Florence and Univ Pisa (Italy)
- Date: 23-26 September, Institution: Northeastern Univ and Boston Univ (Massachusetts, United States)

PRIVATICS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. AMNECYS

- Title: AMNECYS
- Duration: 2015 - .
- Coordinator: CESICE, UPMF.
- Others partners: Inria/Privatics and LIG/Moais, Gipsa-lab, LJK, Institut Fourier, TIMA, Vérimag, LISTIC (Pole MSTIC) .
- Abstract: Privatics participates to the creation of an Alpine Multidisciplinary NEtwork on CYbersecurity Studies (AMNECYS). The academic teams and laboratories participating in this project have already developed great expertise on encryption technologies, vulnerabilities analysis, software engineering, protection of privacy and personal data, international & European aspects of cybersecurity. The first project proposal (ALPEPIC ALPs-Embedded security: Protecting Iot & Critical infrastructure) focuses on the protection of the Internet of Things (IoT) and Critical Infrastructure (CI).

7.1.2. Data Institute

- Title: Data Institute UGA
- Duration: 2017 - .
- Coordinator: TIMC-IMAG.
- Others partners: AGEIS, BIG, CESICE, GIN, GIPSA-lab, IAB, IGE, IPAG, LAPP, LARHRA, LIDILEM, LIG, LISTIC, LITT&ArTS, LJK, LUHCIE, LECA, OSUG, PACTE, TIMC-IMAG
- Abstract: Privatics is leading the WP5 (Data Governance, Data Protection and Privacy). This action (WP5) aims to analyze, in a multi-disciplinary perspective, why and how specific forms of data governance emerge as well as the consequences on the interaction between the state, the market and society. The focus will be on the challenges raised by the collection and use of data for privacy, on the data subjects' rights and on the obligations of data controllers and processors. A Privacy Impact/Risk assessments methodology and software will be proposed. A case study will focus on medical and health data and make recommendations on how they should be collected and processed.

7.1.3. CyberAlps

- Title: CyberAlps
- Duration: 2018 - .
- Coordinator: IF.
- Others partners: CEA LETI, CERAG, CESICE, CREg, G2E lab, GIPSA-lab, GSCOP, IF, LCIS, LIG, LISTIC, LJK, PACTE, TIMC-IMAG, VERIMAG.
- Abstract: The Grenoble Alpes Cybersecurity Institute aims at undertaking ground-breaking interdisciplinary research in order to address cybersecurity and privacy challenges. Our main technical focus is on low-cost secure elements, critical infrastructures, vulnerability analysis and validation of large systems, including practical resilience across the industry and the society. Our approach to cybersecurity is holistic, encompassing technical, legal, law-enforcement, economic, social, diplomatic, military and intelligence-related aspects with strong partnerships with the private sector and robust national and international cooperation with leading institutions in France and abroad.

7.1.4. Antidot

- Title: Antidot
- Type: Fédération Informatique de Lyon (inter laboratories project)
- Duration: September 2018 - 2020.
- Coordinator: Inria.
- Others partners: LIRIS.
- Abstract: The ANTIDOT project is interested in the privacy issues raised by the increasingly ubiquitous collection of mobility data and their exploitation by third-party applications. The objective of this project is to propose solutions and tools to increase the user awareness about the risks of violation of their privacy in the context of the mobile Internet. In order to achieve this objective, ANTIDOT will jointly address the study of information gathering mechanisms, the study of mobility data vulnerabilities and the protection of this personal data.

7.1.5. DARC

- Title: DARC - the Data Anonymization and Re-identification Competition
- Type: Innovation Pédagogique - IDEX LYON
- Duration: September 2019 - 2020.
- Coordinator: INSA.
- Abstract: In order to increase awareness and empower future digital engineers in a fun way on privacy issues, the DARC project offers learning through play through a challenge carried out jointly by three different training courses of INSA students in Bourges and in Lyon. This challenge consists first of all in anonymizing a dataset from an online sales site, then secondly in trying to re-identify the anonymized data of the other groups.

7.2. National Initiatives

7.2.1. ADT PRESERVE

- Title: PRESERVE: Plate-foRme wEb de SEnsibilisation aux pRoblèmes de Vie privéE
- Duration: 2019 - 2020
- Coordinator: INSA.
- Abstract: The goal of this project is to develop a web platform to increase the user awareness on privacy issues. This platform will gather multiple works investigated in the team and will be used to conduct demonstration and stimulate new collaborations and dissemination actions to end users and media.

7.2.2. ANR

7.2.2.1. CISC

Title: Certification of IoT Secure Compilation.

Type: ANR.

Duration: April 2018 - March 2022.

Coordinator: Inria INDES project-team (France)

Others partners: Inria CELTIC project-team (France), College de France (France) (France).

See also: http://cisc.gforge.inria.fr.

Abstract: The objective of the ANR CISC project is to investigate multitier languages and compilers to build secure IoT applications with private communication. A first goal is to extend multitier platforms by a new orchestration language that we call Hiphop.js to synchronize internal and external activities of IoT applications as a whole. CISC will define the language, semantics, attacker models, and policies for the IoT and investigate automatic implementation of privacy and security policies by multitier compilation of IoT applications. To guarantee such applications are correct, and in particular that the required security and privacy properties are achieved, the project will certify them using the Coq proof assistant.

7.2.2.2. SIDES 3.0

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

Type: ANR.

Duration: August 2017 - August 2020.

Coordinator: Uness (France).

Others partners: Inria, UGA, ENS, Theia, Viseo.

Abstract: Since 2013, faculties of medicine have used a shared national platform that enables them to carry out all of their validating exams on tablets with automatic correction. This web platform entitled SIDES allowed the preparation of the medical students to the Computerized National Classing Events (ECN) which were successfully launched in June 2016 (8000 candidates simultaneously throughout France). SIDES 3.0 proposes to upgrade the existing platform. Privatics goals in this project is to ensure that privacy is respected and correctly assessed .

7.2.2.3. DAPCODS/IOTics

Title: DAPCODS/IOTics.

Type: ANR 2016.

Duration: May 2017 - Dec. 2020.

Coordinator: Inria PRIVATICS.

Others partners: Inria DIANA, EURECOM, Univ. Paris Sud, CNIL.

Abstract:

Thanks to the exponential growth of Internet, citizens have become more and more exposed to personal information leakage in their digital lives. This trend began with web tracking when surfing the Internet with our computers. The advent of smartphones, our personal assistants always connected and equipped with many sensors, further reinforced this tendency. And today the craze for "quantified self" wearable devices, for smart home appliances or for other connected devices enable the collection of potentially highly sensitive personal information in domains that were so far out of reach. However, little is known about the actual practices in terms of security, confidentiality, or data exchanges. The enduser is therefore prisoner of a highly asymmetric system. This has important consequences in terms of regulation, sovereignty, and leads to the hegemony of the GAFAs (Google, Amazon, Facebook and Apple). Security, transparency and user control are three key properties that should be followed by all the stakeholders of the smartphone and connected devices ecosystem. Recent scandals show that the reality is sometimes at the opposite.

The DAPCODS project gathers four renowned research teams, experts in security, privacy and digital economy. They are seconded by CNIL, the French data protection agency. The project aims at contributing along several axes:

- by analyzing the inner working of a significant set of connected devices in terms of personal information leaks. This will be made possible by analyzing their data flows (and associated smartphone application if applicable) from outside (smartphone and/or Wifi network) or inside, through ondevice static and dynamic analyses. New analysis methods and tools will be needed, some of them leveraging on previous works when applicable;

- by studying the device manufacturers' privacy policies along several criteria (e.g., accessibility, precision, focus, privacy risks). In a second step, their claims will be compared to the actual device behavior, as observed during the test campaigns. This will enable an accurate and unique ranking of connected devices;
- by understanding the underlying ecosystem, from the economical viewpoint. Data collected will make it possible to define the blurred boundaries of personal information market, a key aspect to set up an efficient regulation;
- and finally, by proposing a public website that will rank those connected devices and will inform citizens. We will then test the impact of this information on the potential change of behavior of stakeholders.

By giving transparent information of hidden behaviors, by highlighting good and bad practices, this project will contribute to reduce the information asymmetry of the system, to give back some control to the endusers, and hopefully to encourage certain stakeholders to change practices.

7.2.3. Inria-CNIL collaboration

Privatics is in charged of the Cnil-Inria collaboration. This collaboration was at the origin of the Mobilitics project and it is now at the source of many discussions and collaborations on data anoymisation, risk analysis, consent or IoT Privacy. Privatics and Cnil are both actively involved on the IoTics project, that is the follow-up of the Mobilitics projects. The goal of the Mobilitics project was to study information leakage in mobile phones. The goal of IoTics is to extend this work to IoT and connected devices.

Privatics is also in charged of the organization of the Cnil-Inria prize that is awarded every year to an outstanding publication in the field of data privacy.

7.3. European Initiatives

7.3.1. Collaborations in European Programs, Except FP7 & H2020

7.3.1.1. UPRISE-IoT

Title: User-centric PRIvacy & Security in IoT

Programm: CHISTERA

Duration: December 2016 - December 2019

Coordinator: SUPSI (Suisse)

Inria contact: Claude Castelluccia

The call states that "Traditional protection techniques are insufficient to guarantee users' security and privacy within the future unlimited interconnection": UPRISE-IoT will firstly identify the threats and model the behaviours in IoT world, and further will build new privacy mechanisms centred around the user. Further, as identified by the call "all aspects of security and privacy of the user data must be under the control of their original owner by means of as simple and efficient technical solutions as possible", UPRISE-IoT will rise the awareness of data privacy to the users. Finally, it will deeply develop transparency mechanisms to "guarantee both technically and regulatory the neutrality of the future internet." as requested by the call. The U-HIDE solution developed inn UPRISE-IoT will "empower them to understand and make their own decisions regarding their data, which is essential in gaining informed consent and in ensuring the take-up of IoT technologies", using a methodology that includes "co-design with users to address the key, fundamental, but inter-related and interdisciplinary aspects of privacy, security and trust."

7.3.1.2. SPARTA

Title: Strategic Programs for Advanced Research and Technology in Europe (SPARTA)

Programm: H2020-SU-ICT-03-2018

Duration: February 2019 - January 2022

Coordinator: CEA

Inria contact: Thomas Jensen (Inria), Vincent Roca (for PRIVATICS)

SPARTA Cybersecurity European Competence Network. The consortium consists of 44 partners from 14 different countries, with the goal to demonstrate the setup and assessment of a European SPARTA Cybersecurity Competence Network.

7.4. International Initiatives

7.4.1. DATA

Title: Data and Algorithmic Transparency and Accountability

International Partner (Institution - Laboratory - Researcher):

Université du Québec à Montréal (UQAM) (Canada) - Département d'informatique - Sébastien Gambs

Start year: 2018

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

The accelerated growth of the Internet has outpaced our abilities as individuals to maintain control of our personal data. The recent advent of personalized services has lead to the massive collection of personal data and the construction of detailed profiles about users. However, users have no information about the data which constitute its profile and how they are exploited by the different entities (Internet companies, telecom operators, ...). This lack of transparency gives rise to ethical issues such as discrimination or unfair processing.

In this associate team, we propose to strengthen the complementary nature and the current collaborations between the Inria Privatics group and UQAM to advance research and understanding on data and the algorithmic transparency and accountability.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Jeremy Decouchant (University of Luxembourg) visited Privatics from 14/10/2019 to 25/10/2019 through the Erasmus Staff Mobility For Teaching program. During the visit, Jeremie Decouchant participated in network programming lectures and practical sessions at the INSA Lyon engineering school at the M1 level. In addition, the existing scientific collaborations with the team have been also extended around the usage of Intel Software Guard Extensions (SGX) to implement a privacy-preserving recommendation systems and genome studies.
- Gergely Acs, assistant professor at Budapest University (Hungary), visited our team in June. He worked together with Claude Castelluccia on the security and privacy of Federated machine learning.
- Rosin Claude Ngueveu (UQAM) visited the team in Lyon in July 2019 for two weeks to increase the DATA collaboration. During the visit, Rosin Claude Ngueveu presented joint work at APVP 2019 and advanced existing collaboration to include fairness in our work on protection of motion sensor data.

STAMP Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- FastRelax, "Fast and Reliable Approximations", started on October 1st, 2014, for 60 months (ending in September 2019), with a grant of 75 kEuros for Marelle. Other partners are Inria Grenoble (ARIC project-team), LAAS-CNRS (Toulouse), Inria Saclay (Toccata and Specfun project-teams), and LIP6-CNRS (Paris). The corresponding researcher for this contract is Laurence Rideau.
- TECAP "Analyse de protocoles, Unir les outils existants", starting on October 1st, 2017, for 60 months, with a grant of 89 kEuros. Other partners are Inria teams PESTO (Inria Nancy grand-est), Ecole Polytechnique, ENS Cachan, IRISA Rennes, and CNRS. The corresponding researcher for this contract is Benjamin Grégoire.
- SafeTLS "La sécurisation de l'Internet du futur avec TLS 1.3" started on October 1st, 2016, for 60 months, with a grant of 147kEuros. Other partners are Université de Rennes 1, and secrétariat Général de la Défense et de la Sécurité Nationale. The corresponding researcher for this contract is Benjamin Grégoire.
- BRUTUS "Chiffrements authentifiés et résistants aux attaques par canaux auxiliaires", started on October 1st, 2014, for 60 months, with a grant of 41 kEuros for STAMP. Other partners are Université de Rennes 1, CNRS, secrétariat Général de la défense et de la sécurité nationale, and Université des Sciences et Technologies de Lille 1. The corresponding researcher for this contract is Benjamin Grégoire.
- Scrypt "Compilation sécurisée de primitives cryptographiques" started on February 1st, 2019, for 48 months, with a grant of 100 kEuros. Other partners are Inria team Celtique (Inria Rennes Bretagne Atlantique), Ecole polytechnique, and AMOSSYS SAS. The corresponding researcher for this contract is Benjamin Grégoire.

7.1.2. FUI

The acronym *FUI* stands for "fonds unique interministériel" and is aimed at research and development projects in pre-industrial phase. The STAMP team is part of one such project.

- VERISICC (formal verification for masking techniques for security against side-channel attacks). This contract concerns 5 partners: CRYPTOEXPERTS a company from the Paris region (Île de France), ANSSI (Agence Nationale de Sécurité des Systèmes d'Information), Oberthur Technologies, University of Luxembourg, and STAMP. A sixth company (Ninjalabs) acts as a sub-contractant. The financial grant for STAMP is 391 kEuros, including 111kEuros that are reserved for the sub-contractant. This project started in October 2018 for a duration of 4 years. The corresponding researcher for this contract is Benjamin Grégoire.

7.2. European Initiatives

7.2.1. Collaborations in European Programs, Except FP7 & H2020

Program: COST

Project acronym: EUTypes

Project title: The European research network on types for programming and verification (EUTypes)

Coordinator: Prof. Herman Geuvers, Radboud University, The Netherlands

Abstract: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.

7.2.2. Collaborations with Major European Organizations

Partner 1: MPI Bochum, Gilles Barthe, Germany

Formally verified cryptography

7.3. International Initiatives

7.3.1. Informal International Partners

We have strong collaborations with AIST in Japan. Reynald Affeldt, a researcher from AIST has been visiting our team since October 1st 2019. The topic of choice is formalization of a variety of topics using the Mathematical Components library, aiming mostly at formalizing robotics.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

We received the visit of Marc Gourjon (Technische Universität Hamburg) in April and from Manuel Barbosa (University of Porto) in June and July.

We received the visit of Reynald Affeldt (AIST, Japan) starting on October 1st.

We received the visit of Kazuhiko Sakaguchi (University of Tsukuba), from January 1st to October 31st.

Stars Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

See CoBTek, Nice Hospital, FRIS

8.2. National Initiatives

See Vedecom

8.2.1. ANR

8.2.1.1. ENVISION

Program: ANR JCJC

Project acronym: ENVISION

Project title: Computer Vision for Automated Holistic Analysis of Humans

Duration: October 2017-September 2020.

Coordinator: Antitza Dantcheva (STARS)

Abstract: The main objective of ENVISION is to develop the computer vision and theoretical foundations of efficient biometric systems that analyze appearance and dynamics of both face and body, towards recognition of identity, gender, age, as well as mental and social states of humans in the presence of operational randomness and data uncertainty. Such dynamics - which will include facial expressions, visual focus of attention, hand and body movement, and others, constitute a new class of tools that have the potential to allow for successful holistic analysis of humans, beneficial in two key settings: (a) biometric identification in the presence of difficult operational settings that cause traditional traits to fail, (b) early detection of frailty symptoms for health care.

8.2.2. FUI

8.2.2.1. Visionum

Program: FUI

Project acronym: Visionum

Project title: Visonium.

Duration: January 2015- December 2018.

Coordinator: Groupe Genious

Other partners: Inria (Stars), StreetLab, Fondation Ophtalmologique Rothschild, Fondation Hospitalière Sainte-Marie.

Abstract: This French project from Industry Minister aims at designing a platform to re-educate at home people with visual impairment.

8.2.2.2. StoreConnect

Program: FUI

Project acronym: StoreConect.

Project title: StoreConnect.

Duration: September 2016 - June 2019.

Coordinator: Ubudu (Paris).

Other partners: Inria (Stars), STIME (groupe Les Mousquetaires Paris), Smile (Paris), Thevolys (Dijon).

Abstract: StoreConnect is a FUI project started in 2016 and ended in 2019. The goal is to improve the shopping experience for customers inside supermarkets by adding new sensors such as cameras, beacons and RFID. By gathering data from all the sensors and combining them, it is possible to improve the way to communicate between shops and customers in a personalized way. StoreConnect acts as a middleware platform between the sensors and the shops to process the data and extract interesting knowledge organized via ontologies.

8.2.2.3. ReMinAry

Program: FUI

Project acronym: ReMinAry.

Project title: ReMinAry.

Duration: September 2016 - June 2020.

Coordinator: GENIOUS Systèmes,

Other partners: Inria (Stars), MENSIA technologies, Institut du Cerveau et de la Moelle épinière, la Pitié-Salpêtrière hospital.

Abstract: This project is based on the use of motor imagery (MI), a cognitive process consisting of the mental representation of an action without concomitant movement production. This technique consists in imagining a movement without realizing it, which entails an activation of the brain circuits identical to those activated during the real movement. By starting rehabilitation before the end of immobilization, a patient operated on after a trauma will gain rehabilitation time and function after immobilization is over. The project therefore consists in designing therapeutic video games to encourage the patient to re-educate in a playful, autonomous and active way in a phase where the patient is usually passive. The objective will be to measure the usability and the efficiency of the re-educative approach, through clinical trials centered on two pathologies with immobilization: post-traumatic (surgery of the shoulder) and neurodegenerative (amyotrophic lateral sclerosis).

8.3. European Initiatives

8.3.1. Collaborations in European Programs, Except FP7 & H2020

See EIT Health.

8.4. International Initiatives

8.4.1. Inria International Labs

- $EASafEE$: Associated team (2018-2020) Safe and Easy Environment for Alzheimer disease and related disorders. Inria Stars, National Taipei University of Technology Taiwan and CoBTeK team. The objective of SafEE is to develop an automated home support system, using information and communication technologies (ICT), to support the loss of autonomy and to improve the quality of life of the elderly population.
- $FER4HM$: Inria International Lab (2017-2020) Facial Expression Recognition for Health Monitoring. Coordinator: François Brémond, Antitza Dantcheva. Other partners: Chinese Academy of Sciences (CAS) (China). FER4HM aims to investigate computer vision methods for facial expression recognition in patients with Alzheimer's disease. Most importantly though, the project seeks to be part of a paradigm shift in current health care, efficiently and cost-effectively finding objective measures to (a) assess different therapy treatments, as well to (b) enable automated human-computer interaction in remote scale health care-frameworks.

8.4.1.1. Other IIL projects

- RESPECT

  Program: ANR PRCI (French-German, ANR-DFG)

  Project acronym: RESPECT

  Project title: Reliable, secure and privacy preserving multi-biometric person authentication

  Duration: April 2019-March 2023.

  Coordinator: Antitza Dantcheva (STARS)

  Abstract: In spite of the numerous advantages of biometric recognition systems over traditional authentication systems based on PINs or passwords, these systems are vulnerable to external attacks and can leak data. Presentations attacks (PAs) – impostors who manipulate biometric samples to masquerade as other people – pose serious threats to security. Privacy concerns involve the use of personal and sensitive biometric information, as classified by the GDPR, for purposes other than those intended. Multi-biometric systems, explored extensively as a means of improving recognition reliability, also offer potential to improve PA detection (PAD) generalisation. Multi-biometric systems offer natural protection against spoofing since an impostor is less likely to succeed in fooling multiple systems simultaneously. For the same reason, previously unseen PAs are less likely to fool multi-biometric systems protected by PAD. RESPECT, a Franco-German collaborative project, explores the potential of using multi-biometrics as a means to defend against diverse PAs and improve generalisation while still preserving privacy. Central to this idea is the use of (i) biometric characteristics that can be captured easily and reliably using ubiquitous smart devices and, (ii) biometric characteristics which facilitate computationally manageable privacy preserving, homomorphic encryption.

  The research focuses on characteristics readily captured with consumer-grade microphones and video cameras, specifically face, iris and voice. Further advances beyond the current state of the art involve the consideration of dynamic characteristics, namely utterance verification and lip dynamics. The core research objective is to determine which combination of biometrics characteristics gives the best biometric authentication reliability and PAD generalisation while remaining compatible with computationally efficient privacy preserving BTP schemes.

- $VIdeoSeizureAnalysis$: Inserm-Inria PhD grant (October 2018- September 2021). Partners: Prof F Bartolomei Inserm UMR 1106 La Timone Hospital Marseille and M Thonnat DR Inria Stars Sophia Antipolis. The objective of the PhD thesis entitled Quantified video analysis of seizure semiology in epilepsy is to provide new automated and objective analysis and interpretation of recorded videos of patients during epilepsy seizures.

8.4.2. Inria Associate Teams Not Involved in an Inria International Labs

8.4.2.1. SafEE (Safe & Easy Environment)

Title: SafEE (Safe Easy Environment) investigates technologies for the evaluation, stimulation and intervention for Alzheimer patients. The SafEE project aims at improving the safety, autonomy and quality of life of older people at risk or suffering from Alzheimer.

International Partner (Institution - Laboratory - Researcher):

National Taipei University of Technology Taipei (Taiwan) - Dept. of Electrical Engineering - Chao-Cheng Wu

Start year: 2018

See also: https://project.inria.fr/safee2/

SafEE (Safe Easy Environment) investigates technologies for the evaluation, stimulation and intervention for Alzheimer patients. The SafEE project aims at improving the safety, autonomy and quality of life of older people at risk or suffering from Alzheimer's disease and related disorders. More specifically the SafEE project : 1) focuses on specific clinical targets in three domains: behavior, motricity and cognition 2) merges assessment and non pharmacological help/intervention and 3) proposes easy ICT device solutions for the end users. In this project, experimental studies will be conducted both in France (at Hospital and Nursery Home) and in Taiwan.

8.4.2.2. Declared Inria International Partners

See Taiwan, China

8.4.3. Participation in Other International Programs

8.4.3.1. International Initiatives

FER4HM

Title: Facial expression recognition with application in health monitoring

International Partner (Institution - Laboratory - Researcher):

Institute of Computing Technology (ICT) of the Chinese Academy of Sciences (CAS) - Prof. Hu HAN

Duration: 2017 - 2019

Start year: 2017

See also: https://project.inria.fr/fer4hm/

The proposed research aims to provide computer vision methods for facial expression recognition in patients with Alzheimer's disease. Most importantly though, the work seeks to be part of a paradigm shift in current healthcare, in efficiently and cost effectively finding objective measures to (a) assess different therapy treatments, as well as to (b) enable automated human-computer interaction in remote large-scale healthcare- frameworks. Recognizing expressions in severely demented Alzheimer's disease (AD) patients is essential, since such patients have lost a substantial amount of their cognitive capacity, and some even their verbal communication ability (e.g., aphasia). This leaves patients dependent on clinical staff to assess their verbal and non-verbal language, in order to communicate important messages, as of discomfort associated to potential complications of the AD. Such assessment classically requires the patients' presence in a clinic, and time consuming examination involving medical personnel. Thus, expression monitoring is costly and logistically inconvenient for patients and clinical staff, which hinders among others large-scale monitoring. Approaches need to cater to the challenging settings of current medical recordings, which include continuous pose variations, occlusions, camera-movements, camera-artifacts, as well as changing illumination. Additionally and importantly, the (elderly) patients exhibit generally less profound facial activities and expressions in a range of intensities and predominantly occurring in combinations (e.g., talking and smiling). Both, Inria-STARS and CAS-ICT have already initiated research activities related to the here proposed topic. While both sides have studied facial expression recognition, CAS-ICT has explored additionally the use of heart rate monitoring sensed from a webcam in this context.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Wael Abd-Almageed from the Information Sciences Institute of the University of Southern California (USC) Viterbi School of Engineering visited in January 2019.
- Timur Luguev from the Intelligent Systems Group of Fraunhofer Institute for Integrated Circuits, Germany visited STARS in March 2019.
- Alan Aboudib from College de France visited STARS in July 2019.

- Julien Pettre from Inria Rennes (Team Rainbow) visited STARS in July 2019.
- Radu Horaud from Inria Grenoble (Team Perception) visited STARS in September 2019.
- Marcos Zuniga from Universidad Tecnica Federico Santa Maria, Chile visited STARS in 2019.
- Chao-Cheng Hu from the National Taipei University of Technology, Taiwan visited STARS in October 2019.

8.5.2. Internships

Several students from India, China, South Korea

TITANE Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

9.1.1.1. PISCO: Perceptual Levels of Detail for Interactive and Immersive Remote Visualization of Complex 3D Scenes

Participants: Pierre Alliez [contact], Flora Quilichini, Florent Lafarge.

The way of consuming and visualizing this 3D content is evolving from standard screens to Virtual and Mixed Reality (VR/MR). Our objective is to devise novel algorithms and tools allowing interactive visualization, in these constrained contexts (Virtual and Mixed reality, with local/remote 3D content), with a high quality of user experience. Partners: Inria, LIRIS INSA Lyon Institut National des Sciences Appiquées (coordinator), Laboratoire d'Informatique en Images et Systèmes d'Information LS2N Nantes University. Total budget 550 KE, 121 KE for TITANE. The PhD thesis of Flora Quilichini is funded by this project which started in January 2018, for a total duration of 4 years.

9.1.1.2. LOCA-3D: Localization Orientation and 3D CArtography

Participants: Fernando Ireta Munoz, Florent Lafarge, Pierre Alliez [contact].

This project is part of the ANR Challenge MALIN LOCA-3D (Localization, orientation and 3D cartography). The challenge is to develop and experiment accurate location solutions for emergency intervention officers and security forces. These solutions must be efficient inside buildings and in conditions where satellite positioning systems do not work satisfactorily. Our solution is based on an advanced inertial system, where part of the inertial sensor drift is compensated by a vision system. Partners: SME INNODURA TB (coordinator), IBISC laboratory (Evry university) and Inria. Total budget: 700 KE, 157 KE for TITANE. The engineer position of Fernando Ireta Munoz is funded by this project which started in January 2018, for a total duration of 4 years.

9.1.1.3. EPITOME: efficient representation to structure large-scale satellite images

Participants: Nicolas Girard, Yuliya Tarabalka [PI].

The goal of this young researcher project is to devise an efficient multi-scale vectorial representation, which would structure the content of large-scale satellite images. More specifically, we seek for a novel effective representation for large-scale satellite images, that would be generic, i.e., applicable for images worldwide and for a wide range of applications, and structure-preserving, i.e. best representing the meaningful objects in the image scene. To address this challenge, we plan to bridge the gap between advanced machine learning and geometric modeling tools to devise a multi-resolution vector-based representation, together with the methods for its effective generation and manipulation. Total budget: 225 KE for TITANE. The PhD thesis of Nicolas Girard is funded by this project which started in October 2017, for a total duration of 4 years.

9.1.1.4. Faults_R_GEMS: Properties of FAULTS, a key to Realistic Generic Earthquake Modeling and hazard Simulation

Participants: Lionel Matteo, Yuliya Tarabalka [contact].

The goal of the project is to study the properties of seismic faults, using advanced math tools including learning approaches. The project is in collaboration with Geoazur lab (coordinator), Arizona State University, CALTECH, Ecole Centrale Paris, ENS Paris, ETH Zurich, Geosciences Montpellier, IFSTTAR, IPGP Paris, IRSN Fontenay-aux-Roses, LJAD Nice, UNAVCO Colorado and Pisa University. The PhD thesis of Lionel Matteo is funded by this project which started in October 2017, for a total duration of 4 years.

9.1.1.5. BIOM: Building Indoor and Outdoor Modeling

Participants: Muxingzi Li, Pierre Alliez, Florent Lafarge [contact].

The BIOM project aims at automatic, simultaneous indoor and outdoor modelling of buildings from images and dense point clouds. We want to achieve a complete, geometrically accurate, semantically annotated but nonetheless lean 3D CAD representation of buildings and objects they contain in the form of a Building Information Models (BIM) that will help manage buildings in all their life cycle (renovation, simulation, deconstruction). The project is in collaboration with IGN (coordinator), Ecole des Ponts Paristech, CSTB and INSA-ICube. Total budget: 723 KE, 150 KE for TITANE. The PhD thesis of Muxingzi Li is funded by this project which started in February 2018, for a total duration of 4 years.

9.2. International Initiatives

9.2.1. Inria International Partners

9.2.1.1. Declared Inria International Partners

We collaborated with David Bommes from Bern University (Switzerland), Gianmarco Cherchi and Riccardo Scateni from University of Cagliary (Sardinia), and Elmar Schoemer from Johannes Gutenberg Universität Mainz.

9.3. International Research Visitors

9.3.1. Visits of International Scientists

- Michael Hemmer, research engineer at Google X, visited us in June.
- Jorg Peters, Professor at University of Florida, visited us in June.

9.3.2. Visits to International Teams

- Pierre Alliez visited the Google X team for one week in April.
- Florent Lafarge visited the Institute of Computer Graphics and Vision at TU Graz in March.

TOSCA Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- C. Henry is the coordinator of the PAIRE project, a TREMPLIN-COMPLEX project funded by University of Côte d'Azur. The project aims at creating new international and cross-sector collaborations to foster innovative solutions for particle contamination in the environment. This will be achieved by bringing together partners in a consortium to submit a research proposal to the European MSCA-RISE-2019 and MSCA-RISE-2020 calls.
- A. Lejay is a member of the Executive board of LUE Impact digistrust on citizens' trust in the digital world (grant of the i-site, U. Lorraine), since 2018.

8.2. National Initiatives

8.2.1. ANR

- N. Champagnat was member of the ANR NONLOCAL (Phénomènes de propagation et équations non locales), coordinated by F. Hamel (Univ. Aix-Marseille), which ended in October.
- C. Henry is the coordinator of the PACE project, a MRSEI project funded by the ANR to help prepare European projects. As for PAIRE, the project aims at creating new international and cross-sector collaborations to foster innovative solutions for particle contamination in the environment. This will be achieved by bringing together partners in a consortium to submit a research proposal to the European MSCA-RISE-2019 and MSCA-RISE-2020 calls.
- U. Herbach is member of the ANR SinCity (Analyses transcriptomiques sur cellules uniques dont la généalogie est identifiée au cours d'un processus de différentiation), coordinated by O. Gandrillon (ENS Lyon).

8.2.2. GDR

A. Lejay is leader of the GdR Project TRAG on rough paths founded by INSMI in 2019.

8.2.3. ITMO Cancer

N. Champagnat, C. Fritsch and U. Herbach are involved in an ITMO Cancer project (INSERM funding) on "Modeling ctDNA dynamics for detecting targeted therapy resistance" (2017-2020), involving researchers from IECL (Institut Elie Cartan de Lorraine), the Inria teams BIGS and TOSCA, ICL (Institut de Cancérologie de Lorraine), CRAN (Centre de Recherche en Automatique de Nancy) and CHRU Strasbourg (Centre Hospitalier Régional Universitaire). This project is coordinated by N. Champagnat.

8.2.4. PEPS

The project SECURE of C. Fritsch obtained a PEPS I3A (Intelligence Artificielle et Apprentissage Automatique).

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

Program: FP7

Project acronym: HBP

Project title: The Human Brain Project

Duration: April 2018 - Mars 2020 (third part)

Coordinator: EPFL

Other partners: see the webpage of the project.

Tosca contact: Etienne Tanré

Abstract: Understanding the human brain is one of the greatest challenges facing 21st century science. If we can rise to the challenge, we can gain profound insights into what makes us human, develop new treatments for brain 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.

M. Bossy and C. Henry are involved in the VIMMP H2020 project, started in January 2018. M. Bossy is responsible for the partner Inria. VIMMP is a four years development for a software platform and simulation market place on the topic of complex multiscale CFD simulations.

8.4. International Initiatives

8.4.1. Participation in Other International Programs

Math AmSud SARC

Title: Stochastic and Statistics analysis for Stochastic Differential equations driven by fractional Brownian motion with non regular coefficients.

International Partner (Institution - Laboratory - Researcher):

Universidade Estadual de Campinas (Brasil)

Universidad de Valparaiso (Chile) - CIMFAV – Facultad de Ingenieria

PI: C. Olivera (Brasil), E. Tanré (France), S. Torrès (Chile)

Duration: 2019 - 2020
Start year: 2019
Keywords: Stochastic differential equations, fractional Brownian motion, Malliavin calculus, Bayesian parametric, and nonparametric statistics.

BRN
Title: Biostochastic Research Network
International Partner (Institution - Laboratory - Researcher):
Universidad de Valparaiso (Chile) - CIMFAV – Facultad de Ingenieria - Soledad Torres, Rolando Rebolledo
CNRS, Inria & IECL - Institut Élie Cartan de Lorraine (France) - N. Champagnat, A. Lejay, D. Villemonnais, R. Schott.
Duration: 2018 - 2022
Start year: 2018

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- E. Horton (University of Bath) spent one week in IECL in April to work with D. Villemonais.
- E. Mordecki (U. de la República, Uruguay) spent 3 months in IECL, with an invited professor position (*poste rouge CNRS*).
- H. Olivero Quintos spent one month at Sophia Antipolis.

8.5.1.1. Internships

- Loubna Ben Allal
  subject: processus de Hawkes
  date: sept. 2019 - june 2020
  institution: École des Mines de Nancy
- Wejdene Ben Nasr
  subject: méthodes de signature pour les séries temporelles multi-variées
  date: sept. 2019 - june 2020
  institution: Master IMSD, U. Lorraine.
- Olivier Coudray
  subject: transmission de la longueur de télomères entre générations
  date: apr. 2019 - aug. 2019
  institution: École Polytechnique, Master Mathématiques de l'aléatoire
- Rémi Maréchal
  subject: processus de fragmentation pour les avalanches
  date: sept. 2019 - june 2020
  institution: École des Mines de Nancy
- Seyedafshin Shekarforush
  subject: particles in the environment: the adaptative grid generation problem in particle agglomeration and fragmentation dynamics
  date: apr. 2019 - aug. 2019
  institution: Université Nice Sophia Antipolis

8.5.2. Visits to International Teams

8.5.2.1. Sabbatical programme

D. Villemonais obtained a *délégation CNRS* which ended in August.

WIMMICS Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

- Nhan Le Thanh is responsible of project Idex Jedi MIRE, Université Côte d'Azur (2017-2020)
- IADB UCA Project *Integration and Learning on Biomedical Data*[0], is a project funded by UCA JEDI Labex (Université Côte d'Azur). The goal of the project is to leverage medical prognosis and decision making in the clinical domain with big data analysis techniques, Natural Language Processing and Machine Learning. The partners are: I3S, Wimmics, CHU Nice, BCL (Bases, Corpus, Language) Laboratory.

9.2. National Initiatives

9.2.1. PIA GDN ANSWER

Participants: Fabien Gandon, Hai Huang, Vorakit Vorakitphan, Serena Villata, Elena Cabrio.

ANSWER stands for Advanced aNd Secured Web Experience and seaRch [0]. It is a GDN project (Grands Défis du Numérique) from the PIA program (Programme d'Investissements d'Avenir) on Big Data. The project is between four Inria research teams and the Qwant company.

The aim of the ANSWER project is to develop the new version of the Qwant [0] search engine by introducing radical innovations in terms of search criteria as well as indexed content and users' privacy.

The purpose is to strengthen everyone's confidence in the search engine and increase the effectiveness of Web search. Building trust in the search engine is based on innovations in (1) Security: computer security, privacy; (2) Completeness: completeness and heterogeneity of (re)sources; and (3) Neutrality: analysis, extraction, indexing, and classification of data.

Increasing the effectiveness of Web-based research relies on innovations related to (1) Relevance: variety and value of content taken into account, measurement of emotions carried by query results; (2) Interaction with the user: adaptation of the interfaces to the types of research; and (3) Performance: perceived relevance of results and response time.

The proposed innovations include:

- Design and develop models and tools for the detection of emotions in query results:
  - Ontology, thesaurus, linguistic resources
  - Metrics, indicators, classification of emotions
- Design and develop new crawling algorithms:
  - Dynamic crawling strategies
  - Crawlers and indexes for linked open data
- Ensure respect for privacy:
  - Detection of Internet tracking
  - Preventive display of tracing techniques
  - Certified security of automatic adaptation of ads to keywords entered by the user

[0] *Intégration et Apprentissage sur les Données Biomédicales*
[0] https://project.inria.fr/answer/
[0] http://www.qwant.com

9.2.2. DGA CONFIRMA

Participants: Elena Cabrio, Serena Villata.

The theme of this new project with DGA is counter argumentation against fake news. Its duration is 2018-2020.

9.2.3. Ministry of Culture: MonaLIA 2.0

Participants: Anna Bobasheva, François Raygagne, Fabien Gandon, Frédéric Precioso.

The objective of the MonaLIA 2 project is to exploit the crossover of the automatic learning methods particularly applied to image analysis and knowledge-based representation and reasoning, in particular for the semantic indexing of annotated works and images in JocondeLab. The goal is to identify automated or semi-automatable tasks to improve the annotation. This project follows the preliminary project MonaLIA 1 which established the state of the art in order to evaluate the potential and the combination of learning (notably deep learning) and the semantization of annotations on the case of JocondeLab. In the project MonaLIA 2 we now want to go beyond the preliminary study and to design and build a prototype and the methods assisting the creation, the improvement and the maintenance of the metadata of the image database in order to assist the actors of the cultural world in their daily tasks. The preliminary study identified several possible coupling points between deep learning from non-necessarily structured data and reasoning from structured data. This project proposes to select the most promising of them to carry out a proof of concept combining these methods by focusing on the assistance to the annotation and curation tasks of the metadata of a real base to improve the contents, the course and exploitation thereafter.

9.2.4. ANR WASABI

Participants: Michel Buffa, Elena Cabrio, Catherine Faron Zucker.

The ANR project WASABI started in January 2017 with IRCAM, Deezer, Radio France and the SME Parisson, consists in building a 2 million songs knowledge base of commercial popular music (rock, pop, etc.) Its originality is the joint use of audio-based music information extraction algorithms, song lyrics analysis algorithms (natural language processing), and the use of the Semantic Web. Web Audio technologies will then explore these bases of musical knowledge by providing innovative applications for composers, musicologists, music schools and sound engineers, music broadcasters and journalists. This project is in its mid-execution and gave birth to many publications in international conferences as well as some mainstream coverage (i.e for “la fête de la Science”). Michel Buffa, national coordinator of this project, presented the project to “Journées Sciences et Musique” in October 2019 in Rennes, and animated a Master Class during the Sophia Summit 2019 event in November 2019. Participation in the ANR OpenMiage project aimed at offering online Bachelor and Master degrees.

Industrial transfer of some of the results of the WASABI project (partnership with AmpedStudio.com/Amp Track company) for integration of our software into theirs), SATT PACA.

Web site: http://wasabihome.i3s.unice.fr

9.2.5. ANR SIDES 3.0

Participants: Catherine Faron Zucker, Olivier Corby, Fabien Gandon, Alain Giboin, Andrea Tettamanzi.

Partners: Université Grenoble Alpes, Inria, Ecole Normale Supérieure de Lyon, Viseo, Theia.

SIDES 3.0 is an ANR project (2017-2020) which started in fall 2017. It is led by Université Grenoble Alpes (UGA) and its general objective is to introduce semantics within the existing SIDES educational platform [0] for medicine students, in order to provide them with added value educational services.

Web site: https://www.uness.fr/anr/projets/dune/sides3.0

9.2.6. ANR D2KAB

Participants: Olivier Corby, Catherine Faron Zucker, Franck Michel.

[0] http://side-sante.org/

Partners: LIRMM, INRA, IRD, ACTA

D2KAB is an ANR project which started in June 2019, led by the LIRMM laboratory (UMR 5506). Its general objective is to to create a framework to turn agronomy and biodiversity data into knowledge - semantically described, interoperable, actionable, open– and investigate scientific methods and tools to exploit this knowledge for applications in science and agriculture.

Web site: http://www.d2kab.org

9.2.7. Smart Enseigno

Participant: Catherine Faron Zucker.

Partner: Educlever, Ludotic, Cabrilog, IFE

As a follow-up of the EduMICS project, the Smart Enseigno project started in September 2019, led by Educlever. It is funded by the Ministry of National Education (MEN), within the Programme des Investissements d'Avenir (PIA2), action Partenariat d'innovation Intelligence artificielle(PI-IA) [00]. This project aims at developing resources and intelligent services within the Educlever platform for secondary school mathematics education.

9.2.8. DBpedia.fr

Participants: Elmahdi Korfed, Fabien Gandon.

The DBpedia.fr project proposes the creation of a French chapter of the DBpedia database. This project was the first project of the Semanticpedia convention signed by the Ministry of Culture, the Wikimedia foundation and Inria.

Web site: http://dbpedia.fr

9.2.9. Convention between Inria and the Ministry of Culture

Participant: Fabien Gandon.

We supervise the research convention with the Ministry of Culture to foster research and development at the crossroad of culture and digital sciences. This convention signed between Inria and the Ministry of Culture provides a framework to support projects at the cross-road of the cultural domain and the digital sciences.

9.2.10. Qwant-Inria Joint Laboratory

Participant: Fabien Gandon.

We supervise the Qwant-Inria Joint Laboratory where joint teams are created and funded to contribute to the search engine research and development. The motto of the joint lab is Smart Search and Privacy with five research directions:

- Crawling, Indexing, Searching
- Execution platform, privacy by design, security, ethics
- Maps and navigation
- Augmented interaction, connected objects, chatbots, personnal assistants
- Education technologies (EdTech)

We released the final, but confidential, report of the Qwant-Culture short-term project. This project aimed at identifying possibilities of exploiting the Qwant search engine to improve the search for information in the digital cultural resources of the French Ministry of Culture. Some possibilities have been selected to be the subject of research actions in the context a long-term project.

9.2.11. GDRI Zoomathia

Participants: Catherine Faron Zucker, Franck Michel, Andrea Tettamanzi.

[0]https://eduscol.education.fr/pid29713/appels-a-projets-numeriques-des-investissements-d-avenir.html
[0]https://primabord.eduscol.education.fr/P2IA

Wimmics is a partner of the International Research Group (GDRI) Zoomathia funded by two CNRS institutes: INEE and INSHS. This group aims at studying transmission of zoological knowledge from Antiquity to Middle-Age through material resources (bio residues, artefacts), iconography and texts.

As a continuation of the work initiated with the *Muséum National d'Histoire Naturelle* (MNHN) during the last three years, the TAXREF-LD linked data dataset, that we produced jointly with the MNHN, now appears in the Linked Open Data cloud [0] and is published on AgroPortal [0]. Relatedly, we have reflected on modelling principles for biodiversity Linked Data [63].

Web site: http://www.cepam.cnrs.fr/zoomathia/

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

- AI4EU : In January 2019, the AI4EU consortium was established to build the first European Artificial Intelligence On-Demand Platform and Ecosystem with the support of the European Commission under the H2020 programme. We participate to the design of an ontology of AI resources. We have set up a prototype of Web server with a SPARQL endpoint to demonstrate the ontology and RDF metadata. Web site: https://www.ai4eu.eu

9.3.2. Collaborations in European Programs, Except FP7 & H2020

MIREL Project

Program: RISE

Project acronym: MIREL

Project title: MIning and REasoning with Legal texts

Duration: January 2016 - December 2019

Coordinator: University of Luxembourg

Other partners: 16 members from 11 countries [0].

Abstract: project that defines a formal framework and develops tools for MIning and REasoning with Legal texts, with the aim of translating these legal texts into formal representations that can be used for querying norms, checking compliance, and supporting decision .

CREEP EIT Project

Program: KIC EIT Digital 2018

Project acronym: CREEP

Project title: Cyberbulling Effects Prevention

Duration: January 2018 - December 2019

Coordinator: Fondazione Bruno Kessler

Other partners: University of Trento, Fondazione Bruno Kessler, ExpertSystem, NeuroNation

Abstract: CREEP (Cyberbulling Effects Prevention) aims at identifying and preventing the possible negative impacts of cyberbullying on young people. It seeks to realize advanced technologies for the early detection of cyberbullying phenomena through the monitoring of social media and the communication of preventive advices and personalized recommendations tailored to teenagers' needs through a virtual coaching system (chatbot).

[0] http://lod-cloud.net/
[0] http://agroportal.lirmm.fr/ontologies/TAXREF-LD/
[0] http://www.mirelproject.eu/members.html

9.4. International Research Visitors

- Laura Alonso Alemany, Professor, Cordoba University, Argentina
- Luigi Asprino, PhD, Research Assistant, Institute of Cognitive Sciences and Technologies, Roma, Italy
- Cristian Cardelino, PhD student, Cordoba University, Argentina
- Alberto Ceselli, Professor, University of Milano, Italy
- Andrei Ciortea, Postdoctoral researcher, University St. Gallen, Switzerland
- Johanna Frau, PhD student, Cordoba University, Argentina
- Marco Guerini, Researcher, Fondazione Bruno Kessler, Trento, Italy
- Phan Hieu Ho, PhD student, Danang Polytech, Vietnam
- Dario Malchiodi, Associate Professor, University of Milano, Italy
- Enrico Mensa, PhD Student, University of Torino, Italy
- Than Tuan Nguyen, Ph. D. student, Université Hanoi, Vietnam
- Debora Nozza, PhD student, University of Milano, Italy
- Johan Pauwels, Research Assistant, Queen Mary University of London
- Mark Sandler, Professor, Queen Mary University of London
- Milagro Teruel, PhD student, Cordoba University, Argentina

9.4.1. Visits to International Teams

9.4.1.1. Research Stays Abroad

- Fabien Gandon visited Stanford, USA from July to August 2019. In the context of the project MIREL he worked on the problem of SHACL-based validation of ontologies.

ZENITH Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. Institut de Convergence Agriculture numérique #DigitAg, (2017-2023), 275Keuro.

Participants: Alexis Joly, Florent Masseglia, Esther Pacitti, Christophe Pradal, Patrick Valduriez.

#DigitAg brings together in a partnership of seventeen actors (public research and teaching organizations, transfer actors and companies) with the objective of accelerating and supporting the development of agriculture companies in France and in southern countries based on new tools, services and uses. Based in Montpellier with an office in Toulouse and Rennes and led by Irstea, #DigitAg's ambition is to become a world reference for digital agriculture. In this project, Zenith is involved in the analysis of big data from agronomy, in particular, plant phenotyping and biodiversity data sharing.

9.1.2. ANR WeedElec (2018-2021), 106 Keuro.

Participants: Julien Champ, Hervé Goëau, Alexis Joly.

The WeedElec project offers an alternative to global chemical weed control. It combines an aerial means of weed detection by drone coupled to an ECOROBOTIX delta arm robot equipped with a high voltage electrical weeding tool. WeedElec's objective is to remove the major related scientific obstacles, in particular the weed detection/identification, using hyperspectral and colour imaging, and associated chemometric and deep learning techniques.

9.1.3. Others

9.1.3.1. Pl@ntNet InriaSOFT consortium, 80 Keuro / year

Participants: Alexis Joly, Jean-Christophe Lombardo, Julien Champ, Hervé Goëau.

This contract between four research organisms (Inria, INRA, IRD and CIRAD) aims at sustaining the Pl@ntNet platform in the long term. It has been signed in November 2019 in the context of the InriaSOFT national program of Inria. Each partner subscribes a subscription of 20K euros per year to cover engineering costs for maintenance and technological developments. In return, each partner has one vote in the steering committee and the technical committee. He can also use the platform in his own projects and benefit from a certain number of service days within the platform. The consortium is not fixed and is not intended to be extended to other members in the coming years.

9.1.3.2. Ministry of Culture, 130 Keuro

Participants: Alexis Joly, Jean-Christophe Lombardo.

Two contracts have been signed with the ministry of culture to adapt, extend and transfer the content-based image retrieval engine of Pl@ntNet ("Snoop") toward two major actors of the French cultural domain: the French National Library (BNF) and the French National institute of audio-visual (INA).

9.1.3.3. INRA/Inria PhD program, 100 Keuro

Participant: Alexis Joly.

This contract between INRA and Inria allows funding a 3-years PhD student (Christophe Botella). The addressed challenge is the large-scale analysis of Pl@ntNet data with the objective to model species distribution (a big data approach to species distribution modeling). The PhD student is supervised by Alexis Joly with François Munoz (ecologist, IRD) and Pascal Monestiez (statistician, INRA).

9.2. European Initiatives

9.2.1. FP7 & H2020 Projects

9.2.1.1. CloudDBAppliance

Participants: Reza Akbarinia, Boyan Kolev, Florent Masseglia, Esther Pacitti, Patrick Valduriez.

Project title: CloudDBAppliance
Instrument: H2020
Duration: 2016 - 2019
Total funding: 5 Meuros (Zenith: 500Keuros)
Coordinator: Bull/Atos, France
Partners: Inria Zenith, U. Madrid, INESC and the companies LeanXcale, QuartetFS, Nordea, BTO, H3G, IKEA, CloudBiz, and Singular Logic.
Inria contact: Florent Masseglia, Patrick Valduriez

The project aims at producing a European Cloud Database Appliance for providing a Database as a Service able to match the predictable performance, robustness and trustworthiness of on premise architectures such as those based on mainframes. In this project, Zenith is in charge of designing and implementing the components for analytics and parallel query processing.

9.2.1.2. Cos4Cloud

Participants: Alexis Joly, Jean-Christophe Lombardo, Antoine Affouard.

Project title: Cos4Cloud
Instrument: H2020
Duration: 2019 - 2022
Total funding: 5 Meuros (Zenith: 400Keuros)
Coordinator: CSIC (Spain)
Partners: The Open University, CREAF, Bineo, EarthWatch, SLU, NKUA, CERT, Bineo, ECSA.
Inria contact: Alexis Joly

Cos4Cloud will integrate citizen science in the European Open Science Cloud (EOSC) through the co-design of innovative services to solve challenges faced by citizen observatories, while bringing Citizen Science (CS) projects as a service for the scientific community and the society and providing new data sources. In this project, Zenith is in charge of developing innovative web services related to automated species identification, location-based species prediction and training data aggregation services.

9.3. International Initiatives

The team has two PhD students funded by an Algerian initiative ("Bourses d'excellence Algériennes "):

- Khadidja Meguelati, since 2016, "Massively Distributed Time Series Clustering via Dirichlet Mixture Models"
- Lamia Djebour, since 2019, "Parallel Time Series Indexing and Retrieval with GPU architectures"

9.3.1. Inria International Labs

In the context of LIRIMA, P. Valduriez gave a one week course in big data at IMSP, Bénin, in march, and an online seminar on Blockchain on 13 dec at Inria Rennes.

9.3.2. Inria Associate Teams Not Involved in an Inria International Labs

9.3.2.1. SciDISC

Title: Scientific data analysis using Data-Intensive Scalable Computing

International Partner (Institution - Laboratory - Researcher):

Universidade Federal do Rio de Janeiro (Brazil) - Computer Laboratory - Marta Mattoso

Start year: 2017

See also: https://team.inria.fr/zenith/scidisc/

Data-intensive science requires the integration of two fairly different paradigms: high-performance computing (HPC) and data-intensive scalable computing (DISC). Spurred by the growing need to analyze big scientific data, the convergence between HPC and DISC has been a recent topic of interest [[Coutinho 2014, Valduriez 2015]. This project will address the grand challenge of scientific data analysis using DISC (SciDISC), by developing architectures and methods to combine simulation and data analysis. The expected results of the project are: new data analysis methods for SciDISC systems; the integration of these methods as software libraries in popular DISC systems, such as Apache Spark; and extensive validation on real scientific applications, by working with our scientific partners such as INRA and IRD in France and Petrobras and the National Research Institute (INCT) on e-medicine (MACC) in Brazil.

9.3.3. Inria International Partners

9.3.3.1. Informal International Partners

We have regular scientific relationships with research laboratories in

- North America: Univ. of Waterloo (Tamer Özsu), UCSB Santa Barbara (Divy Agrawal and Amr El Abbadi), Northwestern Univ. (Chicago), university of Florida (Pamela Soltis, Cheryl Porter, Gil Nelson), Harvard (Charles Davis), UCSB (Susan Mazer).
- Asia: National Univ. of Singapore (Beng Chin Ooi, Stéphane Bressan), Wonkwang University, Korea (Kwangjin Park), Kyoto University (Japan), Tokyo University (Hiroyoshi Iwata)
- Europe: Univ. of Madrid (Ricardo Jiménez-Periz), UPC Barcelona (Josep Lluis Larriba Pey), HES-SO (Henning Müller), University of Catania (Concetto Spampinatto), Cork School of Music (Ireland), RWTH (Aachen, Germany), Chemnitz technical university (Stefan Kahl), Berlin Museum für Naturkunde (Mario Lasseck), Stefanos Vrochidis (Greece, ITI), UK center for hydrology and ecology (Tom August)
- Africa: Univ. of Tunis (Sadok Ben-Yahia), IMSP, Bénin (Jules Deliga)
- Australia: Australian National University (Peter Christen)
- Central America: Technologico de Costa-Rica (Erick Mata, former director of the US initiative Encyclopedia of Life)

9.3.4. Participation in Other International Programs

9.3.4.1. Inria International Chairs

Dennis Shasha (NYU)

Title: Data Science in a Dynamic World

International Partner: New York University (NYU), USA

Duration: 2015 - 2019

Start year: 2015

Many fundamental problems in natural science from astronomy to microbiology require data from heterogeneous sources, hence giving rise to a new “data science”. The basic workflow is to collect that data, form some kind of similarity metric between objects based on each data source, and then weight those different similarity metrics for some data analysis task. The goal is to gain actionable insight such as the cause of some symptoms, the function of some protein, or the likely source of some epidemic. Most often this is conceived of as "do-it-once" exercise. However, as data acquisition techniques improve, data may evolve continuously. When that happens the question is whether new revised insights can be obtained in a close to real time manner. Whether this is possible depends on the qualities of the new data, the weighting of the data sources, and the machine learning algorithms used. This project addresses data science in a dynamic world, aiming to find fast and minimalist methods to update insights as new data appears. This will result in new data management algorithms that will be implemented in tools and validated in the context of real data, in particular biology data.

9.3.5. Visits of International Scientists

- Renan Souza (COPPE/UFRJ and IBM,Brazil): “Providing Online Data Analytical Support for Humans in the Loop of Computational Science and Engineering Applications” on Jan 15.
- Youcef Djenouri (Norwegian University of Science and Technology, Trondheim): “Urban traffic outlier detection” on Feb 14.
- Dennis Shasha (NYU) “Bounce Blockchain: a secure, energy-efficient permission less blockchain” on May 27.
- Alvaro Coutinho (COPPE/UFRJ, Brazil): “Some Reflections on Predictive Science in Geophysical Applications” on Nov 20.
- Marta Mattoso (COPPE/UFRJ, Brazil): “Adding Provenance Data to Experiments: From Computational Science to Deep Learning” on Nov 20.
- Eduardo Ogasawara, (CEFET-RJ, Brazil): “Event Detection in Time Series” on Nov 20.
- Heraldo Borges (CEFET-RJ, Brazil): “Discovering Patterns in Restricted Space-Time Datasets” on Nov 20.