Activity Report 2018

Section Partnerships and Cooperations

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

- FIL Grant, 2018
  Participants: Hervé Rivano
  The partners of this project, supported by the *Fédération d'Informatique de Lyon*, are: CITI, LIP.
  The goal is to use crow-sensing applications with data collection of Wi-Fi networks which are available in the neighborhood in order *i)* to build a map of the wireless network in terms of performance for the application and *ii)* to optimize the wireless network configuration.

- Labex IMU UrPolSens,10/2015-10/2018
  Participants: Walid Bechkit, Amjed Belkhiri, Ahmed Boubrima, Hervé Rivano
  The partners in this project are Ifsttar, LMFA, EVS, TUBA, and Air Rhone-Alpes, with Inria Agora leading the project.
  UrPolSens deals with the monitoring of air pollution using low-cost sensors interconnected by a wireless networks. Although they are less accurate than the high-end sensors used today, low-cost autonomous air quality sensors allow to achieve a denser spatial granularity and, hopefully, a better monitoring of air pollution. The main objectives of this project are to improve the modeling of air pollution dispersion; propose efficient models to optimize the deployment the sensors while considering the pollution dispersion and the impact of urban environment on communications; deploy a small-scale network for pollution monitoring as a proof of concept; compare the measured and estimated levels of exposure; study the spatial disparities in exposure between urban areas.

- Labex IMU 3M'Air 2018-2021
  Participants: Walid Beckhit, Ahmed Boubrima, Manoel Dahan, Mohamed Anis Fekih, Ichrak Mokhtari, Hervé Rivano.
  The partners in this project are: EVS, LMFA, Métropole de Lyon, Ville de Lyon , Atmo AURA, Météo France, Lyon Météo. Inria Agora is the leader of this project.
  The 3M'Air project explore the potential of participatory sensing to improve local knowledge of air quality and urban heat islands. The main aim of this project is therefore to equip citizens with low-cost mobile sensors and then ensure an efficient real-time data collection and analysis. This allows to obtain a finer spatiotemporal granularity of measurements with lighter installation and operational costs while involving citizens.

- ARC6 Robot fleet mobility under communication constraints, 10/2016-09/2019.
  Participant : Fabrice Valois.
  This work is a joint project with the Inria Chroma research group. Considering a fleet of drones moving in a 3D area, looking for a given target, we focus on how to maintain the wireless connectivity of the network of drones while the drones patrol autonomously. The other partners in this project are University of Grenoble and Viameca.

- Labex IMU Veleval, 10/2017-10/2019
  Participant: Hervé Rivano.
  The partners in this project are: EVS, LIRIS, LLSETI and CITI, with LAET leading the project.
  The goal of this pluridisciplinary project is to study, understand and model the behavior of cyclists in an urban environment with a methodology combining quantitative measurements of mobility traces and image analysis with qualitative informations from reactivation interviews. In particular the input of Agora is to provide crowdsourcing tools for gathering mobility data that are optimized for the practice of urban cycling.

9.2. National Initiatives

9.2.1. ANR

- ANR CANCAN 2019 - 2022 (accepted in 2018, kickoff in February 2019)
  Participants: Solohaja Rabenjamina, Razvan Stanica.
  The partners in this project are: CEDRIC, Inria, Orange Labs, with Thalès Communications & Security leading the project.
  The ANR CANCAN (Content and context based adaptation in mobile networks) targets the following objectives: *i)* collecting novel measurement datasets that describe mobile network data traffic at unprecedented spatial and temporal accuracy levels, and for different mobile services separately. The datasets will be gathered in an operational nationwide network, *ii)* evaluating existing analytics for classification, prediction and anomaly detection within real-world high-detail per-service mobile network data, and tailoring them to the specifications of the management of resources at different network levels, and *iii)* demonstrating the integration of data analytics within next-generation cognitive network architectures in several practical case studies.

- ANR MAESTRO 5G 2019 - 2022 (accepted in 2018, kickoff in February 2019)
  Participants: Hervé Rivano, Razvan Stanica.
  The partners in this project are: CEDRIC, Inria, L2S, LIA, Nokia Bell Labs, TSP, with Orange Labs leading the project.
  The ANR MAESTRO 5G (Management of slices int he radio access of 5G networks) is expected to provide: *i)* a resource allocation framework for slices, integrating heterogeneous QoS requirements and spanning on multiple resources including radio, backhauling/fronthauling and processing resources in the RAN, *ii)* acomplete slice management architecture including provisioning and re-optimization modules and their integration with NFV and SDN strata, *iii)* a business layer for slicing in 5G, *iv)* a demonstrator showing the practical feasibility as well as integration of the major functions and mechanisms proposed by the project, on a 5G Cloud RAN platform. The enhanced platform is expected to support the different 5G services.

- ANR CoWorkWorlds 01/2018 - 12/2020.
  Participants: Solohaja Rabenjamina, Razvan Stanica.
  The ANR CoWorkWorlds (Sustainability and spatiality in co-workers' mobility practices) project is lead by ENTPE. Its focus is on the study of co-working environments, and more precisely on the mobility behaviour of users of such spaces. Our role in the project is to collect and analyse mobility data from a set of users, using the PrivaMov smartphone application.

9.2.2. DGA

- DGA CLOTHO 10/2016-10/2018.
  Participants: Junaid Khan, Romain Pujol, Razvan Stanica, Fabrice Valois
  The partners in the DGA CLOTHO project are Traqueur and Sigfox. The objective of the project is to reduce the energy consumption of the device tracking functionality, by taking profit of short-range communications between the tracked objects.

9.2.3. PIA

- PIA ADAGE 07/2016-06/2018.
  Particpants: Elli Zavou, Razvan Stanica
  The partners in the PIA ADAGE project are Orange, LAAS-CNRS and Inria Privatics. The objective of the ADAGE project is to design and evaluate anonymization algorithms for the specific case of mobile traffic data. Our role in the project is focused on evaluating whether the anonymized data is still usable for adaptive networking mechanisms.

9.2.4. Pôle ResCom

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

9.2.5. EquipEx

- SenseCity
  We have coordinated the participation of several Inria teams to the SenseCity EquipEx. Within the
  SenseCity project, several small reproduction of 1/3rd scale city surroundings will be built under
  a climatically controlled environment. Micro and nano sensors will be deployed to experiment on
  smart cities scenarios, with a particular focus on pollution detection and intelligent transport services.
  Agora will have the opportunity to tests some of its capillary networking solutions in a very realistic
  but controlled urban environment. A proof of concept test site has been built in 2015. We have
  deployed an experiment on low cost sensor network for vehicle detection and one on atmospheric
  pollution sensor calibration. The operational site is build, the information system is being finalized
  and the equipment will be inaugurated in April 2018.

9.2.6. Inria Project lab

- CityLab
  Agora is involved in the CityLab Inria Project Lab lead by Valérie Issarny. Within this project, Hervé
  Rivano co-advises, with Nathalie Mitton (FUN team, Inria Lille-Nord-Europe), the PhD thesis of
  Abdoul Aziz Mbacke on "Data gathering in sensor and passive RFID with energy harvesting for
  urban infrastructure monitoring".

9.3. European Initiatives

9.3.1. Collaborations in European Programs, Except FP7 & H2020

Program: Interreg Med

Project acronym: ESMARTCITY

Project title: Enabling Smarter City in the MED Area through Networking

Duration: 02/2018 - 07/2020

Coordinator: Abruzzo Region, Italy

Other partners: ARIC and RWG (Greece), APEGR (Spain), RAIS (Bosnia and Herzegovina), ENA
(Portugal), MCM and PoliMi (Italy), Capergies (France)

Abstract: The project has its primary objective in improving the innovation capacity of MED cities
by creating innovation ecosystems, which involve actors of the quadruple helix (Citizens, Businesses
Operators, Research, Universities and Public Authorities) , and in applying the Smart City concept,
which utilizes digital and energy saving technologies to allow better services for the citizen with
less impact on the environment, producing furthermore new employability and living scenarios. To
achieve this goal, the project envisages the pilot testing of the Smart City concept to provide specific
services to citizens in the field of intelligent urban districts, energy efficiency of buildings and smarter
public lighting.

9.4. International Initiatives

9.4.1. Inria International Partners

9.4.1.1. Informal International Partners

- **University of Waterloo, ON, Canada**. Joint publications and visits to/from the group of Prof.
  Catherine Rosenberg.
- **Nimbus Centre, Cork, Ireland**. Collaboration around LoRa experiments with Dr. Ramona
  Marfievici.

- **CNR-IEIIT, Turin, Italy**. Joint publications and projects with Dr. Marco Fiore.
- **Trento University, Italy**. Collaboration around routing for IoT networks with the group of Prof. Gian Pietro Picco.
- **University of Edinburgh, UK**. Joint publications and visits to/from the group of Dr. Paul Patras.

9.4.2. Participation in Other International Programs

9.4.2.1. PHC Campus France

- **University of Cluj-Napoca, Romania**. PHC DRONEM (2017-2019) on Monitoring using connected fleet of drones, a collaboration with the group of Prof. Gabriela Czibula.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Abdelmalik Bachir, Professor, Biskra University, Algeria: invited professor at INSA Lyon (July, 2018)
- Josep Paradells Aspas, Professor, Universitat Politecnica de Catalunya, Barcelona, Spain: invited professor at INSA Lyon (October 2018)
- Rui Li, PhD student, University of Edinburgh, Scotland, UK: visiting PhD student (March, 2018)

9.5.1.1. Research Stays Abroad

- Ahmed Boubrima visited the group of Prof. Azzedine Boukerche, University of Ottawa, Canada.
- Mihai Popescu visited the group of Prof. Gabriela Czibula, at University of Cluj-Napoca, Romania (3 periods of 1 month duration: April, June and November 2018).

AIRSEA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

C. Prieur is co-leader of work-package 3 of the cross-disciplinary-project Trajectories from Idex Grenoble.

8.2. National Initiatives

8.2.1. ANR

A 4-year contract : ANR COCOA (COmprehensive Coupling approach for the Ocean and the Atmosphere). PI: E. Blayo. (Jan. 2017 - Dec. 2020). Other partners: Laboratoire des Sciences du Climat et de l'Environnement (UMR8212, Gif-sur-Yvette), Laboratoire de Météorologie Dynamique (UMR8539, Paris), Laboratoire d'Océanographie Physique et Spatiale (UMR6523, Brest), Centre National de Recherche Météorologique (UMR3589, Toulouse), Cerfacs (Toulouse). This project aims at revisiting the overall representation of air-sea interactions in coupled ocean-atmosphere models, and particularly in climate models, by coherently considering physical, mathematical, numerical and algorithmic aspects.

A 4-year contract : ANR HEAT (Highly Efficient ATmospheric modelling) http://www.agence-nationale-recherche.fr/?Project=ANR-14-CE23-0010.

A 4-year contract : ANR ADOM (Asynchronous Domain decomposition methods)

A 5-year contract with the French Navy (SHOM) on the improvment of the CROCO ocean model http://www.croco-ocean.org.

C. Prieur and E. Arnaud are involved as experts in project High-Tune http://www.agence-nationale-recherche.fr/Projet-ANR-16-CE01-0010 funded by ANR.

8.2.2. Other Initiatives

A. Vidard leads a group of projects gathering multiple partners in France and UK on the topic "Variational Data Assimilation for the NEMO/OPA9 Ocean Model", see 5.3 .

C. Prieur chaired GdR MASCOT NUM 2010-2017, in which are also involved M. Nodet, E. Blayo, C. Helbert, E. Arnaud, L. Viry, S. Nanty, L. Gilquin. She is still strong involved in thie group (co-chair) http://www.gdr-mascotnum.fr/doku.php.

LEFE/GMMC CASIS, Coupled Assimilation Strategies for the Initialisation of an ocean- atmospheric boundary layer System, A. Vidard en collaboration avec Mercator océan

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

H2020 project IMMERSE (Improving Models for Marine EnviRonment SErvices) is funded from 2018-12-01 to 2022-11-30 (Inria contact: Florian Lemarié, coordinator: J. Le Sommer, CNRS). The overarching goal of the project is to ensure that the Copernicus Marine Environment Monitoring Service (CMEMS) will have continuing access to world-class marine modelling tools for its next generation systems while leveraging advances in space and information technologies, therefore allowing it to address the ever-increasing and evolving demands for marine monitoring and prediction in the 2020s and beyond.

See also https://cordis.europa.eu/project/rcn/218810/factsheet/fr

8.3.2. Collaborations with Major European Organizations

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

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

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

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

8.4. International Initiatives

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

8.4.1.1. UNQUESTIONABLE

Title: UNcertainty QUantification is ESenTIal for OceaNic & Atmospheric flows proBLEms.

International Partner:

Massachusetts Institute of Technology (United States) - Aerospace Computational Design Laboratory - Youssef Marzouk

Start year: 2018

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

The ability to understand and predict the behavior of geophysical flows is of greatest importance, due to its strong societal impact. Numerical models are essential to describe the evolution of the system (ocean + atmosphere), and involve a large number of parameters, whose knowledge is sometimes really poor. The reliability of the numerical predictions thus requires a step of parameter identification. The Inria-AIRSEA team has a strong expertise in variational approaches for inverse problems. An alternative is the use of particle filters, whose main advantage is their ability to tackle non-gaussian frameworks. However, particle filters suffer from the curse of dimensionality. The main objective of the collaboration we propose between the Inria-AIRSEA team and the MIT UQ group is the understanding of potential low-dimensional structure underlying geophysical applications, then the exploitation of such structures to extend particle filter to high-dimensional applications.

F. Lemarié is involved in the Inria associate team NEMOLOCO with Santiago University (Chile)

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

C. Prieur collaborates with Jose R. Leon (Universdad de la república de Uruguay, Montevideo).

C. Prieur collaborates with K. Bertin (CIMFAV, Valparaíso).

F. Lemarié and L. Debreu collaborate with Hans Burchard and Knut Klingbeil from the Leibniz-Institut für Ostseeforschung in Warnemünde (Germany).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Tiangang Cui, associate professor at Monash University (Melbourne, Australia), has visited the AIRSEA team during two weeks in December 2018. The purpose of this visit is to continue the collaboration with O. Zahm on the question of the dimension reduction for Bayesian inverse problems. Tiangang Cui also gave a presentation in the "Bayes in Grenoble" seminar at Inria-Montbonnot (3rd Dec. 2018).

Nicholas Kevlahan, from McMaster University (Canada) is a visiting scientist of the AIRSEA team for 10 months starting September 2018.

8.5.2. Visits to International Teams

Olivier Zahm was invited by Prof. Fabio Nobile to spend one week at EPFL to discuss the possible future collaboration

Clémentine Prieur visited Durham (US) in the framework of the SAMSI program on Quasi-Monte Carlo and High-Dimensional Sampling Methods for Applied Mathematics (QMC). She was invited for a tutorial at the Opening Workshop : August 28 – September 1, 2018. I take part to several working groups of the program.

Clémentine Prieur visited the Isaac Newton Institute for Mathematical Sciences in Cambridge in June 2018. She was invited in the framework of a semester on Uncertainty quantification for complex systems : theory and methodologies.

F.-X. Le Dimet visited the Florida State University during 2 weeks in May 2018. He made one presentation

F.-X. Le Dimet visited the University of Wisconsin during one week in June 2018. He made 2 presentations.

F.-X. Le Dimet visited the Harbin Institute of Technology during two weeks. He gave a 16 hours cours on the Data Assimilation.

ARIC Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR DYNA3S Project

Participants: Guillaume Hanrot, Gilles Villard.

Dyna3S has been a 2013-2018 ANR project headed by Valérie Berthé (IRIF, U. Paris 7). The Web page of the project is https://www.irif.fr/~dyna3s. The aim of Dyna3S was to study algorithms that compute the greatest common divisor (gcd) from the point of view of dynamical systems. A gcd algorithm is considered as a discrete dynamical system by focusing on integer input. In Lyon we have worked on the computation of the gcd of several integers, in link with integer relation algorithms based on lattice basis reduction. A main motivation of Dyna3S was also discrete geometry, a framework where the understanding of basic primitives, discrete lines and planes, relies on algorithms of the Euclidean type.

9.1.2. ANR FastRelax Project

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

FastRelax stands for "Fast and Reliable Approximation". It is a four year ANR project (started in October 2014 and extended till September 2019). The web page of the project is http://fastrelax.gforge.inria.fr/. It is headed by B. Salvy and involves AriC as well as members of the Marelle Team (Sophia), of the Mac group (LAAS, Toulouse), of the Specfun and Toccata Teams (Saclay), as well as of the Pequan group in UVSQ and a colleague in the Plume group of LIP.

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

9.1.3. ANR MetaLibm Project

Participants: Claude-Pierre Jeannerod, Jean-Michel Muller.

MetaLibm is a four-year project (started in October 2013 and extended till March 2018) focused on the design and implementation of code generators for mathematical functions and filters. The web page of the project is http://www.metalibm.org/ANRMetaLibm/. It is headed by Florent de Dinechin (INSA Lyon and Socrate team) and, besides Socrate and AriC, also involves teams from LIRMM (Perpignan), LIP6 (Paris), CERN (Geneva), and Kalray (Grenoble). The main goals of the project are to automate the development of mathematical libraries (libm), to extend it beyond standard functions, and to make it unified with similar approaches developed in or useful for signal processing (filter design). Within AriC, we are especially interested in studying the properties of fixed-point arithmetic and floating-point arithmetic that can help develop such a framework.

9.1.4. ANR ALAMBIC Project

Participants: Benoît Libert, Fabien Laguillaumie, Ida Tucker.

ALAMBIC is a four-year project (started in October 2016) focused on the applications of cryptographic primitives with homomorphic or malleability properties. The web page of the project is https://crypto.di.ens.fr/projects:alambic:description. It is headed by Damien Vergnaud (ENS Paris and CASCADE team) and, besides AriC, also involves teams from the XLIM laboratory (Université de Limoges) and the CASCADE team (ENS Paris). The main goals of the project are: (i) Leveraging the applications of malleable cryptographic primitives in the design of advanced cryptographic protocols which require computations on encrypted data; (ii) Enabling the secure delegation of expensive computations to remote servers in the cloud by using malleable cryptographic primitives; (iii) Designing more powerful zero-knowledge proof systems based on malleable cryptography.

9.1.5. RISQ Project

Participants: Chitchanok Chuengsatiansup, Fabien Laguillaumie, Benoît Libert, Damien Stehlé.

RISQ (Regroupement de l'Industrie française pour la Sécurité Post – Quantique) is a BPI-DGE four-year project (started in January 2017) focused on the transfer of post-quantum cryptography from academia to industrial poducts. The web page of the project is http://risq.fr. It is headed by Secure-IC and, besides AriC, also involves teams from ANSSI (Agence Nationale de la Sécurité des Systèmes d'Information), Airbus, C& S (Communication et Systèmes), CEA (CEA-List), CryptoExperts, Gemalto, Orange, Thales Communications & Security, Paris Center for Quantum Computing, the EMSEC team of IRISA, and the Cascade and Polsys Inria teams. The outcome of this project will include an exhaustive encryption and transaction signature product line, as well as an adaptation of the TLS protocol. Hardware and software cryptographic solutions meeting these constraints in terms of security and embedded integration will also be included. Furthermore, documents guiding industrials on the integration of these post-quantum technologies into complex systems (defense, cloud, identity and payment markets) will be produced, as well as reports on the activities of standardization committees.

9.2. European Initiatives

9.2.1. LattAC ERC grant

Participants: Shi Bai, Laurent Grémy, Gottfried Herold, Elena Kirshanova, Fabien Laguillaumie, Huyen Nguyen, Alice Pellet–Mary, Miruna Rosca, Damien Stehlé, Alexandre Wallet, Weiqiang Wen.

Damien Stehlé was awarded an ERC Starting Grant for his project *Euclidean lattices: algorithms and cryptography* (LattAC) in 2013 (1.4Meur for 5 years from January 2014). The LattAC project aims at studying all computational aspects of lattices, from algorithms for manipulating them to applications. The main objective is to enable the rise of lattice-based cryptography.

9.2.2. PROMETHEUS Project

Participants: Laurent Grémy, Fabien Laguillaumie, Benoît Libert, Damien Stehlé.

PROMETHEUS (Privacy-Preserving Systems from Advanced Cryptographic Mechanisms Using Lattices) is a 4-year European H2020 project (call H2020-DS-2016-2017, Cybersecurity PPP Cryptography, DS-06-2017) that started in January 2018. It gathers 8 academic partners (ENS de Lyon and Université de Rennes 1; CWI, Pays-Bas; IDC Herzliya, Israel; Royal Holloway University of London, United Kingdom; Universitat Politècnica de Catalunya, Spain; Ruhr-Universität Bochum, Germany; Weizmann Institute, Israel), 4 industrial partners (Orange, Thales, TNO, Scytl). The goal of this project is to develop a toolbox of privacy-preserving cryptographic algorithms and protocols (like group signatures, anonymous credentials, or digital cash systems) that resist quantum adversaries. Solutions will be mainly considered in the context of Euclidean lattices and they will be analyzed from a theoretical point of view (i.e., from a provable security aspect) and a practical angle (which covers the security of cryptographic implementations and side-channel leakages). The project is hosted by ENS de Lyon and Benoît Libert is the administrative coordinator while Orange is the scientific leader.

9.2.3. Other international projects

9.2.3.1. IFCPAR grant: "Computing on Encrypted Data: New Paradigms in Functional Encryption"
Participants: Benoît Libert, Damien Stehlé.

3-year project accepted in July 2018. Expected beginning on January 1, 2019. Benoît Libert is co-PI with Shweta Agrawal (IIT Madras, India). Budget on the French side amounts to 100k€.

Functional encryption is a paradigm that enables users to perform data mining and analysis on encrypted data. Users are provided cryptographic keys corresponding to particular functionalities which enable them to learn the output of the computation without learning anything about the input. Despite recent advances, efficient realizations of functional encryption are only available for restricted function families, which are typically represented by small-depth circuits: indeed, solutions for general functionalities are either way too inefficient for pratical use or they rely on uncertain security foundations like the existence of circuit obfuscators (or both). This project will explore constructions based on well-studied hardness assumptions and which are closer to being usable in real-life applications. To this end, we will notably consider solutions supporting other models of computation than Boolean circuits – like Turing machines – which support variable-size inputs. In the context of particular functionalities, the project will aim for more efficient realizations that satisfy stronger security notions.

9.3. International Initiatives

9.3.1. Participation in International Programs

Vincent Lefèvre actively participated in the revision of the IEEE Standard for Floating-Point Arithmetic (IEEE 754) for 2019.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Lloyd Nicholas Trefethen, from Oxford University (UK), is an expert in numerical analysis and notably the systematic use of Chebyshev approximation. He spent the academic year 2017-2018 with AriC.
- Warwick Tucker, from Uppsala University (Sweden), is an expert of certified computation for dynamical systems. He spent the academic year 2017-2018 with AriC.

9.4.2. Internships

Monosij Maitra, PhD student at IIT Madras (India) under the supervision of Shweta Agrawal, did a 2-month internship, in September and October 2018.

Joel Dahne did an internship with Bruno Salvy from May to July.

9.4.3. Visits to International Teams

- From November 15 to December 15, 2018, Benoît Libert visited the "Cryptography and Coding Research Group" of the Nanyang Technological University (Singapore).
- From July 1 to July 31, 2018, Damien Stehlé visited the cryptography group of Prof. Jung Hee Cheon, at Seoul National University (South Korea)

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. CPER

Participants: Thierry Gautier, Laurent Lefèvre, Christian Perez.

The LECO experimental platform is a new medium size scientific instrument deployed in Grenoble in 2018. It was funded by the CPER 2015-2020 LECO++ to investigate research related to BigData and HPC.

9.2. National Initiatives

9.2.1. PIA

9.2.1.1. PIA ELCI, Environnement Logiciel pour le Calcul Intensif, 2014-2018
Participants: Mathilde Boutigny, Thierry Gautier, Laurent Lefèvre, Christian Perez, Issam Raïs, Jérôme Richard, Philippe Virouleau.

The ELCI PIA project is coordinated by BULL with several partners: CEA, Inria, SAFRAB, UVSQ.

This project aims to improve the support for numerical simulations and High Performance Computing (HPC) by providing a new generation software stack to control supercomputers, to improve numerical solvers, and pre- and post computing software, as well as programming and execution environment. It also aims to validate the relevance of these developments by demonstrating their capacity to deliver better scalability, resilience, modularity, abstraction, and interaction on some application use-cases. AVALON is involved in WP1 and WP3 ELCI Work Packages through the PhD of Issam Raïs and the postdoc of Hélène Coullon. Laurent Lefèvre is the Inria representative in the ELCI technical committee.

9.2.2. MRSEI

9.2.2.1. Fennec, FastEr NaNo-Characterisation, 24 months, 2018-2021
Participants: Eddy Caron, Christian Perez.

The goal of the ANR-MRSEI FENNEC project is to support the submission of a project to the European call DT-NMBP-08-2019 entitled "Real-time nano-characterisation technologies (RIA)".

9.2.3. Inria Large Scale Initiative

9.2.3.1. DISCOVERY, DIStributed and COoperative management of Virtual EnviRonments autonomouslY, 4 years, 2015-2019
Participants: Maverick Chardet, Jad Darrous, Christian Perez.

To accommodate the ever-increasing demand for Utility Computing (UC) resources, while taking into account both energy and economical issues, the current trend consists in building larger and larger Data Centers in a few strategic locations. Although such an approach enables UC providers to cope with the actual demand while continuing to operate UC resources through centralized software system, it is far from delivering sustainable and efficient UC infrastructures for future needs.

The DISCOVERY initiative aims at exploring a new way of operating Utility Computing (UC) resources by leveraging any facilities available through the Internet in order to deliver widely distributed platforms that can better match the geographical dispersal of users as well as the ever increasing demand. Critical to the emergence of such locality-based UC (LUC) platforms is the availability of appropriate operating mechanisms. The main objective of DISCOVERY is to design, implement, demonstrate and promote the LUC Operating System (OS), a unified system in charge of turning a complex, extremely large-scale and widely distributed infrastructure into a collection of abstracted computing resources which is efficient, reliable, secure and at the same time friendly to operate and use.

To achieve this, the consortium is composed of experts in research areas such as large-scale infrastructure management systems, network and P2P algorithms. Moreover two key network operators, namely Orange and RENATER, are involved in the project.

By deploying and using such a LUC Operating System on backbones, our ultimate vision is to make possible to host/operate a large part of the Internet by its internal structure itself: A scalable set of resources delivered by any computing facilities forming the Internet, starting from the larger hubs operated by ISPs, government and academic institutions, to any idle resources that may be provided by end-users.

9.2.3.2. HAC SPECIS, High-performance Application and Computers, Studying PErformance and Correctness In Simulation, 4 years, 2016-2020
Participants: Dorra Boughzala, Idriss Daoudi, Thierry Gautier, Laurent Lefèvre, Frédéric Suter.

Over the last decades, both hardware and software of modern computers have become increasingly complex. Multi-core architectures comprising several accelerators (GPUs or the Intel Xeon Phi) and interconnected by high-speed networks have become mainstream in HPC. Obtaining the maximum performance of such heterogeneous machines requires to break the traditional uniform programming paradigm. To scale, application developers have to make their code as adaptive as possible and to release synchronizations as much as possible. They also have to resort to sophisticated and dynamic data management, load balancing, and scheduling strategies. This evolution has several consequences:

First, this increasing complexity and the release of synchronizations are even more error-prone than before. The resulting bugs may almost never occur at small scale but systematically occur at large scale and in a non deterministic way, which makes them particularly difficult to identify and eliminate.

Second, the dozen of software stacks and their interactions have become so complex that predicting the performance (in terms of time, resource usage, and energy) of the system as a whole is extremely difficult. Understanding and configuring such systems therefore becomes a key challenge.

These two challenges related to correctness and performance can be answered by gathering the skills from experts of formal verification, performance evaluation and high performance computing. The goal of the HAC SPECIS Inria Project Laboratory is to answer the methodological needs raised by the recent evolution of HPC architectures by allowing application and runtime developers to study such systems both from the correctness and performance point of view.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. POP
Participant: Frédéric Suter.

Program: H2020 Center of Excellence

Project acronym: POP

Project title: Performance Optimisation and Productivity

Duration: 2015-2018

Coordinator: Barcelona Supercomputing Centre (BSC)

Other partners: High Performance Computing Center Stuttgart of the University of Stuttgart (HLRS), Jülich Supercomputing Centre (JSC), Numerical Algorithm Group (NAG), Rheinisch-Westfälische Technische Hochschule Aachen (RWTH), TERATEC (TERATEC).

Abstract: The Center of Excellence for Performance Optimisation and Productivity provides performance optimisation and productivity services for academic and industrial codes. European's leading experts from the High Performance Computing field will help application developers getting a precise understanding of application and system behaviour. This project is supported by the European Commission under H2020 Grant Agreement No. 676553.

Established codes, but especially codes never undergone any analysis or performance tuning, may profit from the expertise of the POP services which use latest state-of-the-art tools to detect and locate bottlenecks in applications, suggest possible code improvements, and may even help by Proof-of-Concept experiments and mock-up test for customer codes on their own platforms.

9.3.2. Collaborations in European Programs, Except FP7 & H2020

9.3.2.1. COST IC1305 : Nesus
Participants: Marcos Dias de Assunção, Laurent Lefèvre.

Program: COST

Project acronym: IC1305

Project title: Network for Sustainable Ultrascale Computing (NESUS)

Duration: 2014-2018

Coordinator: Jesus Carretero (Univ. Madrid)

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

9.4. International Initiatives

9.4.1. Inria International Labs

9.4.1.1. Joint Laboratory for Extreme Scale Computing (JLESC) (2014-2018)
Participants: Thierry Gautier, Christian Perez, Jérôme Richard.

Partners: NCSA (US), ANL (US), Inria (FR), Jülich Supercomputing Centre (DE), BSC (SP), Riken (JP). The purpose of the Joint Laboratory for Extreme Scale Computing (JLESC) is to be an international, virtual organization whose goal is to enhance the ability of member organizations and investigators to make the bridge between Petascale and Extreme computing. The founding partners of the JLESC are Inria and UIUC. Further members are ANL, BSC, JSC and RIKEN-AICS.

JLESC involves computer scientists, engineers and scientists from other disciplines as well as from industry, to ensure that the research facilitated by the Laboratory addresses science and engineering's most critical needs and takes advantage of the continuing evolution of computing technologies.

9.4.1.2. Associate Team DALHIS – Data Analysis on Large-scale Heterogeneous Infrastructures for Science (2013-2018)
Participant: Frédéric Suter.

Partners: EPC Myriads (Rennes, Bretagne Atlantique), AVALON (Grenoble, Rhône-Alpes), Data Science and Technology Department (LBNL,USA).

The goal of the Inria-LBL collaboration is to create a collaborative distributed software ecosystem to manage data lifecycle and enable data analytics on distributed data sets and resources. Specifically, our goal is to build a dynamic software stack that is user-friendly, scalable, energy-efficient and fault tolerant. We plan to approach the problem from two dimensions: (i) Research to determine appropriate execution environments that allow users to seamlessly execute their end-to-end dynamic data analysis workflows in various resource environments and scales while meeting energy-efficiency, performance and fault tolerance goals; (ii) Engagement in deep partnerships with scientific teams and use a mix of user research with system software R&D to address specific challenges that these communities face, and inform future research directions from acquired experience.

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

9.4.2.1. Associate Team SUSTAM – Sustainable Ultra Scale compuTing, dAta and energy Management (2017-2020)
Participants: Eddy Caron, Hadrien Croubois, Marcos Dias de Assunção, Alexandre Da Silva Veith, Jean-Patrick Gelas, Olivier Glück, Laurent Lefèvre, Valentin Lorentz, Christian Perez, Issam Raïs.

International Partners: Rutgers University (United States) - RDI2 - Manish Parashar

The SUSTAM associate team will focus on the joint design of a multi-criteria orchestration framework dealing with resources, data and energy management in an sustainable way. The SUSTAM associated team will enable a long-term collaboration between the Inria AVALON team and the Rutgers Discovery Informatics Institute (RDI2) from Rutgers University (USA). The SUSTAM associated team is leaded by Laurent Lefèvre.

9.4.3. Participation in Other International Programs

9.4.3.1. Joint Project CNRS/University of Melbourne – Algorithms for Placement and Reconfiguration of Data Stream Processing Applications (2017-2018)
Participants: Marcos Dias de Assunção, Alexandre Da Silva Veith, Laurent Lefèvre.

Partner: Clouds Lab (The University of Melbourne, Australia).

Much of the "big data" produced today is created as continuous data streams that are most valuable when processed quickly. Several data stream processing frameworks have been designed for running on clusters of homogeneous computers. Under most frameworks, an application is a Direct Acyclic Graph (DAG) whose vertices are operators that execute transformations over the incoming data and edges that define how the data flows between operators. While cloud computing is a key infrastructure for deploying such frameworks, more modern solutions leverage the edges of the Internet (e.g. edge computing) to offload some of the processing from the cloud and hence reduce the end-to-end latency. The placement and reconfiguration of stream processing DAGs onto highly distributed and heterogeneous infrastructure are, however, challenging endeavours. This project aims to investigate algorithms for the placement and dynamic reconfiguration of stream processing components considering multiple criteria.

9.5. International Research Visitors

9.5.1. Research Stays Abroad

Participant: Olivier Glück.

Olivier Glück has been invited professor by Concordia University (Faculty of Engineering & Computer Science, Department of Computer Science & Software Engineering). He has conducted researches with Dr. Brigitte Jaumard, Professor & Research Chair, Tier 1, on the Optimization of Communication Networks. He has worked on the following Virtual Machine (VM) migration optimization problem: find a scheduling of VM migration that minimizes the makespan *i.e.,* total duration of the migration assuming that the current VM placement and the target one are given. He has proposed a new sequence-based optimization model with a Mixed Integer Linear Program (MILP), which not only guarantees the finding of the best VM migration scheduling but also the migration of the largest possible number of VMs in the case of deadlocks. He also worked on the design of heuristic algorithms for VM migration and a generator of real VM migration instances to evaluate the models and heuristics proposed. He has also worked on the task offloading problem in edge computing.

BEAGLE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Lipuscale (2018-2019): Hybrid simulation of lipid digestion and absorption, a two-year project funded by the Rhône-Alpes Institute for Complex Systems (IXXI). With Marie-Caroline Michalski (CarMeN, INSERM U1060, INRA U1397) and Samuel Bernard (Institut Camille Jordan and Inria Dracula team). Participant: Carole Knibbe.

8.2. National Initiatives

8.2.1. ANR

Dopaciumcity (2014-2018): Dopamine modulation of calcium influx underlying synaptic plasticity, a 4-year project funded by a grant from the ANR-NSF-NIH Call for French-US Projects in Computational Neuroscience. With L. Venance, College de France, CIRB, CNRS/UMR 7241 - INSERM U1050, Paris, France and K Blackwell, Krasnow Institute of Advanced Studies, George Mason University, Fairfax, VA, USA. Supervisor: L Venance (for France) and K.L. Blackwell (for US). Participants: H Berry, I Prokin, A Foncelle

Dallish (2016-2020): Data Assimilation and Lattice LIght SHeet imaging for endocytosis/exocytosis pathway modeling in the whole cell, Call AAPG ANR 2016. With C. Kervrann (Inria Rennes), J. Salamero (Institute Curie, Paris), B. Laroche (INRA, Jouy-en-Josas). Participants: H. Berry.

Storiz (2018-2020): Horizontal transfers as documents from extinct or unknown species. Call ANR JCJC 2018. Leaded by Damien de Vienne (LBBE, Lyon) Participant: Eric Tannier

LncEvoSys (2017-2019): An evolutionary systems approach to understand long non-coding RNA functionality, Call ANR JCJC 2017. Leaded by Anamaria Necsulea (LBBE, Lyon). Participant: Eric Tannier

8.2.2. Inria

ADT Phylophile (2016-2018). Participants: E Tannier, in collaboration with D Parsons, Inria, V Daubin, B Boussau, CNRS, Université de Lyon 1. This project aims at producing an easy to use software integrating modern algorithmic methods to build gene trees. It has been funded by Inria by a 24 month software engineer.

Naviscope (Inria Project Lab, 2018-2022): image-guided Navigation and VIsualization of large data sets in live cell imaging and microSCOPy. Nowadays, the detection and visualization of important localized events and process in multidimensional and multi-valued images, especially in cell and tissue imaging, is tedious and inefficient. Specialized scientists can miss key events due to complexity of the data and the lack of computer guidance. In Naviscope we develop 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. We build Naviscope upon the strength of scientific visualization and machine learning methods in order to provide systems capable to assist the scientist to obtain a better understanding of massive amounts of information. Such systems will be able to recognize and highlight the most informative regions of the dataset by reducing the amount of information displayed and guiding the observer attention. Head: C. Kervrann (Serpico), other EPIs: Aviz, Beagle, Hybrid, Morpheme, Mosaic, Parietal, and MaIage (INRA unit).

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

- Anton Crombach collaborates with Dr. Alexander Fleischmann, who moved this year from CIRB, College de France (Paris), to Brown University, USA.

- Carole Knibbe collaborates with Kirsty Spalding and Peter Arner from Karolinska University Hospital in Stockholm, Sweden.

- Eric Tannier collaborates with Gergerly Szollosi, Eotvos University, Budapest, Cedric Chauve, SFU, Vancouver, Igor Sharakov, from Virginia Tech, Rob Waterhous, Univ Lausanne, Tom Williams, Univ Bristol, ...

- Eric Tannier has leaded the publication of a collaborative paper on a phylogenetic format co-signed by 27 researchers from 10 nationalities.

8.3.2. Participation in Other International Programs

Program: CNRS-Royal society

Project title: Modeling lateral gene transfer on a new bacterial tree

Duration: 2018

Coordinator: Bastien Boussau

Other partners: Eric Tannier (Beagle), LBBE (Lyon), Eotvos University (Budapest), University of Bristol (UK)

Abstract: Bacteria play a major role in human health and in the functioning of all ecosystems. Most of the genomes available in public databases come from Bacteria. However, we understand little of their evolution: both their phylogeny and their timeline of diversification are highly uncertain. This is due in great part to the difficulty of reconstructing events that happened billions of years ago, and also to the fact that individual genes are often transferred across species and therefore have a history that differs from that of the species that contain them. Recently we have proposed novel methods for dealing with the very problems that make reconstructing the bacterial phylogeny challenging. This proposal aims to support a joint project that will reconstruct and date the bacterial phylogeny by combining novel methods (Boussau, Lyon) with existing skills in microbial phylogenetics, genomics and evolution (Williams, Bristol).

8.4. International Research Visitors

8.4.1. Visits to International Teams

Audrey Denizot stayed 4 months in Okinawa, OIST University, Erik de Schutter's team, from june to october 2018

<div style="text-align:center">**CASH Team**</div>

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- Matthieu Moy submitted an ANR project as scientific coordinator entitled "Distributed Efficient Architecture for the Rapid (Co)simulation of Multiphysics Objects" (48 months, partners Verimag, TIMA and LIP6).
- Laure Gonnord's "Jeune Chercheur" ANR, CODAS, has started in January 2018 (42 months).

8.1.2. Scientific Advising

- Christophe Alias is scientific advisor (concours scientifique, 20%) for the XTREMLOGIC start-up.

8.2. International Initiatives

8.2.1. Informal International Partners

- Christophe Alias has regular collaborations with Sanjay Rajopadhye from Colorado State University, USA (3 publications, one publication submitted 7.1).
- Ludovic Henrio has regular collaborations with university of Linköping (one publication last year, 2 submissions); University of Oslo, University of Uppsala, and TU Darmstadt on active objects (2 publications being written); Chalmers university and Univ of Twente (one publication submitted).
- Laure Gonnord has regular collaborations with Fernando Pereira from UFMG, Brasil (5 publications in total, last in 2017). In 2018 she has began a collaboration with Tobias Grösser, from ETH Zurich.

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. COMODYS project, FIL (Federation d'Informatique de Lyon), 2017-19

Participants: Laetitia Matignon, Olivier Simonin.

Project of the Informatics Federation of Lyon (FIL) between two teams of two laboratories: CHROMA (CITI) and SMA (LIRIS), entitled "COoperative Multi-robot Observation of DYnamic human poSes", 2017-2019. Leader : L. Matignon & O. Simonin.

This project funds materials, missions and internships and its objectives are the on-line adaptation of a team of robots that observe and must recognize human activities.

9.1.2. CORDES ADT Inria project, 2017-19

Participants: Olivier Simonin, Vincent Le Doze, Jilles Dibangoye, Alessandro Renzaglia.

The project CORDES (Coordination d'une Flotte de Drones Connectés pour la Cartographie 3D d'édifices) is an Inria ADT coordinated by Olivier Simonin. It funds an Inria expert engineer position in Chroma (Vincent Le Doze, 10/17-11/19) focusing on UAVs control and path-planning. The project aims to deploy a fleet of UAVs able to autonomously fly over an unknown infrastructure and to build a 3D map.

9.2. National Initiatives

9.2.1. ANR

9.2.1.1. ANR "Valet" (2016-18)

The ANR VALET, led by A. Spalanzani, proposes a novel approach for solving car-sharing vehicles redistribution problem using vehicle platoons guided by professional drivers. An optimal routing algorithm is in charge of defining platoons drivers' routes to the parking areas where the followers are parked in a complete automated mode. The consortium is made of 2 academic partners: Inria (RITS, Chroma, Prima) and Ircyyn Ecole Centrale de Nantes and the AKKA company. The phD student (Pavan Vashista) recruited in this project focus on integrating models of human behaviors to evaluate and communicate a risk to pedestrians that may encounter the trajectory of the VALET vehicle. His phD thesis started in february 2016 and is codirected by D. Vaufreydaz (Inria/PervasiveInteraction).

9.2.1.2. ANR "HIANIC" (2017-20)

The HIANIC project, led by A. Spalanzani, proposes to endow autonomous vehicles with smart behaviors (cooperation, negotiation, socially acceptable movements) that better suit complex SharedSpace situations. It will integrate 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). A. Spalanzani is the leader of this project.

9.2.1.3. PIA Ademe "CAMPUS" (2017-20)

The CAMPUS project aims to identify, develop and deploy new functions for the autonomous cars in urban environments. In this project, Chroma will focus on finding solutions to navigate in complex situations such as crowded environments or dense traffic. The consortium is made of 1 academic partner: Inria (Rits and Chroma teams) and 3 companies: Safran electronics, Gemalto and Valeo.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

Program: ECSEL

Project acronym: ENABLE-S3

Project title: European Initiative to Enable Validation for Highly Automated Safe and Secure Systems

Duration: June 2016 – May 2019

Coordinator: AVL List GesmbH

Other partners: Major European Organizations, including academic partners (such as Inria or KIT) and a Large number of industrial partners from various application domains such as automotive industry or Aeronautics or Train industry

Abstract: ENABLE-S3 is *industry-driven* and therefore aims to foster the leading role of the European industry. This is also reflected in its *use case driven approach*. The main technical objectives are extracted from the use cases defined by the industrial partners, in order to validate the success of the developed methods and tools.

The ENABLE-S3 project will provide European industry with leading-edge technologies that *support the development of reliable, safe and secure functions for highly automated and/or autonomously operating systems* by enabling the *validation and verification at reduced time and costs*.

Enables-S3 is a large European consortium, involving a French consortium leaded by Renault and Inria Grenoble Rhône-Alpes. The Inria Tamis team (Rennes) is also involved in the project.

9.3.2. Collaborations in European Programs, Except FP7 & H2020

9.3.2.1. PHC DRONEM

Program: PHC franco-roumain "Brandusi"

Project acronym: DRONEM

Project title: Optimizing Data Delivery in Multi-robot Network Patrolling using Machine Learning

Duration: 01-2017 - 12-2018

Coordinator: O. Simonin, G. Czibula (University of Babes-Bolyai, Cluj-Napoca, Romania)

Abstract: The present research proposal is an interdisciplinary project that focuses on developing novel machine learning models and techniques for addressing the challenging problem of dynamic multi-robot network patrolling. This proposal brings together a team of researchers in the field of robotics (Chroma) with a team of researchers in the field of Machine Learning from Babe-Bolyai University, Cluj-Napoca (the MLyRE team) and aims to combine their expertise in autonomous robotics and machine learning, as well as to exploit the complementarity between the two fields. Deploying fleets of mobile robots in real scenarios/environments raises several scientific challenges. One of them concerns the ability of the robots to adapt to the complexity of their environment, i.e. its dynamics and uncertainty.

9.3.3. Collaborations with Major European Organizations

Partner 1 : ETHZ, Zurich, Autonomous System laboratory, (Switzerland) and University of Zurich, Robotics and Perception Group (Switzerland)

Subject 1 : Vision and IMU data Fusion for 3D navigation in GPS denied environment.

Partner 2 : Karlsruhe Institut fur Technologie (KIT, Germany)

Subject 2 :Autonomous Driving (student exchanges and common project).

Partner 3 : Vislab Parma (Italy)

Subject 3 : Embedded Perception & Autonomous Driving (visits, projects submissions, and book chapter in the new edition of the Handbook of Robotics).

9.4. International Initiatives

9.4.1. Inria International Labs

9.4.1.1. Informal International Partners

- UC Berkeley & Stanford University (CA, USA)

  Subject: Autonomous Driving (postdoc in the scope of Inria@SV, common publications and patent, visits).

- NUS Singapore & NTU Singapore.

  Subject: Autonomous Driving (visits, common ICT Asia projects, common organization of workshops, review of PhD students).

- Massachussetts Institute of Technology (MIT), Cambridge, MA (USA)

  Subject: Decentralized Control of Markov Decision Processes.

  Subject: Autonomous Driving (visits and common organization of a workshop).

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Visit of 3 researchers (Maria-Iuliana Bocicor, Vlad-Sebastian Ionescu, Ioan-Gabriel Mircea) from University Babes-Bolyai, Cluj-Napoca (Romania). In the context of our PHC project "DRONEM" (2017-18) we worked with them, in Lyon (CITI lab), on Sept. 11-14 2018.

- Jorge Villagra, Senior Scientist at the Center for Automation and Robotics (CSIC-UPM) in Madrid, visited us and given a seminar in novembre 2018. He also co-organized with C.Laugier an Autonomous Vehicle Demonstration event at IEEE IROS 2018 in Madrid (October 2018).

9.5.2. Visits to International Teams

- O. Simonin and J. Dibangoye visited the team of Prof. G. Czibula, at University Babes-Bolyai, Cluj-Napoca (Romania), on April 16-19. The visit was organized in the context of the PHC project "DRONEM" (2017-18). O. Simonin given a talk on the Chroma researches.

CONVECS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ARC6 Programme
Participants: Lina Marsso, Radu Mateescu [correspondent], Wendelin Serwe.

ARC6 is an academic research community funded by the Auvergne Rhône-Alpes region, whose objective is to foster the scientific collaborations between different academic institutions of the region working in the domain of information and communication technologies. ARC6 organizes various scientific animations (conferences, working groups, summer schools, etc.) and issues a yearly call for PhD and post-doctorate research project proposals.

Lina Marsso is supported by an ARC6 grant (from October 2016 to October 2019) on formal methods for testing networks of programmable logic controllers, under the supervision of Radu Mateescu and Wendelin Serwe (CONVECS), Ioannis Parissis and Christophe Deleuze (LCIS, Valence).

8.2. National Initiatives

8.2.1. PIA (Programme d'Investissements d'Avenir)

8.2.1.1. CAPHCA
Participants: Frédéric Lang, Radu Mateescu [correspondent], Wendelin Serwe.

CAPHCA (*Critical Applications on Predictable High-Performance Computing Architectures*) is a project funded by the PIA. The project, led by IRT Saint-Exupéry (Toulouse), involves a dozen of industrial partners (among which Airbus, CS Systèmes d'Information, Synopsis, and Thalès Avionics), the University Paul Sabatier (Toulouse), and Inria Grenoble – Rhône-Alpes (CONVECS and SPADES project-teams). CAPHCA addresses the dual problem of achieving performance and determinism when using new, high performance, multicore System-on-Chip (SoC) platforms for the deployment of real-time, safety-critical applications. The methodology adopted by CAPHCA consists in building a pragmatic combination of methods, tools, design constraints and patterns deployable at a short-term horizon in the industrial domains targeted in the project.

CAPHCA started in December 2017 for four years. The main contributions of CONVECS to CAPHCA are the detection of concurrency errors in parallel applications by means of formal methods and verification techniques.

8.2.2. Competitivity Clusters

8.2.2.1. SECURIOT-2
Participants: Lian Apostol, Hubert Garavel [correspondent], Radu Mateescu, Wendelin Serwe.

SECURIOT-2 is a project funded by the FUI (*Fonds Unique Interministériel*) within the *Pôle de Compétitivité* Minalogic. The project, led by Tiempo Secure (Grenoble), involves the SMEs (*Small and Medium Enterprises*) Alpwise, Archos, Sensing Labs, and Trusted Objects, the Institut Fourier and the VERIMAG laboratories of Université Grenoble Alpes, and CONVECS. SECURIOT-2 aims at developing a secure micro-controller unit (SMCU) that will bring to the IoT a high level of security, based on the techniques used for smart cards or electronic passports. The SMCU will also include an original power management scheme adequate with the low power consumption constraints of the IoT.

SECURIOT-2 started in September 2017 for three years. The main contributions of CONVECS to SECURIOT-2 are the formal modeling and verification of the asynchronous hardware implementing the secure elements developed by the project partners.

8.2.3. Other National Collaborations

We had sustained scientific relations with the following researchers:

- Xavier Etchevers (Orange Labs, Meylan),
- Fabrice Kordon and Lom Messan Hillah (LIP6, Paris),
- Eric Jenn and Viet Anh Nguyen (IRT Saint-Exupéry, Toulouse),
- Ioannis Parissis and Oum-El-Kheir Aktouf (LCIS, Valence),
- Pascal Poizat (LIP6, Paris).

8.3. European Initiatives

8.3.1. Collaborations in European Programs, Except FP7 & H2020

Program: PHC Amadeus

Project acronym: RIDINGS

Project title: Rigourous Development of GALS Systems

Duration: January 2017 – December 2018

Coordinator: Inria Grenoble – Rhône-Alpes / CONVECS

Other partners: TU Graz, Institute of Software Technology (Austria)

Abstract: GALS systems, composed of synchronous components (driven by local clocks) that communicate through a network, are increasingly spreading with the development of the IoT. GALS systems are intrinsically complex due to the interplay of synchronous and asynchronous aspects, which make their development and debugging difficult. Therefore, it is necessary to adopt rigorous design methodologies, based on formal methods assisted by efficient validation tools. The RIDINGS project aims at enhancing the design flow of a GALS system by integrating the automatic generation of conformance tests from the formal model and the temporal properties used for verifying the system. This yields a double benefit for the designer: (i) it makes possible to check that a physical implementation conforms to the verified model; (ii) the development cost of the model and properties is distributed on the verification and testing phases of the design process, therefore increasing the return on investment.

8.3.2. Collaborations with Major European Organizations

The CONVECS project-team is member of the FMICS (*Formal Methods for Industrial Critical Systems*) working group of ERCIM [0]. H. Garavel and R. Mateescu are members of the FMICS board, H. Garavel being in charge of dissemination actions.

8.4. International Initiatives

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

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

Saarland University (Germany): we collaborate on a regular basis with the DEPEND (*Dependable Systems and Software*) research group headed by Holger Hermanns, who received an ERC Advanced Grant ("POWVER") in 2016.

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[0] http://fmics.inria.fr

8.4.2. Other International Collaborations

In 2018, we had scientific relations with several universities and institutes abroad, including:

- University of Málaga, Spain (Francisco Durán),
- University of Cali, Colombia (Camilo Rocha),
- University of Zaragoza, Spain (José Ignacio Requeno),
- ISTI/CNR, Pisa, Italy (Franco Mazzanti),
- RWTH Aachen, Germany (Joost-Pieter Katoen),
- Saarland University, Germany (Holger Hermanns),
- Eindhoven University of Technology, The Netherlands (Anton Wijs and Sander de Putter).

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- H. Garavel is an invited professor at Saarland University (Germany) as a holder of the Gay-Lussac Humboldt Prize.
- Josip Bozic, Birgit Hofer, Hermann Felbinger, and Franz Wotawa (TU Graz, Austria) visited us from March 5 to March 9, 2018 in the framework of the RIDINGS PHC project (see § 8.3.1).
- G. Salaün visited the University of Málaga (Spain) from May 30 to June 13 and from December 16 to December 22, 2018.
- L. Marsso and R. Mateescu visited TU Graz (Austria) from August 20 to August 24, 2018 in the framework of the PHC RIDINGS project.

The annual CONVECS seminar was held in Dullin (France) on July 10–12, 2018. The following invited scientists attended the seminar:

- Eric Jenn (IRT Saint-Exupéry / Thales Avionics) gave on July 10, 2018 a talk entitled "*The CAPHCA Project, or How to Be Fast and Reasonable*".
- Viet Anh Nguyen (IRT Saint-Exupéry) gave on July 12, 2018 a talk entitled "*Cache-conscious Off-line Real-time Scheduling for Multi-core Platforms: Algorithms and Implementation*".
- Yliès Falcone (CORSE project-team) gave on July 11, 2018 a talk entitled "*Some Recent Work on the Runtime Monitoring of Systems*".

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. HEAVEN Persyval Project

- Title: HEterogenous Architectures: Versatile Exploitation and programiNg
- HEAVEN leaders: François Broquedis, Olivier Muller [TIMA lab]
- CORSE participants: François Broquedis, Frédéric Desprez, Georgios Christodoulis, Manuel Selva
- Computer architectures are getting more and more complex, exposing massive parallelism, hierarchically-organized memories and heterogeneous processing units. Such architectures are extremely difficult to program as they most of the time make application programmers choose between portability and performance.

  While standard programming environments like OpenMP are currently evolving to support the execution of applications on different kinds of processing units, such approaches suffer from two main issues. First, to exploit heterogeneous processing units from the application level, programmers need to explicitly deal with hardware-specific low-level mechanisms, such as the memory transfers between the host memory and private memories of a co-processor for example. Second, as the evolution of programming environments towards heterogeneous programming mainly focuses on CPU/GPU platforms, some hardware accelerators are still difficult to exploit from a general-purpose parallel application.

  FPGA is one of them. Unlike CPUs and GPUs, this hardware accelerator can be configured to fit the application needs. It contains arrays of programmable logic blocks that can be wired together to build a circuit specialized for the targeted application. For example, FPGAs can be configured to accelerate portions of code that are known to perform badly on CPUs or GPUs. The energy efficiency of FPGAs is also one of the main assets of this kind of accelerators compared to GPUs, which encourages the scientific community to consider FPGAs as one of the building blocks of large scale low-power heterogeneous multicore platforms.

  However, only a fraction of the community considers programming FPGAs for now, as configurations must be designed using low-level description languages such as VHDL that application programmers are not experienced with.

  The main objective of this project is to improve the accessibility of heterogeneous architectures containing FPGA accelerators to parallel application programmers. The proposed project focuses on three main aspects:
  - Portability: we don't want application programmers to redesign their applications completely to benefit from FPGA devices. This means extending standard parallel programming environments like OpenMP to support FPGA. Improving application portability also means leveraging most of the hardware-specific low-level mechanisms at the run-time system level;
  - Performance: we want our solution to be flexible enough to get the most out of any heterogeneous platforms containing FPGA devices depending on specific performance needs, like computation throughput or energy consumption for example;
  - Experiments: Experimenting with FPGA accelerators on real-life scientific applications is also a key element of our project proposal. In particular, the solutions developed in this project will allow comparisons between architectures on real-life applications from different domains like signal processing and computational finance.

Efficient programming and exploitation of heterogeneous architectures implies the development of methods and tools for system design, embedded or not. The HEAVEN project proposal fits in the PCS research action of the PERSYVAL-lab. The PhD of Georgios Christodoulis and the PostDoc of Manuel Selva are funded by this project.

9.2. National Initiatives

9.2.1. PIA ELCI

- Title: Software environment for computation-intensive applications
- Coordinator: Corinne Marchand (BULL SAS)
- CORSE participants: François Broquedis, Philippe Virouleau
- INRIA Partners: Avalon, Cardamon, Myriads; Realopt, Roma, Storm, Tadaam
- Other Partners: Algo'Tech, CEA, Cenaero, CERFACS, CORIA, Kitware, Onera, SAFRAN
- Duration: from Sept. 2014 to March 2018
- Abstract: The ELCI project main goal is to develop a highly-scalable new software stack to tackle high-end supercomputers, from numerical solvers to programming environments and run-time systems. In particular, the CORSE team is studying the scalability of OpenMP run-time systems on large scale shared memory machines through the PhD of Philippe Virouleau, co-advised by researchers from the CORSE and AVALON Inria teams. This work intends to propose new approaches based on a compiler/run-time cooperation to improve the execution of scientific task-based programs on NUMA platforms. The PhD of Philippe Virouleau is funded by this project.

9.2.2. IPL ZEP

- Title: Zero-Power computing systems
- Coordinator: Kevin Marquet (INRIA Socrate)
- CORSE participants: Fabrice Rastello
- Other INRIA Partners: Cairn, Pacap
- Duration: from Apr. 2017 to Sept. 2019
- Abstract: The ZEP project addresses the issue of designing tiny computing objects with no battery by combining non-volatile memory (NVRAM), energy harvesting, micro-architecture innovations, compiler optimizations, and static analysis. The main application target is Internet of Things (IoT) where small communicating objects will be composed of this computing part associated to a low-power wake-up radio system. The ZEP project gathers four Inria teams that have a scientific background in architecture, compilation, operating system and low power together with the CEA Lialp and Lisan laboratories of CEA LETI & LIST. The major outcomes of the project will be a prototype harvesting board including NVRAM and the design of a new microprocessor associated with its optimizing compiler and operating system.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. EoCoE

Title: Energy oriented Centre of Excellence for computer applications

Programm: H2020

Duration: October 2015 - October 2018

Coordinator: CEA

Partners:

Barcelona Supercomputing Center - Centro Nacional de Supercomputacion (Spain)

Commissariat A L Energie Atomique et Aux Energies Alternatives (France)

Centre Europeen de Recherche et de Formation Avancee en Calcul Scientifique (France)

Consiglio Nazionale Delle Ricerche (Italy)

The Cyprus Institute (Cyprus)

Agenzia Nazionale Per le Nuove Tecnologie, l'energia E Lo Sviluppo Economico Sostenibile (Italy)

Fraunhofer Gesellschaft Zur Forderung Der Angewandten Forschung Ev (Germany)

Instytut Chemii Bioorganicznej Polskiej Akademii Nauk (Poland)

Forschungszentrum Julich (Germany)

Max Planck Gesellschaft Zur Foerderung Der Wissenschaften E.V. (Germany)

University of Bath (United Kingdom)

Universite Libre de Bruxelles (Belgium)

Universita Degli Studi di Trento (Italy)

INRIA contact: Michel Kern

CORSE contact: Jean Francois Méhaut

CORSE participants: Jean Francois Méhaut, Frédéric Desprez and Francieli Zanon Boito

The aim of the present proposal is to establish an Energy Oriented Centre of Excellence for computing applications, (EoCoE). EoCoE (pronounce "Echo") will use the prodigious potential offered by the ever-growing computing infrastructure to foster and accelerate the European transition to a reliable and low carbon energy supply. To achieve this goal, we believe that the present revolution in hardware technology calls for a similar paradigm change in the way application codes are designed. EoCoE will assist the energy transition via targeted support to four renewable energy pillars: Meteo, Materials, Water and Fusion, each with a heavy reliance on numerical modeling. These four pillars will be anchored within a strong transverse multidisciplinary basis providing high-end expertise in applied mathematics and HPC. EoCoE is structured around a central Franco-German hub coordinating a pan-European network, gathering a total of 8 countries and 23 teams. Its partners are strongly engaged in both the HPC and energy fields; a prerequisite for the long-term sustainability of EoCoE and also ensuring that it is deeply integrated in the overall European strategy for HPC. The primary goal of EoCoE is to create a new, long lasting and sustainable community around computational energy science. At the same time, EoCoE is committed to deliver high-impact results within the first three years. It will resolve current bottlenecks in application codes, leading to new modeling capabilities and scientific advances among the four user communities; it will develop cutting-edge mathematical and numerical methods, and tools to foster the usage of Exascale computing. Dedicated services for laboratories and industries will be established to leverage this expertise and to foster an ecosystem around HPC for energy. EoCoE will give birth to new collaborations and working methods and will encourage widely spread best practices.

Francieli Zanon Boito started in November 2017 as post-doc for the EoCoe project. She is working with Frédéric Desprez, Thierry Deutsch (CEA INAC) and Jean Francois Méhaut. Francieli is investigating the data storage issues for the scientific workflows on the nano-scale characterization center (PFNC@Minatec http://inac.cea.fr/en/Phocea/Vie_des_labos/Ast/ast_technique.php?id_ast=217).

9.3.1.2. PRACE-5IP

Title: PRACE-5IP (PRACE Fifht Implementation Phase)

Program H2020

Duration: 01/01/2013 - 30/04/2019

Inria partners: Hiepacs team (Inria Bordeaux Sud-Ouest), Storm team (Inria Bordeaux Sud-Ouest), Nachos team (Inria Sophia Antipolis Méditerranée), CORSE team (Inria Grenoble Rhône Alpes)
INRIA contact: Stéphane Lanteri (Nachos, Sophia Antipolis)
CORSE contact: Jean Francois Méhaut
CORSE participants: François Broquedis, Jean Francois Méhaut

The objectives of PRACE-5IP 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 transition to PRACE2 including analysis of TransNational Access;
- strengthening the internationally recognized PRACE brand;
- continuing and extend advanced training which so far provided more than 18800 person-training days;
- preparing strategies and best practices towards Exascale computing;
- coordinating and enhancing the operation of the multi-tier HPC systems and services;
- supporting users to exploit massively parallel systems and novel architectures.

The INRIA contribution is in the prolongation of involvement (jointly with CINES) in PRACE 4IP – WP7. The participation of Inria's researchers has been enlarged to include project-teams that were all involved in the C2S@Exa Inria Project Lab. The Inria teams will contribute to the WP7 and the following sub-tasks:

- Task 7.1: Applications Enabling Services for PRACE systems
- Task 7.4 Provision of Numerical Libraries for Heterogeneous/Hybrid Architectures

The activities are organized along two complementary lines

- Generic (or transverse) technologies for simulation software
- Specific (or vertical) technologies i.e. simulation software

The CORSE activities for PRACE-5IP will start with the hiring of one year postdoc in 2018. We will work on the DIOGENEs (DisOntinous GalErkin Nanoscale Solvers) software suite developed in the Nachos team. The post-doc will investigate the new vectorization features of processors.

9.3.2. Collaborations in European Programs, Except FP7 & H2020

Program: COST
Project acronym: ArVI
Project title: Run-Time Verification beyond Monitoring
Duration: December 2014 - Dec 2018
Coordinator: Martin Leucker, University of Lubeck
Abstract: Run-Time verification (RV) is a computing analysis paradigm based on observing a system at run-time to check its expected behavior. RV has emerged in recent years as a practical application of formal verification, and a less ad-hoc approach to conventional testing by building monitors from formal specifications.

There is a great potential applicability of RV beyond software reliability, if one allows monitors to interact back with the observed system, and generalizes to new domains beyond computers programs (like hardware, devices, cloud computing and even human centric systems). Given the European leadership in computer based industries, novel applications of RV to these areas can have an enormous impact in terms of the new class of designs enabled and their reliability and cost effectiveness.

This Action aims to build expertise by putting together active researchers in different aspects of run-time verification, and meeting with experts from potential application disciplines. The main goal is to overcome the fragmentation of RV research by (1) the design of common input formats for tool cooperation and comparison; (2) the evaluation of different tools, building a growing sets benchmarks and running tool competitions; and (3) by designing a road-map and grand challenges extracted from application domains.

9.4. International Initiatives

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

9.4.1.1. IOComplexity

Title: Automatic characterization of data movement complexity

International Partner (Institution - Laboratory - Researcher):

Ohio State University (United States) - Computer Science and Artificial Intelligence Laboratory - P. Sadayappan

Start year: 2018

See also: https://team.inria.fr/corse/iocomplexity/

The goal of this project is to extend techniques for automatic characterisation of data movement of an application to the design of performance estimation.

The EA as three main objectives: 1. broader applicability of IO complexity analysis; 2. Hardware characterisation; 3. Performance model.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Mohamad Jaber visited the Inria Corse team in January 2018.

9.5.2. Visits to International Teams

9.5.2.1. Sabbatical programme

- Fabrice Rastello was on sabbatical at Colorado State University (USA) from July 2017 till July 2018.
- Yliès Falcone visited American University of Beirut (Lebanon) in May 2018 through an Erasmus exchange programme.

9.5.2.2. Research Stays Abroad

- Fabian Gruber visited the Colorado State University to work with Louis-Noël Pouchet from 18.03.2018 to 17.04.2018.
- Fabian Gruber visited the Ohio State University to work with P. Sadayappan , Changwan Hong, and Aravind Sukumaran-Rajam from 18.11.2018 to 01.12.2018.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Grenoble Alpes Cybersecurity Institute Cross-Disciplinary Project of the Idex

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.

In Ctrl-A, it is funding an internship position followed by a PhD position to be provided in September 2019 and supervised by Stephane Mocanu.

8.2. National Initiatives

8.2.1. ANR HPeC

HPeC is an ANR project on Self-Adaptive, Energy Efficient High Performance Embedded Computing, with a UAV case study (http://hpec.fr/). The Coordinator is Lab-STICC / MOCS (Lorient / Brest), and the duration: 42 month from october 2015. Others Partners are: UBO, U. Clermont-Ferrand, InPixal.

In Ctrl-A, it is funding a post-doc position, hired in Grenoble and co-advised with Lorient : Soguy Gueye. The work will be continued with a post-doc hired in Lorient : Erwan Moreac. A PhD based in Brest, Chabha Hireche, is co-advised by Stéphane Mocanu.

8.2.2. ANR Sacade

The ANR ASTRID Sacade project is funded by DGA. Stéphane Mocanu is in charge of several workpackages including a demonstrator. An expert engineer position is funded for the implementation of attack/defense scenarios in SCADA.

8.2.3. Informal National Partners

We have contacts with colleagues in France, in addition to the cooperation mentioned before, and with whom we are submitting collaboration projects, co-organizing events and workshops, etc. They feature : Avalon Inria team in Lyon (Ch. Perez, L. Lefevre, E. Caron), LIP6 (J. Malenfant), Scales Inria team in Sophia-Antipolis (L. Henrio), LIRRM in Montpellier (A. Gamatié, K. Godary, D. Simon), IRISA/Inria Rennes (J. Buisson, J.L. Pazat, ...), Telecom Paris-Tech (A. Diaconescu, E. Najm), LAAS (Thierry Monteil), LURPA ENS Cachan (J.M. Faure, J.J. Lesage).

8.2.4. Informal National Industrial Partners

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

8.3. International Initiatives

8.3.1. Inria International Labs

We participate in the jLESC, Joint Laboratory for Extreme Scale Computing, with partners Inria, the University of Illinois, Argonne National Laboratory, Barcelona Supercomputing Center, Jülich Supercomputing Centre and RIKEN AICS.

We participated to the 7th Workshop of the JLESC at Urbana-Champain in July 2017.

We started a cooperation with Argonne National Labs, on Improving the performance and energy efficiency of HPC applications using autonomic computing techniques.

https://jlesc.github.io/projects/energy_autonomic/

We are also exploring possibilities on the topic of integrating FPGAs in HPC grids, with a participation in a workshop at FPT 18.

https://collab.cels.anl.gov/display/HPCFPGA/HPC-FPGA

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

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

DANTE Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Idex Lyon ACADEMICS
Participants: Paulo Gonçalves, Dominique Barbe, Gaetan Frusque.

See Section 5.1.1 for an executive summary of this project. The project brings together a **consortium of 4 teams from Laboratories of Université de Lyon** (UdL) and will form a working group with complementary expertise in machine learning (deep learning, statistical learning, data mining), in data science (complex data analysis, adaptive and/or data-driven methods, network science) and in the studies of climate modeling and of computational social science. It comprises:

- Laboratoire Informatique du Parallélisme (LIP): P. Gonçalves (PI), M. Karsai (PI for Comp. Social Sc.)
- Laboratoire de Physique (LP): P. Borgnat (Coordinator), F. Bouchet (PI for Climate)
- Laboratoire Hubert Curien (LabHC), Université Jean Monnet: M. Sebban (PI)
- Laboratoire d'InfoRmatique en Images et Systèmes d'information (LIRIS): C. Robardet (PI)

The **impacts** of the project will stem from the efficiency of our proposed methods to learn from complex and dynamic data, and if so, **future applications** will naturally follow in many areas: social science and study of social interactions, climate and environmental science but also in technological networks, neuroscience with the study of brain networks and more generally in any domain where effective dynamical models of complex situations are to be learned from data. All these situations go beyond the current classical applicative frameworks of ML (time measurements, 2D images, or texts) and compel us to work out a major scientific breakthrough.

9.1.2. ISI Torino / Dante
Participant: Márton Karsai [correspondant].

Duration of the project: **October 2016 - October 2020**.

This project involves M. Karsai and L. Gauvin (ISI Torino) and funded by the IXXI Complex System Institute. The purpose of this project is to investigate the presence and the importance of higher-order correlations in dynamical networks. As the first attempt to address this problem we applied autoencoder, a recent representation using deep neural networks, on modelled and small-scale real temporal networks. However, since the results were trivial on the modelled network and not convincing on the real one we decided to take a different approach during the second phase of the project. We involved an ISI PhD student Maddalena Toricelli, to work out a method for temporal network embedding. Our idea is to extend the node2vec representation of static networks for time-varying structures, by using a local random walk to explore the structural-temporal neighbourhood of a node. Based on such local information we can effectively propose an embedding, which captures the temporal and structural properties of nodes in a temporal network.

9.2. National Initiatives

9.2.1. Equipex FIT (Futur Internet of Things)
Participant: Éric Fleury [correspondant].

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

9.2.2. ANR GRAPHSIP (Graph Signal Processing)

Participants: Paulo Gonçalves [correspondant], Éric Fleury, Thomas Begin, Mikhail Tsitsvero.

Duration of the project: **October 2014 - October 2018**.

An increasing number of application areas require the processing of massive datasets. These data can often be represented by graphs in order to encode complex interactions. When data vectors are associated with graph vertices, a so-called graph signal is obtained. The processing of such graph signals includes several open challenges because of the nature of the involved information. Indeed graph theory and signal and image processing methodologies do not combine readily. In particular, such a combination requires new developments, allowing classical signal processing methods to work on irregular grids and non Euclidean spaces. Considering the significant success of classical signal processing tools, it appears essential to generalise their use to graph signals. The GRAPHSIP project aims at developing a set of advanced methods and algorithms for the processing of graph signals: multi-scale transforms and solutions of variational problems on graphs. The major outcomes of this project are expected to lead to significant breakthroughs for graph data processing. The project will also focus on two novel applications on instances of graph signals: brain networks and 3D colour point clouds. They will exemplify and illustrate the proposed methodological advances on emerging applications.

9.2.3. ANR SoSweet

Participants: Jean Pierre Chevrot, Éric Fleury, Márton Karsai [correspondant], Jean-Philippe Magué [PI].

Duration of the project: **November 2015 - November 2019**.

The SoSweet project focuses on the synchronic variation and the diachronic evolution of the variety of French used on Twitter. The recent rise of novel digital services opens up new areas of expression which support new linguistic behaviours. In particular, social medias such as Twitter provide channels of communication through which speakers/writers use their language in ways that differ from standard written and oral forms. The result is the emergence of new varieties of languages. The main goal of SoSweet is to provide a detailed account of the links between linguistic variation and social structure in Twitter, both synchronically and diachronically. Through this specific example, and aware of its bias, we aim at providing a more detailed understanding of the dynamic links between individuals, social structure and language variation and change.

9.2.4. ANR DylNet

Participants: Márton Karsai [correspondant], Jean Pierre Chevrot, Jean-Philippe Magué, Éric Fleury.

Duration of the project: **September 2016 - September 2020**.

The DylNet project aims to observe and to characterise the relationships between childhood sociability and oral-language learning at kindergarten. With a view to this, it takes an multidisciplinary approach combining work on language acquisition, sociolinguistics, and network science. It will be implemented by following all the children (≈ 220) and teaching staff in one kindergarten over a 3-year period. The use of wireless proximity sensors will enable collection of social contacts throughout the study. The data on sociability will be linked to the results of language tests and recordings of verbal interactions used to follow the children's progress on both a psycholinguistic level (lexicon, syntax, pragmatics) and a sociolinguistic level (features showing belonging to a social group). The aim is to better understand the mechanisms of adaptation and integration at work when young children first come into contact with the school context.

9.2.5. Inria PRE LIAISON

Participants: Márton Karsai [correspondant], Éric Fleury.

Duration of the project: **November 2017 - December 2019**.

This project implements unsupervised deep learning approaches to infer correlations/patterns that exist between dynamic linguistic variables, the mesoscopic and dynamic structure of the social network, and their socio-economic attributes. This interdisciplinary project is positioned at the crossroads of Natural Language Processing (NLP), Network Science, Data Science and Machine Learning.

More precisely, we develop a joint feature-network embedding, named AN2VEC (Attributed Network to Vector), which ultimately aims at disentangling the information shared by the structure of a network and the features of its nodes. Building on the recent developments of Graph Convolutional Networks (GCN), we use a multitask GCN Variational Autoencoder where different dimensions of the generated embeddings can be dedicated to encoding feature information, network structure, or shared feature-network information separately. This method thus defines a range of models whose performance in embedding a given data set varies depending with the allocation of dimensions. By exploring the behaviour of these models on synthetic data sets having different levels of feature-network correlation, we show (i) that embeddings relying on shared information perform better than the corresponding reference with unshared information, and (ii) that this performance gap increases with the correlation between network and feature structure, thus confirming that our embedding is able to capture joint information of structure and features.

9.2.6. *Inria & HCERES*

Participants: Éric Guichard [correspondant], Éric Fleury.

Bilateral project on the evolution of the Multi/inter-disciplinary of SHS.

An increasing number of researchers in SHS has the desire to develop new researches with computer scientists or mathematicians because they want to apply new methodologies (according to various or numerous data) or to develop older ones, which can now be easily implemented online. Some also develop a reflexion on their discipline, with the idea that epistemological questions are revitalized by the internet. This reality invite them to discuss with philosophers or with other SHS scientists who have the same intuition (eg: cartography, visualisation).

The project is hence to measure these new forms or inter-multi-disciplinarity. The main source will be the publications of all academics of French SHS laboratories, to find out who writes a paper with somebody of a different discipline and/or laboratories. All data are anonymized,

9.2.7. *Inria IPL BetterNet*

Participant: Éric Guichard.

An Observatory to Measure and Improve Internet Service Access from User Experience [0].

BetterNet aims at building and delivering a scientific and technical collaborative observatory to measure and improve the Internet service access as perceived by users. In this Inria Project Lab, we will propose new original user-centered measurement methods, which will associate social sciences to better understand Internet usage and the quality of services and networks with a particular focus on geography and cartography.

9.3. European Initiatives

9.3.1. *FP7 & H2020 Projects*

9.3.1.1. EMBERS

- Title: Enabling a Mobility Back-End as a Robust Service
- Programm: H2020
- Duration: December 2015 - November 2018
- Coordinator: UPMC

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[0]https://www.inria.fr/en/research/research-teams/inria-project-labs

- Partners:
    - Fraunhofer Gesellschaft Zur Forderung Der Angewandten Forschung Ev (Germany)
    - Technische Universitat Berlin (Germany)
    - Universite Pierre et Marie Curie - Paris 6 (France)
    - Ubiwhere Lda (Portugal)
- Inria contact: Eric Fleury
- EMBERS will bring to market a back-end for smart city mobility that is developed by a European small enterprise based upon its smart parking and smart traffic management products that two municipalities in Portugal currently deploy. The Mobility Back-end as a Service (MBaaS) replaces such all-in-one systems, in which a municipality purchases the full set of components from a single vendor. Instead, the city manager can purchase best-of-breed devices and apps developed by third parties, with the only constraint being that they interoperate with the back-end via a free, open, smart city mobility API. This domain-specific API lowers barriers to entry for app and device developers, making it easier for innovative SMEs to enter the market. Furthermore, the API is offered via a variety of generic interfaces, including oneM2M, ETSI M2M, OMA LWM2M, and FIWARE NGSI. EMBERS thus clears the way for developers and to municipalities that have adopted any one of these potential emerging machine-to-machine (M2M) communication standards. Beyond its primary goal of bringing the MBaaS to market, EMBERS will stimulate development of an entire ecosystem around the MBaaS smart city mobility API. Separating out the back-end from the other components will, however, require rigorous testing. EMBERS will experiment with the system on two testbeds that are part of the FIRE OneLab facility: the FUSECO Playground, for M2M communications, and FIT IoT-LAB, for wireless sensor devices. EMBERS will host a hackathon and an app challenge to bring in third party developers. The project will also include three demonstrators by third parties via an open call. These activities will contribute back to FIRE by demonstrating successful experimentation by SMEs developing close-to-market products. The project will also conduct real world pilots in two or more cities as a final step in bringing the MBaaS to market.

9.3.1.2. ARMOUR

Title: Large-Scale Experiments of IoT Security & Trust (Project nÂ°688237)

Programm: H2020

Duration: 2015 Dec to 2018

Coordinator: UPMC

Partners:

- Synelixis Lyseis Pliroforikis Automatismou & Tilepikoinonion Monoprosopi EPE (Greece)
- Smartesting Solutions & Services (France)
- Unparallel Innovation, Lda (Portugal)
- Easy Global Market (France)
- ODIN Solutions (Spain)
- Universite Pierre et Marie Curie - Paris 6 (France)

Inria contact: Eric Fleury

ARMOUR will provide duly tested, benchmarked and certified Security & Trust solutions for large-scale IoT using upgraded FIRE large-scale IoT/Cloud testbeds properly-equipped for Security & Trust experimentations. ARMOUR takes the top large-scale FIT IoT-LAB testbed a FIRE OpenLAB / FIT IoT LAB facility â and enhances it as to enable experimentally-driven research on a key research dimension: large-scale IoT Security & Trust. Presently, no proper installations exist to experiment IoT Security & Trust on large-scale conditions; ARMOUR will develop and install such capability.

9.4. International Initiatives

9.4.1. Participation in International Programs

9.4.1.1. PHC Peridot

Participants: Mohammed Amer, Thomas Begin, Anthony Busson, Isabelle Guérin Lassous.

Framework for Control and Monitoring of Wireless Mesh Networks (WMN) using Software-Defined Networking (SDN). The main objective of this project is propose mechanisms and modifications in the SDN architecture, specifically in the OpenFlow, which allow SDN mechanisms to operate over WMN considering the dynamic network topology that WMN may experience and some other relevant characteristics. The project will involve devising mechanisms for controlling mesh switches through controllers in a wireless environment, which will require developing novel and WMN-specific rules, actions and commands. The project will involve proposing mechanism that consider dynamic environment of WMN along with providing redundancy in the network. Besides, there is a requirement to have an adaptive measurement API for WMN. This is the second objective of our research project. The proposed measurement API will enable the network operators to monitor network traffic over WMN which may be content-specific or host-specific. This is a joint project between DANTE and M. A. Jinnah University, Islamabad. It started in June 2015 and will end in June 2018.

9.4.2. International Initiatives

9.4.2.1. MOTif - Mobile phone sensing of human dynamics in techno-social environment

- Program: Stic AmSud
- Duration: January 2018 - December 2019
- Coordinator: Inria DANTE (Márton Karsai)
- Partners:
    - Universidad de Buenos Aires (Argentina)
    - Grandata (USA-Argentina)
    - Universidade Federal de Minas Gerais (Brazil)
    - LNCC (Brazil)

This project brings together two Inria teams - INFINE (Saclay) - DANTE (Lyon) and multiple Latin-American partners to work together with the IT company Grandata.

Scope of the project: Information and Communication Technology (ICT) is becoming increasingly social, as demonstrated by the multitude of emerging technologies and technology platforms that facilitate social interactions, taking place as communication via telephone, text message, email, online social networks etc. At the same time, our social activities are increasingly embedded in the ICT environments that enable and enhance our ability to transact, share experiences, and maintain social relationships. One of the best ways to explore these developments is through the mining and analysis of data, which are collected through mobile phones and allow us to investigate how individuals act when embedded in a technology-enabled environment. Unlimited access to a wide range of mobile applications and services may change our way to gain information, to communicate, or even to behave in different contextual places like home, work, or anywhere else. Thus understanding individual activity patterns and the source of decisions behind them is moreover important for the design of future services and to estimate the demand on the infrastructure. The MOTIf project builds on the analysis and modeling of geo-localized temporally detailed but fully anonymised mobile phone call networks. These datasets allow us to address the two scientific objectives about spatiotemporal patterns of service usage of anonymised individuals to learn when, where, and what people are doing; and about the fine-grained sociodemographic structure of society and its effect on the the individual social behaviour. In other words our goal in general is to understand how individuals behave in a dynamic techno-social environment.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Don Towsley, University of Massachusetts, Amherst, USA (march 15 - june 15, 2018).
- Alexandre Brandwajn, University of California Santa Cruz, USA (march 2018)

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

- Philippe Nain visited the University of Massachusetts at Amherst (Sep. 1, 2018 - Jan. 31, 2019). He taught a graduate course on Performance Evaluation of Computer and Communication Systems and collaborated with Prof. D. Towsley and some of his students/collaborators on several research projects.
- Christophe Crespelle is on leave with a Marie Sklodowska-Curie Grant from EU. He is currently at the University of Bergen (Norway) until the beginning of 2020.
- Christophe Crespelle visited the Institute of Mathematics of the Vietnam Academy of Science and Technology, Hanoi, Vietnam (Nov. 6 - Dec. 6, 2018).

DATAMOVE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- **ANR grant GRECO (2017-2020).** Resource manager for cloud of things. Coordinator: Quarnot Computing. Partners: Quarnot Computing, Grenoble-INP, Inria.
- **ANR grant Energumen (2018-2022).** Resource management: malleable jobs for a better use of the resources along with energy optimization. Coordinator: Denis Trystram. Partners: Grenoble-INP, IRIT, Sorbonne Université.

8.1.2. Competitivity Clusters

- **PIA Avido (2015-2018)**. In situ analysis and visualization for large scale numerical simulation. Coordinator: EDF SA. Partners: EDF R&D, Total SA, Kitware SAS , Université Pierre et Marie CURIE, Inria (DataMove).
- **FUI OverMind (2015-2018)**. Task planification and asset management for the cartoon productions. Coordinator: Teamto Studio. Partners: Teamto Studio, Folimage Studio, Ecole de Gobelins, Inria (DataMove).
- **FUI IDIOM (2018-2020)**. Monitoring and optimization of I/Os. Coordinator DDN Storage. Partners: DDN Storage, Criteo, Quarnot, QuasarDB, CEA, Université de Bretagne Occidentale, Telecom SudParis, Inria (DataMove).

8.1.3. Inria

- Inria PRE COSMIC (exploratory research project), 2017-2019. Photovoltaic Energy Management for Distributed Cloud Platforms. Myriads, DataMove.
- Inria IPL HPC-BigData, 2018-2021). Convergence between HPC, Big Data and AI. Coordinator: Bruno Raffin. Partners: the Inria teams Zenith, Kerdata, Datamove, Tadaam, SequeL, Parietal, Tau, and the external partners ATOS, ANL, IBPC, ESI-Group. See https://project.inria.fr/hpcbigdata/

8.2. European Initiatives

8.2.1. Collaborations in European Programs, Except FP7 & H2020

Program: SKŁODOWSKA-CURIE ACTIONS - Individual Fellowship

Project acronym: DAMA

Project title: Extreme-Scale Data Management

Duration: November 2018 - October 2020

Coordinator: Bruno Raffin

Followship Recipient: Francieli Zanon Boito.

Abstract: This project is concerned with the I/O challenges that arise from the convergence between these two different paradigms. It is clear data analytics tools cannot simply replace their typical storage solutions for the HPC I/O stack, centered on the abstraction of files and powered by a parallel file system, because their workload is not well suited for that and would observe poor performance. Moreover, the separated storage infrastructure breaks the data affinity idea in which they are built upon. Finally, even among traditional HPC applications there is a need to minimize data movement, as it imposes high latency and increases energy consumption.

8.3. International Initiatives

8.3.1. Inria International Labs

8.3.1.1. JLESC

Title: Joint Laboratory for Extreme-Scale-Computing.

International Partners:

University of Illinois at Urbana Champaign (USA)

Argonne National Laboratory (USA),

Barcelona Supercomputing Center (Spain),

Jülich Supercomputing Centre (Germany)

Riken Advanced Institute for Computational Science (Japan)

Start year: 2009

See also: https://jlesc.github.io/

The purpose of the Joint Laboratory for Extreme Scale Computing is to be an international, virtual organization whose goal is to enhance the ability of member organizations and investigators to make the bridge between Petascale and Extreme computing. The JLESC organizes a workshop every 6 months DataMove participates to. DataMove developed several collaborations related to in situ processing with Tom Peterka group (ANL) , the Argo exascale operating system with Swann Perarnau (ANL).

8.3.2. Participation in Other International Programs

8.3.2.1. LICIA

Title: International Laboratory in High Performance and Ubiquitous Computing

International Partner (Institution - Laboratory - Researcher):

UFRGS (Brazil)

Duration: 2011 - 2018

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

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

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Professor visit: Alba Cristina Magalhaes Alves De Melo, Professor at University of Brasilia, visited the Datamove for one month in 2018.

PhD in progress: Danilo Carastan Dos Santos, Dynamic Scheduling of Tasks in High Performance Platforms with Machine Learning (Sao Paulo, Brasil). 1 year "sandwich" visit. Local adviser: Denis Trystram

DATASPHERE Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

The team is hosted by IXXI, the Complex System Institute, at ENS Lyon, and strongly involved in the interdisciplinary cooperation promoted by IXXI. Stéphane Grumbach is vice-director of IXXI. Kavé Salamatian is in the Executive committee of the Data Institute of Grenoble Alps Institute, and of the Cyber@Alps Institute of cybersecurity.

9.2. National Initiatives

- Chaire Castex, Ecole Militaire, Paris.
- AMNECYS (Alpine Multidisciplinary NEtwork on CYber-security Studies), University of Grenoble-Alpes.
- GEODE Research team on Geopolitics.

9.3. International Initiatives

9.3.1. Inria International Partners

9.3.1.1. Informal International Partners

- RIHN, Research Institute on Humanity and Nature, Kyoto.
- Information School, UC Berkeley.
- ICT, Institute of Computing Technologies, Chinese Academy of Sciences, Beijing.
- CSIRO, Sydney.
- Center for CyberSecurity, University Macquarie, Sydney.
- Center for Internet Human Rights (CIHR), Berlin.

9.4. International Research Visitors

9.4.1. Visits to International Teams

9.4.1.1. Research Stays Abroad

Stéphane Grumbach has been visiting scientist at the Research Institute on Humanity and Nature, RIHN, in Kyoto.

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

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. ANR

- ANR SinCity "Single cell transcriptomics on genealogically identified differentiating cells", 2017-2020.
  Participant: Olivier Gandrillon [Coordinator].
- Olivier Gandrillon participates in the ANR MEMOIRE (head Jacqueline Marvel) dedicated to "MultiscalE MOdeling of CD8 T cell Immune REsponses". 2018-2021.
- Fabien Crauste participates in the ANR MEMOIRE (head Jacqueline Marvel) dedicated to "MultiscalE MOdeling of CD8 T cell Immune REsponses". 2018-2021.
- Thomas Lepoutre is a member of the ANR KIBORD (head L. Desvillettes) dedicated to "kinetic and related models in biology". 2014-2018: https://www.ljll.math.upmc.fr/kibord/.

6.1.2. Other projects

- Association France Alzheimer Sciences Médicales: PAMELA "Prion et Alzheimer : Modélisation et Expérimentation d'une Liaison Agressive", 2014-2017 (https://www.youtube.com/watch?v=X0mLf8IJhV4).
  Participants: Mostafa Adimy, Samuel Bernard, Thomas Lepoutre, Laurent Pujo Menjouet [Coordinator], Léon Tine.
- Thomas Lepoutre is a member of the ERC MESOPROBIO (head V. Calvez) dedicated to "Mesoscopic models for propagation in biology". 2015-2020: .

6.2. European Initiatives

6.2.1. FP7 & H2020 Projects

Fabien Crauste and Olivier Gandrillon participates in the EU RTN network COSMIC (head Antpoine. van Kampen) dedicated to "Combatting disorders of adaptive immunity with systems medicine"). 2018-2021. https://cosmic-h2020.eu

6.3. International Initiatives

6.3.1. MODELLING_LEUKEMIA

Title: Modeling quiescence and drug resistance in Chronic Myeloid Leukemia

International Partner (Institution - Laboratory - Researcher):

University of Maryland (United States) - Center for Scientific Computation and Mathematical Modeling (CSCAMM) - Levy Doron

Start year: 2016

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

This project is dedicated to the mathematical modelling of chronic myeloid leukemia and treatment effects. We focus especially on the interplay between the immune response and treatment. This has a potential impact on the study of treatment cessation. This work is conducted in close collaboration with a clinician.

6.3.2. Participation in Other International Programs

6.3.2.1. Indo-French Center of Applied Mathematics

Mathematical modeling of hematopoiesis process in application to chronic and acute myelogenous leukemia

Title: Mathematical modeling of hematopoiesis process in application to chronic and acute myelogenous leukemia

International Partner (Institution - Laboratory - Researcher):

      (India)- Subhas Khajanchi

Duration: 2018 - 2021

Start year: 2018

6.4. International Research Visitors

6.4.1. Visits of International Scientists

Antone dos Santos Benedito, PHD student on Adding temperature and anthropogenic actions in the study of spatial-temporal behavior of insectplague Chrysodeixis Includens. Institute of Biosciences, São Paulo State University (UNESP), Botucatu, Brazil not a team member but visiting for 6 months (from September 1st 2018 to February 28, 2019)

6.4.2. Visits to International Teams

Paul Lemarre is visiting University of Merced in 2018-2019.

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

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. FP7 & H2020 Projects

7.1.1.1. GEM

Title: from GEometry to Motion, inverse modeling of complex mechanical structures

Programm: H2020

Type: ERC

Duration: September 2015 - August 2021

Coordinator: Inria

Inria contact: Florence BERTAILS-DESCOUBES

With the considerable advance of automatic image-based capture in Computer Vision and Computer Graphics these latest years, it becomes now affordable to acquire quickly and precisely the full 3D geometry of many mechanical objects featuring intricate shapes. Yet, while more and more geometrical data get collected and shared among the communities, there is currently very little study about how to infer the underlying mechanical properties of the captured objects merely from their geometrical configurations. The GEM challenge consists in developing a non-invasive method for inferring the mechanical properties of complex objects from a minimal set of geometrical poses, in order to predict their dynamics. In contrast to classical inverse reconstruction methods, my proposal is built upon the claim that 1/ the mere geometrical shape of physical objects reveals a lot about their underlying mechanical properties and 2/ this property can be fully leveraged for a wide range of objects featuring rich geometrical configurations, such as slender structures subject to frictional contact (e.g., folded cloth or twined filaments). To achieve this goal, we shall develop an original inverse modeling strategy based upon a/ the design of reduced and high-order discrete models for slender mechanical structures including rods, plates and shells, b/ a compact and well-posed mathematical formulation of our nonsmooth inverse problems, both in the static and dynamic cases, c/ the design of robust and efficient numerical tools for solving such complex problems, and d/ a thorough experimental validation of our methods relying on the most recent capturing tools. In addition to significant advances in fast image-based measurement of diverse mechanical materials stemming from physics, biology, or manufacturing, this research is expected in the long run to ease considerably the design of physically realistic virtual worlds, as well as to boost the creation of dynamic human doubles.

7.2. International Initiatives

7.2.1. Inria International Partners

7.2.1.1. Declared Inria International Partners

- Long-term partnership with Rahul Narain (University of Minnesota, USA, and IIT Delhi, INDIA) and Rahul Narain's PhD student Jie Li (University of Minnesota, USA).
- Long-term partnership with Alexandre-Derouet-Jourdan (OLM Digital, JAPAN).

ERABLE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Muse

- Title: Multi-Omics and Metabolic models iNtegration to study growth Transition in *Escherichia coli*
- Coordinators: Delphine Ropers (EPI Ibis) and Marie-France Sagot
- ERABLE participants: Marie-France Sagot and Arnaud Mary.
- Type: IXXI Project (2018-2019).
- Web page: none for now.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. Aster

- Title: Algorithms and Software for Third gEneration Rna sequencing
- Coordinator: Hélène Touzet, University of Lille and CNRS.
- ERABLE participants: Vincent Lacroix (ERABLE coordinator), Clara Benoît-Pilven, Audric Cologne, Alex di Genova, Leandro I. S. de Lima, Arnaud Mary, Marie-France Sagot, Camille Sessegolo, Blerina Sinaimeri.
- Type: ANR (2016-2020).
- Web page: http://bioinfo.cristal.univ-lille.fr/aster/.

8.2.1.2. ExHyb

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

8.2.1.3. GraphEn

- Title: Enumération dans les graphes et les hypergraphes : Algorithmes et complexité
- Coordinator: D. Kratsch
- ERABLE participant(s): A. Mary
- Type: ANR (2015-2019)
- Web page: http://graphen.isima.fr/

8.2.1.4. GrR

- Title: Graph Reconfiguration
- Coordinator: N. Bousquet
- ERABLE participant(s): A. Mary
- Type: ANR JCJC (2019-2021)
- Web page: Not available

8.2.1.5. Green

- Title: Deciphering host immune gene regulation and function to target symbiosis disturbance and endosymbiont control in insect pests
- Coordinator: A. Heddi
- ERABLE participant(s): M.-F. Sagot, C. Vieira
- Type: ANR (2018-2021)
- Web page: Not yet available

8.2.1.6. Hmicmac

- Title: Host-microbiota co-adaptations: mechanisms and consequences
- Coordinator: F. Vavre
- ERABLE participant(s): F. Vavre
- Type: ANR PRC (2017-2020)
- Web page: Not available

8.2.1.7. IMetSym

- Title: Immune and Metabolic Control in Intracellular Symbiosis of Insects
- Coordinator: A. Heddi
- ERABLE participant(s): H. Charles, S. Colella
- Type: ANR Blanc (2014-2017)
- Web page: Not available

8.2.1.8. Resist

- Title: Rapid Evolution of Symbiotic Interactions in response to STress: processes and mechanisms
- Coordinator: N. Kremer
- ERABLE participant(s): F. Vavre
- Type: ANR JCJC (2017-2020)
- Web page: Not available

8.2.1.9. Suzukill

- Title: Managing cold tolerance and quality of mass-produced *Drosophila suzukii* flies to facilitate the application of biocontrol through incompatible and sterile insect techniques
- Coordinator: H. Colinet
- ERABLE participant(s): F. Vavre
- Type: ANR PCRI (2015-2018)
- Web page: Not available

8.2.1.10. Swing

- Title: Worldwide invasion of the Spotted WING Drosophila: Genetics, plasticity and evolutionary potential
- Coordinator: P. Gibert
- ERABLE participant(s): C. Vieira
- Type: ANR PCR (2016-2020)
- Web page: Not available

8.2.1.11. U4atac-brain

- Title: Rôle de l'épissage mineur dans le développement cérébral
- Coordinator: Patrick Edery, Centre de Recherche en Neurosciences de Lyon.

- ERABLE participants: Vincent Lacroix (ERABLE coordinator), Clara Benoît-Pilven, Audric Cologne.
- Type: ANR (2018-2021).
- Web page: Not available.

8.2.2. Idex

8.2.2.1. Micro-be-have

- Title: Microbial Impact on insect behaviour: from niche and partner selection to the development of new control methods for pests and disease vectors
- Coordinator: F. Vavre
- ERABLE participant(s): F. Vavre
- Type: AO Scientific Breakthrough (2018-2021)
- Web page: Not available

8.2.3. ADT Inria

8.2.3.1. ADT Inria Kirikomics

- Main objective: Development of a portal to increase the visibility of the tools and resources elaborated by ERABLE around the analysis – using omics data – of metabolic networks modelled by hypergraphs, and enable to visualise the results. (the web page is for now private, it will be made public later in the project).
- Duration: 2016-2017, renewable one more year.
- Person responsible for ADT: Arnaud Mary with David Parsons (Inria).
- Beneficiary of ADT: Martin Wannagat.
- Funds received: Salary for engineer.

8.2.4. Others

Notice that were included here national projects of our members from Italy and the Netherlands when these have no other partners than researchers from the same country.

8.2.4.1. Advanced computational methodologies for the analysis of biomedical data

- Title: Advanced computational methodologies for the analysis of biomedical data
- Coordinator: P. Milazzo
- ERABLE participant(s): R. Grossi, N. Pisanti
- Type: PRA, MIUR PRIN, Italian Ministry of Research National Projects (2017-2018)
- Web page: Not available

8.2.4.2. Advanced Tools and Techniques for the analysis of criminal networks

- Title: Advanced Tools and Techniques for the analysis of criminal networks
- Coordinator: G. Italiano
- ERABLE participant(s): G. Italiano
- Type: LEONARDO SpA (2015-2018)
- Web page: Not available

8.2.4.3. Open Innovation: Digital Innovation for Driving

- Title: Open Innovation: Digital Innovation for Driving
- Coordinator: G. Italiano
- ERABLE participant(s): G. Italiano
- Type: Bridgestone (2018-2019)

- Web page: Not available

8.2.4.4. CMACBioSeq

- Title: Combinatorial Methods for analysis and compression of biological sequences
- Coordinator: G. Rosone
- ERABLE participant(s): N. Pisanti
- Type: SIR, MIUR PRIN, Italian Ministry of Research National Projects (2015-2019)
- Web page: http://pages.di.unipi.it/rosone/CMACBioSeq.html

8.2.4.5. Statistical Models for Structural Genetic Variants in the Genome of the Netherlands

- Title: Statistical Models for Structural Genetic Variants in the Genome of the Netherlands
- Coordinator: A. Schönhuth
- ERABLE participant(s): A. Schönhuth
- Type: Nederlandse Wetenschappelijke Organisatie (NWO) (2013-2018)
- Web page: Not available

8.2.4.6. TALS and splicing

- Title: Development of bioinformatic methods for the analysis of splicing events in patients with the Taybi-Linder Syndrome (TALS)
- Coordinator: P. Edery
- ERABLE participant(s): C. Benoît-Pilven, Audric Cologne, V. Lacroix
- Type: INSERM
- Web page: Not available

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. MicroWine

- Title: Microbial metagenomics and the modern wine industry
- Duration: January 2015 - January 2019
- Coordinator: Lars Hestbjerg Hansen, University of Copenhagen
- ERABLE participant(s): A. Marchetti-Spaccamela, A. Mary, H. T. Pusa, M.-F. Sagot, L. Stougie
- Type: H2020-MSCA-ETN-2014
- Web page: https://team.inria.fr/erable/en/microwine/ and http://www.microwine.eu/

8.3.2. Collaborations in European Programs, Except FP7 & H2020

8.3.2.1. Combinatorics of co-evolution

- Title: The combinatorics of co-evolution
- Duration: 2015 - 2018
- Coordinator: Katharina Huber, University of Warwick, UK
- ERABLE participant(s): M.-F. Sagot, B. Sinaimeri
- Type: The Royal Society
- Web page: not available

8.3.3. Collaborations with Major European Organizations

By itself, ERABLE is built from what initially were collaborations with some major European Organisations (CWI, Sapienza University of Rome, Universities of Florence and Pisa, Free University of Amsterdam) and now has become a European Inria Team.

8.4. International Initiatives

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

Compasso

- Title: COMmunity Perspective in the health sciences: Algorithms and Statistical approacheS for explOring it
- Duration: 2018, renewable from 2 to 5 years more
- Coordinator: On the Portuguese side, Susana Vinga, IST, Lisbon, Portugal; on the French side, Marie-France Sagot
- ERABLE participant(s): R. Andrade, M. Ferrarini, G. Italiano, A. Marchetti-Spaccamela, A. Mary, H. T. Pusa, M.-F. Sagot, B. Sinaimeri, L. Stougie, A. Viari, I. Ziska
- Web page: http://team.inria.fr/erable/en/projects/inria-associated-team-compasso/

8.4.2. Participation in International Programs

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

ERABLE also participated to the BASIS project. This was funded by the European Community Seventh Framework Programme (Grant 242006 - 2010-2015). It was led by Dr. Mike Stratton and involved six European countries. It was primarily focused on ER+/HER2- breast cancers, but during the course of the project, was merged with the HER2+ French-ICGC and triple negative UK-ICGC projects, resulting in the analysis of the whole spectrum of breast cancers. The French group was initiated by Dr. Gilles Thomas and was pursued by Alain Viari after the loss of Dr. Thomas in 2014. The project resulted in the sequencing and thorough analysis of 560 breast cancer whole genomes (Nik-Zainai *et al.*, *Nature*, 534:47-54, 2016), including 75 HER2+ performed by the French working group (Ferrari *et al.*, *Nature Communications*, 7, 2016) and funded by the Institut National du Cancer and by Inserm.

Finally, Marie-France Sagot participates in a Portuguese FCT project, Perseids for "Personalizing cancer therapy through integrated modeling and decision" (2016-2019), with Susana Vinga and a number of other Portuguese researchers. The budget of Perseids is managed exclusively by the other Portuguese partner.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

In 2018, ERABLE greeted the following International scientists:

- In France: Alexander Stuart Ralph (University of Melbourne), Katharina Huber and Vincent Moulton (University of Warwick, UK), Ifigeneia Kyrkou (Aarhus University, Danemark), Ana Tereza Vasconcelos from the LNCC, Brazil), Nuno Mira (IST Portugal), May Alzamel and Costas Iliopoulos (King's College, London, UK), Simona Rombo (University of Palermo, Italy).
- In Italy: Loukas Georgiadis (University of Ioannina, Greece), Matthias Mnich (University of Bonn, Germany), Adam Karczmarcz (University of Warsaw, Poland).
- In the Netherlands: Solon Pissis (King's College, UK).

8.5.1.1. Internships

In 2018, ERABLE in France greeted the following Internships:

- Gabriela Paludo, Federal University of Mato Grosso do Sul, Brazil, from Dec 1st 2017 to June 30 2018, funds for 6 months from Capes, Brazil, and for the last month from ERABLE;
- Rafael Nahat, University of São Paulo, Brazil, from June 1st 2018 to Dec 15, 2018.

In the Netherlands, ERABLE greeted the following Internship: Luca Denti, University Bicocca of Milano, Italy, from October 1 to January 2019.

8.5.2. *Visits to International Teams*

8.5.2.1. Research Stays Abroad

In 2018, two members of ERABLE from France did research stays at Sapienza University of Rome. These were Marie-France Sagot and Blerina Sinaimeri, both funded by Sapienza, M.-F. Sagot as senior scientist for a visit of one month, and B. Sinaimeri as a junior scientist for a visit of three months. The visits took place at the beginning of 2018, Jan-Feb for M.-F. Sagot, and Jan-Apr for B. Sinaimeri. In the context of her visit to Sapienza, Blerina furthermore gave a mini-course (9h) at the University.

IBIS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Project name	MuSE: MUlti-Omics and Metabolic models integration to study growth transition in Escherichia coli
Coordinator IBIS participants Type Web page	D. Ropers D. Ropers, T. Etienne IXXI/BioSyl project (2018-2020) http://www.biosyl.org/news/ muse-2013-multi-omics-and-metabolic-models-integration-to- study-growth-transition-in-escherichia-coli

Project name	RNAfluo: Quantification d'ARN régulateurs *in vivo*
Coordinator	S. Lacour
IBIS participants	S. Lacour
Type	AGIR project Univ Grenoble Alpes (2016-2019)

7.2. National Initiatives

Project name	MEMIP – Modèles à effets mixtes de processus intracellulaires : méthodes, outils et applications
Coordinator	G. Batt
IBIS participants	E. Cinquemani, A. Marguet, D. Ropers
Type	ANR project (2016-2020)

Project name	ENZINVIVO – Détermination in vivo des paramètres enzymatiques dans une voie métabolique synthétique
Coordinator	G. Truan
IBIS participants	J. Geiselmann, H. de Jong
Type	ANR project (2016-2020)

Project name	MAXIMIC: Optimal control of microbial cells by natural and synthetic strategies
Coordinator	H. de Jong
IBIS participants	C. Boyat, E. Cinquemani, J. Geiselmann, H. de Jong, A. Pavlou, C. Pinel, D. Ropers
Type	ANR project (2017-2021)
Web page	https://project.inria.fr/maximic

Project name	RIBECO (RIBonucleotide ECOnomy): Engineering RNA life cycle to optimize economy of microbial energy
Coordinator	M. Cocaign-Bousquet
IBIS participants	E. Cinquemani, T. Etienne, D. Ropers
Type	ANR project (2018-2022)
Web page	https://project.inria.fr/ribeco/

Project name	COSY: real-time COntrol of SYnthetic microbial communities
Coordinator	E. Cinquemani
IBIS participants	E. Cinquemani, H. de Jong, J. Geiselmann, M. Mauri, T. Muszbek, C. Pinel, D. Ropers
Type	Inria Project Lab (2017-2021)
Web page	https://project.inria.fr/iplcosy/

Project name	CoSoft: Control software for a system of mini-bioreactors
Coordinator	E. Cinquemani
IBIS participants	E. Cinquemani, H. de Jong, J. Geiselmann, T. Muszbek
Type	Inria Hub (2017-2018)

Project name	AlgeaInSilico: Prédire et optimiser la productivité des microalgues en fonction de leur milieu de croissance
Coordinator	O. Bernard
IBIS participants	H. de Jong, N. Giordano
Type	Inria Project Lab (2015-2019)
Web page	https://project.inria.fr/iplalgaeinsilico/

Project name	Analyse intégrative de la coordination entre stabilité des ARNm et physiologie cellulaire chez Escherichia coli
Coordinators	D. Ropers, M. Cocaign-Bousquet (Inra, LISBP)
IBIS participants	T. Etienne, D. Ropers
Type	Contrat Jeune Scientifique Inra-Inria (2016-2019)

7.3. European Initiatives

7.3.1. Collaborations with Major European Organizations

Systems biotechnology department at Technische Universität Münich (Germany), Andreas Kremling

Modeling of carbon metabolism in bacteria

Automatic control laboratory at ETH Zürich (Switzerland), John Lygeros, and Cell cycle laboratory, School of Medicine, University of Patras (Greece), Zoe Lygeros

Control theory and systems identification with applications to single-cell systems biology

IMAGINE Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Performance Lab (January 2018 - June 2021)

Participants: Rémi Ronfard, Qianqian Fu, Mélina Skouras, Maxime Garcia, Pierre Casati, Vaishnavi Ameya Murukutla, Rémi Colin de Verdière.

Performance Lab is a cross-disciplinary project (CDP) by IDEX Univ. Grenoble Alpes, started in January 2018, which is funding the Phd thesis of Qianqian Fu.

Conceived as an international platform, the Performance Lab brings together a community of researchers who are exploring contemporary issues that link embodiment, society and technology. The ambition of the project is to renew the ways in which research is conceived and practiced at Univ. Grenoble Alpes by developing new methods inspired by Anglo-Saxon notions of Performance as Research (PAR), research creation, practice-led and based research.

As part of the Performance Lab, tIMAGINE is actively involved in the research group on "digital dramaturgies" co-led by Remi Ronfard and Julie Valero.

9.2. National Initiatives

9.2.1. InriaHub ADT Kino Ai (October 2018-September 2020)

Participants: Rémi Ronfard, Rémi Colin de Verdière, Qianqian Fu.

This two-year contract is a follow up to the one-year InriaHub ULTRAHD project which was successfully completed in December 2017. Kino Ai is a joint research project of the IMAGINE team at Inria Grenoble Alpes, and the Performance Lab at Univ. Grenoble Alpes. Following our previous work in "multiclip video editing" and "Split Screen Video Generation", we are working to provide a user-friendly environment for editing and watching ultra-high definition movies online, with an emphasis on recordings of live performances.

The code from Vineet Gandhi's PhD thesis was r entirely re-designed for supporting ultra high definition video. T The software was extensively tested in 2017 on a large dataset of 4K video recordings of theatre rehearsals, in collaboration with the Litt&Arts team at Univ. Grenoble Alpes, theatre director Jean-Francois Peyret in Paris, Theatre de l'Hexagone in Meylan and Theatre de Vidy in Lausanne. The goal of the Kino AI ADT is to allow the Kino Ai python code to run in a web server, and to provide a redesigned user interface (in javascript) running on a web client. The user interface will be designed, tested and evaluated with the Litt&Arts team at Univ. Grenoble Alpes, as part of CDP project Performance Lab.

9.2.2. FUI LIVE360 TV(December 2015 - December 2018)

Participants: Frédéric Devernay, Sandra Nabil Mahrous Yacoub.

L'objectif de ce projet collaboratif est de développer une solution bout-en-bout pour la création « live », la diffusion et la restitution d'audio/vidéo 360° multi-écrans, et ce avec une qualité répondant aux exigences du marché « broadcast ».

Ce projet est né sous l'impulsion d'un consortium formé de PME (Arkamys, ATEME, Aviwest et Kolor) et de laboratoires (Inria et Télécom ParisTech). Il bénéficie du programme FUI19, le Fonds Unique Interministériel. This 3-year contract with industrial partners Arkamys, ATEME, Aviwest et Kolor (now GoPRO) was dedicated to creating an end-to-end solution for recording and broadcasting immersive multi-screen 360 degree audio/video movies with a professional quality.

The project has funded the PhD thesis of Sandra Nabil. It was completed in November 2018, with the Phd defense of Sandra Nabil and the closing FUI project meeting.

9.2.3. FUI Collodi 2 (December 2016 - April 2019)

Participants: Rémi Ronfard, Maguelonne Beaud de Brive, Julien Daval.

This 2-year contract with two industrial partners: TeamTo and Mercenaries Engineering (software for production rendering), is a follow-up and a generalization of Dynam'it and Collodi 1. The goal is to propose an integrated software for the animation and final rendering of high-quality movies, as an alternative to the ever-ageing Maya. The project is funding 2 engineers for 2 years.

The project was extended for four additional months from January to April 2019 to allow extended expert evaluation of our sketch-based animation toolkit.

9.2.4. FUI 3D-Oncochip (October 2018 - September 2021)

Participants: Jean-Claude Léon, Musaab Khalid Osman Mohammed.

3D-Oncochip project is a collaboration with Microlight 3D, with the objective of fabricating nanoscale 3D microtumors, which are human biological models of real tumors. This 3-year contract is funding the postdoc position of Musaab Khalid Osman Mohammed.

9.2.5. ANR E-ROMA (November 2017 - October 2020)

Participants: Rémi Ronfard, Stefanie Hahmann, Pierre Casati.

The eRoma project aims at revisiting the digitization and virtual restoration of archaeological and fine arts artefacts by taking advantage of the sites from which they were retrieved and the eras they belong to. To do so, e-Roma will develop a new virtual representation both versatile and unified enough to be used for both restoration and animation of digitized artworks. Traditional cardboard models with a fixed and rigid representation will therefore be replaced by interactive dynamic virtual prototypes, to help restore statues and illustrate changes over time.

This 3-year contract is a joint project with GeoMod team at LIRIS and the musée gallo-romain in Lyon. The contract started in November 2017 and is funding the PhD thesis of Pierre Casati.

9.2.6. ANR FOLD-DYN (November 2017 - October 2020)

Participant: Thomas Buffet.

The FOLDDyn project (Field-Oriented Layered Dynamics animating 3D characters) proposes the study of new theoretical approaches for the effective generation of virtual characters deformations, when they are animated. These deformations are twofolds: character skin deformations (skinning) and garment simulations. We propose to explore the possibilities offered by a novel theoretical way of addressing character deformations: the implicit skinning. This method jointly uses meshes (the standard representation for 3D animations) and volumetric scalar functions (an unusual representation in this community).

This 3-year contract is a joint project with the University of Toulouse. The contract started in November 2017 and is funding the PhD thesis of Thomas Buffet.

9.2.7. ANR ANATOMY2020 (November 2017 - October 2020)

Participants: Olivier Palombi, Rémi Ronfard, Vaishnavi Ameya Murukutla.

Anatomy2020 aims at developing an innovative educational platform to facilitate learning of functional anatomy. This platform will integrate recent advances in computer graphics, human-computer interaction together with recent insights in educational and cognitive sciences to design and test optimal scenarios for anatomy learning. The approach is based on evidences that body movements could improve learning of different knowledge by "augmenting" or "enriching" traces in long-term memory. This "embodied" perspective is particularly relevant for learning of functional anatomy as the knowledge to acquire could be specifically related to the learner's body in motion.

This 3-year contract is a joint project with TIMC (Computer-Assisted Medical Intervention team), Anatoscope, Gipsa-Lab (speech and cognition dept.), LIBM and LIG (Engineering Human-Computer Interaction team). The contract started in November 2017 and is funding the PhD thesis of Ameya Murukutla.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

We have frequent exchanges and on-going collaborations with Cyril Crassin from nVIDIA-Research, and Eric Heitz, Laurent Belcour, Jonathan Dupuy and Kenneth Vanhoey from Unity-Research. Maverick is part of the GPU Research Center labeled by nVIDIA at Inria Grenoble. Team contact: Fabrice Neyret.

8.2. National Initiatives

8.2.1. ANR: Materials

Participants: Nicolas Holzschuch [contact], Romain Vergne.

We are funded by the ANR for a joint research project on acquisition and restitution of micro-facet based materials. This project is in cooperation with Océ Print Logic technologies, the Museum of Ethnography at the University of Bordeaux and the Manao team at Inria Bordeaux. The grant started in October 2015, for 48 months.

8.2.2. CDP: Patrimalp 2.0

Participants: Nicolas Holzschuch [contact], Romain Vergne.

The main objective and challenge of Patrimalp 2.0 is to develop a cross-disciplinary approach in order to get a better knowledge of the material cultural heritage in order to ensure its sustainability, valorization and diffusion in society. Carried out by members of UGA laboratories, combining skills in human sciences, geosciences, digital engineering, material sciences, in close connection with stakeholders of heritage and cultural life, curators and restorers, Patrimalp 2.0 intends to develop of a new interdisciplinary science: Cultural Heritage Science. The grant starts in January 2018, for a period of 48 months.

8.2.3. ANR: CaLiTrOp

Participant: Cyril Soler [contact].

Computing photorealistic images relies on the simulation of light transfer in a 3D scene, typically modeled using geometric primitives and a collection of reflectance properties that represent the way objects interact with light. Estimating the color of a pixel traditionally consists in integrating contributions from light paths connecting the light sources to the camera sensor at that pixel.

In this ANR we explore a transversal view of examining light transport operators from the point of view of infinite dimensional function spaces of light fields (imagine, e.g., reflectance as an operator that transforms a distribution of incident light into a distribution of reflected light). Not only are these operators all linear in these spaces but they are also very sparse. As a side effect, the sub-spaces of light distributions that are actually relevant during the computation of a solution always boil down to a low dimensional manifold embedded in the full space of light distributions.

Studying the structure of high dimensional objects from a low dimensional set of observables is a problem that becomes ubiquitous nowadays: Compressive sensing, Gaussian processes, harmonic analysis and differential analysis, are typical examples of mathematical tools which will be of great relevance to study the light transport operators.

Expected results of the fundamental-research project CALiTrOp, are a theoretical understanding of the dimensionality and structure of light transport operators, bringing new efficient lighting simulation methods, and efficient approximations of light transport with applications to real time global illumination for video games.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

Title: "MAIS": Mathematical Analysis of Image SynthesisInternational Partner (Institution - Laboratory - Researcher):

University of Montreal (Canada) - Département d'Informatique et Recherche Opérationnelle - Derek Nowrouzezahrai
Duration: 2015 - 2019

8.4. International Research Visitors

8.4.1. Visits to International Teams

8.4.1.1. Research Stays Abroad

Alban Fichet has returned in October 2018 from a 12 months research stay at Charles University in Prague, to work with Alexander Wilkie and Jaroslav Krivanek on material models.

MISTIS Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. Grenoble Idex projects

MISTIS is involved in a transdiciplinary project **NeuroCoG** and in a newly accepted cross-disciplinary project (CDP) **Risk@UGA**. F. Forbes is also a member of the executive committee and responsible for the *Data Science for life sciences* work package in another project entitled **Grenoble Alpes Data Institute**.

- The main objective of the RISK@UGA project is to provide some innovative tools both for the management of risk and crises in areas that are made vulnerable because of strong interdependencies between human, natural or technological hazards, in synergy with the conclusions of Sendai conference. The project federates a hundred researchers from Human and Social Sciences, Information & System Sciences, Geosciences and Engineering Sciences, already strongly involved in the problems of risk assessment and management, in particular natural risks. The PhD thesis of Meryem Bousebata is one of the eleven PhDs funded by this project.

- The NeuroCoG project aims at understanding the biological, neurophysiological and functional bases of behavioral and cognitive processes in normal and pathological conditions, from cells to networks and from individual to social cognition. No decisive progress can be achieved in this area without an aspiring interdisciplinary approach. The interdisciplinary ambition of NeuroCoG is particularly strong, bringing together the best scientists, engineers and clinicians at the crossroads of experimental and life sciences, human and social sciences and information and communication sciences, to answer major questions on the workings of the brain and of cognition. One of the work package entitled InnobioPark is dedicated to Parkinson's Disease. The PhD thesis of Veronica Munoz Ramirez is one of the three PhDs in this work package.

- The Grenoble Alpes Data Institute aims at undertaking groundbreaking interdisciplinary research focusing on how data change science and society. It combines three fields of data-related research in a unique way: data science applied to spatial and environmental sciences, biology, and health sciences; data-driven research as a major tool in Social Sciences and Humanities; and studies about data governance, security and the protection of data and privacy. In this context, a 2-year multi-disciplinary projects has been granted in November 2018 to Mistis in collaboration with the Grenoble Institute of Neuroscience. The objective of this project is to develop a statistical learning technique that is able to solve a problem of tracking and analyzing a large population of single molecules. The main difficulties are: 1) the large number of observations to analyse, 2) the noisy nature of the signals, 3) the definition of a quality index to allow the elimination of poor-quality data and false positive signals. We also aim at providing a powerful, well-documented and open-source software, that will be user-friendly for non-specialists.

Also in the context of the Idex associated with the Université Grenoble Alpes, Alexandre Constantin was awarded half a PhD funding from IRS (Initiatives de Recherche Stratégique), 50 keuros.

9.1.2. Competitivity Clusters

The MINALOGIC VISION 4.0 project: MISTIS is involved in a three-year (2016-19) project. The project is led by VI-Technology, a world leader in Automated Optical Inspection (AOI) of a broad range of electronic components. The other partners are the G-Scop Lab in Grenoble and ACTIA company based in Toulouse. Vision 4.0 (in short Vi4.2) is one of the 8 projects labeled by Minalogic, the digital technology competitiveness cluster in Auvergne-Rhône-Alpes, that has been selected for the Industry 4.0 topic in 2016, as part of the 22nd call for projects of the FUI-Régions, for a total budget of the project of 3,4 Meuros.

Today, in the printed circuits boards (PCB) assembly industry, the assembly of electronic cards is a succession of ultra automated steps. Manufacturers, in constant quest for productivity, face sensitive and complex adjustments to reach ever higher levels of quality. Project VI4.2 proposes to build an innovative software solution to facilitate these adjustments, from images and measures obtained in automatic optical inspection (AOI). The idea is - from a centralized station for all the assembly line devices - to analyze and model the defects finely, to adjust each automatic machine, and to configure the interconnection logic between them to improve the quality. Transmitted information is essentially of statistical nature and the role of sc mistis is to identify which statistical methods might be useful to exploit at best the large amount of data registered by AOI machines. Preliminary experiments and results on the Solder Paste Inspection (SPI) step, at the beginning of the assembly line, helped determining candidate variables and measurements to identify future defects and to discriminate between them. More generally, the idea is to analyze two databases at both ends (SPI and Component Inspection) of the assembly process so as to improve our understanding of interactions in the assembly process, find out correlations between defects and physical measures and generate accordingly proactive alarms so as to detect as early as possible departures from normality.

9.1.3. Networks

MSTGA and AIGM INRA (French National Institute for Agricultural Research) networks: F. Forbes and J.B Durand are members of the INRA network called AIGM (ex MSTGA) network since 2006, http://carlit.toulouse.inra.fr/AIGM, on Algorithmic issues for Inference in Graphical Models. It is funded by INRA MIA and RNSC/ISC Paris. This network gathers researchers from different disciplines. MISTIS co-organized and hosted 2 of the network meetings in 2008 and 2015 in Grenoble. Thibaud Rahier and Brice Olivier participated as speakers to meetings of the network in 2018.

9.2. International Initiatives

9.2.1. Inria International Labs

International Laboratory for Research in Computer Science and Applied Mathematics
Associate Team involved in the International Lab:

9.2.1.1. SIMERG2E

Title: Statistical Inference for the Management of Extreme Risks, Genetics and Global Epidemiology

International Partner:

UGB (Senegal) - Abdou Kâ Diongue

Start year: 2018

See also: http://mistis.inrialpes.fr/simerge

SIMERG2E is built on the same two research themes as SIMERGE, with some adaptations to new applications: 1) Spatial extremes, application to management of extreme risks. We address the definition of new risk measures, the study of their properties in case of extreme events and their estimation from data and covariate information. Our goal is to obtain estimators accounting for possible variability, both in terms of space and time, which is of prime importance in many hydrological, agricultural and energy contexts. 2) Classification, application to genetics and global epidemiology. We address the challenge to build statistical models in order to test association between diseases and human host genetics in a context of genome-wide screening. Adequate models should allow to handle complexity in genomic data (correlation between genetic markers, high dimensionality) and additional statistical issues present in data collected from a family-based longitudinal survey (non-independence between individuals due to familial relationship and non-independence within individuals due to repeated measurements on a same person over time).

9.2.2. Inria International Partners

9.2.2.1. Informal International Partners

The context of our research is also the collaboration between MISTIS and a number of international partners such as the statistics department of University of Michigan, in Ann Arbor, USA, the statistics department of McGill University in Montreal, Canada, Université Gaston Berger in Senegal and Universities of Melbourne and Brisbane in Australia.

The main active international collaborations in 2018 are with:

- G. Stupfler, Nottingham University, UK.
- K. Qin, H. Nguyen and Kerrie Mengersen, D. Wraith resp. from Swinburne University and La Trobe university in Melbourne, Australia and Queensland University of Technology in Brisbane, Australia.
- E. Deme and S. Sylla from Gaston Berger university and IRD in Senegal.
- M. Houle from National Institute of Informatics, Tokyo, Japan.
- N. Wang and C-C. Tu from University of Michigan, Ann Arbor, USA.
- R. Steele, from McGill university, Montreal, Canada.
- Guillaume Kon Kam King, Stefano Favaro, Pierpaolo De Blasi, Collegio Carlo Alberto, Turin, Italy.
- Igor Prünster, Antonio Lijoi, and Riccardo Corradin Bocconi University, Milan, Italy.
- Bernardo Nipoti, Trinity College Dublin, Ireland.
- Yeh Whye Teh, Oxford University and DeepMind, UK.
- Stephen Walker, University of Texas at Austin, USA.

9.3. International Research Visitors

9.3.1. Visits of International Scientists

- Hien Nguyen, researcher at La Trobe University in Melbourne visited for a month in October 2018.
- Eric Marchand Professor at University of Sherbrook Canada, visited from March to June 2018.
- Riccardo Corradin, PhD student at Bocconi University, Milan, Italy visited for a month in March 2018.
- Aboubacrène Ag Ahmad, PhD student at Univ. Gaston Berger, Senegal visited from September 2018 until November 2018.

9.3.1.1. Internships

Caroline Lawless from University College Dublin visited for 2 months as part of her internship.

5. Partnerships and Cooperations

5.1. National Initiatives

5.1.1. ANR Elker

Program: ANR-PRC

Project acronym: ELKER

Project title: Extending link keys: extraction and reasoning

Duration: October 2017 - September 2021

Coordinator: LIG/Manuel Atencia

Participants: Manuel Atencia Arcas, Jérôme David, Jérôme Euzenat

Other partners: Inria Lorraine, Université de Vincennes

Abstract: The goal of ELKER is to extend the foundations and algorithms of link keys (see §3.2) in two complementary ways: extracting link keys automatically from datasets and reasoning with link keys.

5.1.2. Framework agreement Ministère de la culture et de la communication

Program: Framework agreement Inria-Ministère de la culture et de la communication

Project acronym: GINCO V3

Project title: Outil d'aide à l'alignement pour l'élaboration du graphe culture

Duration: November 2017 - December 2018

Coordinator: Jérôme David

Participants: Jérôme David, Jérôme Euzenat, Manuel Atencia Arcas

Abstract: The GINCO V3 project aims at extending the GINCO tool with ontology alignment capabilities.

Program: Framework agreement Inria-Ministère de la culture et de la communication

Project acronym: FNE

Project title: Algorithmes d'aide à la définition de clés de liage et d'alignement d'autorités

Duration: November 2017 - December 2018

Coordinator: Jérôme David

Participants: Jérôme David, Manuel Atencia Arcas, Jérôme Euzenat

Other partners: Bibliothèque nationale de France

Abstract: The goal of the FNE cooperation is to evaluate the suitability of link key extraction algorithms to matching authorities from BnF, ABES and the ministry of Culture and to improve such algorithms if necessary.

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

9.1.1.1. ANR PRCE CaMoPi – Capture and Modelling of the Shod Foot in Motion

The main objective of the CaMoPi project is to capture and model dynamic aspects of the human foot with and without shoes. To this purpose, video and X-ray imagery will be combined to generate novel types of data from which major breakthroughs in foot motion modelling are expected. Given the complexity of the internal foot structure, little is known about the exact motion of its inner structure and the relationship with the shoe. Hence the current state-of-the art shoe conception process still relies largely on ad-hoc know-how. This project aims at better understanding the inner mechanisms of the shod foot in motion in order to rationalise and therefore speed up and improve shoe design in terms of comfort, performance, and cost. This requires the development of capture technologies that do not yet exist in order to provide full dense models of the foot in motion. To reach its goals, the CaMoPi consortium comprises complementary expertise from academic partners : Inria (combined video and X-ray capture and modeling) and Mines St Etienne (finite element modeling), as well as industrial : CTC Lyon (shoe conception and manufacturing, dissemination). The project has effectively started in October 2017 with Claude Goubet's recruitment as a PhD candidate followed by Tomas Svaton as an engineer in April 2018.

9.1.1.2. ANR project Achmov – Accurate Human Modeling in Videos

The technological advancements made over the past decade now allow the acquisition of vast amounts of visual information through the use of image capturing devices like digital cameras or camcorders. A central subject of interest in video are the humans, their motions, actions or expressions, the way they collaborate and communicate. The goal of ACHMOV is to extract detailed representations of multiple interacting humans in real-world environments in an integrated fashion through a synergy between detection, figure-ground segmentation and body part labeling, accurate 3D geometric methods for kinematic and shape modeling, and large-scale statistical learning techniques. By integrating the complementary expertise of two teams (one French, MORPHEO and one Romanian, CLVP), with solid prior track records in the field, there are considerable opportunities to move towards processing complex real world scenes of multiple interacting people, and be able to extract rich semantic representations with high fidelity. This would enable interpretation, recognition and synthesis at unprecedented levels of accuracy and in considerably more realistic setups than currently considered. This project has funded the work of two soon to defend PhD students Vincent Leroy and Jinlong Yang, and ended during the year 2018.

9.1.2. Competitivity Clusters

9.1.2.1. FUI project Creamove

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

9.1.2.2. FUI24 SPINE-PDCA

The goal of the SPINE-PDCA project is to develop a unique medical platform that will streamline the medical procedure and achieve all the steps of a minimally invasive surgery intervention with great precision through a complete integration of two complementary systems for pre-operative planning (EOS platform from EOS IMAGING) and imaging/intra-operative navigation (SGV3D system from SURGIVISIO). Innovative low-dose tracking and reconstruction algorithms will be developed by Inria, and collaboration with two hospitals (APHP Trousseau and CHU Grenoble) will ensure clinical feasibility. The medical need is particularly strong in the field of spinal deformity surgery which can, in case of incorrect positioning of the implants, result in serious musculoskeletal injury, a high repeat rate (10 to 40% of implants are poorly positioned in spine surgery) and important care costs. In paediatric surgery (e. g. idiopathic scoliosis), the rate of exposure to X-rays is an additional major consideration in choosing the surgical approach to engage. For these interventions, advanced linkage between planning, navigation and postoperative verification is essential to ensure accurate patient assessment, appropriate surgical procedure and outcome consistent with clinical objectives. The project has effectively started in October 2018 with Di Meng's recruitment as a PhD candidate.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *ENS de Lyon projets Emergents - Phyllo (2018 - 2019)*

Participants: Christophe Godin, Bruno Leggio, Teva Vernoux [External Collaborator].

The aim in this project is to develop a model of phyllotaxis that would be compatible with the recent detailed and quantitative observations made by our group of the distribution of auxin in space and time at the SAM. In particular the work will seek at using the new quantitative data to estimate the parameters of the stochastic model previously developed of organ patterning.

8.1.2. *IDEX Lyon Impulsion - MecaField (2019 - 2020*

Participants: Christophe Godin, Teva Vernoux [External Collaborator].

In a previous work, we have shown that the coupling of mechanical and hydraulical descriptions in a 2D model of multicellular tissue growth induces the emergence of remarkable phenomena at tissue level. In particular, we have shown that the growth of an organ may induce a lateral inhibition surrounding the organ that prevents other organs to grow in its vicinity. The goal of this project is to estimate the hydraulic and mechanical parameters of such a model from confocal images of a growing SAM and to compare observations with the order of magnitude of the predicted inhibitory zones and of their amplitude at cellular resolution.

8.2. National Initiatives

8.2.1. *Inria ADT - Gnomon*

Participants: Olivier Ali, Romain Azaïs, Guillaume Cerutti, Florian Gacon, Christophe Godin, Jonathan Legrand, Grégoire Malandain [External Collaborator], Teva Vernoux [External Collaborator].

Gnomon is a user-friendly computer platform developed by the Mosaic team for seamless simulation of form development in silico. It is intended to be a major tool for the team members to develop, integrate and share their models, algorithms and tools. Flexible components (plugins) make it possible to up-load or to create such data-structures, to program their development, to analyze, visualize them and interact with them in 3D+time.

Based on the past experience of the team with the OpenAlea platform, the goal of this ADT is to develop a more scalable software engineering solution based on the dtk kernel developed by the group of software engineers (SED) from the Sophia-Antipolis Inria Center.

Partners:
- SED Sophia Antipolis Inria Research Centre
- Morpheme Inria projec-team, Sophia Antipolis, France

8.2.2. *Inria IPL - Naviscope*

Participants: Guillaume Cerutti, Emmanuel Faure [External Collaborator], Christophe Godin, Jonathan Legrand, Grégoire Malandain [External Collaborator].

In this project, we plan to develop 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. We will build Naviscope upon the strength of scientific visualization and machine learning methods in order to provide systems capable to assist the scientist to obtain a better understanding of massive amounts of information. Such systems will be able to recognize and highlight the most informative regions of the dataset by reducing the amount of information displayed and guiding the observer attention. Finally, we will overcome the technological challenge of gathering up the software developed in each team to provide a unique original tool for users in biological imaging, and potentially in medical imaging.

8.2.3. ANR - ReVeRIES

Participant: Guillaume Cerutti.

The aim of ReVeRIES (Reconnaissance de Végétaux Récréative, Interactive et Educative sur Smartphone) is to make use of mobile technologies to transmit general knowledge and identification skills on the plant world to an urban audience who has little to no botanical background. Following the work of the ReVeS project and the development of the Folia mobile application, a major objective is to recognize automatically the species of trees and shrubs encountered in France using photographs of their leaves, fruits, flowers and barks, while providing the user the botanical vocabulary and the keys to learn how to identify species.

Partners:

- EVS Laboratoire Environnement Ville et Société, Saint-Etienne
- IRHS Institut de Recherches en Horticulture et Semences, Angers
- LIRIS Laboratoire d'Informatique en Image et Système d'Information, Lyon
- LISTIC Laboratoire d'Informatique, Système, Traitement de l'Information et de la Connaissance, Annecy
- LIUM Laboratoire d'Informatique de l'Université du Maine, Le Mans

8.2.4. ANR - Imago (2016 - 2019)

Participants: Guillaume Cerutti, Christophe Godin, Jonathan Legrand.

The goal of this project is to investigate the role of ovule growth constraints on germ cell fate establishment. This project is motivated by recent findings from the partners' groups suggesting that disturbances in cell divisions and expansion in early (pre-meiotic) ovules are sufficient to induce ectopic germ cells. These observations suggest novel routes to engineer apomixis in plants but remains poorly understood. Recent developments in high-resolution 3D imaging, image processing, and modeling offer a powerful combination of approaches to investigate this question. IMAGO proposes to elucidate patterning rules governing ovule growth, and their contribution to female germ cell fate acquisition. We use a combination of high-resolution static and real-time 3D imaging, quantitative image processing, cell-based growth models and functional approaches to (1) define cellular growth patterns in the ovule primordium using quantitative imaging (2) test patterning rules in silico by cell-based growth models (3) validate patterning rules in vivo using genetic, pharmacological and mechanical perturbations.

Partners:

- UMR DIADE, IRD, Montpellier, France
- Department of Plant and Microbial Biology, Zurich, Swisszerland
- RDP, ENS de Lyon, France

8.2.5. ANR DigEM (2015 - 2019)

Participants: Christophe Godin, Bruno Leggio, Patrick Lemaire [External Collaborator], Grégoire Malandain [External Collaborator].

In this project, we will use advanced ligh-sheet imaging of live embryos to quantitatively describe embryonic morphogenesis in ascidians, a class of animals that undergo very rapid genomic divergence, yet show an extraordinary stasis of embryonic morphologies, based on invariant early cell lineages shared by all studied species. The global aims of the proposal, which will bridge micro- and macroevolutionary scales of analysis, are: i) to provide a global systems-level description at cellular resolution of an animal embryonic program; ii) to use this description to characterize intra-specific and inter-specific patterns of morphogenetic variations; iii) to analyze possible molecular mechanisms explaining the unusual robustness of this program to environmental and genetic perturbations. To achieve these aims, we will combine advanced live light-sheet microscopy, computational biology, functional gene assays and evolutionary approaches.

Partners:

- UMR CRBM, CNRS Montpellier, France
- Morpheme Inria projec-team, Sophia Antipolis, France

8.2.6. ERA-CAPS Genes2shape (2018 - 2021)

Participants: Olivier Ali, Guillaume Cerutti, Christophe Godin, Bruno Leggio, Jan Traas [External Collaborator].

This project is aimed at understanding how molecular regulation integrates with mechanics to control overall plant shape, an unresolved problem with wide implications for both fundamental and applied biology. We will address this issue in the Arabidopsis flower, which, besides their obvious importance as reproductive structures, are amongst the best characterised systems in plant developmental biology. From a mechanistic point of view, it is widely accepted that regulatory molecular networks interfere with the properties of the structural cellular elements (cell wall, cytoskeleton) to induce particular growth patterns. How this occurs and how this is coordinated in space is not known. To obtain a mechanistic understanding of such a complex process, information from multiple scales, from molecular networks to physical properties and geometry have to be combined into a single picture. An integrated tool to do so is currently not available. Building on our complementary experience in interdisciplinary research on plant development, we will therefore develop a tool, called the "Computable Flower" that permits (i) integration of data on geometry, gene expression and biomechanics and (ii) the user to explore, interpret and generate hypotheses based on data supported by mechanistic modelling approaches. The tool therefore provides an integrated description in the form of a 3D dynamic template of the growing flower bud.

Partners:

- University of Cambridge (Sainsbury Lab.)
- California Institute of Technology
- MaxPlanck Institutes of Molecular Plant Physiology

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

Program: H2020

Project acronym: ROMI

Project title: RObotics for MIcrofarms

Duration: November 2017 - October 2021

Coordinator: Sony

Other partners: Iaac, (Spain), FEI (France), Inria (France), CNRS (France), UBER (Germany), Chatelain (France)

Abstract: All over Europe, young farmers are starting small market farms and direct sales businesses. These farms can be found both in rural, peri-urban and urban areas. They grow a large variety of crops (up to 100 different varieties of vegetables per year) on small surfaces (0.01 to 5 ha) using organic farming practices. These farms have proven to be highly productive, sustainable and economically viable. However, a lot of work is done manually, resulting in physically challenging work conditions. ROMI will develop an open and lightweight robotics platform for these microfarms. We will assist these farms in weed reduction and crop monitoring. This will reduce manual labour and increase the productivity through advanced planning tools. Thanks to ROMI's weeding robot, farmers will save 25 percents of their time. This land robot will also acquire detailed information on sample plants and will be coupled with a drone that acquires more global information at crop level. Together, they will produce an integrated, multi-scale picture of the crop development that will help the farmer monitor the crops to increase efficient harvesting. For this, ROMI will have to adapt

and extend state-of-the-art land-based and air-borne monitoring tools to handle small fields with complex layouts and mixed crops. To achieve this, we will: (i) develop and bring to the market an affordable, multi-purpose, land-based robot, (ii) develop a weeding app for this robot that is adapted for organic microfarms, (iii) apply advanced 3D plant analysis and modelling techniques to in-field data acquisition, (iv) integrate these analysis techniques in the robot for detailed plant monitoring, (iv) integrate these techniques also in the aerial drone N-E-R-O for multi-scale crop monitoring, (v) extend the robot with novel, adaptive learning techniques to improve sensorimotor control of the plant monitoring app, and (vii) test the effectiveness of our solution in real-world field conditions.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

8.3.2.1.1. Laboratoire International Associé (LIA): Computing Plant Morphogenesis

The focus of this LIA headed by Teva Vernoux (RDP) and Ottoline Leyser (SLCU) is on plant morphogenesis i.e. the mechanisms allowing the generation of plant shapes at different scales. Both the RDP and SLCU Laboratories are leaders of this field. The scenario for morphogenesis that has recently emerged is that chemical signals controlling cell identities lead to changes in mechanical properties of cells, triggering changes in shapes feeding back on the gene regulatory network. This in turn affects the distribution of chemical signals and mechanical forces, thus channeling morphogenesis. However, our understanding of the molecular and physical basis of morphogenesis in plants or in any other eukaryotic system is still in its infancy due to the complexity and non-linearity of processes involved in morphogenesis dynamics (or Morphodynamics). Understanding morphodynamics requires a modeling environment for the explicit representation of forms at multiple scales and for incorporating complex data from different origins and nature (chemical, mechanical, geometrical). In addition to creating a unique scientific environment, this LIA will gather the critical mass and interdisciplinary expertise required to create such a computational platform and to generate the data to produce an integrated vision of how chemical and mechanical signals interaction drive morphogenesis.

Partners:

- Sainsbury Lab. University of Cambridge (SLCU)

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Farah Ben Naoum, associate professor at the University of Sidi Bel Abbes, paid a one-month visit (July 2018) in the Mosaic group to work with Romain Azaïs and Christophe Godin on algorithms to compute incrementally tree-edit distances based on their directed acyclic graph representation. This visit was funded by Inria and will be followed by another one month visit in March 2019 to complete the writing a related paper.

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

- Sergei Grudinin has obtained an IDEX UGA grant. It covers 2 years of post-doc of Didier Devaurs, starting from December 2018.
- Doctoral UGA grant covers PhD thesis of Maria Kadukova (supervised by Sergei Grudinin).

7.2. National Initiatives

7.2.1. ANR

In 2018, NANO-D had funding from one ANR program:

- **ANR PRCI**: covers PhD thesis of Guillaume Pages.

7.3. European Initiatives

7.3.1. Collaborations with Major European Organizations

Partner 1: The European Bioinformatics Institute (EMBL-EBI), Protein Data Bank in Europe (PDBe) team, Hinxton (UK)

We are collaborating on the integration of methods developed in the team into the PDBe web resource.

Partner 2: The Institute Laue-Langevin (ILL), the bioSANS team, Grenoble (France)

We are collaborating on the development of neutron small-angle scattering software.

Partner 3: The Ecole polytechnique fédérale de Lausanne (EPFL), Laboratory for Biomolecular Modeling, Lausanne (Switzerland)

We are collaborating on the integrative structural biology approaches.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Declared Inria International Partners : BIOTOOLS

Title: Novel Computational Tools for Structural Bioinformatics

International Partner (Institution - Laboratory - Researcher):

> MIPT (Russia (Russian Federation)) - Department of Control and Applied Mathematics - Vadim Strijov

Duration: 2016 - 2020

Start year: 2016

Abstract : The general scientific objectives of the forthcoming collaboration are the new developments of computational tools for structural bioinformatics. In particular, we plan to collaborate on several subjects: 1. Development of tractable approximations for intractable combinatorial problems in structural biology. 2. Development of new computational tools for scattering experiments. 3. Machine learning for structural bioinformatics.

7.4.1.2. Informal International Partners

- University of Stony Brook, lab of Dima Kozakov (USA). We have been collaborating on the development of novel protein docking methods.

- University of Vilnius, department of Bioinformatics (Lithuania). We have been collaborating on the development of novel protein docking methods.

- KU Copenhagen (Denmark), department of Chemistry. We collaborate on the integrative structural biology approaches.

- Autonomous University of Madrid (Spain), Bioinformatics Unit. We collaborate on the development of computational methods for protein flexibility.

- Francis Crick Institute, London (UK), Biomolecular Modelling Laboratory. We collaborate on the development of flexible protein docking methods.

7.4.2. Participation in Other International Programs

Our team has obtained the PHC Gilibert grant for a 2-year collaboration with the Vilnius University (Lithuania). Our partner is the Department of Bioinformatics, http://www.bti.vu.lt/en/departments/department-of-bioinformatics.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Karina Dos Santos Machado, lecturer at the Federal University of Rio Grande (FURG, Brazil), Oct 2018 - Oct 2019.

7.5.1.1. Internships

- Amal Akkari (Mohammed V University, Rabat, Morocco), Jun 2018 - Nov 2018.
- Khalid Mustafin (MIPT Moscow, Russia), Sep 2018 - Feb 2019.

7.5.2. Visits to International Teams

Sergei Grudinin has visited and gave talks in the following research labs :

- Department of Bioinformatics, University of Vilnius, Lithuania, May 10-11, 2018.
- The team of Dima Kozakov, Stony Brook University, USA, November 12th-14th, 2018.
- The team of Simon Billinge, Columbia University, USA, November 15th, 2018.
- Department of Biology, University of Copenhagen, Denmark, November 19th, 2018.
- Department of Chemistry, University of Copenhagen, Denmark, November 22nd, 2018.
- Department of Bioinformatics, State Belorussian University, Minsk, Belarus, Dec 28, 2018.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. *Control of Cyber-Social Systems (C2S2)*

C2C2 is a two-year project funded by the University Grenoble Alpes, MSTIC department. Evolving from recent research on network systems, this exploratory project has the objective to concentrate on cyber-social systems, that is, complex systems with interacting social and technological components. A strong motivation for this novel research direction comes from the need for innovative tools for the management of vehicular traffic. In this application, state-of-the-art approaches concentrate on hard control actions, like traffic lights: instead, future management methods should exploit soft control actions aimed at controlling the traffic demand, that is, the aggregated behaviors of the drivers.

8.1.2. *Understanding data accidents for traffic safety (DATASAFE)*

DATASAFE is a two years project funded by Grenoble Data Institute, with the aim to understand from real traffic data the behavior of traffic in the moments preceding an accident. The general approach is to use novel statistical techniques in order to learn traffic characteristics that can be used to develop new traffic models. Bayesian approaches are used to (supervised) classification and (unsupervised) clustering in order to respectively predict collision occurrences and discover traffic patterns.

8.1.3. *Modeling autonomous vehicles in traffic flow (MAVIT)*

MAVIT is a two year project funded by the University Grenoble Alpes, MSTIC department. The goal of this project is to develop a unified micro-macro approach for traffic management, involving human and autonomous vehicles drivers by providing analytical and numerical tools for traffic modeling, estimation and control. We will work towards field operational tests, by using instrumented cars to collect data on AVs trajectory and their interaction with the traffic flow with human drivers. The proposed research provides new mathematical models, computational/software tools, and engineering solutions for the control of human controlled vehicles via intelligently controlled AVs in the traffic stream. Moreover, the control of traffic via moving actuators provides a new alternative to contemporary control technologies, such as ramp metering and variable speed limits; even when AVs comprise a tiny fraction of the total fleet, these techniques may be viable, and rapidly configurable. This research considers new types of traffic models, new control algorithms for traffic flow regulation, and new sensing and control paradigms that are enabled by a small number of controllable systems anticipated in a flow. Specifically, the research focuses on new (1) micro-macro models to model few AVs in a flow; (2) estimation techniques for AV interactions with the traffic flow; (3) developing and assessing dynamical controllers to mitigate traffic events.

8.1.4. *NanoSatellite Project: Advanced modelling and Control of attitude dynamics for quantum communication (SPACE)*

SPACE is a two-year project funded by the IDEX University Grenoble Alpes. It aims to launch an exploratory study to find the required minimal data we need to collect and combine for software design of Nanosatellite Attitude Determination and Control System (ADCS).

8.1.5. *caPture de mOuvements humainS par cenTrales inertielles/d'attitUde et smaRtphonEs : Vers l'analyse d'anomalies neurologiques et fonctions motrices (POSTURE)*

POSTURE is a one-year project funded by CDP NeuroCog. The project is focused on 1) the identification and characterization of postures and reference movements in humans using appropriate algorithms of classification (machine learning), and 2) the analysis of the effects of the number, location and orientation of the inertial sensors on the performance of the methods of identification and classification of postures and movements.

8.2. National Initiatives

8.2.1. Models of Bubbles in Online Social Networks (MOB)

MOB is a PEPS S2IH INS2I 2018 interdisciplinary project. This exploratory project focuses on the effects of online recommendation systems on social dynamics, which may entail the formation of «filter bubbles» that distort the experience of the users. The project will develop a mathematical model to demonstrate these effects and propose designs for their mitigation. The research will be conducted by a blend of tools from dynamical systems, network theory, complex systems, and control systems.

8.2.2. AgileWorld-MRSEI

AgileWorld is an ANR-MRSEI project (2018-2020), which aims at building an European network for an innovative training on road transportation systems in a connected world. The funding will help to prepare and then submit a proposal for the MSCA-ITN 2019 call.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, Except FP7 & H2020

8.3.1.1. Scale-FreeBack

Type: ERC Advanced Grant

Duration: Sep. 2016 to Aug. 2021

Coordinator: C. Canudas de Wit

Inria contact: C. Canudas de Wit

Abstract: The overall aim of Scale-FreeBack is to develop holistic scale-free control methods of controlling complex network systems in the widest sense, and to set the foundations for a new control theory dealing with complex physical networks with an arbitrary size. Scale-FreeBack envisions devising a complete, coherent design approach ensuring the scalability of the whole chain (modelling, observation, and control). It is also expected to find specific breakthrough solutions to the problems involved in managing and monitoring large-scale road traffic networks. Field tests and other realistic simulations to validate the theory will be performed using the equipment available at the Grenoble Traffic Lab center (see GTL), and a microscopic traffic simulator replicating the full complexity of the Grenoble urban network.

See also: http://scale-freeback.eu

8.4. International Initiatives

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

8.4.1.1. MEMENTO

Title: ModEling autonoMous vEhicles iN Traffic flOw

International Partner:

Vanderbilt University, Nashville (United States) - Dan Work

Start year: 2018

See also: http://necs.inrialpes.fr/memento/index.html

In recent years, the strategic priorities of automotive and transportation systems focus on research, development and adoption of automation-related technologies as they emerge. As these technology developments are introduced in the traffic stream, an open question is how the mathematical models that are at the heart of transportation planning and operations will need to be advanced to accommodate these changes. The goal of the NeCS-Vanderbilt, MEMENTO, associate team is to create a multidisciplinary environment to model autonomous vehicles (AV) in human traffic flow. Specifically, our goal is to develop a unified micro-macro approach for traffic management, involving human drivers and autonomous vehicles by providing analytical and numerical tools for traffic modeling, estimation and control. We will work towards field operational tests, by using instrumented cars to collect data on AVs trajectories and their interaction with the traffic flow with human drivers.

8.4.2. Participation in Other International Programs

8.4.2.1. TICO-MED

TicoMed (Traitement du signal, Traitement numérique multidimensionnel de l'Information avec applications aux Télécommunications et au génie Biomédical) is a French-Brazilian project funded by CAPES-COFECUB for the period 2015-2018. It involves University of Nice Sophia Antipolis (I3S Laboratory), CNAM, SUP-ELEC, University of Grenoble Alpes (Gipsa-Lab), Universidade Federal do Ceara, Universidade Federal do Rio de Janeiro, and Universidade Federal do Santa Catarina as partners.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Prof. Andrea Tosin (Politecnico di Torino, Italy) visited the team in February 2018 in the frame of the Scale-FreeBack ERC project. He gave a talk on "Control strategies for road risk mitigation in kinetic traffic modeling". He exchanged ideas with Carlos Canudas De Wit, Paolo Frasca, Stephane Mollier, Maria Laura Delle Monache and Thibault Liard.

Prof. Sandro Zampieri (Univ. Padova, Italy) visited the team in February 2018 in the frame of the Scale-FreeBack ERC project, to work with Carlos Canudas De Wit and Giacomo Casadei.

Prof. Karl Henrik Johansson (KTH, Stockholm, Sweden) visited the team in March 2018 in the frame of the Scale-FreeBack ERC project, and gave a talk on "Control of vehicle platoons and their influence on traffic".

Prof. Dan Work (Vanderbilt University (USA)), visited the team in July 2018 to work with Maria Laura Delle Monache and Thibault Liard, in the framework of the associated team MEMENTO.

Mauro Franceschelli (University of Cagliari, Italy) visited the team in October 2018 to collaborate with P. Frasca.

Prof. Olga Lucia Quintero Montoya, Univ. EAFIT, Medellin, Colobmia, visited the team in September 2018. She worked with C. Canudas de Wit on the theoretical development of a normalized macroscopic fundamental diagram for urban traffic.

George Gunter and Raphael Stern (University of Illinois at Urbana-Champaign and Vanderbilt University (USA)) visited the team in November 2018 to work with Maria Laura Delle Monache and Thibault Liard, in the framework of the associated team MEMENTO.

Maolong Lyu is a PhD student from TU Delft (Netherlands) under the supervision of Prof. Simone Baldi. He visited the team for two months to work with M.L. Delle Monache and P. Frasca on string stability for microscopic traffic flow models describing mixed traffic (human drivers and autonomous vehicles).

Diego Deplano is a PhD student from Univ. Cagliari (Italy) under the supervision of Prof. Alessandro Giua. He is visiting the team since Sept. 2018, working with C. Canudas de Wit.

8.5.1.1. Internships

Alexandre Olikier, "Open multi-agent systems with fixed size and possibly not complete topologies", December 2017–June 2018. Université catholique de Louvain, Belgium. Jointly advised by Paolo Frasca and Julien Hendrickx.

8.5.2. *Visits to International Teams*

8.5.2.1. Research Stays Abroad

P. Frasca is a Visiting Scientist at the IEIIT-CNR Institute, National Research Council CNR, Torino, Italy. By this collaboration, he performs research on distributed estimation in sensor networks and distributed control of social networks. He visited Torino three times in 2018.

P. Frasca is a Visiting Faculty at the Department of Applied Mathematics, University of Twente, Enschede, The Netherlands. By this collaboration, he performs research on vehicle platooning and on the dynamics of social media. He visited Enschede three times in 2018.

M. L. Delle Monache visited University of Alabama (USA) in April 2018.

M. L. Delle Monache visited Vanderbilt University (USA) in May 2018, and T. Liard visited the same university in May-June and December 2018. These visits are in the frame of the MEMENTO associate team.

F. Garin visited Rutgers University (Philadelphia, USA) in April 2018, to initiate a collaboration with Prof. Benedetto Piccoli and his students on metabolic networks.

A. Kibangou visited the University of Johannesburg (South Africa) in October 2018. During his stay, he gave a lecture to students of Department of Town and Regional Planning of Univ. of Johannesburg on Mobility and traffic management.

N. Martin visited Imura Laboratory at Tokyo University of Technology from June 20th to August 20th, in the frame of the JSPS summer program. The aim of this collaboration is to integrate controllability and/or observability notions in the network reduction problem at the core of this Ph.D. work.

M. U. B. Niazi visited Professor Jacquelien Scherpen at the University of Groningen, Netherlands, in October 2018, to work on model reduction for network systems.

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

5. Partnerships and Cooperations

5.1. National Initiatives

5.1.1. ANR

CNRS InFIniti, 2017-2018 (P. Vigneaux): 12ke in 2018

PERCEPTION Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. VHIA

Title: Vision and Hearing in Action

EU framework: FP7

Type: ERC Advanced Grant

Duration: February 2014 - January 2019

Coordinator: Inria

Inria contact: Radu Horaud

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

Website: https://team.inria.fr/perception/projects/erc-vhia/

7.1.2. VHIALab

Title: Vision and Hearing in Action Laboratory

EU framework: H2020

Type: ERC Proof of Concept

Duration: February 2018 - January 2019

Coordinator: Inria

Inria contact: Radu Horaud

The objective of VHIALab is the development and commercialization of software packages enabling a robot companion to easily and naturally interact with people. The methodologies developed in ERC VHIA propose state of the art solutions to human-robot interaction (HRI) problems in a general setting and based on audio-visual information. The ambitious goal of VHIALab will be to build software packages based on VHIA, thus opening the door to commercially available multi-party multi-modal human-robot interaction. The methodology investigated in VHIA may well be viewed as a generalization of existing single-user spoken dialog systems. VHIA enables a robot (i) to detect and to locate speaking persons, (ii) to track several persons over time, (iii) to recognize their behavior, and (iv) to extract the speech signal of each person for subsequent speech recognition and face-to-face dialog. These methods will be turned into software packages compatible with a large variety of companion robots. VHIALab will add a strong valorization potential to VHIA by addressing emerging and new market sectors. Industrial collaborations set up in VHIA will be strengthened.

7.2. International Research Visitors

7.2.1. Visits of International Scientists

- Professor Sharon Gannot, Bar Ilan University, Tel Aviv, Israel.
- Professor Tomislav Pribanic, University of Zagreb, Zagreb, Croatia.
- Doctor Christine Evers, Imperial College, London, United Kingdom.

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

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. LabEx Persyval, Project RHUM, "Robots in Human Environments"

Participants: Thierry Fraichard, Rémi Paulin, Patrick Reignier.

Partners: GIPSA, Inria, LIG, LJK and TIMC.
Dates:*[Sep. 15-Dec. 19]*.

The RHUM project from the LabEx Persyval (ANR-11-LABX-0025-01) brings together ten teams from different labs from the Grenoble academic scene: GIPSA, Inria, LIG, LJK and TIMC. Its goal is to tackle scientific problems related to active perception, navigation in human environments, learning and adaptation of robots behaviors for social interaction. PERVASIVE contributes to the navigation in human environments aspects.

9.1.2. ANR Project Involved

Participants: Amr Al-Zhouri Al-Yafi, Patrick Reignier.

Other Partners: UMR G-SCOP, UMR LIG (Persuasive Interaction, IIHM, Getalp), CEA Liten, PACTE, Vesta Systems and Elithis.

Dates: Jan 2015 to Dec 2018

The ANR project Involved focuses on bringing solutions to building actors for upcoming challenges in energy management in residential buildings. The project explores a user centric energy management system, where user needs and tacit knowledge drive the search of solutions. These are calculated using a flexible energy model of the living areas. The system is personified by energy consultants with which building actors such as building owners, building managers, technical operators but also occupants, can interact with in order to co-define energy strategies, benefiting of both assets: tacit knowledge of human actors, and measurement with computation capabilities of calculators. Putting actors in the loop, i.e. making energy not only visible but also controllable is the needed step before large deployment of energy management solutions.

The project will develop interactive energy consultants for all the actors, providing energy management aided systems embedding models in order to support the decision making processes. MIRROR (interactive monitoring), WHAT-IF (interactive quantitative simulation), EXPLAIN (interactive qualitative simulation), SUGGEST- AND-ADJUST (interactive management) and RECOMMEND (interactive diagnosis) functionalities will be developed.

9.1.3. ANR Project CEEGE: Chess Expertise from Eye Gaze and Emotion

Participants: James Crowley, Dominique Vaufreydaz, Rafaellea Balzarini, Thomas Guntz

Other Partners: Dept of NeuroCognition, CITEN, Bielefeld University

Dates: Jan 2016 to Dec 2019

CEEGE is a multidisciplinary scientific research project conducted by the Inria PRIMA team in cooperation with the Dept of Cognitive Neuroscience at the University of Bielefeld. The primary impacts will be improved scientific understanding in the disciplines of Computer Science and Cognitive NeuroScience. The aim of this project is to experimentally evaluate and compare current theories for mental modelling for problem solving and attention, as well as to refine and evaluate techniques for observing the physiological reactions of humans to situation that inspire pleasure, displeasure, arousal, dominance and fear.

In this project, we will observe the visual attention, physiological responses and mental states of subject with different levels of expertise solving classic chess problems, and participating in chess matches. We will observe chess players using eye-tracking, sustained and instantaneous face-expressions (micro-expressions), skin conductivity, blood flow (BVP), respiration, posture and other information extracted from audio-visual recordings and sensor readings of players. We will use the recorded information to estimate the mental constructs with which the players understand the game situation. Information from visual attention as well as physiological reactions will be used to determine and model the degree to which a player understands the game situation in terms of abstract configurations of chess pieces. This will provide a structured environment that we will use for experimental evaluation of current theories of mental modeling and emotional response during problem solving and social interaction.

The project is organized in three phases. During the first phase, we will observe individual players of different levels of chess expertise solving known chess problems. We will correlate scan-path from eye tracking and other information about visual attention to established configurations of pieces and known solutions to chess problems. This will allow us to construct a labeled corpus of chess play that can be used to evaluate competing techniques for estimating mental models and physiological responses. In a second phase, we will observe the attention and face expressions of pairs of players of different levels of chess ability during game play. In particular, we will seek to annotate and segment recordings with respect to the difficulty of the game situation as well as situations that elicit particularly strong physiological reactions. In the final phase, we will use these recordings to evaluate the effectiveness of competing techniques for mental modeling and observation of emotions in terms of their abilities to predict the chess abilities of players, game outcomes and individual moves and player self reports. Results of our work will be published in scientific conferences and journals concerned with cognitive science and cognitive neuroscience as well as computer vision, multimodal interaction, affective computing and pervasive computing. Possible applications include construction of systems that can monitor the cognitive abilities and emotional reactions of users of interactive systems to provide assistance that is appropriate but not excessive, companion systems that can aid with active healthy ageing, and tutoring systems that can assist users in developing skills in a variety of domains including chess.

9.1.4. CDP EcoSesa - Cross Disciplinary Project of the ComUE UGA

Participants: James Crowley, Patrick Reignier, Rafaellea Balzarini Dates: Jan 2017 to Dec 2020

Cities and their energy systems are undergoing profound transformations. Electric Power networks are being transformed from centralized, high capacity, generating plants, dimensioned to meet peak loads to decentralized, local, production based on intermittent renewable sources. This transformation is made possible by integration of information and energy technologies, new energy materials and components, and the rapid spread of pervasive computing. The result is a change in the socio-economics of energy distribution, and a change in the role of users from passive consumers to active participants in a dynamically fluctuating energy market. Many cities worldwide have initiated research projects and experiments to accelerate the spread of clean technologies. However, these initiatives generally focus on a specific issue that depends on the priorities and preferences of the local decision makers and stakeholders. At the same time, academic research has generally been confined to specialized silos in energy materials and management systems, in Social Sciences as well as in Information and Communication Technologies (ICT), resulting in piecemeal knowledge.

The vision of Eco-SESA is to address the problems resulting from the transition to clean decentralized energy production based on renewable sources with a holistic integrated humansystem approach. The project will address the development of Safe, Efficient, Sustainable and Accessible energy systems, from the individual end-user to dynamic communities of stakeholders at the district and grid levels.

Pervasive is involved in two research front of the project :

- Interactive systems to involve occupants of buildings
- Emerging behaviors from individual to communities

9.1.5. ANR VALET

Participant: Dominique Vaufreydaz.

Partners: Inria (Pervasive and Chroma teams for Inria Rhône-Alpes, RITS in Paris), Ircyyn (Nantes), AKKA (Paris)
Dates:*[2016-2018]*.

The ANR VALET project investigates two aspects of car sharing. In the first one, a novel approach for solving vehicle redistribution problem is proposed by managing an autonomous platoons guided by professional drivers. The second aspect concerns autonomous parking of shared cars when they arrived at their destination parking lot. In this project, our researches address the prediction of pedestrians' behaviors during urban fleet movements and during parking phases. The PhD student (Pavan Vashista) recruited in this project focus on integrating models of human behaviors to evaluate the risk that surrounding pedestrians encounter the trajectory of the VALET vehicles. His PhD thesis started in February 2016 is co-supervised by Anne Spalanzani (Chroma team) and Dominique Vaufreydaz.

9.1.6. ANR HIANIC

Participant: Dominique Vaufreydaz.

Partners: ARMEN and PACCE teams from LS2N laboratory (Nantes), Inria (Pervasive and Chroma teams for Inria Rhône-Alpes, RITS in Paris), MAGMA from LIG laboratory (Grenoble).
Dates:*[2018-2021]*.

The HIANIC project proposes to endow autonomous vehicles with smart behaviors (cooperation, negotiation, socially acceptable movements) to address problems that arise when autonomous cars are mixed with pedestrians in urban shared environment. It aims at developing new technologies in term of autonomous navigation in dense and human populated traffic. In order to contribute to urban safety and intelligent mobility, the HIANIC project also explores the complex problem of sociable interactions between pedestrians and cars while sharing the same urban environment.

In this project, Dominique Vaufreydaz works jointly with the Chroma team on perceiving pedestrians and their behaviors around autonomous cars and on interaction between autonomous vehicles and pedestrians.

9.1.7. LabEx Persyval - Project MicroBayes: Probabilistic Machines for Low-level Sensor Interpretation

Participants: Emmanuel Mazer, Raphael Frisch Other Partners: Laurent Girin (GIPSA Lab), Didier Piau (L'Institut Fourier)

Dates: Nov 2016 to Nov 2019

The project MicroBayes builds on results of the recently completed EC FET Open project BAMBI to explore a new technique for Blind source separation and acoustic signal location using a new form of Bayesian Computer. The techniques have recently been demonstrated using a software simulation. Current plans are to implement and demonstrate the Bayesian computer using an FPGA. By the end of the project we expect to produce a hardware implementation suitable for use in low-cost low-power applications.

9.1.8. Competitivity Clusters

James Crowley is on the scientific committee for the Minalogic Competitivity Cluster. Minalogic is the global innovation cluster for digital technologies serving France's Auvergne-Rhône-Alpes region. The Scientific Committee advises the pole of strategy, advises local industry in proposal preparation, reviews FUI project proposals, and makes recommendations about labelling and support of project proposals.

9.2. European Initiatives

9.2.1. H2020 Project AI4EU - ICT-26-2018 Artificial Intelligence

From February 2018 to Sept 2018, James Crowley has participated in the core writing team for the H2020 proposal AI4EU submitted to the call ICT-26-2018 Artificial Intelligence. The project proposal was submitted in April 2018. The consortium has been notified in September 2018 that the project has been accepted for funding, and will begin on 1 January 2019.

AI4EU will bring together European researchers, educators, entrepreneurs and socio-economic innovators around a shared, crowd-sourced, innovation ecosystem that lowers barriers for education, research and innovation through AI. This ecosystem will be constructed by federating existing national innovation platforms and their user communities wherever possible, and by completing this federation with new components, new services and new enabling technologies that respond to opportunities for innovation.

9.2.2. H2020 FET Flagship Humane AI

James Crowley has participated as part of the core team for the proposal to create a FET Flagship named Humane AI. The Humane AI Flagship will develop the scientific and technological foundations needed to shape the AI revolution in a direction that is beneficial to humans on both individual and social level and strictly adheres to European ethical values and social norms. The core concept is that of AI systems that understand and adapt to complex dynamic environments and social settings in order enhance human capabilities and empower people as individuals and the society as whole.

Following a successful 1st stage proposal submitted in 2017, the consortium was invited to submit a 2nd stage proposal in Sept. 2018. We have been notified in November that this 2nd stage proposal has been accepted for funding. The project is start date is proposed for March 2019.

9.3. International Initiatives

9.3.1. Participation in Other International Programs

Vietnam

International partnership with **HUST** (Hanoi University of Science and Technology), Vietnam Joint lab unit between Grenoble INP and HUST, with the support of CNRS: **International Research Institute MICA** (Multimedia, Information, Communication and Applications) – UMI 2954 of CNRS from January 2006 to March 2018.

- Eric Castelli: French director of UMI 2954 "MICA Institute", Vietnam, from 01 September 2001 to 5 February 2018
- Eric Castelli: now Adjunct Member of International Research Institute MICA, Vietnam (from June 2018)
- Eric Castelli: Responsible (and co-founder) of the International MASTER degree ACMI (Ambient Computing, Multimedia & Interactions), Hanoi University of Science and Technology (from January 2014 to June 2018)
- Eric Castelli: International scientific expert for the Vietnamese agency for research development NAFOSTED (National Foundation for Science and Technology Development), Ministry of Science and Technology, Vietnam (from 2015 to now)
- Eric Castelli: active participant to the bilateral French-Vietnam program PFIEV (Programme de Formation d'Ingénieurs d'Excellence au Vietnam), Grenoble INP is one of the main French partners.

Cambodia

International partnership with **ITC** (Institut de Technologie du Cambodge), Phnom Penh, Cambodia

- Eric Castelli: Member of the International Consortium of "Institut de Technologie du Cambodge (ITC)", Phnom Penh, Cambodia, representative of Hanoi University of Science and Technology (from 2008 to March 2018)
- Eric Castelli: Elected Member, representative of the International Consortium at the Administration Council of the "Institut de Technologie du Cambodge" (ITC), Phnom Penh, Cambodia (from 2014 to March 2018)

International partnership with **NIPTICT** (National Institute of Post and Telecoms, and Information Communication Technologies), Phnom Penh, Cambodia. NIPTICT Institute is under the authority of the Ministry of Posts and Telecommunications of Cambodia

- Eric Castelli: Scientific advisor for the Ministry of Posts and Telecommunications of Cambodia, for the creation of the research center CSSD (Computer Sciences for Social Development, a new research lab of NIPTICT)
- Eric Castelli: cowriter of the MELISSA international project, submitted to French AFD Agency (with NIPTICT (leader), NUOL, and HUST partners) in 2018 (1st submission) and 2019 (2nd submission)

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. IDEX UGA

Nicolas Gast received a grant from the IDEX UGA that funds a two-years post-doctoral researcher (Takai Kennouche) for two years (2018 and 2019) to work on the smart-grid project that focus on distributed optimization in electrical distribution networks.

Patrick Loiseau and Panayotis Mertikopoulos received a grant from the IDEX UGA that partly funds a PhD student (Benjamin Roussillon) to work on game theoretic models for adversarial classification.

9.2. National Initiatives

9.2.1. Inria Project Labs

Arnaud Legrand is the leader of the HAC SPECIS project. The goal of the HAC SPECIS (High-performance Application and Computers: Studying PErformance and Correctness In Simulation) project is to answer methodological needs of HPC application and runtime developers and to allow to study real HPC systems both from the correctness and performance point of view. To this end, we gather experts from the HPC, formal verification and performance evaluation community. Inria Teams: AVALON, POLARIS, MYRIADS, SUMO, HIEPACS, STORM, MEXICO, VERIDIS.

9.2.2. DGA Grants

Patrick Loiseau and Panayotis Mertikopoulos received a grant from DGA that complements the funding of PhD student (Benjamin Roussillon) to work on game theoretic models for adversarial classification.

9.2.3. PGMO Projects

PGMO projects are supported by the Jacques Hadamard Mathematical Foundation (FMJH). Our project (HEAVY.NET) is focused on congested networks and their asymptotic properties.

9.2.4. PEPS

Panayotis Mertikopoulos est co-PI of a PEPS I3A project: MixedGAN ("Mixed-strategy generative adversarial networks") (PI: R. Laraki, U. Dauphine).

9.2.5. Fondation Blaise Pascal

Project IAM (Informatique à la Main) funded by fondation Blaise Pascal (Jean-Marc Vincent).

9.2.6. ANR

- *ORACLESS (2016–2021)*
  ORACLESS is an ANR starting grant (JCJC) coordinated by Panayotis Mertikopoulos. The goal of the project is to develop highly adaptive resource allocation methods for wireless communication networks that are provably capable of adapting to unpredictable changes in the network. In particular, the project will focus on the application of online optimization and online learning methodologies to multi-antenna systems and cognitive radio networks.

- *CONNECTED (2016–2019)*
  CONNECTED is an ANR Tremplin-ERC (T-ERC) grant coordinated by Patrick Loiseau. The goal of the project is to work on several game-theoretic models involving learning agents and data revealed by strategic agents in response to the learning algorithms, so as to derive better learning algorithms for such special data.

9.3. International Initiatives

9.3.1. Inria International Labs

The POLARIS team is involved in the JLESC (Joint Laboratory for Extreme-Scale Computing) with University of University of Illinois Urbana Champaign, Argonne Nat. Lab and BSC.

9.3.2. Participation in Other International Programs

- *LICIA:* The CNRS, Inria, the Universities of Grenoble, Grenoble INP, and Universidade Federal do Rio Grande do Sul have created the LICIA (*Laboratoire International de Calcul intensif et d'Informatique Ambiante*). LICIA's main research themes are high performance computing, language processing, information representation, interfaces and visualization as well as distributed systems. Jean-Marc Vincent is the director of the laboratory on the French side and visited Porto Alegre for three weeks in November 2018.

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

- *GENE*: Stochastic dynamics of large games and networks. This is a joint project (2018 - 2019) with Universidad de Buenos Aires, Argentina (Matthieu Jonckheere), Universidad de la Republica Uruguay (Federico La Rocca), CNRS (Balakrishna Prabhu) and Universidad ORT Uruguay (Andrés Ferragut).

  Through the creation and consolidation of strong research and formation exchanges between Argentina, France and Uruguay, the GENE project will contribute to the fields of performance evaluation and control of communication networks, using tools of game theory, probability theory and control theory. Some of the challenges this project will address are: (1) Mean-field games and their application to load balancing and resource allocations, (2) Scaling limits for centralized and decentralized load balancing strategies and implementation of practical policies for web servers farms, (3) Information diffusion and communication protocols in large and distributed wireless networks.

- *LEARN*: Learning algorithms for games and applications (2016-2018). POLARIS is a member of the Franco-Chilean collaboration network LEARN with CONICYT (the Chilean national research agency), formed under the ECOS-Sud framework. The main research themes of this network is the application of continuous optimization and game-theoretic learning methods to traffic routing and congestion control in data networks. Panayotis Mertikopoulos was an invited researcher at the University of Chile in October 2016.

  More information can be found at http://www.conicyt.cl/pci/2016/02/11/programa-ecos-conicyt-adjudica-proyectos-para-el-ano-2016.

9.4. International Research Visitors

9.4.1. Visits to International Teams

9.4.1.1. Research Stays Abroad

Panayotis Mertikopoulos was a visiting scientist at UC Berkeley / Simons Institute for the Theory of Computing (Feb.-March 2018) and a visiting scientist at U Athens / STSM in the framework of the EU COST Action GAMENET (Apr. - May 2018).

Jean-Marc Vincent is the director of Licia (Laboratoire de Calcul Intensif et d'Informatique Ambiante) and stayed 20 days at Porto Alegre to teaching and nurture research collaborations.

<div align="center" style="color:red">**PRIVATICS Project-Team**</div>

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.

7.2. National Initiatives

7.2.1. FUI

Title: ADAGE (Anonymous Mobile Traffic Data Generation).

Type: FUI.

Duration: July 2016 - September 2018.

Coordinator: Orange.

Others partners: Inria, CNRS LAAS.

Abstract: The project ADAGE aims at developping solutions for the anonymization of mobility traces produced by mobile operators.

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 Innovation Laboratory

Title: LEELCO (Low End-to-End Latency COmmunications).

Duration: 3 years (2015 - 2018).

Coordinator: Inria PRIVATICS.

Others partners: Expway.

Abstract:

This Inria Innovation Lab aims at strengthening Expway (http://www.expway.com/) commercial offer with technologies suited to real-time data transmissions, typically audio/video flows. In this context, the end-to-end latency must be reduced to a minimum in order to enable a high quality interaction between users, while keeping the ability to recover from packet losses that are unavoidable with wireless communications in harsh environments. In this collaboration we focus on new types of Forward Erasure Correction (FEC) codes based on a sliding encoding windows, and on the associated communication protocols, in particular an extension to FECFRAME (RFC6363) to such FEC codes. The outcomes of this work are proposed to both IETF and 3GPP standardisation organisations, in particular in the context of 3GPP mission critical communication services activity. The idea of this 3GPP activity is to leverage on the 3GPP Evolved Multimedia Broadcast Multicast Services (eMBMS) and on the existing Long Term Evolution (LTE) infrastructure for critical communications and such services as group voice transmissions, live high-definition video streams and large data transmissions. In this context, the advanced FEC codes studied in LEELCO offer a significant improvement both from the reduced latency and increased loss recovery viewpoints compared to the Raptor codes included in the existing standard (https://hal.inria.fr/hal-01571609v1/en/).

7.2.4. Inria CNIL project

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. COPES

Title: COnsumer-centric Privacy in smart Energy gridS

Programm: CHISTERA

Duration: December 2015 - december 2018

Coordinator: KTH Royal Institute of Technology

Inria contact: Cédric Lauradoux

Smart meters have the capability to measure and record consumption data at a high time resolution and communicate such data to the energy provider. This provides the opportunity to better monitor and control the power grid and to enable demand response at the residential level. This not only improves the reliability of grid operations but also constitutes a key enabler to integrate variable renewable generation, such as wind or solar. However, the communication of high resolution consumption data also poses privacy risks as such data allows the utility, or a third party, to derive detailed information about consumer behavior. Hence, the main research objective of COPES is to develop new technologies to protect consumer privacy, while not sacrificing the "smartness", i.e.,

advanced control and monitoring functionalities. The core idea is to overlay the original consumption pattern with additional physical consumption or generation, thereby hiding the consumer privacy sensitive consumption. The means to achieve this include the usage of storage, small scale distributed generation and/or elastic energy consumptions. Hence, COPES proposes and develops a radically new approach to alter the physical energy flow, instead of purely relying on encryption of meter readings, which provides protection against third party intruders but does not prevent the use of this data by the energy provider.

7.3.1.2. 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."

7.4. 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

- Sébastien Gambs visited the team in Lyon in April 2018 for a week to initiate the DATA collaboration. We also organized a workshop in data and algorithmic transparency during this week.

- Gergely Acs, assistant professor at Budapest University (Hungary), visited our team for 2 months, from mi-May to mid-July. He worked together with Claude Castelluccia on machine learning (in)security. In particular, he studied how adversarial examples can be used to evade monitoring, and consequently improve privacy.

<div align="center">

ROMA Project-Team

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9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. PhD grant laboratoire d'excellence MILYON-Mumps consortium

The doctoral program from Labex MILYON dedicated to applied research in collaboration with industrial partners funded 50% of a 3-year PhD grant (the other 50% being funded by the MUMPS consortium) to work on improvements of the solution phase of the MUMPS solver. The PhD aimed at answering industrial needs in application domains where the cost of the solution phase of sparse direct solvers is critical. The PhD was defended on December 10, 2018 [2].

9.2. National Initiatives

9.2.1. ANR

ANR Project SOLHAR (2013-2018), 4,5 years. The ANR Project SOLHAR was launched in November 2013, for a duration of 48 months. It gathers five academic partners (the HiePACS, Cepage, ROMA and Runtime Inria project-teams, and CNRS-IRIT) and two industrial partners (CEA/CESTA and EADS-IW). This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computers equipped with accelerators.

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

9.3. International Initiatives

9.3.1. Inria International Labs

9.3.1.1. JLESC — Joint Laboratory on Extreme Scale Computing

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

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

Several members of the ROMA team are involved in the JLESC joint lab through their research on scheduling and resilience. Yves Robert is the Inria executive director of JLESC.

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

9.3.2.1. Keystone

Title: Scheduling algorithms for sparse linear algebra at extreme scale

International Partner (Vanderbilt University - Department of Electrical Engineering and Computer Science - Padma Raghavan):

Start year: 2016

See also: http://graal.ens-lyon.fr/~abenoit/Keystone

The Keystone project aims at investigating sparse matrix and graph problems on NUMA multicores and/or CPU-GPU hybrid models. The goal is to improve the performance of the algorithms, while accounting for failures and trying to minimize the energy consumption. The long-term objective is to design robust sparse-linear kernels for computing at extreme scale. In order to optimize the performance of these kernels, we plan to take particular care of locality and data reuse. Finally, there are several real-life applications relying on these kernels, and the Keystone project is assessing the performance and robustness of the scheduling algorithms in applicative contexts.

9.3.3. Inria International Partners

9.3.3.1. Declared Inria International Partners

- Anne Benoit, Frederic Vivien and Yves Robert have a regular collaboration with Henri Casanova from Hawaii University (USA). This is a follow-on of the Inria Associate team that ended in 2014.

9.3.4. Cooperation with ECNU

ENS Lyon has launched a partnership with ECNU, the East China Normal University in Shanghai, China. This partnership includes both teaching and research cooperation.

As for teaching, the PROSFER program includes a joint Master of Computer Science between ENS Rennes, ENS Lyon and ECNU. In addition, PhD students from ECNU are selected to conduct a PhD in one of these ENS. Yves Robert is responsible for this cooperation. He has already given two classes at ECNU, on Algorithm Design and Complexity, and on Parallel Algorithms, together with Patrice Quinton (from ENS Rennes).

As for research, the JORISS program funds collaborative research projects between ENS Lyon and ECNU. Anne Benoit and Minsong Chen are leading a JORISS project on scheduling and resilience in cloud computing. Frédéric Vivien and Jing Liu (ECNU) are leading a JORISS project on resilience for real-time applications. In the context of this collaboration two students from ECNU, Li Han and Changjiang Gou, have joined Roma for their PhD.

9.4. International Research Visitors

9.4.1. Visits to International Teams

9.4.1.1. Research Stays Abroad

- Yves Robert has been appointed as a visiting scientist by the ICL laboratory (headed by Jack Dongarra) at the University of Tennessee Knoxville since 2011. He collaborates with several ICL researchers on high-performance linear algebra and resilience methods at scale.

- Anne Benoit and Bora Uçar visited the School of Computational Science and Engineering Georgia Institute of Technology, Atlanta, GA, USA. During their stay August 2017–June 2018, they worked with the research group of Prof. Umit V. Çatalyürek.

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Equipex FIT- Future Internet of Things

The FIT projet is a national equipex (*equipement d'excellence*), headed by the Lip6 laboratory. As a member of Inria, Socrate is in charge of the development of an Experimental Cognitive Radio platform that is used as test-bed for SDR terminals and cognitive radio experiments. This has been operational since 2014 and is maintained for a duration of 7 years. To give a quick view, the user will have a way to configure and program through Internet several SDR platforms (MIMO, SISO, and baseband processing nodes).

8.1.2. Insa-Spie IoT Chair

The Insa-Spie IoT Chair http://www.citi-lab.fr/chairs/iot-chair/ relies on the expertise of the CITI Lab. The skills developed within the different teams of the lab integrate the study, modelling, conception and evaluation of technologies for communicating objects and dedicated network architectures. It deals with network, telecom and software matters as well as societal issues such as privacy. The chair will also lean on the skills developed at INSA Lyon or in IMU LabEx.

8.1.3. Inria Project Lab: ZEP

The ZEP project addresses the issue of designing tiny computing objects with no battery by combining non-volatile memory (NVRAM), energy harvesting, micro-architecture innovations, compiler optimizations, and static analysis. The main application target is Internet of Things (IoT) where small communicating objects will be composed of this computing part associated to a low-power wake-up radio system. The ZEP project gathers four Inria teams that have a scientific background in architecture, compilation, operating system and low power together with the CEA Lialp and Lisan laboratories of CEA LETI & LIST. The major outcomes of the project will be a prototype harvesting board including NVRAM and the design of a new microprocessor associated with its optimizing compiler and operating system.
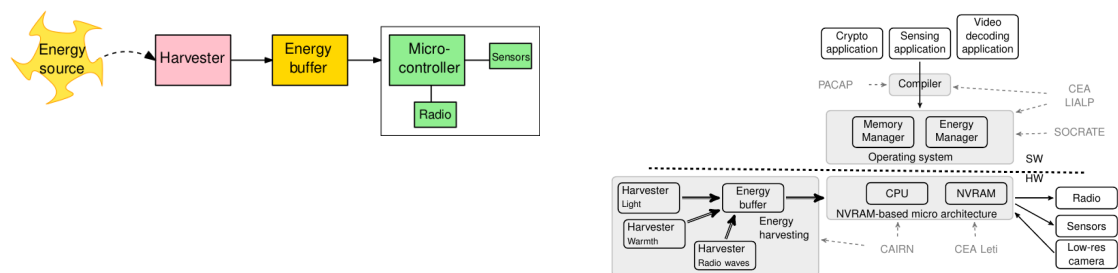

Figure 4. Example of system targeted by the ZEP project on the left, and on the right: the ZEP research program.

The scientific work (in progress) is organized around three fields :
- specific NVRAM-based architecture
- dedicated compiler pass that computes a worst-case energy consumption
- operating system managing NVRAM and energy, ensuring memory consistency across power outages

The project is illustrated by the figure 4 , where PACAP, SOCRATE, CORSE, and CAIRN are the teams involved in the project.

Another important goal of the project is to structure the research and innovation that should occur within Inria to prepare the important technological shift brought by NVRAM technologies.

8.1.4. ANR - Imprenum

The objective of this project (INSA-Lyon, École Normale Supérieure de Lyon, CEA LETI) is to promote **accuracy as a first class concern** in all the levels of a computing system:

- at the hardware level, with better support for lower-than-standard and higher-than-standard precisions;

- at the level of run-time support software, in particular answering the memory management challenges entailed by adaptive precision;

- at the lower level of mathematical libraries (kernel level), for instance BLAS for linear algebra, enhancing well established libraries with precision and accuracy control;

- at the higher level of mathematical libraries (solver level, including algebraic linear solvers such as LAPACK, ad hoc steppers for Ordinary Differential Equation, eigenvalues kernels, triangularization problems for computational geometry, etc.) Here, accuracy and precision control of the lower levels should enable higher-level properties such as convergence and stability;

- at the compiler level, enhancing optimising compilers with novel optimisations related to precision and accuracy;

- at the language level, embedding accuracy specification and control in existing languages, and possibly defining domain-specific languages with accuracy-aware semantics for some classes of applications.

8.1.5. ADT CorteXlab

The Socrate project-team is in charge of the FIT/CorteXlab platform. This platform (ADT Inria 2015-2017) makes use of many complex technologies from signal processing to computer science through micro-electornics and FPGA. The objectiv of the CorteXlab ADT is to maintain a support to the user of the FPGA-based platform of CorteXlab and to provide tutorial and running experiment that will help them in builing experimentation using the PicoSDR machines.

8.1.6. ANR - Ephyl

The general objective of the project EPHYL - "Enhanced PHY for Cellular Low Power Communication IoT" (2016-2019, 183 keuros) is to investigate coming and future LPWA technologies with the aim to improve coverage, data rate and connectivity while keeping similar level of complexity and power consumption at the node for the access. New waveforms enablers will be investigated and trialled in order to increase the efficiency of future systems and to provide efficient and fair access to the radio resource. The proposed new waveforms should comply with system constraints and with the coexistence of multiple communications.

8.1.7. ANR - Arburst

In this project Arburst - "Achievable region of bursty wireless networks" (2016-2020, 195 KEuros), we propose an original approach complementary to other existing projects. Instead of proposing one specific technical solution, our objective is to define a unified theoretical framework devoted to the study of IoT networks fundamental limits. We aim at establishing the fundamental limits for a decentralized system in a bursty regime which includes short packets of information and impulsive interference regime. We are targeting the fundamental limits, their mathematical expression (according to the usual information theory framework capturing the capacity region by establishing a converse and achievability theorems). We will use the recent results relative to finite block-length information theory and we will evaluate the margin for improvement between existing approaches and these limits and we will identify the scientific breakthrough that may bring significant improvements for IoT/M2M communications. This project will contribute to draw the roadmap

for the development of IoT/M2M networks and will constitute a unified framework to compare existing techniques, and to identify the breakthrough concepts that may afford the industry the leverage to deploy IoT/M2M technical solutions.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. COM-MED

Title: COMMunication systems with renewable Energy micro-griD

Programm: H2020

Duration: October 2016 - October 2019

Coordinator: Inria

Inria contact: Samir M. Perlaza

A smart micro-grid is a small-scale power-grid system consisting of a number of distributed energy sources and loads which is responsible to ensure power sufficiency in a small area. The effectiveness of a smart micro-grid depends on the proper implementation of a communications and networking system which monitors, controls and manages the grid's operations. Due to the ever growing worldwide energy consumption, the need of an efficient framework for managing the way power is distributed and utilized has increased. The main objective of the project COM-MED is to study the fundamental interplay between communications and power networks in the context of smart micro-grids and renewable energy sources. On one hand, we study advanced signal processing techniques and communications methods to optimize the operation of smart micro-grid systems. On the other hand, we focus on mobile communications networks with renewable energy base-stations (BSs) and we investigate communications and networking techniques that take into account both data traffic and energy profiles to support high quality-of-service (QoS). The objectives of each technical WP have been assigned in such a way as to ensure that the project's target is realized during the project's time period. The theoretical results derived from the WPs 3, 4 and 5 will be tested using the telecommunication network of MTN in Cyprus but also the state-of-the-art equipment of the CITI/Inria research lab in France. The outcome of this project will provide a theoretical framework for the optimal cooperation between communications networks and power networks in the context of smart micro-grids and renewable energy sources. This is in line with the objectives of the call's theme "Renewable Energy" and is of paramount importance for the Mediterranean area. The consortium of the project has the expertise and the infrastructure to implement the objectives set and to bring the project to a successful end.

8.2.2. Collaborations in European Programs, Except FP7 & H2020

Socrate is very active in COST IRACON CA15104: Guillaume Villemaud is National Delegate (Alt.) and FIT/CorteXlab is identify as one of the COST platform: .

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

Socrate has strong collaborations with several international partners.

- **Princeton University**, School of Applied Science, Department of Electrical Engineering, NJ. USA. This cooperation with Prof. H. Vincent Poor is on topics related to decentralized wireless networks. Samir M. Perlaza has been appointed as Visiting Research Collaborator at the EE Department for the academic period 2016-2017. Scientific-Leaders at Inria: Samir M. Perlaza and Jean-Marie Gorce.

- **Technical University of Berlin**, Dept. of Electrical Engineering and Computer Science, Germany. This cooperation with Prof. Rafael Schaffer is on secrecy and covert communications. Scientific-Leaders at Inria: Samir M. Perlaza.

- **National University Singapore (NUS)**, Department of Electrical and Computer Engineering, Singapore. This collaboration with Prof. Vincent Y. F. Tan is on the study of finite block-length transmissions in multi-user channels and the derivation of asymptotic capacity results with non-vanishing error probabilities. Scientific-Leaders at Inria: Samir M. Perlaza

- **University of Sheffield**, Department of Automatic Control and Systems Engineering, Sheffield, UK. This cooperation with Prof. Inaki Esnaola is on topics related to information-driven energy systems and multi-user information theory. Scientific-in-charge at Inria: Samir M. Perlaza.

- **Rutgers University**, Winlab, Orbit testbed. This cooperation with Ivan Seskar is related to experimental wireless testbed. Orbit has been one of the first wireless testbeds of its type. Tanguy Risset and Leonardo Sampaio-Cardoso have visited Winlab and I. Seskar visited the Socrate team for one week. Their collaboration is on the development of tools to ease experiment handling on wireless testbeds: visualisation, synchronization etc. Scientific-Leader at Inria: Tanguy Risset

- **University of Arizona**, Department of Electrical and Computer Engineering, Tucson, AZ, USA. This cooperation with Prof. Ravi Tandon is on topics related to channel-output feedback in wireless networks. Scientific-Leader at Inria: Samir M. Perlaza.

- **University of Cyprus**, Department of Electrical and Computer Engineering, University of Cyprus, Nicosia, Cyprus. This cooperation with Prof. Ioannis Krikidis is on topics related to energy-harvesting and wireless communications systems. Scientific-Leaders at Inria: Guillaume Villemaud and Samir M. Perlaza.

- **Universidade Federal do Ceará**, GTEL, Departamento de Teleinformática, Fortaleza, Brazil. This recently started cooperation with Prof. Tarcisio Ferreira Maciel is on topics related to the optimization of radio ressources for massive MIMO in 5G and 5G-like wireless communications systems. Scientific-in-charge at Inria: Leonardo Sampaio-Cardoso.

- **Universidad Nacional del Sur**, LaPSyC laboratory, Bahía Blanca , Argentina. This cooperation with Prof. Juan Cousseau is on topics related to Full-Duplex communications and Interference Alignment. Scientific-in-charge at Inria: Guillaume Villemaud.

- **Bell Labs New Jersey, USA**, This cooperation with Prof. Antonia Tulino (affiliated to Bell Labs and to University of Napoli, Italy) is on caching in wireless networks. The objective is to demonstrate the efficiency of caching at the edge of wireless networks through experimentations on CorteXlab. This work will be published in 2017 in a special issue of IEEE Communication magazine (Yasser Fadlallah, Antonia M. Tulino, Dario Barone, Giuseppe Vettigli, Jaime Llorca and Jean-Marie Gorce: Coding for caching in 5G networks, IEEE Communication Magazine, 2017, accepted for publication). Scientific leader at Inria : Jean-Marie Gorce.

- **Technical University "Gh. Asachi" of Iasi, Romania**, Department of Electronics, Telecommunications and Information Technology. This recent collaboration has started on topics related on the theoretical aspects of the ultra-low power radio communications. Scientific-in-charge at Inria: Florin Hutu

- **Queen's University Belfast**, UK. This collaboration is on molecular communication and massive MIMO with Prof. Trung Q. Duong. Scientific-in-charge at Inria: Malcolm Egan

- **Czech Technical University in Prague**, Czech Republic. This collaboration is on optimisation methods related to machine learning with Dr. Vyacheslav Kungurtsev. Scientific-in-charge at Inria: Malcolm Egan

- **TUMCREATE**, Singapore. This collaboration is on signal processing in communications with Dr. Ido Nevat. Scientific-in-charge at Inria: Malcolm Egan

- **telecommunications department of UMNG (Universidad Militar de Nueva Granada), Bogota, Colombia. Ongoing collaboration on security for GSM networks using deep learning. Scientific-in-charge at Inria: Leonardo Sampaio-Cardoso.**

8.4. International Research Visitors

8.4.1. Visits from International Teams

- Prof. Edward Guillen and his joint PhD student with Leonardo Sampaio-Cardoso, José Rugeles, came to Lyon in June 2018 for a 1-month academic stay, to develop work on FIT/CorteXlab for the security for GSM networks using deep learning project

8.4.2. Visits to International Teams

8.4.2.1. Sabbatical programme

Samir M. Perlaza has been on Sabatical year at Princeton University up to septembre 2018.

Malcolm Egan has been a visiting research collaborator in Prof. Poor's group in Princeton University March-April 2018.

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

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CASERM (PERSYVAL-Lab project)
Participants: Pascal Fradet, Alain Girault, Gregor Goessler, Xiaojie Guo, Maxime Lesourd, Xavier Nicollin, Stephan Plassart, Sophie Quinton, Jean-Bernard Stefani, Martin Vassor.

Despite recent advances, there exists currently no integrated formal methods and tools for the design and analysis of reconfigurable multi-view embedded systems. This is the goal of the CASERM project.

The CASERM project represents a significant effort towards a COQ-based design method for reconfigurable multi-view embedded systems, in order to formalize the structure and behavior of systems and to prove their main properties. The use of a proof assistant to support such a framework is motivated by the fact that the targeted systems are both extremely complex and critical. The challenges addressed are threefold:

1. to model software architectures for embedded systems taking into account their dynamicity and multiple constraints (functional as well as non functional);
2. to propose novel scheduling techniques for dynamically reconfiguring embedded systems; and
3. to advance the state of the art in automated proving for such systems.

The objectives of CASERM that address these challenges are organized in three tasks. They consist respectively in designing an architecture description framework based on a process calculus, in proposing online optimization methods for dynamic reconfiguration systems (this is the topic of Stephan Plassart's PhD), and in developing a formal framework for real-time analysis in the COQ proof assistant (this is the topic of Xiaojie Guo's and Maxime Lesourd's PhD). A fourth task focuses on common case studies for the evaluation of the obtained results.

The CASERM consortium gathers researchers from the LIG and VERIMAG laboratories who are reknowned specialists in these fields. The project started in November 2016 and will last three years.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. RT-Proofs
Participants: Pascal Fradet, Xiaojie Guo, Maxime Lesourd, Sophie Quinton.

RT-Proofs is an ANR/DFG project between Inria, MPI-SWS, Onera, TU Braunschweig and Verimag, running from 2018 until 2020.

The overall objective of the RT-Proofs project is to lay the foundations for computer-assisted formal verification of timing analysis results. More precisely, the goal is to provide:

1. a strong formal basis for schedulability, blocking, and response-time analysis supported by the Coq proof assistant, that is as generic, robust, and modular as possible;
2. correctness proofs for new and well-established generalized response-time analysis results, and a better, precise understanding of the role played by key assumptions and formal connections between competing analysis techniques;
3. an approach for the generation of proof certificates so that analysis results – in contrast to analysis tools – can be certified.

8.2.1.2. DCore

Participants: Gregor Goessler, Jean-Bernard Stefani.

DCORE is an ANR project between Inria project teams ANTIQUE, FOCUS and SPADES, and the IRIF lab, running from 2019 to 2023.

The overall objective of the project is to develop a semantically well-founded, novel form of concurrent debugging, which we call *causal debugging*, that aims to alleviate the deficiencies of current debugging techniques for large concurrent software systems. The causal debugging technology developed by DCORE will comprise and integrate two main novel engines:

1. *a reversible execution engine* that allows programmers to backtrack and replay a concurrent or distributed program execution, in a way that is both precise and efficient (only the exact threads involved by a return to a target anterior or posterior program state are impacted);
2. a *causal analysis engine* that allows programmers to analyze concurrent executions, by asking questions of the form "what caused the violation of this program property?", and that allows for the precise and efficient investigation of past and potential program executions.

8.2.2. Institute of Technology (IRT)

8.2.2.1. CAPHCA

Participants: Alain Girault, Nicolas Hili.

CAPHCA is a project within the Antoine de Saint Exupéry IRT. The general objective of the project is to provide methods and tools to achieve performance and determinism on modern, high-performance, multi-core and FPGA-enabled SOCs. Our specific contribution lies withing work pakacges dedicated to the design of novel PRET architectures and programming languages (see Section 6.2.1).

8.3. European Initiatives

8.3.1. Collaborations in European Programs, Except FP7 & H2020

> Program: Celtic-Plus
> Project acronym: SENDATE
> Project title: Secure Networking for a Data center cloud in Europe
> Duration: April 2016 - March 2019
> Coordinator: Nokia France
> Other partners: Nokia, Orange, IMT, Inria
> Abstract: The SENDATE project aims to develop a clean-slate architecture for converged telecommunications networks and distributed data centers supporting 5G cellular networks and the needs from the Industrial Internet and the Internet of Things. It aims to provide scientific and technical solutions for intra and inter data centres security, control, management and orchestration, placement and management of virtual network functions, as well as high-speed transport networks for data centers access and interconnection.

8.3.2. Collaborations with Major European Organizations

We have a strong collaboration with the Technische Universität Braunschweig in Germany. In particular, Sophie Quinton is involved in the CCC project (http://ccc-project.org/) to provide methods and mechanisms for the verification of software updates after deployment in safety-critical systems, and in the TypicalCPA project which aims at computing deadline miss models for distributed systems.

We also have a recent collaboration with the MPI-SWS in Kaiserslautern (Germany) on formal proofs for real-time systems. This collaboration will be concretized by an ANR-PRCI project called RT-PROOFS starting in 2018, which involves MPI-SWS, TU Braunschweig, Inria, and Onera.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Ismail Assayad (from U. Casablanca, Morocco) visited the team for one month in September 2018, to work on a two layer adaptive scheduling method.

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. QAMECS / MOBIL'AIR : ATMOSPHERIC POLLUTION: Characterization of novel exposure markers, of biological, health, economic and societal impacts and evaluation of public policies

Project funded by ADEME, Grenoble metropolis, IDEX Université Grenoble Alpes
Duration: 2016 – 2022
Project coordinator : Remy Slama (INSERM) and Sandrine Mathy (GAEL, CNRS). Inria Coordinator: Emmanuel Prados
Other partners: Air Rhône-Alpes, CNRS, Sciences Po Grenoble, Inserm, IAB, Université Grenoble-Alpes
Abstract: Urban atmospheric pollution is one of the main threats to human health that can be to some extent controlled by public action. In Europe, many cities have implemented various types of low emission zones (LEZ, focused on traffic and heating emissions), France being a notable exception. Although fine particulate matter (PM2.5) is usually assessed through its mass concentration, other metrics, such as PM chemical speciation as well as the so far little considered oxidative potential (OP) of PM, are worth considering, both in terms of associations with human health and in the context of monitoring of the efficiency of LEZ. QAMECS covers all dimensions from atmospheric emissions, impact of meteorological conditions on air pollution human behaviours related to transportation, environmental levels, health, associated economic costs and societal awareness. The project relies on environmental measurements, modelling, repeated observational (representative) population studies, an existing mother-child cohort, a controlled human experiment, health impact and related economic assessment. It is conducted by a consortium of specialists of chemistry and physics of air pollution, economics, sociology, epidemiology, geography, in relation with local authorities. It will bring results important for urban planning, public health, and more fundamental research on the measurement of PM and assessment of their biological and health impact.

7.2. National Initiatives

7.2.1. AF Filières : Analyse des Flux des Filières biomasse pour des stratégies régionales de bioéconomie

Project funded by ADEME
Duration: 2017-2019
Coordinator: Jean-Yves COURTONNE (Equipe STEEP, Inria) [Emmanuel Prados (STEEP/Inria) for Inria partner]
Other partners: Equipe STEEP, Inria, Grenoble Rhônalpénergie-Environnement (RAEE), Lyon Laboratoire d'Economie Forestière (LEF), INRA / AgroParisTech Nancy.
Keywords: Environmental assessment, Ecological accounting, Material Flow Analysis, Sustainable supply chains, Multicriteria analysis.
Abstract: Flow analyses of biomass supply chains for regional bioeconomy policies. The goals of the project are the following:

- Improve knowledge on the material flows of the forest-wood and agri-food supply chains in France at national and regional levels,

- Provide a holistic vision of the situation by associating environmental and socio-economic indicators to material flows,

- Provide a more precise assessments (quantitatively and qualitatively) in the case of the Auvergne-Rhône-Alpes region.

THOTH Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. DeCore (Deep Convolutional and Recurrent networks for image, speech, and text)
Participants: Jakob Verbeek, Maha Elbayad.

DeCore is a project-team funded by the Persyval Lab for 3.5 years (september 2016 - February 2020), coordinated by Jakob Verbeek. It unites experts from Grenoble's applied-math and computer science labs LJK, GIPSA-LAB and LIG in the areas of computer vision, machine learning, speech, natural language processing, and information retrieval. The purpose of DeCore is to stimulate collaborative interdisciplinary research on deep learning in the Grenoble area, which is likely to underpin future advances in machine perception (vision, speech, text) over the next decade. It provides funding for two full PhD students. Maha Elbayad is one of them, supervised by Jakob Verbeek and Laurant Besacier (LIG, UGA).

9.1.2. PEPS AMIES AuMalis POLLEN
Participant: Karteek Alahari.

This is a collaborative project with POLLEN, a startup in the Grenoble area, which develops POLLEN Metrology, a software editor specialized in signal processing, hybrid metrology and machine learning for the automatic processing of heterogeneous data. This funding supports a postdoc to accelerate the introduction of artificial intelligence, and in particular computer vision, techniques, into the manufacture of new generation of microprocessors. Karteek Alahari and Valerie Perrier (LJK, UGA) jointly supervise a postdoc as part of this collaboration.

9.2. National Initiatives

9.2.1. ANR Project Macaron
Participants: Julien Mairal, Zaid Harchaoui [Univ. Washington], Laurent Jacob [CNRS, LBBE Laboratory], Michael Blum [CNRS, TIMC Laboratory], Joseph Salmon [Telecom ParisTech], Mikita Dvornik, Thomas Dias-Alves, Daan Wynen.

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

This is a 4 years and half project, funded by ANR under the program "Jeunes chercheurs, jeunes chercheuses", which started in October 2014. The principal investigator is Julien Mairal.

9.2.2. ANR Project DeepInFrance
Participants: Jakob Verbeek, Adria Ruiz Ovejero.

DeepInFrance (Machine learning with deep neural networks) project also aims at bringing together complementary machine learning, computer vision and machine listening research groups working on deep learning with GPUs in order to provide the community with the knowledge, the visibility and the tools that brings France among the key players in deep learning. The long-term vision of Deep in France is to open new frontiers and foster research towards algorithms capable of discovering sense in data in an automatic manner, a stepping stone before the more ambitious far-end goal of machine reasoning. The project partners are: INSA Rouen, Univ. Caen, Inria, UPMC, Aix-Marseille Univ., Univ. Nice Sophia Antipolis.

9.2.3. ANR Project AVENUE

Participant: Karteek Alahari.

This new ANR project (started in October 2018) aims to address the perception gap between human and artificial visual systems through a visual memory network for human-like interpretation of scenes. To this end, we address three scientific challenges. The first is to learn a network representation of image, video and text data collections, to leverage their inherent diverse cues. The second is to depart from supervised learning paradigms, without compromising on the performance. The third one is to perform inference with the learnt network, e.g., to estimate physical and functional properties of objects, or give cautionary advice for navigating a scene. The principal investigator is Karteek Alahari, and the project involves participants from CentraleSupelec and Ecole des Ponts in Paris.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. ERC Advanced grant Allegro
Participants: Cordelia Schmid, Pavel Tokmakov, Konstantin Shmelkov, Vladyslav Sydorov, Daan Wynen, Mikita Dvornik, Xavier Martin.

The ERC advanced grant ALLEGRO started in April 2013 and will end in April 2019. The aim of ALLEGRO is to automatically learn from large quantities of data with weak labels. A massive and ever growing amount of digital image and video content is available today. It often comes with additional information, such as text, audio or other meta-data, that forms a rather sparse and noisy, yet rich and diverse source of annotation, ideally suited to emerging weakly supervised and active machine learning technology. The ALLEGRO project will take visual recognition to the next level by using this largely untapped source of data to automatically learn visual models. We will develop approaches capable of autonomously exploring evolving data collections, selecting the relevant information, and determining the visual models most appropriate for different object, scene, and activity categories. An emphasis will be put on learning visual models from video, a particularly rich source of information, and on the representation of human activities, one of today's most challenging problems in computer vision.

9.3.1.2. ERC Starting grant Solaris
Participants: Julien Mairal, Ghislain Durif, Andrei Kulunchakov, Alberto Bietti, Dexiong Chen, Gregoire Mialon.

The project SOLARIS started in March 2017 for a duration of five years. The goal of the project is to set up methodological and theoretical foundations of deep learning models, in the context of large-scale data processing. The main applications of the tools developed in this project are for processing visual data, such as videos, but also structured data produced in experimental sciences, such as biological sequences.

The main paradigm used in the project is that of kernel methods and consist of building functional spaces where deep learning models live. By doing so, we want to derive theoretical properties of deep learning models that may explain their success, and also obtain new tools with better stability properties. Another work package of the project is focused on large-scale optimization, which is a key to obtain fast learning algorithms.

9.4. International Initiatives

9.4.1. Inria International Labs

Inria@EastCoast

Associate Team involved in the International Lab:

9.4.1.1. GAYA

Title: Semantic and Geometric Models for Video Interpretation

International Partner (Institution - Laboratory - Researcher):

Carnegie Mellon University (United States) - Robotics Institute - Deva Ramanan

Start year: 2016

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

We propose to form an associate team GAYA, with the primary goal of interpreting videos in terms of recognizing actions, understanding the human-human and human-object interactions. Despite several years of research, it is yet unclear what is an efficient and robust video representation to attack this challenge. In order to address this, GAYA will focus on building semantic models, wherein we learn the video feature representation with limited supervision, and also geometric models, where we study the geometric properties of object shapes to better recognize them. The team consists of researchers from two Inria project-teams (LEAR and WILLOW) and a US university (Carnegie Mellon University [CMU]). It will allow the three teams to effectively combine their respective strengths in areas such as inference and machine learning approaches for vision tasks, feature representation, large-scale learning, geometric reasoning. The main expected outcomes of this collaboration are: effective learnt representations of video content, new machine learning algorithms for handling minimally annotated data, large-scale public datasets for benchmarking, theoretical analysis of objects shapes and contours.

9.4.2. Inria International Partners

9.4.2.1. Informal International Partners

- **MPI Tübingen:** Cordelia Schmid collaborates with Michael Black, a research director at MPI, starting in 2013. End of 2015 she was award a Humbolt research award funding a long-term research project with colleagues at MPI. She spent one month at MPI in April 2018. In 2018, the project resulted in the development of an approach for object interaction.
- **University of Washington:** Julien Mairal collaborates with Zaid Harchaoui, former member of the team, on the topic of large-scale optimization.

9.4.3. Participation in Other International Programs

- **Indo-French project EVEREST** with IIIT Hyderabad, India, funded by CEFIPRA (Centre Franco-Indien pour la Promotion de la Recherche Avancee). The aim of this project between Cordelia Schmid, Karteek Alahari and C. V. Jawahar (IIIT Hyderabad) is to enable the use of rich, complex models that are required to address the challenges of high-level computer vision. The work plan for the project will follow three directions. First, we will develop a learning framework that can handle weak annotations. Second, we will build formulations to solve the non-convex optimization problem resulting from the learning framework. Third, we will develop efficient and accurate energy minimization algorithms, in order to make the optimization computationally feasible.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

9.5.1.1. Internships

- Pia Bideau (PhD student, Univ. Massachusetts Amherst) was an intern in the team from Sep to Dec 2018.

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

B. Brogliato coordinates the ANR project Digitslid (PRC, ANR-18-CE40-0008-01), Differentiateurs et commandes homogenes par modes glissants en temps discret: l'approche implicite. Partners: LS2N (Ecole Centrale de Nantes), Inria Lille Nord Europe (team Non-A-Post), and Tripop. October 2018-September 2021. 12 participants overall (3 post-doc students recruited by the project, 3 Ph.D. students supported by other means). Total financial support by the ANR: 338 362 euros (100 762 for Tripop, 18 months of post-doc to be recruited in 2019).

8.1.2. FUI Modeliscale.

https://team.inria.fr/modeliscale/

The ModeliScale FUI focuses on the modeling, simulation and analysis of large cyber-physical systems. It federates the research activities of several teams, covering a broad spectrum of topics, namely hybrid systems modeling & verification, numerical analysis, programming language design and automatic control. Our research agenda includes the following tracks:

- New compilation techniques for Modelica modelers: structural analysis of multimode DAE (Differential Algebraic Equations) systems, modular compilation, combining state-machines and non-smooth dynamical systems (complementarity dynamical systems and Filippov differential inclusions), contract-based specification of cyber-physical systems requirements, requirements capture using under-/over-determined DAE systems.

- Simulation of large cyber-physical systems: distributed simulation, discretization methods for non-smooth dynamical systems, space-/time-adaptive discretization methods for multimode DAE systems, quantized state solvers (QSS).

- Guaranteed numerics: guaranteed simulation of non-smooth and hybrid dynamical systems, numerical methods preserving invariant properties of hybrid systems, contract-based reasoning methods.

8.1.3. Inria Project Lab (IPL): ModeliScale, Languages and Compilation for Cyber-Physical System Design

https://team.inria.fr/modeliscale/

The project gathers researchers from three Inria teams, and from three other research labs in Grenoble and Paris area.

The main objective of ModeliScale is to advance modeling technologies (languages, compile-time analyses, simulation techniques) for CPS combining physical interactions, communication layers and software components. We believe that mastering CPS comprising thousands to millions of components requires radical changes of paradigms. For instance, modeling techniques must be revised, especially when physics is involved. Modeling languages must be enhanced to cope with larger models. This can only be done by combining new compilation techniques (to master the structural complexity of models) with new mathematical tools (new numerical methods, in particular).

ModeliScale gathers a broad scope of experts in programming language design and compilation (reactive synchronous programming), numerical solvers (nonsmooth dynamical systems) and hybrid systems modeling and analysis (guaranteed simulation, verification). The research program is carried out in close cooperation with the Modelica community as well as industrial partners, namely, Dassault Systèmes as a Modelica/FMI tool vendor, and EDF and Engie as end users.

Table 1. Member of IPL Modeliscale

Name	Team	Inria Center or Laboratory
Vincent Acary	Bipop	Inria Grenoble Rhône Alpes
Bernard Brogliato		
Albert Benveniste	Hycomes Inria Rennes	
Benoît Caillaud		Bretagne Atlantique
Khalil Ghorbal		
Marc Pouzet	Parkas	ENS
Tim Bourke		Inria Paris
Goran Frehse	Tempo	Verimag-univ. Grenoble Alpes
Antoine Girard		L2S-CNRS, Saclay
Eric Goubault	Cosynus	LIX, École Polytechnique,
Sylvie Putot		Saclay

8.2. International Research Visitors

8.2.1. Visits of International Scientists

- Mathias Legrand (McGill University, Mechanical Engineering).

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

7. Partnerships and Cooperations

7.1. Regional Initiatives

Data-CILE

Title: Query Compilation

Call: Appel à projet Grenoble Innovation Recherche (AGIR-Pôle)

Duration: 2016-2018

Coordinator: Nabil Layaïda

Abstract: The goal of this project is to contribute to foundational and algorithmic challenges introduced by increasingly popular data-centric paradigms for programming on distributed architectures such as spark and the massive production of big linked open data. The focus of the project is on building robust and more efficient workflows of transformations of semantic and graph web data.

BioQurate

Title: Querying and Curating Hierarchies of Biological Graphs

Funding: Fédération Informatique de Lyon (FIL)

Duration: 2018-2020

Coordinator: Angela Bonifati

Others partners: LIP/LIRIS. The project involves a bio-computing team and a database team on a common research problem

Abstract: This project aims at leveraging graph rewriting techniques of ReGraph and graph data management techniques in order to provide a persistent, robust and scalable substrate for the construction and manipulation of hierarchies of biological graphs. Moreover, we wish to investigate whether the involved graphs need further expressive graph constraints for enforcing consistency and performing data cleansing.

7.2. National Initiatives

7.2.1. ANR

CLEAR

Title: Compilation of intermediate Languages into Efficient big dAta Runtimes

Call: Appel à projets générique 2016 défi 'Société de l'information et de la communication' – JCJC

Duration: January 2017 – September 2021

Coordinator: Pierre Genevès

See also: http://tyrex.inria.fr/clear

Abstract: This project addresses one fundamental challenge of our time: the construction of effective programming models and compilation techniques for the correct and efficient exploitation of big and linked data. We study high-level specifications of pipelines of data transformations and extraction for producing valuable knowledge from rich and heterogeneous data. We investigate how to synthesize code which is correct and optimized for execution on distributed infrastructures.

DataCert

Title: Coq deep specification of security aware data integration

Call: Appel à projets Sciences et technologies pour la confiance et la sécurité numérique

Duration: January 2016 – January 2020

Participant: Angela Bonifati

Others partners: Université Paris Sud/Laboratoire de Recherche en Informatique, Université de Lille/Centre de Recherche en Informatique, Signal et Automatique de Lille, Université de Lyon/Laboratoire d'InfoRmatique en Image et Systèmes d'information.

See also: http://datacert.lri.fr/

Abstract: This project's aim is to develop a comprehensive framework handling the fundamental problems underlying security-aware data integration and sharing, resulting in a paradigm shift in the design and implementation of security-aware data integration systems. To fill the gap between both worlds, we strongly rely on deep specifications and proven-correct software, develop formal models yielding highly reliable technology while controlling the disclosure of private or confidential information.

QualiHealth

Title: Enhancing the Quality of Health Data

Call: Appel à projets Projets de Recherche Collaborative – Entreprise (PRCE)

Duration: 2018-2022

Coordinator: Angela Bonifati

Others partners: LIMOS, Université Clermont Auvergne. LIS, Université d'Aix-Marseille. HEGP, INSERM, Paris. Inst. Cochin, INSERM, Paris. Gnubila, Argonay. The University of British Columbia, Vancouver (Canada)

Abstract: This research project is geared towards a system capable of capturing and formalizing the knowledge of data quality from domain experts, enriching the available data with this knowledge and thus exploiting this knowledge in the subsequent quality-aware medical research studies. We expect a quality-certified collection of medical and biological datasets, on which quality-certified analytical queries can be formulated. We envision the conception and implementation of a quality-aware query engine with query enrichment and answering capabilities.

To reach this ambitious objectives, the following concrete scientific goals must be fulfilled : (1) An innovative research approach, that starts from concrete datasets and expert practices and knowledge to reach formal models and theoretical solutions, will be employed to elicit innovative quality dimensions and to identify, formalize, verify and finally construct quality indicators able to capture the variety and complexity of medical data; those indicators have to be composed, normalized and aggregated when queries involve data with different granularities (e.g., accuracy indications on pieces of information at the patient level have to be composed when one queries cohort) and of different quality dimensions (e.g., mixing incomplete and inaccurate data); and (2) In turn, those complex aggregated indicators have to be used to provide new quality-driven query answering, refinement, enrichment and data analytics techniques. A key novelty of this project is the handling of data which are not rectified on the original database but sanitized in a query-driven fashion: queries will be modified, rewritten and extended to integrate quality parameters in a flexible and automatic way.

7.2.2. PERSYVAL-lab LabEx

Title: Mobile Augmented Reality Applications for Smart Cities

Call: Persyval Labex ("Laboratoire d'excellence").

Duration: 2014 – 2018

Coordinators: Pierre Genevès and Nabil Layaïda

Others partners: NeCS team at GIPSA-Lab laboratory.

Abstract: The goal of this project is to increase the relevance and reliability of augmented reality (AR) applications, through three main objectives:

1. Finding and developing appropriate representations for describing the physical world (3D maps, indoor buildings, ways...), integrated advanced media types (3D, 3D audio, precisely geo-tagged pictures with lat., long. and orientation, video...)

2. Integrating the different abstraction levels of these data streams (ranging from sensors data to high level rich content such as 3D maps) and bridging the gap with Open Linked Data (the semantic World). This includes opening the way to query the environment (filtering), and adapt AR browsers to users' capabilities (e.g. blind people). The objective here is to provide an open and scalable platform for mobile-based AR systems (just like the web represents).

3. Increasing the reliability and accuracy of localization technologies. Robust and high-accuracy localization technologies play a key role in AR applications. Combined with geographical data, they can also be used to identify user-activity patterns, such as walking, running or being in an elevator. The interpretation of sensor values, coupled with different walking models, allows one to ensure the continuity of the localization, both indoor and outdoor. However, dead reckoning based on Inertial Navigation Systems (INS) or Step-and-Heading Systems (SHS) is subject to cumulative errors due to many factors (sensor drift (accelerometers, gyroscopes, etc.), missed steps, bad estimation of the length of each stride, etc.). One objective is to reduce such errors by merging and mixing these approaches with various external signals such as GPS and Wi-Fi or relying on the analyses of user trajectories with the help of a structured map of the environment. Some filtering methods (Kalman Filter, observer, etc.) will be useful to achieve this task.

7.3. International Research Visitors

7.3.1. *Visits of International Scientists*

We had short visits from Wim Martens (University of Bayreuth, Germany) and Efthymia Tsamoura (University of Oxford, UK).