Activity Report 2017

Section Partnerships and Cooperations

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

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- ANR ASTER: ASTER is a national project that aims at developing algorithms and software for analyzing third-generation sequencing data, and more specifically RNA sequencing. BONSAI is the principal investigator in this ANR. Other partners are Erable (LBBE in Lyon) and two sequencing and analysis platforms that have been very active in the MinION Access Program (Genoscope and Institut Pasteur de Lille).

- PIA France Génomique: National funding from "Investissements d'Avenir" (call *Infrastructures en Biologie-Santé*). France Génomique is a shared infrastructure, whose goal is to support sequencing, genotyping and associated computational analysis, and increases French capacities in genome and bioinformatics data analysis. It gathers 9 sequencing and 8 bioinformatics platforms. Within this consortium, we are responsible for the workpackage devoted to the computational analysis of sRNA-seq data, in coordination with the bioinformatics platform of Génopole Toulouse-Midi-Pyrénées.

8.1.2. ADT

- ADT Vidjil (2015–2017): The purpose of this ADT was to strengthen Vidjil development and to ensure a better diffusion of the software by easing its installation, administration and usability. This enabled the software to be well suited for a daily clinical use. Vidjil is now used in routine practice by seven European hospitals (France, Germany, Italy and Czech Republic). Hospitals from the United Kingdom and the Japan are currently assessing Vidjil and may do their clinical routine practice with the software in a near future.

- ADT SeedLib (2017–2019): The SeedLib ADT aims to consolidate existing software developments in Bonsai, into an existing and well-engineered framework. Bonsai has published several new results on spaced seeds and developed several tools that integrate custom implementations of spaced seeds. In parallel, the GATB project is a C++ software library that facilitates the development of next-generation sequencing analysis tools. It is currently maintained by a collaboration between the GenScale team at Inria Rennes and the Bonsai team. Many users from other institutions (including the Erable team at Inria Rhones-Alpes) actively develop tools using GATB. The core object in GATB is k-mers, which can be seen as the predecessor of spaced seeds. The goal of this ADT is to integrate existing space seeds formalisms into GATB, therefore further expanding the features offered by the library, and at the same time provide visibility for tools and results in the Bonsai team.

8.2. European Initiatives

8.2.1. Collaborations in European Programs, Except FP7 & H2020

- International ANR RNAlands (2014-2018): National funding from the French Agency Research (call *International call*). Our objective is the fast and efficient sampling of structures in RNA Folding Landscapes. The project gathers three partners: Amib from Inria Saclay, the Theoretical Biochemistry Group from Universität Wien and BONSAI.

- Interreg Va (France-Wallonie-Vlaanderen): Portfolio "SmartBioControl", including 5 constitutive projects and 25 partners working together towards sustainable agriculture.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

- *Astrid Lindgrens Hospital, Stockholm University:* Collaboration with Anna Nilsson and Shanie Saghafian-Hedengren on RNA sequencing of stromal cells (pilot study done in 2017).

- *Childhood Leukaemia Investigation Prague (CLIP), Department of Pediatric Hematology/Oncology, 2nd Faculty of Medicine, Charles University, Prague, Czech Republic:* Collaboration with Michaela Kotrová and Eva Fronkova on leukemia diagnosis and follow-up.

- *CWI Amsterdam:* Collaboration with Alexander Schoenhuth on data structures for genomic data.

- *Department of Statitics, North Carolina State University:* Collaboration with Donald E. K. Martin on spaced seeds coverage [21].

- *Département des Sciences de la Vie, Faculté des Sciences de Liège:* Collaboration with Denis Beaurain on nonribosomal peptides.

- *Gembloux Agro-Bio Tech, Université de Liège:* Collaboration with Philippe Jacques on nonribosomal peptides.

- *Institute of Biosciences and Bioresources, Bari:* Collaboration with Nunzia Scotti on the assembly of plant mitochondrial genomes.

- *Medvedev lab, The Pennsylvania State University:* Collaboration with Paul Medvedev on algorithms and data structures for genomic data, e.g. the Allsome Sequence Bloom Trees.

- *Novo Nordisk Foundation Center for Biosustainability, Technical University of Denmark:* Collaboration with Tilmann Weber on nonribosomal peptides.

- *Proteome Informatics Group, Swiss Institute of Bioinformatics:* Collaboration with Frédérique Lisacek on nonribosomal peptides.

- *School of Social and Community Medicine, University of Bristol:* Collaboration with John Moppett and Stephanie Wakeman on leukemia diagnosis follow-up.

- *Theoretical Biochemistry Group, Universität Wien:* Collaboration with Andrea Tanzer and Ronny Lorenz on RNA folding and RNA kinetics.

8.3.2. Participation in Other International Programs

- Participation in the EuroClonality-NGS consortium. This consortium aims at standardizing the study of immune repertoire, clonality and minimal residual disease in leukemia at the european level. We are part of the bioinformatics workgroup led by Nikos Darzentas (CEITEC, Brno, Czech Republic). Withing this consortium, we participated to a lead opinion paper on immunohematology [20].

DEFROST Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. Inserm

Olivier Goury was hired as a postdoctoral researcher by the "Réhabilitation chirurgicale mini-invasive et robotisée de l'audition" to collaborate with the DEFROST team on the simulation of Cochlear Implant surgery. The contract stopped since Olivier has been recruited as a Research scientist. The collaboration with Inserm has been continued since, with the hiring of Piyush Jain as an engineer.

9.1.2. ANR

- **Tremplin ERC** Christian Duriez recieved a ANR grant "tremplin ERC" (150k€) given the result obtained last year on the ERC proposal (evaluated at "grade A"). The project has allowed to allocate new resources on the developments that were presented in this ERC.

- **CO2DMod** Control-Oriented Data-Driven Modeling of Complex System. The goal of this project was to propose Data-Driven Modelling technique (model reduction as well as model identification) that provides an Uncertainty Certificate (UC). The goal of these certificates are (i) to guarantee that the models obtained from data are good enough for control, (ii) to help the user determine the class of controller design problem the model is tuned for. Unfortunately, the project has not been funded. It was resubmitted this year with hopefully a better outcome.

- **ROBOCOP** ROBOtization of COchlear imPlant. ROBOCOP aims at creating a new prototype of cochlear implant, and robotize (i.e. actuate and control) its insertion process to facilitate the work of surgeon, to increase the success ratio, and to decrease the probability of trauma. Partnership with IEMN (Institute of Electronics, Microelectronics and Nanotechnology), OTICON Medical and UMRS-1159 at Inserm. This project was submitted in 2017 and we are awaiting the answer from the ANR.

9.2. European Initiatives

9.2.1. Collaborations in European Programs, Except FP7 & H2020

Program: FEDER

Project acronym: COMOROS

Project title: Control of deformable robots for surgery

Duration april 2017 to march 2020 (in two phases)

Coordinator: C. Duriez

Abstract: Surgical procedures are often carried out using instruments made of stiff materials that interact with delicate biological tissues such as internal organs, blood vessel walls and small cavities. This incompatibility of stiffness is one of the sources of danger in many surgical procedures. The use of robots made of soft materials, also called soft robots, would limit such risks by reducing contact pressures and stress concentrations. Their intrinsic deformability would also increase the ability to manoeuvre in confined spaces. However, the promising concept of using soft robots for surgical procedures cannot be practically implemented, due to the lack of precise modelling and control methods for soft robots. This scientific obstacle, identified as a pending issue by major surveys in this field, becomes particularly challenging when interacting with an environment as complex as the human anatomy. Drawing on our background in soft tissue simulation, contact models, surgical applications and soft robotics, our ambition in this project is to:

- Develop accurate and generic numerical methods for continuum mechanics, adapted to strong real-time constraints in order to demonstrate the ability to model soft mechatronics systems.
- Reconsider parametrization methodologies of digital models of the patient anatomy through the observation of mechanical interactions with soft robots via embedded sensors and medical imaging.
- Rethink motion generation and teleoperation control with force feedback so as to be compatible with the large number of degrees of freedom of soft robots and be based on accurate, rapidly-computed deformable models and interaction models.

The project also targets the development of software with the required performance and features, as well as the experimental validation of models and methods using prototypes in realistic environments.

9.2.2. Collaborations with Major European Organizations

- Université Libre Brussels, Pr. Terwagne, Pr.Massar and Mr Tillema
- Artificial Intelligence Algorithms for the control of soft robots, based on the simulation (associated north-european team 2016-2017)
- University of Luxembourg: Pr Bordas
- Model order reduction and topological changes (journal in 2013 & submission of a proposal in 2017)
- King's college: Pr Liu
- Robotic catheter navigation and control and soft surgcial robotics (conference publication at IROS in 2017)

9.3. International Research Visitors

9.3.1. Visits of International Scientists

Margaret Koehler is a PhD student in Mechanical Engineering from the Collaborative Haptics and Robotics in Medicine (CHARM) Lab at Stanford University, led by Allison Okamura. Her PhD topic is "Design and Control of Soft Haptic Devices." Supported by a Chateaubriand Fellowship in partnership with Inria, she is conducting a 6-month research internship with the DEFROST team from September 2017 through February 2018. Her internship is part of a year-long collaboration between the DEFROST team and the CHARM Lab. In 2018, Christian Duriez will spend six months as a visiting scholar in the CHARM Lab to continue this exchange. The collaboration focuses on the development of a soft haptic device using the SOFA framework and soft robot control methods developed by the DEFROST team for design and control.

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DOLPHIN Team

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9. Partnerships and Cooperations

9.1. Regional Initiatives

- CPER "data" (2015-2020): This project is jointly supported by the government together with the region. The Advanced Data Science and Technology (Data) CPER project aims to conduct a research program on data intelligence at a high international level in a strong synergy with the regional economic fabric and to set up a research infrastructure in line with the associated challenges. It focuses on three areas of research: Internet of Things, Intelligence of Data and Knowledge, High Performance Computing (HPC) and Optimization, and four main levers: (i) research infrastructure, (ii) attractiveness - particularly researchers from EPST, (iii) demonstrators, (iv) Transfer for innovation to SMEs. Dolphin (N. Melab) is the scientific leader of the HPC and optimization scientific area and the research infrastructure lever (Grid'5000 part). The budget for this part is 1.2M€. C. Dhaenens is coordinator of the project for the University of Lille.

- CPER ELSAT (2015-2019) of CPER (Contrat Plan Etat Région): transversal research action "Planning and scheduling of maintenance logistics in transportation".

9.2. National Initiatives

9.2.1. ANR

- ANR project Modèles Numériques "NumBBO - Analysis, Improvement and Evaluation of Numerical Blackbox Optimizers" (2012-2016) in collaboration with Inria Saclay, TAO team, Ecole des Mines de St. Etienne, CROCUS team, and TU Dortmund University, Germany (2012-2016)

- ANR project TECSAN (Technologies pour la Santé) "ClinMine - Optimisation de la prise en Charge des Patients à l'Hôpital", in collaboration with University Lille 1, University Lille 2, Inria, CHRU Lille, CHICL, Alicante (6 partners) (2014-2017) - Coordinator C. Dhaenens

- Bilateral ANR/RGC France/Hong Kong PRCI "Big Multiobjective Optimization" (2016-2021) in collaboration with City University of Hong Kong

- PGMO project "Towards a Complexity Theory for Black-Box Optimization", together with Carola Doerr (CNRS, LIP6), Benjamin Doerr (Ecole Polytechnique), Anne Auger, Nikolaus Hansen (both Inria Saclay), Timo Koetzing (University of Jena, Germany), Johannes Lengler (ETH Zurich, Switzerland), and Jonathan Rowe (The University of Birmingham, UK), (2014-2016)

- PGMO project "Demand side management in smart grids", together with EDF, (2015-2017)

- PGMO project "Multi-home Demand side management in micro grids", together with EDF, (2017-2019)

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

Program: H2020

Project acronym: SYNERGY

Project title: Synergy for Smart Multi-Objective Optimisation

Duration: 02 2016 - 01 2019

Coordinator: Jožef Stefan Institute (JSI), Ljubljana, Slovenia

Other partners: University of Lille (France), Cologne University of Applied Sciences (Germany)

Abstract: Many real-world application areas, such as advanced manufacturing, involve optimization of several, often time-consuming and conflicting objectives. For example, they require the maximization of the product quality while minimizing the production cost, and rely on demanding numerical simulations in order to assess the objectives. These, so-called multi-objective optimization problems can be solved more efficiently if parallelization is used to execute the simulations simultaneously and if the simulations are partly replaced by accurate surrogate models.

9.3.2. Collaborations in European Programs, Except FP7 & H2020

Program: COST CA15140

Project acronym: ImAppNIO

Project title: Improving applicability of nature-inspired optimization by joining theory and practice

Duration: 2016-2019

Coordinator: Thomas Jansen

Abstract: The main objective of the COST Action is to bridge this gap and improve the applicability of all kinds of nature-inspired optimisation methods. It aims at making theoretical insights more accessible and practical by creating a platform where theoreticians and practitioners can meet and exchange insights, ideas and needs; by developing robust guidelines and practical support for application development based on theoretical insights; by developing theoretical frameworks driven by actual needs arising from practical applications; by training Early Career Investigators in a theory of nature-inspired optimisation methods that clearly aims at practical applications; by broadening participation in the ongoing research of how to develop and apply robust nature-inspired optimisation methods in different application areas.

9.3.3. Collaborations with Major European Organizations

University of Luxembourg: (Luxembourg)

Energy aware scheduling in Cloud computing systems

University of Oviedo: (Spain)

Optimization under uncertainty for fuzzy flow shop scheduling

University of Elche and University of Murcia: (Spain)

Matheuristics for DEA

9.4. International Initiatives

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

9.4.1.1. MOHA

Title: Mixed Multi-objective Optimization using Hybrid Algorithms: Application to smart grids

International Partner (Institution - Laboratory - Researcher):

Ecole Mohammadia d'Ingénieurs (Morocco) - LERMA (Laboratoire d'Etudes et de Recherches en Mathématiques Appliquées) - Rachid Ellaia

Start year: 2016

See also: https://ocm.univ-lille1.fr/~talbi/momh/

The key challenge of this project is to propose new optimization models and new hybrid algorithms to the demand side management of smart grids in a context of uncertainty and in the presence of several conflicting objectives.

Those complex optimization problems are also characterized by the presence of both continuous and discrete variables. We need to design new efficient optimization algorithms combining state-of-the-art exact and metaheuristic algorithms from the global optimization and combinatorial optimization communities

9.4.1.2. s3-bbo

Title: Threefold Scalability in Any-objective Black-Box Optimization (s3-bbo)

International Partner (Institution - Laboratory - Researcher):

Shinshu University, Japan

Duration: 2015-2017

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

The main scientific goals of this collaboration is to theoretically derive, analyze, design, and develop scalable evolutionary and other stochastic local search algorithms for large-scale optimization considering three different axes of scalability: (i) decision space, (ii) objective space, and (iii) availability of distributed and parallel computing resources. This research will allow us to design, control, predict, analyze and optimize parameters of recent complex, large-scale, and computationally expensive systems, providing the basic support for problem solution and decision-making in a variety of real world applications. For single-objective continuous optimization, we want to theoretically derive variants of the state-of-the-art CMA-ES with linear time and space complexity scalings with respect to the number of variables. We will exploit the information geometry framework to derive updates using parametrization of the underlying family of probability distribution involving a linear number of components. The challenges are related to finding good representations that are theoretically tractable and meaningful. For the design of robust algorithms, implementing the derived updates, we plan to follow the same approach as for the design of CMA-ES. For multi- and many-objective optimization, we will start by characterizing and defining new metrics and methodologies to analyze scalability in the objective space and in terms of computational resources. The first challenge is to accurately measure the impact of adding objectives on the search behavior and on the performance of evolutionary multi- and many- objective optimization (EMyO) algorithms. The second challenge is to investigate the new opportunities offered by large-scale computing platforms to design new effective algorithms for EMyO optimization. To this end, we plan to follow a feature-based performance analysis of EMyO algorithms, to design new algorithms using decomposition-based approaches, and to investigate their mapping to a practical parallel and distributed setting.

9.4.1.3. Informal International Partners

- Collaboration with Université de Mons (UMONS). The collaboration consists mainly in the joint supervision of the Phd thesis of Jan Gmys started in 2014.
- University of Coimbra, Portugal
- University of Lisbon, Portugal
- University of Manchester, United Kingdom
- University of Elche, Spain

9.5. International Research Visitors

9.5.1. *Visits of International Scientists*

- Prof. Fred Glover (University of Colorado, USA), Feb 2017
- Prof. Rachid Ellaia (EMI, Univ. Rabat, Morocco), Nov 2017
- Prof. Oliver Schutez (CINVESTAV, Mexico), Nov 2017
- Manuel López-Ibáñez, Manchester University (United Kingdom), June 2017
- Kiyoshi Tanaka, Shinshu University (Japan), March 2017
- Qingfu Zhang, City University (Hong Kong), April 2017
- Manuel López-Ibáñez, Manchester University (United Kingdom), June 2017
- Kiyoshi Tanaka, Shinshu University (Japan), March 2017
- Qingfu Zhang, City University (Hong Kong), April 2017

9.5.1.1. Internships

- Oliver Cuate, CINVESTAV, Mexico
- Jihene Serrar, EMI, Morocco
- Zineb Hattab, EMI, Morocco

9.5.2. Visits to International Teams

9.5.2.1. Sabbatical programme

Prof. El-Ghazali Talbi has been at Sabbatical from the University of Lille (2016-2017) visiting many Universities at International level (USA, Spain, Italy, Mexico, Morocco, Luxembourg, ...).

9.5.2.2. Research Stays Abroad

- B. Derbel: University of Lisbon (Portugal), 2 months
- A. Liefooghe: Shinshu University (Japan), 1 month, May 2017
- B. Derbel: Shinshu University (Japan), 1 month, June-July 2017
- E-G. Talbi: EMI, University of Rabat (Morocco), 1 month, 2017
- E-G. Talbi, JSI, Ljubljana (Slovenia), 1 month, 2017

FUN Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. StoreConnect

Participants: Nathalie Mitton [correspondant], Valeria Loscri, Antonio Costanzo, Abdoul Aziz Mbacke.

Title: StoreConnect
Type: FUI
Duration: September 2016 - October 2018
Coordinator: NEOSENSYS
Others partners: Inria FUN, SPIRALS and STARS, TeVolys, Ubudu, Smile, STIME, Leroy Merlin
The aim of StoreConnect is to provide French large retailers with efficient and powerful tools in the in-store customer interaction. This project has yield to several publications in 2017: [50], [23], [24].

9.1.2. PIPA

Participants: Nathalie Mitton [correspondant], Farouk Mezghani.

Title: Partager de l'Info PArtout à bas coût
Type: Chercheur citoyen
Duration: Dec 2015 - Dec 2017
Coordinator: Inria FUN
Others partners: SpotTrotter
PIPA project aims to provide an innovative low cost solution to share information in places where communication infrastructure are lacking, insuffisant or not adapted, going beyond technical, economical or political limitations. This project has yield to several publications in 2017: [27], [28], [44].

9.2. National Initiatives

9.2.1. Inria Project Lab

9.2.1.1. CityLab@Inria

Participants: Valeria Loscri, Abdoul Aziz Mbacke, Nathalie Mitton [correspondant].

- Title: CityLab@Inria
- Type: IPL
- Duration: 2015 - 2019
- Coordinator: Valerie Issarny
- CityLab@Inria studies ICT solutions toward smart cities that promote both social and environmental sustainability. A strong emphasis of the Lab is on the undertaking of a multi-disciplinary research program through the integration of relevant scientific and technology studies, from sensing up to analytics and advanced applications, so as to actually enact the foreseen smart city Systems of Systems. Obviously, running urban-scale experiments is a central concern of the Lab, so that we are able to confront proposed approaches to actual settings. The Lab's research leverages relevant effort within Inria project-teams that is further revisited as well as integrated to meet the challenges of smart cities. Research themes span: energy-efficient wireless communication protocols, urban-scale social and physical sensing, privacy by design, cloud-based urban data management, data assimilation, visual analysis, and urban system software engineering. In addition, CityLab Inria research builds upon collaborative effort at the International level, and especially collaboration in the context of the Inria SiliconValley program. This project has yield to the set up of a full course on Smart Cities via a MOOC [51], [52], [53], [54] and a set of publications [23], [24], [32].

9.2.2. ADT

9.2.2.1. RFunID
Participants: Ibrahim Amadou, Nathalie Mitton [correspondant], Julien Vandaele.

Duration: September 2015 - December 2017

Coordinator: Inria FUN

The purpose of this project is to deploy a large scale experimental RFID platform that enables remote programmation of RFID scenario on heterogeneous devices.

9.2.2.2. Catimex
Participants: Matthieu Berthome, Nathalie Mitton [correspondant], Julien Vandaele.

Duration: September 2017 -June 2019

Coordinator: Inria FUN

The purpose of this project is to foster research transfer in IoT from ADT members to their industrial partners by widening experimental features and PoC realization.

9.2.3. Equipements d'Excellence

9.2.3.1. FIT
Participants: Nathalie Mitton [correspondant], Julien Vandaele, Matthieu Berthome.

Title: Future Internet of Things

Type: EquipEx

Duration: March 2010 - December 2019

Coordinator: UPMC

See also: http://fit-equipex.fr/

Abstract: FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet. FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's "Equipements d'Excellence" (Equipex) research grant program. Coordinated by Professor Serge Fdida of UPMC Sorbonne Universités and running over a nine-year period, the project will benefit from a 5.8 million euro grant from the French government. This project has yield to [39].

9.3. European Initiatives

9.3.1. H2020 Projects

9.3.1.1. VESSEDIA
Participants: Simon Duquennoy, Nathalie Mitton [correspondant], Allan Blanchard.

- Title: VERIFICATION ENGINEERING OF SAFETY AND SECURITY CRITICAL DYNAMIC INDUSTRIAL APPLICATIONS
- Program: H2020
- Duration: January 2017 - Dec. 202019
- TECHNIKON FORSCHUNGS UND PLANUNGSGESELLSCHAFT MBH (TEC)

The VESSEDIA project will bring safety and security to many new software applications and devices. In the fast evolving world we live in, the Internet has brought many benefits to individuals, organizations and industries. With the capabilities offered now (such as IPv6) to connect billions of devices and therefore humans together, the Internet brings new threats to the software developers and VESSEDIA will allow connected applications to be safe and secure. VESSEDIA proposes to enhance and scale up modern software analysis tools, namely the mostly open-source Frama-C Analysis platform, to allow developers to benefit rapidly from them when developing connected applications. At the forefront of connected applications is the IoT, whose growth is exponential and whose security risks are real (for instance in hacked smart phones). VESSEDIA will take this domain as a target for demonstrating the benefits of using our tools on connected applications. VESSEDIA will tackle this challenge by 1) developing a methodology that allows to adopt and use source code analysis tools efficiently and produce similar benefits than already achieved for highly-critical applications (i.e. an exhaustive analysis and extraction of faults), 2) enhancing the Frama-C toolbox to enable efficient and fast implementation, 3) demonstrating the new toolbox capabilities on typical IoT (Internet of Things) applications including an IoT Operating System (Contiki), 4) developing a standardization plan for generalizing the use of the toolbox, 5) contributing to the Common Criteria certification process, and 6) defining a label "Verified in Europe" for validating software products with European technologies such as Frama-C.

9.4. International Initiatives

9.4.1. Inria International Labs

9.4.1.1. Agrinet
Participants: Abdoul Aziz Mbacke, Nathalie Mitton [correspondant].

Agrinet

Title: Agrinet

International Partner (Institution - Laboratory - Researcher):

Type: LIRIMA Associate team

Duration: 2017-2020

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

The current drought and limited water resources in many parts of Southern Africa and beyond, already have a significant impact on agriculture and hence, food production. Sustainable food security depends upon proper plant and crop management respectful of soils and natural re- sources, such as water. This includes very important South African farming areas, such as the Western Cape and Northern Cape. In France, agriculture is also hugely important. Not just nationally, but also in Europe. The system proposed can be applied to a variety of crops. The economic- and social consequences are profound and any contribution towards more efficient farming within increasingly onerous natural constraints, should be a priority. To address these constraints, we propose to develop a flexible, rapidly deployable, biological/agricultural data acquisition platform and associated machine learning algorithms to create advanced agricultural monitoring and management techniques, to improve crop management and use of natural resources. The project also addresses an industry with very high socioeconomic impact.

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

9.4.2.1. DepIoT
Participants: Simon Duquennoy [correspondant], Nathalie Mitton.

Title: DepIoT: Coexistence and Security for Dependable Internet of Things

Type: North-European Inria Associate Team with SICS, Sweden

Duration: Sept 2016 - August 2018

Abstract: In order to foster the adoption of IoT technologies, dependability must be guaranteed. We will tackle this challenge by ensuring operation even in the presence of other networks sharing the same frequency band (coexistence) and by enabling a secure communication.

9.4.3. Inria International Partners

9.4.3.1. Declared Inria International Partners

Université Mediterranea di Reggio Calabria (UNIC) (Italy) Objective of this collaboration is the design of an innovative architecture that enables autonomic and decentralized fruition of the services offered by the network of smart objects in many heterogeneous and dynamic environments, in a way that is independent of the network topology, reliable and flexible. The result is an 'ecosystem' of objects, self-organized and self-sustained, capable of making data and services available to the users wherever and whenever required, thus supporting the fruition of an 'augmented' reality thanks to a new environmental and social awareness. This collaboration has allowed students and researchers exchanges and joint publications, among them for 2017: [30].

9.4.3.2. Informal International Partners

Southern University, China

The purpose of this collaboration is to study the green (or energy-efficient) communication problem in vehicular ad hoc networks (VANETs) and the application of vehicular network communication in green transportation. In this framework, Nathalie Mitton visited the Nanjing University. It gave birth to joint project submission, joint conference organization (WCSP 2017) and joint publications, among them, in 2017 [40].

Arun Sen from Arizona State University, USA

The purpose of this collaboration is to study the joint scheduling and trajectory of RFID readers in a mobile environment. In this framework, Arun Sen visited the FUN team for 6 months in 2015 and in July 2016. It gave birth to joint project submission, joint conference submission and joint publications, among them in 2017 [12].

Anna-Maria Vegni from Roma Tre University, Italy

The purpose of this collaboration is to study alternative communication paradigms and investigate their limitations and different effects on performances. In this framework, joint publications have been obtained, among them in 2017 [14], [15], [20], [35], [47], [48].

9.4.4. Participation in Other International Programs

9.4.4.1. CROMO

Participants: Valeria Loscri, Nathalie Mitton [correspondant].

Title: Crowd Data In the mobile cloud

Duration: January 2015 - December 2019

CroMo (Crowd Data In the mobile cloud) is a submission to the CAPES-COFECUB project call lead by Inria from the French side and University of Rio de Janeiro from Brazilian Side. Other partner institutions are Université Pierre et Marie Curie and Université de la Rochelle.

Mobile cloud computing is an emerging paradigm to improve the quality of mobile applications by transferring part of the computational tasks to the resource-rich cloud. The multitude data sources combined with the known difficulties of wireless communications represent an important issue for mobile cloud computing. Therefore, the additional computational power added by the cloud has to deal with the constraints of the wireless medium. One could imagine a situation where different sensors collect data and require intensive computation. This data must be transmitted at high rates before becoming stale. In this case, the network becomes the main bottleneck, not the processing power or storage size. To circumvent this issue, different strategies can be envisioned. As usual alternatives, wireless data rates must be increased or the amount of data sent to the cloud must be reduced. CROMO tackles challenges from all these three components of the mobile clouds (data generation, collect and processing) to then integrate them as a whole enhanced mobile cloud with improved network performances in terms of delay, energy consumption, availability, and reliability. In this context, joint exchanges and crossed visits have been done (Aziz went to Rio, Dianne went to Lille). The project yield to several publications such as [16], [41].

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Several researchers have visited our group in 2017, mainly from our partner universities but not only:

- Luis Henrique Costa, Brazil, December 2017
- Milan Erdejl, UTC, France, December 2017
- Pedro Braconnot Velloso, UFRJ, Brasil, July 2017
- Essia Hamouda, Riverside University, USA, May 2017
- Felipe Lalanne, Inria Chile, June 2017
- Nicola Accettura, CNRS, March 2017
- Jacques Tiberghien, ULB, Brussels, May 2017
- Jens Gerlach, Frauhnofer FOKUS, March 2017
- Virgile Prevosto, CEA, March 2017

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

- Abdoul Aziz Mbacke visited Stellenbosch university from October to December 2017
- Jad Nassar visited Metropolitan Autonomous University Cuajimalpa Campus, Mexico in September 2017

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INOCS Team

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9. Partnerships and Cooperations

9.1. Regional Initiatives

The ELSAT research program addresses the issues involved in sustainable transportation and mobility. Within ELSAT, INOCS is involved on two projects devoted to hybrid optimization methods in logistics and to city logistics in collaboration with LAMIH (University of Valenciennes), LGI2A (University of Artois) and LEOST (IFSTTAR). ELSAT is supported by the CPER 2015-2020 (State-Region Contract).

9.2. National Initiatives

9.2.1. ANR

ANR project PI-Commodality "Co-modal freight transportation chains: an approach based on physical internet" in collaboration with CGS-ARMINES (Paris), LAAS (Toulouse), DHL (2016 - 2018). The PI-co-modality project aims to design new sustainable logistic services between preset origins and destinations. It is based on innovative approaches both in terms of: 1) Logistics and transportation services: by considering the PI-internet approach, specifically: mesh logistics and transportation networks based on available capacities, by designing consistent integrated co-modal chains; 2) Methodology: by addressing the underlying problems according to two approaches: centralized and decentralized, by proposing news realistic models relevant for practitioner taking into account the consistency, by developing state-of-the-art decision making algorithms.

9.2.2. National Initiatives (Belgium)

Combinatorial Optimization: Meta-heuristics and Exact Methods (2012-2017), coordinator: Bernard Fortz (GOM-ULB/INOCS-Inria). Inter-university Attraction Pole funded by the Belgian Federal Science Policy Office. Study and modeling of combinatorial optimization problems; Advancements in algorithmic techniques; Implementation of solution methods for large-scale, practically relevant problems.

9.3. European Initiatives

9.3.1. Collaborations in European Programs, Except FP7 & H2020

Program: COST

Project acronym: TD1207

Project title: Mathematical Optimization in the Decision Support Systems for Efficient and Robust Energy Networks

Duration: 04/2014 - 04/2017

Coordinator: Thorsten Koch (ZIB, Germany)

INOCS partners: Bernard Fortz, Martine Labbé

Abstract: Energy Production and Distribution (EP&D) is among the biggest challenges of our time, since energy is a scarce resource whose efficient production and fair distribution is associated with many technical, economical, political and ethical issues like environmental protection and people health. EP&D networks have rapidly increased their size and complexity, e.g. with the introduction and interconnection of markets within the EU. Thus, there is an increasing need of systems supporting the operational, regulatory and design decisions through a highly inter-disciplinary approach, where experts of all the concerned fields contribute to the definition of appropriate mathematical models. This is particularly challenging because these models require the simultaneous use of many different mathematical optimization tools and the verification by experts of the underlying engineering and financial issues. The COST framework is instrumental for this Action to be able to coordinate the inter-disciplinary efforts of scientists and industrial players at the European level.

Program: JPI Urban Europe

Project acronym: e4-share

Project title: Models for Ecological, Economical, Efficient, Electric Car-Sharing

Duration: 10/2014 - 09/2017

Coordinator: Markus Leitner (University of Vienna, Austria)

Other partners:

- Austrian Institute of Technology, Austria
- Université Libre de Bruxelles (INOCS), Belgium
- University of Bologna, Italy
- tbw research GesmbH, Austria

Abstract: Car-sharing systems and the usage of electric cars become increasingly popular among urban citizens. Thus, providing vast opportunities to meet today's challenges in terms of environmental objectives, sustainability and living quality. Our society needs to manage a transformation process that ultimately shall lead to fewer emissions and less energy consumption while increasing the quality of public space available. In e4-share, the team will lay the foundations for efficient and economically viable electric car-sharing systems by studying and solving the optimization problems arising in their design and operations. A main goal is to derive generic methods and strategies for optimized planning and operating in particular for flexible variants which best meet preferences of customers but impose nontrivial challenges to operators. This project will develop novel, exact and heuristic, numerical methods for finding suitable solutions to the optimization problems arising at the various planning levels as well as new, innovative approaches considering these levels simultaneously.

9.4. International Initiatives

9.4.1. Inria International Labs

9.4.1.1. BIPLOS

Title: BIlevel Problems in LOgistics and Security

International Partner (Institution - Laboratory - Researcher):

Universidad de Chile (Chile) - Instituto Sistemas Complejos de Ingeieria (ISCI) - Ordonez Fernando

Start year: 2017

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

This projet is devoted to bilevel optimisation problems with application in the security and logistics domains. Stackelberg games, including one defender and several followers, and competitive location problems will be considered. Mixed integer linear optimisation models and efficient algorithms to solve them will be developed.

Related publications: [29], [11], [66].

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

9.4.2.1. North-European associated team

Title: Physical-internet services for city logistics

International Partner (Institution - Laboratory - Researcher):

Norwegian School of Economics - Stein Wallace

Start year: 2017

In this project, we consider an urban logistic terminal and new logistics services which could be developed according to a Physical Internet approach. The main objective is to evaluate the services using optimization models created within the project. We are developing optimization models to identify win-win cooperation between carriers based on supply and demand. We aim to explore how to include stochasticity in the description of the supplies and demands, as well as travel times, and to what extent the plans within a day can improve by such knowledge. The second task is to develop solution algorithms for these models. These are real scientific challenges as we are facing stochastic mixed integer problems.

9.4.3. Inria International Partners

9.4.3.1. Informal International Partners

Department of Statistics and Operations Research, University of Vienna, Austria.
Centre for Quantitative Methods and Operations Management, HEC-Liège, Belgique.
Interuniversity Centre on Entreprise Networks, Transportation and Logistics (CIRRELT), Montreal, Canada.
Department of Industrial Engineering, Universidad de Talca, Curicó, Chile.
Instituto Sistemas Complejos de Ingeniería (ISCI), Santiago, Chile.
The Centre for Business Analytics, University College Dublin, Ireland.
Department of Electrical, Electronic, and Information Engineering, University of Bologna, Italy.
Department of Electrical and Information Engineering, University of Padova, Italy.
Department of Mathematics, University of Aveiro, Portugal.
Department of Statistics and Operations Research, University of Lisbon, Portugal.
Instituto de Matemáticas, University of Seville, Spain.
Departamento de Estadística e Investigación Operativa, Universidad de Murcia, Spain.
Dipartimento di Matematica, Universita degli studi di Padova, Italy.

9.4.4. Participation in Other International Programs

STIC Algérie, University of Oran, Algeria.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

9.5.1.1. Visiting Professors and Ph.D. students

Claudio Arbib, Professor at Università degli Studi dell'Aquila, Feb 2017.
Victor Bucarey, Postdoctoral researcher at Universidad de Chile, Dec 2017.
Paula Carroll, Professor at Centre for Business Analytics, School of Business, University College Dublin, Sep 2017.
Sebastián Dávila, Ph.D. student at Universidad de Chile, Dec 2017.
Bernard Gendron, Professor at Université de Montréal, Nov 2017.
Anton Kleywegt, Professor at Georgia Institue of Technology, from Jun 2017 until Jul 2017.
Marina Leal, Ph.D. student at Universidad de Sevilla, from Jun until Oct 2017.
Paulo Macedo, Ph.D. student at Universidade Federal do Ceará, from Mar 2017 until Jul 2017.
Vladimir Marianov, Professor at Pontificia Universidad Católica de Chile, from Nov until Dec 2017.
Alfredo Marín, Professor at Universidad de Murcia, Oct 2017.
Fernando Ordóñez, Professor at Universidad de Chile, Sep 2017.
Juan José Palacios Alonso, Professor at Universidad de Oviedo, from Sep until Dec 2017.
Mercedes Pelegrin Garcia, Ph.D. student at Universidad de Murcia, from Sep 2017 until Dec 2017.

9.5.1.2. Internships

Juan Alejandro Gomez Herrera, Ecole Polytechnique de Montréal, from Apr 2017 until Jul 2017.
Sebastien Michel, Centrale Lille, from Jun 2017 until Sep 2017.
Luis Salazar Zendeja, University of Monterrey, Mexico, from Apr 2017 until Aug 2017.
Grégoire Pellissier, Université Blaise Pascal, Clermont-Ferrand, from June 2017 until Sept 2017.

<div align="center">**LINKS Project-Team**</div>

8. Partnerships and Cooperations

8.1. National Initiatives

ANR Aggreg (2014-19): Aggregated Queries.
- Particpants: J. Niehren [correspondent], P. Bourhis, A. Lemay, A. Boiret
- The coordinator is J. Niehren and the parteners are the University Paris 7 (A. Durand) including members of the Inria project DAHU (L. Ségoufin), the University of Marseille (N. Creignou) and University of Caen (E. Grandjean).
- Objective: the main goal of the Aggreg project is to develop efficient algorithms and to study the complexity of answering aggregate queries for databases and data streams of various kinds.

ANR Colis (2015-20): Correctness of Linux Scripts.
- Participants: J. Niehren [correspondent], A. Lemay, S. Tison, A. Boiret, V. Hugot, N. Bacquey, P. Gallot, S. Salvati.
- The coordinator is R. Treinen from the University of Paris 7 and the other partner is the Tocata project of Inria Saclay (C. Marché).
- Objective: This project aims at verifying the correctness of transformations on data trees defined by shell scripts for Linux software installation. The data trees here are the instance of the file system which are changed by installation scripts.

ANR DataCert (2015-20):
- Participants: I. Boneva [correspondent], S. Tison, J. Lozano.
- Partners: The coordinator is E. Contejean from the University of Paris Sud and the other partner is the University of Lyon.
- Objective: the main goals of the Datacert project are to provide deep specification in Coq of algorithms for data integration and exchange and of algorithms for enforcing security policies, as well as to design data integration methods for data models beyond the relational data model.

ANR Headwork (2016-21):
- Participants: P. Bourhis [correspondant], J. Niehren, M. Sakho.
- Scientific partners: The coordinateur is D. Gross-Amblard from the Druid Team (Rennes 1). Other partners include the Dahu team (Inria Saclay) and Sumo (Inria Bretagne)
- Industrial partners: Spipoll, and Foulefactory.
- Objective: The main object is to develop data-centric workflows for programming crowd sourcing systems in flexible declarative manner. The problem of crowd sourcing systems is to fill a database with knowledge gathered by thousands or more human participants. A particular focus is to be put on the aspects of data uncertainty and for the representation of user expertise.

ANR Delta (2016-21):
- Participants: J. Niehren, P. Bourhis [correspondent], S. Salvati, N. Bacquey, D. Gallois.
- Partners: The coordinator is M. Zeitoun from LaBRI, other partners are LIF (Marseille) and IRIF (Paris-Diderot).
- Objective: Delta is focused on the study of logic, transducers and automata. In particular, it aims at extending classical framework to handle input/output, quantities and data.

ANR Bravas (2017-22):

- Participants: S. Salvati [correspondent]
- Scientific Partners: The coordinator is Jérôme Leroux from LaBRI, University of Bordeaux. The other partner is LSV, ENS Cachan.
- Objective: The goal of the BraVAS project is to develop a new and powerful approach to decide the reachability problems for Vector Addition Systems (VAS) extensions and to analyze their complexity. The ambition here is to crack with a single hammer (ideals over well-orders) several long-lasting open problems that have all been identified as a barrier in different areas, but that are in fact closely related when seen as reachability.

8.2. European Initiatives

Edinburgh-Links exchange projet funded by the University of Lille. The coordiator is Slawek Staworko.

Lille-Oxford cooperation project funded by the University of Lille. Links' contact is Pierre Bourhis.

8.3. International Initiatives

8.3.1. Inria International Partners

Niehren and Bourhis continue to cooperate with Domagoy Vrgoc from the University of Satiago di Chile, also after the end of the AMSud project.

<div align="center">**MAGNET Project-Team**</div>

9. Partnerships and Cooperations

9.1. Regional Initiatives

We strengthen our partnership with the linguistic laboratory STL in Lille university. We welcome Bert Cappelle for a stay (delegation) in the group. The topic of this collaboration is to study modal verbs and the translation of the notion of compositionality when applied to vectorial representation of words.

We also participate to the *Data Advanced data science and technologies* project (CPER Data). This project is organized following three axes: internet of things, data science, high performance computing. MAGNET is involved in the data science axis to develop machine learning algorithms for big data, structured data and heterogeneous data. The project MyLocalInfo is an open API for privacy-friendly collaborative computing in the internet of things.

9.2. National Initiatives

9.2.1. ANR Pamela (2016-2020)

Participants: MARC TOMMASI [correspondent], AURÉLIEN BELLET, RÉMI GILLERON, FABIO VITALE

The Pamela project aims at developing machine learning theories and algorithms in order to learn local and personalized models from data distributed over networked infrastructures. Our project seeks to provide first answers to modern information systems built by interconnecting many personal devices holding private user data in the search of personalized suggestions and recommendations. More precisely, we will focus on learning in a collaborative way with the help of neighbors in a network. We aim to lay the first blocks of a scientific foundation for these new types of systems, in effect moving from graphs of data to graphs of data and learned models. We argue that this shift is necessary in order to address the new constraints arising from the decentralization of information that is inherent to the emergence of big data. We will in particular focus on the question of learning under communication and privacy constraints. A significant asset of the project is the quality of its industrial partners, Snips and Mediego, who bring in their expertise in privacy protection and distributed computing as well as use cases and datasets. They will contribute to translate this fundamental research effort into concrete outcomes by developing personalized and privacy-aware assistants able to provide contextualized recommendations on small devices and smartphones. https://project.inria.fr/pamela/.

9.2.2. ANR JCJC GRASP (2016-2020)

Participants: PASCAL DENIS [correspondent], AURÉLIEN BELLET, RÉMI GILLERON, MIKAELA KELLER, MARC TOMMASI

The GRASP project aims at designing new graph-based Machine Learning algorithms that are better tailored to Natural Language Processing structured output problems. Focusing on semi-supervised learning scenarios, we will extend current graph-based learning approaches along two main directions: (i) the use of structured outputs during inference, and (ii) a graph construction mechanism that is more dependent on the task objective and more closely related to label inference. Combined, these two research strands will provide an important step towards delivering more adaptive (to new domains and languages), more accurate, and ultimately more useful language technologies. We will target semantic and pragmatic tasks such as coreference resolution, temporal chronology prediction, and discourse parsing for which proper Machine Learning solutions are still lacking. https://project.inria.fr/grasp/.

9.2.3. ANR-NFS REM (2016-2020)

With colleagues from the linguistics departments at Lille 3 and Neuchâtel (Switzerland), PASCAL DENIS is a member of another ANR project (REM), funded through the bilateral ANR-NFS Scheme. This project, co-headed by I. Depreatere (Lille 3) and M. Hilpert (Neufchâtel), proposes to reconsider the analysis of English modal constructions from a multidisciplinary perspective, combining insights from theoretical, psycho-linguistic, and computational approaches.

9.2.4. EFL (2010-2020)

PASCAL DENIS is an associate member of the Laboratoire d'Excellence *Empirical Foundations of Linguistics* (EFL), http://www.labex-efl.org/.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

ERC-PoC 713626 SOM "Statistical modeling for Optimization Mobility": This project aims at bringing to practice results from the project ERC-StG 240186 MiGraNT in the domain of mobility and mobile devices. In particular, a proof of concept will be made of graph mining approaches to learn predictive models and/or recommendation systems from collections of data distributed over a large number of devices (cars, smartphones, ...) while caring about privacy-friendliness.

9.3.2. Collaborations in European Programs, Except FP7 & H2020

9.3.2.1. Sci-GENERATION (2013-2017)

Program: COST

Project acronym: Sci-GENERATION

Project title: Next Generation of Young Scientist: Towards a Contemporary Spirit of R&I.

Duration: 2013-2017

Coordinator: JAN RAMON is an MC member for belgium and a core group member

Other partners: More information on http://scigeneration.eu/en/participants.html

Abstract: Sci-Generation is a COST targeted network that addresses the challenges faced by next generation of researchers in Europe. We aim to improve the visibility, inclusion and success of excellent young researchers and research teams in European science and policy-making. We study and deliberate how changes in research funding opportunities and career perspectives can facilitate these improvements. We wish to promote new and emergent research topics, methods and management organizations. We are developing recommendations for EU science policy that will foster transformations at national and regional levels to promote scientific excellence and to establish a true European research area. (See http://scigeneration.eu).

9.3.2.2. TextLink (2014-2018)

Program: COST Action

Project acronym: TextLink

Project title: Structuring Discourse in Multilingual Europe

Duration: Apr. 2014 - Apr. 2018

Coordinator: Prof. Liesbeth Degand, Université Catholique de Louvain, Belgium. PASCAL DENIS is member of the Tools group.

Other partners: 26 EU countries and 3 international partner countries (Argentina, Brazil, Canada)

Abstract: Effective discourse in any language is characterized by clear relations between sentences and coherent structure. But languages vary in how relations and structure are signaled. While monolingual dictionaries and grammars can characterize the words and sentences of a language and bilingual dictionaries can do the same between languages, there is nothing similar for discourse. For discourse, however, discourse-annotated corpora are becoming available in individual languages. The Action will facilitate European multilingualism by (1) identifying and creating a portal into such resources within Europe - including annotation tools, search tools, and discourse-annotated corpora; (2) delineating the dimensions and properties of discourse annotation across corpora; (3) organizing these properties into a sharable taxonomy; (4) encouraging the use of this taxonomy in subsequent discourse annotation and in cross-lingual search and studies of devices that relate and structure discourse; and (5) promoting use of the portal, its resources and sharable taxonomy. With partners from across Europe, TextLink will unify numerous but scattered linguistic resources on discourse structure. With its resources searchable by form and/or meaning and a source of valuable correspondences, TextLink will enhance the experience and performance of human translators, lexicographers, language technology and language learners alike.

9.4. International Initiatives

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

9.4.1.1. RSS

Program: Inria North-European Labs

Project title: Rankings and Similarities in Signed graphs

Duration: late 2015 to late 2017

Partners: Aristides Gionis (Data Mining Group, Aalto University, Finland) and Mark Herbster (Centre for Computational Statistics and Machine Learning, University College London, UK)

Abstract: The project focuses on predictive analysis of networked data represented as signed graphs, where connections can carry either a positive or a negative semantic. The goal of this associate team is to devise novel formal methods and machine learning algorithms towards link classification and link ranking in signed graphs and assess their performance in both theoretical and practical terms.

9.4.1.2. LEGO

Title: LEarning GOod representations for natural language processing

International Partner (Institution - Laboratory - Researcher):

University of Southern California (United States) - Department of Computer Science - Fei Sha

Start year: 2016

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

LEGO lies in the intersection of Machine Learning and Natural Language Processing (NLP). Its goal is to address the following challenges: what are the right representations for structured data and how to learn them automatically, and how to apply such representations to complex and structured prediction tasks in NLP? In recent years, continuous vectorial embeddings learned from massive unannotated corpora have been increasingly popular, but they remain far too limited to capture the complexity of text data as they are task-agnostic and fall short of modeling complex structures in languages. LEGO strongly relies on the complementary expertise of the two partners in areas such as representation/similarity learning, structured prediction, graph-based learning, and statistical NLP to offer a novel alternative to existing techniques. Specifically, we will investigate the following three research directions: (a) optimize the embeddings based on annotations so as to minimize structured prediction errors, (b) generate embeddings from rich language contexts represented as graphs, and (c) automatically adapt the context graph to the task/dataset of interest by learning a similarity between nodes to appropriately weigh the edges of the graph. By exploring these complementary research strands, we intend to push the state-of-the-art in several core NLP problems, such as dependency parsing, coreference resolution and discourse parsing.

9.5. International Research Visitors

9.5.1. *Visits of International Scientists*

PETER KLING   The objective of the visit of PETER KLING was centered around Learning in Distributed Environments. This initiative contributes to the recent effort of Magnet towards decentralized learning also supported for instance by the Pamela project (Personalized and decentrAlized MachinE Learning under constrAints). Peter Kling's background in distributed computing, combinatorial optimization, online algorithms, and stochastic processes is a good opportunity to investigate new machine learning approaches in this area. In this first of one month, we have started to study Population and Spreading Processes. Two other topics on distributed load balancing and energy-aware algorithms will be the investigated in a second visit in 2018.

VALENTINA ZANTEDESCHI   During her one month stay, VALENTINA ZANTEDESCHI has collaborated with AURÉLIEN BELLET and MARC TOMMASI on decentralized learning. A paper on collaborative and decentralized boosting will be submitted in 2018.

ISABEL VALERA   visited MAGNET for 3 days to collaborate with AURÉLIEN BELLET on fairness in machine learning.

CLEMENT WEISBECKER   visited MAGNET for 1 week to collaborate with AURÉLIEN BELLET on large-scale kernel methods using block low-rank approximations.

WILHELMIINA HAMALAINEN   visited MAGNET for 2 weeks to collaborate with JAN RAMON. In particular, they worked on multiple hypothesis tests for regression and discretization problems.

BERT CAPPELLE   visited MAGNET for a semester, as part of his "delegation", to collaborate with PASCAL DENIS and MIKAELA KELLER on compositional distributional semantics, and more specifically on the distributional analysis of so-called privative adjectives. A collaborative paper on this work will be submitted in 2018.

Several international researchers have also been invited to give a talk at the MAGNET seminar:

- R. Babbar (Max Planck Institute): Algorithms for Extreme Multi-Class and Multi-Label Classification

- M. Chehreghani (Xerox Research): Unsupervised Learning over Graphs: Distances, Algorithms, and an Information-Theoretic Model Validation Principle

- G. Boleda (University Pompeu Fabra): Instances and Concepts in Distributional Space

- M. Blondel (NTT): A Regularized Framework for Sparse and Structured Neural Attention

- L. Wehenkel (University of Liège): Probabilistic Reliability Management of the European Electric Power System

- A. Herbelot (University Pompeu Fabra): A Formal Distributional Semantics for Cognitively-Plausible Reference Acts

- H. Ivey-Law (Data61/CSIRO): Private Federated Learning on Vertically Partitioned Data via Entity Resolution and Additively Homomorphic Encryption

9.5.1.1. Internships

Juhi Tandon   worked on developing re-ranking parsing models that exploit and compare various tree kernels in the context of semi-supervised graph-based multilingual dependency parsing.

Quentin Tremouille   worked on applications of the Hypernode graphs model [39] in the context of (movie) recommendation based on reviews in natural language.

Hippolyte Bourel   worked on the application of the decentralized learning algorithms [15] for mobility data.

Rumei Li   worked on a Yanakakis style algorithm for computing the effective sample size of a set of dependent training examples.

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

MATHIEU DEHOUCK   visited USC during one month. He worked with pairs of 8 main and auxiliary NLP tasks. More specifically, he looked at transfer learning from low-level tasks (such as part-of-speech tagging, named entity recognition, chunking, word polarity classification) to high-level tasks (e.g., semantic relatedness, textual entailment, sentiment analysis). In contrast to a common belief in the NLP community that transfer learning between these tasks should be possible, we discovered that the widely-used technique in which word representations act as a medium of transfer only leads to limited improvements. These results were presented by Fei Sha at the Inria SiliconValley workshop (BIS'2017), and a paper is in preparation for 2018.

AURÉLIEN BELLET   visited École Polytechnique Fédérale de Lausanne (EPFL) during 1 week. He worked with the distributed computing group of Rachid Guerraoui on decentralized and privacy-preserving machine learning, leading to some joint papers [18], [16].

AURÉLIEN BELLET and PASCAL DENIS   visited USC during two weeks in December 2017. In collaboration with MELISSA AILEM, recently recruited as a post-doc on the LEGO project, they worked on developing a new algorithm for joint learning of word and image embeddings inspired on the Skip-Gram word2vec model. In addition, they furthered the work initiated with MATHIEU DEHOUCK along with USC colleagues on multi-task learning by proposing a new encoder-decoder model that integrates task and domain embeddings.

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

5. Partnerships and Cooperations

5.1. National Initiatives

5.1.1. ANR BECASIM

G. Dujardin is a member of the ANR BECASIM project (http://becasim.math.cnrs.fr/). This ANR project gathers mathematicians with theoretical and numerical backgrounds together with engineers. The objective is to develop numerical methods to accurately simulate the behavior of Bose-Einstein condensates.

Title: Simulation numérique avancée pour les condensats de Bose-Einstein.

Type: Modèles Numériques - 2012.

ANR reference: ANR-12-MONU-0007.

Coordinator: Ionut DANAILA, Université de Rouen.

Duration: January 2013 - December 2017.

Partners: Université Lille 1, UPMC, Ecole des Ponts ParisTech, Inria-Nancy Grand-Est, Université Montpellier 2, Université Toulouse 3.

5.1.2. ANR EDNHS

M. Simon is a member of the ANR EDNHS project.

Title: Diffusion de l'énergie dans des système hamiltoniens bruités.

Type: Défi de tous les savoirs (DS10) 2014.

ANR reference: ANR-14-CE25-0011.

Coordinator: Cédric Bernardin, Université de Nice.

Duration: October 2014 - October 2019.

5.1.3. Labex CEMPI

Title: Centre Européen pour les Mathématiques, la Physique et leurs Interactions.

Coordinator: Stephan De Bièvre.

Duration: January 2012 - December 2019.

Partners: Laboratoire Paul Painlevé and Laser physics department (PhLAM), Université Lille 1.

The "Laboratoire d'Excellence" Centre Européen pour les Mathématiques, la Physique et leurs interactions (CEMPI), a project of the Laboratoire de Mathématiques Paul Painlevé and the Laboratoire de Physique des Lasers, Atomes et Molécules (PhLAM), was created in the context of the "Programme d'Investissements d'Avenir" in February 2012.

The association Painlevé-PhLAM creates in Lille a research unit for fundamental and applied research and for training and technological development that covers a wide spectrum of knowledge stretching from pure and applied mathematics to experimental and applied physics.

One of the three focus areas of CEMPI research is the interface between mathematics and physics. This focus area encompasses three themes. The first is concerned with key problems of a mathematical, physical and technological nature coming from the study of complex behavior in cold atoms physics and non-linear optics, in particular fibre optics. The two other themes deal with fields of mathematics such as algebraic geometry, modular forms, operator algebras, harmonic analysis and quantum groups that have promising interactions with several branches of theoretical physics.

5.1.4. PEPS "Jeunes Chercheurs"

M. Simon obtained a CNRS grant "PEPS Jeunes Chercheurs" for a project in collaboration with Oriane Blondel (Université Lyon 1), Clément Erignoux (IMPA, Rio de Janeiro) and Makiko Sasada (Tokyo University).

5.1.5. MIS

Incentive Grant for Scientific Research (MIS) of the Fonds National de la Recherche Scientifique (Belgium).

> Title: Patterns, Phase Transitions, 4NLS & BIon.
>
> Coordinator: D. Bonheure.
>
> Duration: January 2014 - December 2016.
>
> Partner: Université libre de Bruxelles.

5.1.6. PDR

Research Project (PDR) of the Fonds National de la Recherche Scientifique (Belgium).

D. Bonheure is co-investigator of this PDR.

> Title: Asymptotic properties of semilinear systems.
>
> Coordinator: Christophe Troestler (UMons).
>
> Duration: July 2014 - June 2018.
>
> Partner: Université de Mons, Université catholique de Louvain, Université libre de Bruxelles.

5.2. European Initiatives

5.2.1. FP7 & H2020 Projects

5.2.1.1. QUANTHOM

> Title: Quantitative methods in stochastic homogenization.
>
> Programm: FP7.
>
> Duration: February 2014 - August 2017.
>
> Coordinator: Inria.
>
> Partner: Département de mathématique, Université Libre de Bruxelles (Belgium).
>
> Inria contact: Antoine Gloria.
>
> This proposal deals with the development of quantitative tools in stochastic homogenization, and their applications to materials science. Three main challenges will be addressed. First, a complete quantitative theory of stochastic homogenization of linear elliptic equations will be developed starting from results we recently obtained on the subject combining tools originally introduced for statistical physics, such as spectral gap and logarithmic Sobolev inequalities, with elliptic regularity theory. The ultimate goal is to prove a central limit theorem for solutions to elliptic PDEs with random coefficients. The second challenge consists in developing an adaptive multiscale numerical method for diffusion in inhomogeneous media. Many powerful numerical methods were introduced in the last few years, and analyzed in the case of periodic coefficients. Relying on my recent results on quantitative stochastic homogenization, we have made a sharp numerical analysis of these methods, and introduced more efficient variants, so that the three academic examples of periodic, quasi-periodic, and random stationary diffusion coefficients can be dealt with efficiently. The emphasis of this challenge is put on the adaptivity with respect to the local structure of the diffusion coefficients, in order to deal with more complex examples of interest to practitioners. The last and larger objective is to make a rigorous connection between the continuum theory of nonlinear elastic materials and polymer-chain physics through stochastic homogenization of nonlinear problems and random graphs. Analytic and numerical preliminary results show the potential of this approach. We plan to derive explicit constitutive laws for rubber from polymer chain properties, using the insight of the first two challenges. This requires a good understanding of polymer physics in addition to qualitative and quantitative stochastic homogenization.

5.2.2. HyLEF

M. Simon is a collaborator of the ERC HyLEF project.

- Title: Hydrodynamic Limits and Equilibrium Fluctuations: universality from stochastic systems.
- Duration: May 2017 - April 2022.
- Coordinator: P. Gonçalves, Instituto Superior Técnico, Lisbon.
- A classical problem in the field of interacting particle systems (IPS) is to derive the macroscopic laws of the thermodynamical quantities of a physical system by considering an underlying microscopic dynamics which is composed of particles that move according to some prescribed stochastic, or deterministic, law. The macroscopic laws can be partial differential equations (PDE) or stochastic PDE (SPDE) depending on whether one is looking at the convergence to the mean or to the fluctuations around that mean.

  One of the purposes of this research project is to give a mathematically rigorous description of the derivation of SPDE from different IPS. We will focus on the derivation of the stochastic Burgers equation (SBE) and its integrated counterpart, namely, the KPZ equation, as well as their fractional versions. The KPZ equation is conjectured to be a universal SPDE describing the fluctuations of randomly growing interfaces of 1d stochastic dynamics close to a stationary state. With this study we want to characterize what is known as the KPZ universality class: the weak and strong conjectures. The latter states that there exists a universal process, namely the KPZ fixed point, which is a fixed point of the renormalization group operator of spacetime scaling 1:2:3, for which the KPZ is also invariant. The former states that the fluctuations of a large class of 1d conservative microscopic dynamics are ruled by stationary solutions of the KPZ.

  Our goal is threefold: first, to derive the KPZ equation from general weakly asymmetric systems, showing its universality; second, to derive new SPDE, which are less studied in the literature, as the fractional KPZ from IPS which allow long jumps, the KPZ with boundary conditions from IPS in contact with reservoirs or with defects, and coupled KPZ from IPS with more than one conserved quantity. Finally, we will analyze the fluctuations of purely strong asymmetric systems, which are conjectured to be given by the KPZ fixed point.

5.3. International Initiatives

5.3.1. Inria International Partners

5.3.1.1. Informal International Partners

Max Planck Institute for Mathematics in the Sciences: long-term collaboration with Felix Otto on stochastic homogenization.
University of Umea: long-time collaboration with David Cohen on numerical methods for the numerical integration of stochastic evolution problems.

5.4. International Research Visitors

5.4.1. Research Stays Abroad

M. Simon spent three weeks in Berkeley University, visiting Pr. Alan Hammond (July 2017).
M. Simon spent two weeks at Braga University, as a guest of P. Gonçalves (September 2017).

MINT2 Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. StimTac, 2015-2017

Participants: Frédéric Giraud [correspondant], Patricia Plénacoste, Laurent Grisoni, Michel Amberg, Nicolas Bremmard.

The aim of this project is to create the first digital book, enhanced with haptic feedback, in order to anticipate the integration of this technology into everyday products. This project addresses technological issues, like programming haptic content in a multimedia software, and design issues to understand how the haptic feedback is perceived by the users.

Stimtac is a book, and could thus be presented to non-specialists users and to a wide public during presentations, demos and forums. The scenario and the illustrations were made by Dominique Maes, a Belgium artist, who did the digital book "Bleu de toi" among other things. The Public Library of Lille is a partner of this project and allows us to meet the public.
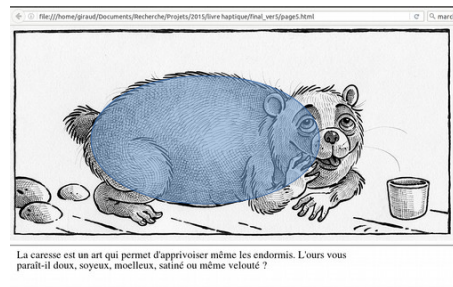
(a)   (b)

Figure 1. Demo session at "La nuit des Bibliothèques (Lille, October 2016), and a page of Stimtac; the ellipse highlights the tactile feedback on E-Vita.

This project has been granted 8Keuros from IRCICA.

8.1.2. MATRICE (sept 2015-sept. 2017

Participant: Laurent Grisoni [correspondant].

This regional project, funded by ERDF, led by Lille School of Architecture, aims at understanding in which way 3D printing may be interesting for the building economy. partners: Ecole d'architecture de Lille, Inria, Ecole Centrale de Lille, Télécom Lille 1, Ecole des Mines de Douai.

8.2. National Initiatives

8.2.1. Equipex IRDIVE (ANR project 2012-2020)

3 Meuros project, co-funded by ERDF for the development of a pluri-disciplinary project on ICT-based tools for understanding human perception of visual contents. Laurent Grisoni is member of the lead group of this project, and animates an axis devoted to art-sciences and technologies collaborations.

8.2.2. MAUVE CPER ("Contrat de Plan État-Région") 2016-2020 project

Funds: 4 Meuros (validated at national level, funded by Region), and 1 Meuro additional funding provided by ERDF.
Subject: ICT tools for mediation and access to knowledge.
Lead: University of Lille, University of Artois. Laurent Grisoni is co-lead of this project.

8.2.3. InriaRT

Participants: Laurent Grisoni [correspondant], Samuel Degrande, Francesco de Comité.

Art/science Inria internal network gathering projects interested in collaborating with artists.
Inria teams involved: MuTANT (Paris), Imagine (Grenoble), Flowers, Potioc (Bordeaux), Hybrid, MimeTic (Rennes). This initiative will take advantage of an agreement between Inria and French Ministry of Culture, signed early December 2016.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, Except FP7 & H2020

MINT participates to the VR4REHAB (2018-2020) project, funded by ENO Interreg. This project gathers rehabilitation structures and provides animation of hackathons for prototyping VR systems for rehabilitation. MINT role is to provide technical support and help mature relevant approaches for getting closer to using VR for personnal, lightweight rehabilitation systems. Funds for the team: 430 Keuros. Contact for the team: Laurent Grisoni.

8.3.2. Collaborations with Major European Organizations

we collaborate with INESC-ID (through exchange of students, join publications).

Mjolnir Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Mjolnir/UCLIC associate team (Inria Lille, 2015-2017)
Participants: Sylvain Malacria [correspondent], Nicolas Roussel.

The goal of this project, whose funding ends 2017, is the design and implementation of novel cross-device systems and interaction techniques. Thanks to this funding, the Mjolnir group and UCLIC are currently working on two scientific research projects. The first one investigates the design of notification systems for smart watches, smartphones, and in distributed computing environments based on device proximity, location, and time. A group of three Computer Science students from UCL is currently designing and implementing the first prototype of this system. The second project studies the influence of the shape and color of icons on visual search, on smartphones and smartwatches. In addition, UCLIC and the Mjolnir group also collaborate on the design and implementation of a software tool for helping HCI researchers to create non-photorealistic figures aimed at illustrating interaction techniques.

Partner: University College London Interaction Centre (United Kingdom).

9.2. National Initiatives

9.2.1. Turbotouch (ANR, 2014-2019)
Participants: Géry Casiez [correspondent], Sylvain Malacria, Mathieu Nancel, Thomas Pietrzak, Sébastien Poulmane, Nicolas Roussel.

Touch-based interactions with computing systems are greatly affected by two interrelated factors: the transfer functions applied on finger movements, and latency. This project aims at transforming the design of touch transfer functions from black art to science to support high-performance interactions. We are working on the precise characterization of the functions used and the latency observed in current touch systems. We are developing a testbed environment to support multidisciplinary research on touch transfer functions and will use this testbed to design latency reduction and compensation techniques, and new transfer functions.

Partners: Inria Lille's NON-A team and the "Perceptual-motor behavior group" from the Institute of Movement Sciences.

Web site: http://mjolnir.lille.inria.fr/turbotouch/

Related publications: [21], [17], [12], [18]

9.2.2. ParkEvolution (Carnot Inria - Carnot STAR, 2015-2018)
Participants: Géry Casiez [correspondent], Sébastien Poulmane.

This project studies the fine motor control of patients with Parkinson disease in an ecological environment, at home, without the presence of experimenters. Through longitudinal studies, we collect raw information from pointing devices to create a large database of pointing behavior data. From the analysis of this big dataset, the project aims at inferring the individual's disease progression and influence of treatments.

Partners: the "Perceptual-motor behavior group" from the Institute of Movement Sciences and Hôpital de la Timone.

Web site: http://parkevolution.org/

9.2.3. BCI-LIFT (Inria Project Lab, 2015-2019)
Participants: Géry Casiez [correspondent], Nicolas Roussel.

The goal of this large-scale initiative is to design a new generation of non-invasive Brain-Computer Interfaces (BCI) that are easier to appropriate, more efficient, and suited for a larger number of people.

Partners: Inria's ATHENA, NEUROSYS, POTIOC, HYBRID & DEMAR teams, *Centre de Recherche en Neurosciences de Lyon* (INSERM) and INSA Rouen.

Web site: https://bci-lift.inria.fr/

Related publications: [22], [33]

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. Happiness (H2020-ICT-2014-1/ICT-03-2014/RIA, 2015-2018)
Participants: Julien Decaudin, Christian Frisson, Thomas Pietrzak [correspondent], Nicolas Roussel.

The main objective of this project is to develop and evaluate new types of haptic actuators printed on advanced Thin, Organic and Large Area Electronics (TOLAE) technologies for use in car dashboards. These actuators are embedded in plastic molded dashboard parts. The expected outcome is a marketable solution for haptic feedback on curved interactive surfaces.

In this project, Inria is responsible for WP2: Human Factors and Interaction Design, as well as the software development of the project main demo. A first version of this demo was showcased at the Geneva Motor Show 2017. We developed the dashboard software of the Mojave concept car, built by the Sbarro school.

Partners: CEA (coordinator), Inria Rennes' HYBRID team, Arkema, Bosch, Glasgow University, ISD, Walter Pack, Fundacion Gaiker.

Web site: http://happiness-project.eu/

Related publications: [26], [36]

9.4. International Initiatives

9.4.1. Inria International Partners

9.4.1.1. Informal International Partners
Andy Cockburn, University of Canterbury, Christchurch, NZ [12]

Daniel Vogel, University of Waterloo, Waterloo, CA [14]

Nathalie Henry Riche, Microsoft Research, Seattle, USA [16]

Audrey Girouard, Carleton University, Ottawa, CA [23]

Daniel Wigdor, University of Toronto, Toronto, CA [25]

Ravin Balakrishnan, University of Toronto, Toronto, CA [26]

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Ed Lank, Associate Professor at the University of Waterloo, has already spent one year in our team until Aug. 2017 (funded by Région Hauts-de-France and Université Lille 1). His stay was extended until Feb. 2018, funded by Inria.

Marcelo Wanderley, Professor at McGill University, who has been awarded an Inria International Chair in our team in 2016, spent 2 months in our group this year (June to July).

9.5.1.1. Internships
Shaishav Siddhpuria, Master student, Univ of Waterloo, from Feb. to Apr. 2017

Keiko Katsuragawa, Postdoc, Univ of Waterloo, Mar. 2017

Rina Wehbe, PhD student, Univ of Waterloo, Mar. 2017

Jeff Avery, PhD student, Univ of Waterloo, from Jun. to Aug. 2017

<div align="center">**MODAL Project-Team**</div>

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. *Main partners of bilille*
Participant: Guillemette Marot.

Bilille, the bioinformatics platform of Lille, officially gathers from Nov. 2015 a few bioinformaticians, biostatisticians and bioanalysts from the following teams:

>   EA2694 (Univ. Lille, CHRU, Inria)
>   FRABIO, FR3688 (Univ. Lille,CNRS)
>   CBP / GFS (Univ. Lille, CHRU)
>   TAG (Univ. Lille, CNRS, INSERM, Institut Pasteur de Lille)
>   U1167 (Univ. Lille, CHRU, INSERM et Institut Pasteur de Lille)
>   U1011 (Univ. Lille, INSERM)
>   UMR8198 (Univ. Lille, CNRS)
>   LIGAN PM (Univ. Lille, CNRS)
>   BONSAI (Inria, Univ. Lille, CNRS).

These last teams are thus the main partners of Modal concerning biostatistics for bioinformatics. Guillemette Marot is the co-head of the platform and works in close collaboration with the following people for the leadership of the scientific strategy related to the platform:

>   H. Touzet, BONSAI, UMR 9189 (co-head of bilille)
>   P. Touzet, UMR 8198 (deputy head of bilille)
>   V. Chouraki, U1167
>   M. Figeac, CBP / GFS
>   D. Hot, TAG
>   V. Leclère, Insitut Charles Viollette
>   M. Lensink, UMR 8576.

9.1.2. *Collaborations of the year linked to bilille, the bioinformatics and bioanalysis platform*
Participants: Guillemette Marot, Vincent Vandewalle.

Guillemette Marot and Vincent Vandewalle have supervised the data analysis part or support in biostatistics tools testing for the following research projects involving engineers from bilille (only the names of the principal investigators of the project are given even if several partners are sometimes involved in the project):

>   UMR 8576, E. Goulas, FLAM project
>   JPARC, M.H. David, AGI-HOX project
>   JPARC, M.C. Chartier-Harlin, RNA-Seq meta-analysis
>   U1003, D. Gkika, TRP canals screening
>   UMR 1167, F. Pinet, INCA-Network project.

9.1.3. *Coordinator of the regional (Haut-De-France) project*
Participant: Sophie Dabo-Niang.

Sophie Dabo-Niang is the coordinator of the regional (Haut-De-France) project "Bridging cell biomechanical phenotype and their biological expressions for Cancer diagnosis (STATE-CELL)". It is a project in partnership with Modal-Inria, LIMMS UMI 2820, LEM UMR 9221, Yncrea Hauts de France, INSERM U908. This project is submitted to I-SITE ULNE, SUSTAIN proposals 2017.

9.2. National Initiatives

9.2.1. Programme of Investments for the Future (PIA)

Bilille is a member of two PIA "Infrastructures en biologie-santé":

France Génomique (https://www.france-genomique.org/spip/?lang=en)

IFB, French Institute of Bioinformatics (https://www.france-bioinformatique.fr/en)

As leader of the platform, Guillemette Marot is thus involved in these networks.

9.2.2. RHU PreciNASH

Participant: Guillemette Marot.

Acronym: PreciNASH

Project title: Non-alcoholic steato-hepatitis (NASH) from disease stratification to novel therapeutic approaches

Coordinator: F. Pattou

Duration: 5 years

Partners: FHU Integra and Sanofi

PreciNASH, project coordinated by Pr. F. Pattou (UMR 859, EGID), aims at better understanding non alcoholic stratohepatitis (NASH) and improving its diagnosis and care. In this RHU, Guillemette Marot supervises a 2 years post-doc, as her team EA 2694 is member of the FHU Integra. EA 2694 is involved in the WP1 for the development of a clinical-biological model for the prediction of NASH. Other partners of the FHU are UMR 859, UMR 1011 and UMR 8199, these last three teams being part of the labex EGID (European Genomic Institute for Diabetes). Sanofi is the main industrial partner of the RHU PreciNASH. The whole project will last 5 years (2016-2021).

9.2.3. ANR

9.2.3.1. ANR ClinMine

Participants: Cristian Preda, Vincent Vandewalle.

ClinMine Project-2014-2017

ANR project (ANR TECSAN - Technologie de la santé)

Main coordinator of the project: Clarisse Dhaenens, CRIStAL, USTL

7 partners - EA 1046 (Maladie d'Alzheimer et pathologies vasculaires, Faculté de Médecine, Lille), EA 2694 (Centre d'Etudes et de Recherche en Informatique Médicale - Faculté de Médecine, Lille), MODAL (Inria LNE), Alicante (Entreprise), CHRU de Montpelier, GHICL (Groupe Hospitalier de l'Institut Catholique de Lille), CRIStAL, USTL.

9.2.3.2. ANR TheraSCUD2022

Participant: Guillemette Marot.

Acronym: TheraSCUD2022

Project title: Targeting the IL-20/IL-22 balance to restore pulmonary, intestinal and metabolic homeostasis after cigarette smoking and unhealthy diet

Coordinator: P. Gosset

Duration: 3 years

Partners: CIIL Institut Pasteur de Lille and UMR 1019 INRA Clermont-Ferrand

TheraSCUD2022, project coordinated by P. Gosset (Institut Pasteur de Lille), studies inflammatory disorders associated with cigarette smoking and unhealthy diet (SCUD). Guillemette Marot is involved in this ANR project as head of bilille platform, and will supervise 1 year engineer on integration of omic data. The duration of this project is 3 years (2017-2020).

9.2.4. Working groups

Sophie Dabo-Niang belongs to the following working groups:

- STAFAV (STatistiques pour l'Afrique Francophone et Applications au Vivant)
- ERCIM Working Group on computational and Methodological Statistics, Nonparametric Statistics Team
- Ameriska

Benjamin Guedj belongs to the following working groups (GdR) of CNRS:

- ISIS (local referee for Inria Lille - Nord Europe)
- MaDICS
- MASCOT-NUM (local referee for Inria Lille - Nord Europe).

Guillemette Marot belongs to the StatOmique working group.

9.2.5. Other initiatives

Participants: Serge Iovleff, Cristian Preda, Vincent Vandewalle.

Serge Iovleff is the head of the project CloHe granted in 2016 by the Mastodons CNRS challenge "Big data and data quality". The project is axed on the design of classification and clustering algorithms for mixed data with missing values with applications to high spatial resolution multispectral satellite image time-series. Website. Cristian Preda and Vincent Vandewalle are also members of the CloHe project.

9.3. International Initiatives

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

9.3.1.1. Equipes associées nord-européennes
Participants: Christophe Biernacki, Benjamin Guedj.

Benjamin Guedj and Christophe Biernacki pursue a two years collaboration as "Equipes associées nord-européennes" with the Irish team "INSIGHT". The Centre for Data Analytics INSIGHT is about the size of Inria Lille - Nord Europe and is the main Irish research facility in Statistics and Machine Learning. It is focused on the next generation of machine learning (ML) and statistics (Stat) algorithms that can operate on large-scale dynamic data. Nial FRIEL (NF) is the leader of the ML/Stat axis of INSIGHT, Brendan MURPHY (BM) is a professor. The topic of this project is to manage statistical models inflation by the mean of model clustering.

Benjamin Guedj and Christophe Biernacki visited NF and BM in Dublin once in 2017 to progress in the current collaboration.

9.3.1.2. EMC and CIMPA
Participant: Sophie Dabo-Niang.

EMS (European Mathematical Society): Sophie Dabo-Niang is a nominated member of EMS-CDC (Committee of Developing counties). She will be vice-chair of this committee in 2018.

CIMPA (International Center of Pure and Applied Mathematics): Sophie Dabo-Niang is a nominated member of CIMPA.

9.3.1.3. SIMERGE
Participants: Sophie Dabo-Niang, Serge Iovleff.

Sophie Dabo-Niang and Serge Iovleff are members of SIMERGE, a LIRIMA project-team (January 2015-December 2017). It includes researchers from Mistis (Inria Grenoble - Rhône-Alpes, France) and Inria-MODAL (Lille Nord de France), LERSTAD (Laboratoire d'Etudes et de Recherches en Statistiques et Développement, Université Gaston Berger, Sénégal), IRD (Institut de Recherche pour le Développement, Unité de Recherche sur les Maladies Infectieuses et Tropicales Emergentes, Dakar, Sénégal) and LEM lab (Lille Economie et Management, University of Lille). This project is submitted for renewal with a new partner (Institut Paster of Dakar, Senegal).

9.3.2. Inria International Partners

9.3.2.1. Informal International Partners
Participant: Benjamin Guedj.

Benjamin Guedj collaborates with Wouter Koolen (CWI, Netherlands), Peter Grünwald (CWI & Leiden University, Netherlands).

Benjamin Guedj collaborates with Olivier Wintenberger (KU, Denmark).

9.4. International Research Visitors

9.4.1. Visits to International Teams
Participant: Pascal Germain.

Pascal Germain will visit to "Groupe de recherche en apprentissage automatique de l'Université Laval" (Québec, Canada) to work with Professor François Laviolette from 11/12/2017 to 20/12/2017.

NON-A Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

- Project ARCIR ESTIREZ "Estimation distribuée de systèmes dynamiques en réseaux", coordinators: D. Efimov, M. Petreczky, 2013-2017.
- CPER DATA 2016-2020 (involved in two projects: "FIT" related to the wireless robots and sensors network and "DATA", related to platform). FIT includes our robotic activity and DATA corresponds to our computation need in fluid mechanics as well as possible security issues in the ControlHub development platform.
- ELSAT20202 (Ecomobilité, Logistique, Sécurité, Adaptabilité dans les Transports) is a Regional consortium gathering aeronautics (ONERA), micro/nano technologies (IEMN), control sciences (Non-A) and fluid mechanics (LAMIH, LML) and working on technologies and methods for the active control of separated flows.

9.2. National Initiatives

- ANR project Finite4SoS (Finite time control and estimation for Systems of Systems), coordinator: W. Perruquetti, 2015-2020.
- ANR project WaQMoS (Coastal waters quality surveillance using bivalve mollusk-based sensors), coordinator: D. Efimov, 2015-2019.
- ANR project TurboTouch (High-performance touch interactions), coordinator: G. Casiez (MJOL-NIR team, Inria), 2014-2018.
- ANR project ROCC-SYS (Robust Control of Cyber-Physical Systems), coordinator: L. Hetel (CNRS, EC de Lille), 2013-2018.
- ANR project MSDOS (Multidimensional System: Digression on Stability), coordinator: Nima Yeganefar (Poitiers University), 2014-2018.
- We are also involved in several technical groups of the GDR MACS (CNRS, "Modélisation, Analyse de Conduite des Systèmes dynamiques", see http://www.univ-valenciennes.fr/GDR-MACS), in particular: Technical Groups "Identification", "Time Delay Systems", "Hybrid Systems", "Complex Systems, Biological Systems and Automatic Control," and "Control in Electrical Engineering".
- Model-free control: collaborations with the startup ALIEN SAS (created by C. Join and M. Fliess).

9.3. European Initiatives

9.3.1. Collaborations with Major European Organizations

Partner 1: KULeuven, labo 1 (Belgium)
Supervisor: W. Michiels
Partner 2: TU/Eindhoven, labo 1 (The Netherlands)
Supervisor: H. Nijmeijer
Partner 3: Centrale Lille, labo 1 (France)
Supervisor: J.-P. Richard

H2020 project UCoCoS ("Understanding and Controlling of Complex Systems", 2016-2020) is a European Joint Doctorate aiming at creating a framework for complex systems, and at defining a common language, common methods, tools and software for the complexity scientist. It strongly relies on a control theory point of view. Six ESR (early stage researchers) perform a cutting-edge project, strongly relying on the complementary expertise of the 3 academic beneficiaries and benefiting from training by 4 non-academic partners from different sectors. ESR1: Analytical and numerical bifurcation analysis of delay-coupled systems; ESR2: Estimation in complex systems; ESR3: Grip on partial synchronization in delay-coupled networks; ESR4: Reduced modelling of large-scale networks ; ESR5: Network design for decentralized control ; ESR6: Networks with event triggered computing. Non-A is firstly invested on ESR 2 (Haik Silm), 4 (Quentin Voortman), 5 (Deesh Dileep), 6 (Jijju Thomas).

9.4. International Initiatives

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

9.4.1.1. HoTSMoCE

Title: Homogeneity Tools for Sliding Mode Control and Estimation

International Partner (Institution - Laboratory - Researcher):

UNAM (Mexico), Departamento de Ingeniería de Control y Robótica, Leonid Fridman

Start year: 2016

See also: https://team.inria.fr/non-a/asso-team-hotsmoce/

The team Non-A is developing an estimation theory, built around differential algebra and operational calculation on the one hand, and high gain algorithms (such as sliding mode) on the other hand. The Mexican partner team comes from "Sliding Mode Control" laboratory of UNAM. There exists a strong intersection of interests of both teams (application of homogeneity for design of sliding mode control and estimation algorithms, and analysis of finite-time stability). That is why there exists a long history of collaboration between these two teams. The goal of the project is development of control and estimation algorithms converging in fixed or in finite time by applying the last generation sliding mode techniques and the homogeneity theory. The project realization is planned in the form of short-time visits of permanent staff and visits of PhD students for a long period of stay. Such visits are very important for young scientists, and also help Non-A team to prepare and find good PhDs/post-docs for future.

9.4.2. Inria International Partners

9.4.2.1. Informal International Partners

- Emilia Fridman, Tel Aviv University, Israel
- Leonid Fridman, UNAM, Mexico
- Jaime Moreno, UNAM, Mexico
- Johannes Schiffer, Leeds University, UK
- ITMO University, Saint-Petersburg, Russia
- Eva Zerz, Aachen University, Germany

9.4.3. Participation in Other International Programs

PHC Amadeus "Computer Algebra and Functional Equations", 2016-2017, with the University of Limoges (XLIM) and the University of Linz (Austria).

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Leonid Fridman, UNAM, Mexico
- Petteri Laakkonen, Tampere University of Technology, Finland, 11–14/12/2017

9.5.2. Visits to International Teams

G. Zheng visited two weeks at Wuhan University (China) in July 2017.

9.5.2.1. Research Stays Abroad

G. Zheng held a visiting professor position in Nanjing University of Science and Technology (China) for one month stay in August 2017.

RAPSODI Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- The region Haut-de-France supported financially the organization of the FVCA8 conference.
- The PhD program of Ahmed Ait Hammou Oulhaj is partially supported (50%) by the region Haut-de-France (formerly Nord–Pas-de-Calais).

8.2. National Initiatives

8.2.1. ANR

C. Cancès is the coordinator of the ANR GEOPOR project (http://www.agence-nationale-recherche.fr/Project-ANR-13-JS01-0007). This project aims to study realistic models for complex porous media flows from a variational point of view, and to take advantage of this new approach to design and analyze some efficient numerical methods.

Title: Approche géométrique pour les écoulements en milieux poreux : théorie et numérique.

Type: Jeunes Chercheuses Jeunes Chercheurs SIMI 1- 2013

ANR Reference: ANR-13-JS01-0007-01

Coordinator: Clément Cancès, Inria Lille - Nord Europe.

Duration: January 2014 – June 2017

C. Chainais-Hillairet is a member of the ANR MOONRISE project (http://moonrise.math.cnrs.fr/). The MOONRISE project aims at exploring modeling, mathematical and numerical issues originating from the presence of high oscillations in nonlinear PDEs mainly from the physics of nanotechnologies and from the physics of plasmas.

Title: Modèles, Oscillations et schémas numériques.

Type: Fondements du numérique (DS0705) - 2014

ANR reference: ANR-14-CE23-0007

Coordinator: Florian MEHATS, Université de Rennes 1.

Duration: October 2014 - September 2019.

B. Merlet is a member of the ANR GEOMETRYA project (https://www.ljll.math.upmc.fr/lemenant/GEOMETRYA/). The GEOMETRYA project addresses several problems within the framework of geometric measure theory, from both theoretical and numerical viewpoints. Most of these problems are derived from the modeling of physical phenomenons. The main topics are: the Geometric Measure Theory in singular metric spaces, the Plateau problem, the Mumford-Shah functional, irrigation and branched transport problems, the Willmore energy.

Title: Théorie géométrique de la mesure et applications

Type: Blanc SIMI 1 - 2012

ANR reference: ANR-12-BS01-0014

Coordinator: Hervé Pajot, Université Joseph Fourier (Grenoble).

Duration: january 2013 - june 2017.

I. Lacroix is the local coordinator at Université Lille 1 of the ANR BECASIM project (http://becasim.math.cnrs.fr/). This ANR project gathers mathematicians with theoretical and numerical backgrounds together with engineers. The objective is to develop numerical methods to accurately simulate the behavior of Bose-Einstein condensates.

Title: Simulation numérique avancée pour les condensats de Bose-Einstein.

Type: Modèles Numériques - 2012

ANR reference: ANR-12-MONU-0007

Coordinator: Ionut DANAILA, Université de Rouen.

Duration: January 2013 - November 2017.

8.2.2. *Labex CEMPI*

Title: Centre Européen pour les Mathématiques, la Physique et leurs interactions

Coordinator: Stephan De Bièvre.

Duration: January 2012 - December 2019.

Partners: Laboratoire Paul Painlevé and Laser physics department (PhLAM), Université Lille 1.

The "Laboratoire d'Excellence" Centre Européen pour les Mathématiques, la Physique et leurs interactions (CEMPI), a project of the Laboratoire de Mathématiques Paul Painlevé and the Laboratoire de Physique des Lasers, Atomes et Molécules (PhLAM), was created in the context of the "Programme d'Investissements d'Avenir" in February 2012.

The association Painlevé-PhLAM creates in Lille a research unit for fundamental and applied research and for training and technological development that covers a wide spectrum of knowledge stretching from pure and applied mathematics to experimental and applied physics.

One of the three focus areas of CEMPI research is the interface between mathematics and physics. This focus area encompasses three themes. The first is concerned with key problems of a mathematical, physical and technological nature coming from the study of complex behavior in cold atoms physics and non-linear optics, in particular fibre optics. The two other themes deal with fields of mathematics such as algebraic geometry, modular forms, operator algebras, harmonic analysis and quantum groups that have promising interactions with several branches of theoretical physics.

8.2.3. *Microturbu Project*

B. Merlet and T. Rey were both members of the Microturbu project. This project, headed by Stephan De Bièvre, was supported by the interdisciplinarity mission of the CNRS in 2017. Its purpose was to strengthen the collaborations between applied mathematicians from the Paul Painlevé laboratory and physicists from the PhLAM laboratory.

8.3. International Research Visitors

8.3.1. *Visits of International Scientists*

We have a long time collaboration with Ansgar Jüngel team from TU Wien. He visited Lille on January 9–13, 2017. His PhD Student, Anita Gerstenmayer came for the third time in Lille on July 3–7, 2017.

Ezzeddine Zahrouni (Univ. Carthage, Tunisia) was invited in Lille in May 2017 thanks to a support of the Labex CEMPI.

<div align="center">**RMOD Project-Team**</div>

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. CAR IMT Douai

Participants: Pablo Tesone, Guillermo Polito, Marcus Denker, Stéphane Ducasse with: L. Fabresse and N. Bouraqadi (IMT Douai)
From 2009, ongoing.

We have signed a convention with the CAR team led by Noury Bouraqadi of IMT Douai. In this context we co-supervised three PhD students (Mariano Martinez-Peck, Nick Papoylias and Guillermo Polito). The team is also an important contributor and supporting organization of the Pharo project.

Currently, Pablo Tesone is doing a PhD co-supervided by RMOD and Pr. L. Fabresse and N. Bouraqadi. We are preparing a collaboration in the Context of CPER Data in 2018.

9.2. National Initiatives

9.2.1. CEA List

Participants: Jason Lecerf, Stéphane Ducasse with T. Goubier (CEA List)
From 2016, ongoing.

Jason Lecerf started a shared PhD Oct 2016: *Reuse of code artifacts for embedded systems through refactoring*.

9.3. European Initiatives

9.3.1. Collaborations in European Programs, Except FP7 & H2020

Namur University, Belgium
Participants: Anne Etien, Nicolas Anquetil, Olivier Auverlot, Stéphane Ducasse.

From Sept 2016 to Dec. 2018.

Lille Nord Europe European Associated Team with the PreCISE research center of Pr. A. Cleve from Namur University (Belgium).

This project aims to study the co-evolution between database structure and programs and to propose recommendations to perform required changes on cascade. These programs are either internal to the schema as functions or triggers or external as applications written in Java or Php built on top of the DB. Our intuition is that software engineering techniques can be efficient for such issues. This project also aims to unify the abstract representation of the DB and its relationships with the internal or external program.

University of Turin (Italy)
Participants: Marco Naddéo, Stéphane Ducasse.
From 2015 to 2017.

Marco Naddéo was a PhD student co-supervised by Damien Cassou, Stéphane Ducasse at RMoD and Viviana Bono from University of Turin (Italy): *A modular Approach of Object initialization for Pharo*, University Turin, November 2017.

VUB Brussels, Belgium
Participants: Guillermo Polito, Stéphane Ducasse.

From 2016, ongoing.

Student: Matteo Marra, collaboration with Eliza Gonzalez Boix. Guillermo Polito co-supervised Matteo Marra's master thesis. This collaboration led to a workshop paper [29] and a paper under revision for Programming 2018.

University of Prague
Participants: Stéphane Ducasse.

From 2015, ongoing.

We are working with Dr. Robert Pergl from the University of Prague. Stéphane Ducasse gave a lecture at the University of Prague in 2017.

9.4. International Initiatives

9.4.1. Informal International Partners

Uqbar Argentina

Participants: Pablo Tesone, Esteban Lorenzano, Guillermo Polito, Stéphane Ducasse.

From 2015, ongoing.

We are working with the Uqbar team from different Argentinian universities. We hired three of the people: Nicolas Passerini(engineer), Esteban Lorenzano (engineer) and Pablo Tesone (PhD).

Pharo in Research:

Participants: Pablo Tesone, Esteban Lorenzano, Guillermo Polito, Marcus Denker, Stéphane Ducasse.
From 2009, ongoing.

We are building an ecosystem around Pharo with international research groups, universities and companies. Several research groups (such as Software Composition Group – Bern, and Pleaid – Santiago) are using Pharo. Many universities are teaching OOP using Pharo and its books. Several companies worldwide are deploying business solutions using Pharo.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Prof. Serge Demeyer, Universiteit Antwerpen, Belgium. September 1st until December 31st, 2017. Sabbatical on the topic of Test Automation
- Andrew Black, Department of Computer Science, Portland State University, September 1st until December 9th. Sabbatical, Implementing the Grace Language using Pharo
- Fernando Brito, Université de Lisbonne, 27 to 18/2/2017
- Sébastien Proksch, 09/02/2017
- Sébastien Martinez, Université de Rennes 1, 09/03/2017
- Sergiu Ivanov, CNRS Grenoble, 9 to 10/2/2017
- Coen de Roover, Université Bruxelles, 28/02/17
- Yoshiki Oshima, YCombinator Research, 13 to 17/3/17
- Abdelghani Alidra, Université de Skikda, 15/05 to 18/06/2017
- Sergiu Ivanov, CNRS Grenoble, 21/04/17
- Ronie Salgado, Université du Chili, 11/9 to 22/9/2017
- Andy Zaidman, Université de Delft, 08/11/17
- Laurence Tratt, King's College London, 15/09/17
- Elisa Gonzales, Université de Bruxelles, 15/09/17
- Théo D'Hondt, Université de Bruxelles, 15/09/17

- Rim Drira, RIADI Laboratory - National School of Computer Science, Tunisia, 09/11/17
- Gordana Rakic, Université de Belgrade - Serbie, 29/11 to 6/12/2017
- Henda Ben Gezahla, Ecole Nationale des Sciences de l'Informatique (ENSI) en Tunisie, 7/11 to 12/11/2017
- Abir Mbaya, Université de Lyon, 11 to 15/12/2017
- Olivier Flückiger (Northeastern University, US) 28/11 to 01/12. Talk: Correctness of Speculative Optimizations with Dynamic Deoptimization
- Gabriel Scherer (Parsifal, Inria Saclay, France) 28/11 to 29/11. Talk: Correctness of Speculative Optimizations with Dynamic Deoptimization

9.5.1.1. Internships

- Thomas Dupriez, ENS Cachan/Paris-Saclay, from 2017-03-16 until 2017-07-21, and from 2017-08-07 until 2017-08-11
- Sophie Kaleba, from Apr 2017 until Sep 2017
- Clement Mastin, from May 2017 until Aug 2017
- Amal Noussi Mbeyim, Ecole Normale Supérieure de Rennes, from May 2017 until Jul 2017
- Morgane Pigny, until Feb 2017
- Jeremie Regnault, from Jun 2017 until Aug 2017
- Benoit Verhaeghe, Université des Sciences et Technologies de Lille, from May 2017 until Aug 2017

9.5.2. Visits to International Teams

- Anne Etien: Labri, Université Bordeaux 1, January 2017.
- Nicolas Anquetil, Julien Delplanque and Anne Etien, Visit Namur University (Belgium), Decembre 2017.
- Stéphane Ducasse: Technical University Prague, Czech Republic.
- Stéphane Ducasse: ENIS Tunisia.
- Stéphane Ducasse: University of Novi Sad, Serbia.
- Stéphane Ducasse: Maribor, Slovenia.
- Stéphane Ducasse: VUB Bussels, Belgium.
- Stéphane Ducasse: University de Bretagne Occidentale.
- Stéphane Ducasse: Software Vomposition Group University of Bern/Switzerland.
- Guillermo Polito: VUB Brussel, Belgium.

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

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR BoB

Participants: Rémi Bardenet, Michal Valko.

- *Title*: Bayesian statistics for expensive models and tall data
- *Type*: National Research Agency
- *Coordinator*: CNRS (Rémi Bardenet)
- *Duration*: 2016-2020
- *Abstract*:

  Bayesian methods are a popular class of statistical algorithms for updating scientific beliefs. They turn data into decisions and models, taking into account uncertainty about models and their parameters. This makes Bayesian methods popular among applied scientists such as biologists, physicists, or engineers. However, at the heart of Bayesian analysis lie 1) repeated sweeps over the full dataset considered, and 2) repeated evaluations of the model that describes the observed physical process. The current trends to large-scale data collection and complex models thus raises two main issues. Experiments, observations, and numerical simulations in many areas of science nowadays generate terabytes of data, as does the LHC in particle physics for instance. Simultaneously, knowledge creation is becoming more and more data-driven, which requires new paradigms addressing how data are captured, processed, discovered, exchanged, distributed, and analyzed. For statistical algorithms to scale up, reaching a given performance must require as few iterations and as little access to data as possible. It is not only experimental measurements that are growing at a rapid pace. Cell biologists tend to have scarce data but large-scale models of tens of nonlinear differential equations to describe complex dynamics. In such settings, evaluating the model once requires numerically solving a large system of differential equations, which may take minutes for some tens of differential equations on today's hardware. Iterative statistical processing that requires a million sequential runs of the model is thus out of the question. In this project, we tackle the fundamental cost-accuracy trade-off for Bayesian methods, in order to produce generic inference algorithms that scale favourably with the number of measurements in an experiment and the number of runs of a statistical model. We propose a collection of objectives with different risk-reward trade-offs to tackle these two goals. In particular, for experiments with large numbers of measurements, we further develop existing subsampling-based Monte Carlo methods, while developing a novel decision theory framework that includes data constraints. For expensive models, we build an ambitious programme around Monte Carlo methods that leverage determinantal processes, a rich class of probabilistic tools that lead to accurate inference with limited model evaluations. In short, using innovative techniques such as subsampling-based Monte Carlo and determinantal point processes, we propose in this project to push the boundaries of the applicability of Bayesian inference.

9.1.2. ANR Badass

Participants: Odalric Maillard, Émilie Kaufmann.

- *Title*: BAnDits for non-Stationarity and Structure
- *Type*: National Research Agency
- *Coordinator*: Inria Lille (O. Maillard)
- *Duration*: 2016-2020

- *Abstract*: Motivated by the fact that a number of modern applications of sequential decision making require developing strategies that are especially robust to change in the stationarity of the signal, and in order to anticipate and impact the next generation of applications of the field, the BADASS project intends to push theory and application of MAB to the next level by incorporating non-stationary observations while retaining near optimality against the best not necessarily constant decision strategy. Since a non-stationary process typically decomposes into chunks associated with some possibly hidden variables (states), each corresponding to a stationary process, handling non-stationarity crucially requires exploiting the (possibly hidden) structure of the decision problem. For the same reason, a MAB for which arms can be arbitrary non-stationary processes is powerful enough to capture MDPs and even partially observable MDPs as special cases, and it is thus important to jointly address the issue of non-stationarity together with that of structure. In order to advance these two nested challenges from a solid theoretical standpoint, we intend to focus on the following objectives: *(i)* To broaden the range of optimal strategies for stationary MABs: current strategies are only known to be provably optimal in a limited range of scenarios for which the class of distribution (structure) is perfectly known; also, recent heuristics possibly adaptive to the class need to be further analyzed. *(ii)* To strengthen the literature on pure sequential prediction (focusing on a single arm) for non-stationary signals via the construction of adaptive confidence sets and a novel measure of complexity: traditional approaches consider a worst-case scenario and are thus overly conservative and non-adaptive to simpler signals. *(iii)* To embed the low-rank matrix completion and spectral methods in the context of reinforcement learning, and further study models of structured environments: promising heuristics in the context of e.g. contextual MABs or Predictive State Representations require stronger theoretical guarantees.

  This project will result in the development of a novel generation of strategies to handle non-stationarity and structure that will be evaluated in a number of test beds and validated by a rigorous theoretical analysis. Beyond the significant advancement of the state of the art in MAB and RL theory and the mathematical value of the program, this JCJC BADASS is expected to strategically impact societal and industrial applications, ranging from personalized health-care and e-learning to computational sustainability or rain-adaptive river-bank management to cite a few.

9.1.3. ANR ExTra-Learn

Participants: Alessandro Lazaric, Jérémie Mary, Michal Valko.

- *Title*: Extraction and Transfer of Knowledge in Reinforcement Learning
- *Type*: National Research Agency (ANR-9011)
- *Coordinator*: Inria Lille (A. Lazaric)
- *Duration*: 2014-2018
- *Abstract*: ExTra-Learn is directly motivated by the evidence that one of the key features that allows humans to accomplish complicated tasks is their ability of building knowledge from past experience and transfer it while learning new tasks. We believe that integrating transfer of learning in machine learning algorithms will dramatically improve their learning performance and enable them to solve complex tasks. We identify in the reinforcement learning (RL) framework the most suitable candidate for this integration. RL formalizes the problem of learning an optimal control policy from the experience directly collected from an unknown environment. Nonetheless, practical limitations of current algorithms encouraged research to focus on how to integrate prior knowledge into the learning process. Although this improves the performance of RL algorithms, it dramatically reduces their autonomy. In this project we pursue a paradigm shift from designing RL algorithms incorporating prior knowledge, to methods able to incrementally discover, construct, and transfer "prior" knowledge in a fully automatic way. More in detail, three main elements of RL algorithms would significantly benefit from transfer of knowledge. *(i)* For every new task, RL algorithms need exploring the environment for a long time, and this corresponds to slow learning processes for large environments. Transfer learning would enable RL algorithms to dramatically reduce the exploration

of each new task by exploiting its resemblance with tasks solved in the past. *(ii)* RL algorithms evaluate the quality of a policy by computing its state-value function. Whenever the number of states is too large, approximation is needed. Since approximation may cause instability, designing suitable approximation schemes is particularly critical. While this is currently done by a domain expert, we propose to perform this step automatically by constructing features that incrementally adapt to the tasks encountered over time. This would significantly reduce human supervision and increase the accuracy and stability of RL algorithms across different tasks. *(iii)* In order to deal with complex environments, hierarchical RL solutions have been proposed, where state representations and policies are organized over a hierarchy of subtasks. This requires a careful definition of the hierarchy, which, if not properly constructed, may lead to very poor learning performance. The ambitious goal of transfer learning is to automatically construct a hierarchy of skills, which can be effectively reused over a wide range of similar tasks.

- *Activity Report*: Research in ExTra-Learn continued in investigating how knowledge can be transferred into reinforcement learning algorithms to improve their performance. Pierre-Victor Chaumier did a 4 months internship in SequeL studying how to perform transfer neural networks across different games in the Atari platform. Unfortunately, the preliminary results we obtained were not very positive. We investigated different transfer models, from basic transfer of a fully trained network, to co-train over multiple games and retrain with initialization from a previous network. In most of the cases, the improvement from transfer was rather limited and in some cases even negative transfer effects appeared. This seems to be intrinsic in the neural network architecture which tends to overfit on one single task and it poorly generlizes over alternative tasks. Another activity was related to the study of macro-actions in RL. We proved for the first time under which conditions macro-actions can actually improve the learning speed of an RL exploration-exploitation algorithm. This is the first step towards the automatic identification and construction of useful macro-actions across multiple tasks.

9.1.4. ANR KEHATH

Participants: Olivier Pietquin, Alexandre Bérard.

- *Acronym*: KEHATH
- *Title*: Advanced Quality Methods for Post-Edition of Machine Translation
- *Type*: ANR
- *Coordinator*: Lingua & Machina
- *Duration*: 2014-2017
- *Other partners*: Univ. Lille 1, Laboratoire d'Informatique de Grenoble (LIG)
- *Abstract*: The translation community has seen a major change over the last five years. Thanks to progress in the training of statistical machine translation engines on corpora of existing translations, machine translation has become good enough so that it has become advantageous for translators to post-edit machine outputs rather than translate from scratch. However, current enhancement of machine translation (MT) systems from human post-edition (PE) are rather basic: the post-edited output is added to the training corpus and the translation model and language model are re-trained, with no clear view of how much has been improved and how much is left to be improved. Moreover, the final PE result is the only feedback used: available technologies do not take advantages of logged sequences of post-edition actions, which inform on the cognitive processes of the post-editor. The KEHATH project intends to address these issues in two ways. Firstly, we will optimise advanced machine learning techniques in the MT+PE loop. Our goal is to boost the impact of PE, that is, reach the same performance with less PE or better performance with the same amount of PE. In other words, we want to improve machine translation learning curves. For this purpose, active learning and reinforcement learning techniques will be proposed and evaluated. Along with this, we will have to face challenges such as MT systems heterogeneity (statistical and/or rule-based), and ML scalability so as to improve domain-specific MT. Secondly, since quality prediction (QP) on MT outputs is

crucial for translation project managers, we will implement and evaluate in real-world conditions several confidence estimation and error detection techniques previously developed at a laboratory scale. A shared concern will be to work on continuous domain-specific data flows to improve both MT and the performance of indicators for quality prediction. The overall goal of the KEHATH project is straightforward: gain additional machine translation performance as fast as possible in each and every new industrial translation project, so that post-edition time and cost is drastically reduced. Basic research is the best way to reach this goal, for an industrial impact that is powerful and immediate.

9.1.5. PEPS Project BIO

Participants: Émilie Kaufmann, Lilian Besson.

- *Title*: Bandits pour l'Internet des Objets
- *Type*: CNRS PEPS project
- *Coordinator*: CNRS (E. Kaufmann)
- *Duration*: april-december 2017
- *Abstract*: (in French) Dans le but d'améliorer le qualité et de minimiser les coûts énergétiques des communications entre les objets communicants et leurs stations de base, nous cherchons dans ce projet à adapter les avancées récentes du domaine de la radio intelligente à la spécificité des communications de type Internet des Objets. Vu l'engorgement du spectre fréquentiel, il est nécessaire pour ces objets d'apprendre à détecter de manière adaptative quand et sur quelle fréquence communiquer. Nous proposons pour cette tâche l'utilisation d'algorithmes dits de bandit à plusieurs bras, déjà connus dans le contexte de la radio intelligente, mais pas toujours adaptés à la spécificité des communications pour l'Internet des Objets. Nous introduirons de nouveaux algorithmes de bandit multi-joueurs, traduisant la coordination nécessaire entre les multiples objets en plus de l'apprentissage de la qualité des canaux fréquentiel. Ensuite nous envisagerons une nouvelle modélisation, de type bandit adversarial, pour décrire les communications dans des standards comme LoRa où les objets reçoivent des messages de confirmation des stations de bases, conduisant à des algorithmes minimisant la latence de ces communications.

9.1.6. National Partners

- ENS Paris-Saclay
  – M. Valko collaborated with V. Perchet on structured bandit problem. They co-supervise a PhD student (P. Perrault) together.
- Institut de Mathématiques de Toulouse
  – E. Kaufmann collaborated with Aurélien Garivier on sequential testing and structured bandit problems.
- CentraleSupélec Rennes
  – E. Kaufmann co-advises Lilian Besson, who works at CentraleSupélec with Christophe Moy. Christophe, Lilian and Émilie worked together on a PEPS project about bandits for Internet Of Things. One paper was published to the CROWNCOM conference, and another has been submitted to the ALT conference.

9.2. European Initiatives

9.2.1. FP7 & H2020 Projects

9.2.1.1. H2020 BabyRobot

Program: H2020

Project acronym: BabyRobot

Project title: Child-Robot Communication and Collaboration

Duration: 01/2016 - 12/2018

Coordinator: Alexandros Potamianos (Athena Research and Innovation Center in Information Communication and Knowledge Technologies, Greece)

Other partners: Institute of Communication and Computer Systems (Greece), The University of Hertfordshire Higher Education Corporation (UK), Universitaet Bielefeld (Germany), Kunlgliga Tekniska Hoegskolan (Sweden), Blue Ocean Robotics ApS (Denmark), Univ. Lille (France), Furhat Robotics AB (Sweden)

Abstract: The crowning achievement of human communication is our unique ability to share intentionality, create and execute on joint plans. Using this paradigm we model human-robot communication as a three step process: sharing attention, establishing common ground and forming shared goals. Prerequisites for successful communication are being able to decode the cognitive state of people around us (mindreading) and building trust. Our main goal is to create robots that analyze and track human behavior over time in the context of their surroundings (situational) using audio-visual monitoring in order to establish common ground and mind-reading capabilities. On BabyRobot we focus on the typically developing and autistic spectrum children user population. Children have unique communication skills, are quick and adaptive learners, eager to embrace new robotic technologies. This is especially relevant for special eduation where the development of social skills is delayed or never fully develops without intervention or therapy. Thus our second goal is to define, implement and evaluate child-robot interaction application scenarios for developing specific socio-affective, communication and collaboration skills in typically developing and autistic spectrum children. We will support not supplant the therapist or educator, working hand-inhand to create a low risk environment for learning and cognitive development. Breakthroughs in core robotic technologies are needed to support this research mainly in the areas of motion planning and control in constrained spaces, gestural kinematics, sensorimotor learning and adaptation. Our third goal is to push beyond the state-of-the-art in core robotic technologies to support natural human-robot interaction and collaboration for edutainment and healthcare applications. Creating robots that can establish communication protocols and form collaboration plans on the fly will have impact beyond the application scenarios investigated here.

9.2.1.2. CHIST-ERA DELTA
Participants: Michal Valko, Émilie Kaufmann.

Program: CHIST-ERA

Project acronym: DELTA

Project title: Dynamically Evolving Long-Term Autonomy

Duration: October 2017 - December 2021

Coordinator: Anders Jonsson (PI)

Inria coPI: Michal Valko

Other partners: UPF Spain, MUL Austria, ULG Belgium

Abstract: Many complex autonomous systems (e.g., electrical distribution networks) repeatedly select actions with the aim of achieving a given objective. Reinforcement learning (RL) offers a powerful framework for acquiring adaptive behaviour in this setting, associating a scalar reward with each action and learning from experience which action to select to maximise long-term reward. Although RL has produced impressive results recently (e.g., achieving human-level play in Atari games and beating the human world champion in the board game Go), most existing solutions only work under strong assumptions: the environment model is stationary, the objective is fixed, and trials end once the objective is met. The aim of this project is to advance the state of the art of fundamental research in lifelong RL by developing several novel RL algorithms that relax the above assumptions. The new algorithms should be robust to environmental changes, both in terms of the observations that

the system can make and the actions that the system can perform. Moreover, the algorithms should be able to operate over long periods of time while achieving different objectives. The proposed algorithms will address three key problems related to lifelong RL: planning, exploration, and task decomposition. Planning is the problem of computing an action selection strategy given a (possibly partial) model of the task at hand. Exploration is the problem of selecting actions with the aim of mapping out the environment rather than achieving a particular objective. Task decomposition is the problem of defining different objectives and assigning a separate action selection strategy to each. The algorithms will be evaluated in two realistic scenarios: active network management for electrical distribution networks, and microgrid management. A test protocol will be developed to evaluate each individual algorithm, as well as their combinations.

9.2.1.3. CHIST-ERA IGLU

Program: CHIST-ERA

Project acronym: IGLU

Project title: Interactively Grounded Language Understanding

Duration: 11/2015 - 10/2018

Coordinator: Jean Rouat (Université de Sherbrooke, Canada)

Other partners: UMONS (Belgique), Inria (France), Univ-Lille (France), KTH (sweden), Universidad de Zaragoza (Spain)

Abstract: Language is an ability that develops in young children through joint interaction with their caretakers and their physical environment. At this level, human language understanding could be referred as interpreting and expressing semantic concepts (e.g. objects, actions and relations) through what can be perceived (or inferred) from current context in the environment. Previous work in the field of artificial intelligence has failed to address the acquisition of such perceptually-grounded knowledge in virtual agents (avatars), mainly because of the lack of physical embodiment (ability to interact physically) and dialogue, communication skills (ability to interact verbally). We believe that robotic agents are more appropriate for this task, and that interaction is a so important aspect of human language learning and understanding that pragmatic knowledge (identifying or conveying intention) must be present to complement semantic knowledge. Through a developmental approach where knowledge grows in complexity while driven by multimodal experience and language interaction with a human, we propose an agent that will incorporate models of dialogues, human emotions and intentions as part of its decision-making process. This will lead anticipation and reaction not only based on its internal state (own goal and intention, perception of the environment), but also on the perceived state and intention of the human interactant. This will be possible through the development of advanced machine learning methods (combining developmental, deep and reinforcement learning) to handle large-scale multimodal inputs, besides leveraging state-of-the-art technological components involved in a language-based dialog system available within the consortium. Evaluations of learned skills and knowledge will be performed using an integrated architecture in a culinary use-case, and novel databases enabling research in grounded human language understanding will be released.

9.3. International Initiatives

9.3.1. With CWI

Title: Non-parametric sequential prediction project

     Centrum Wiskunde & Informatica (CWI), Amsterdam (NL) - Peter Grünwald

Duration: 2016 - 2018

Start year: 2016

Abstract: The aim is to develop the theory of learning for sequential decision making under uncertainty problems.

In 2017, this collaboration involved D. Ryabko, É. Kaufmann, J. Ridgway, M. Valko, O. Maillard. A post-doc funded by Inria has been recruited in Fall 2016.

https://project.inria.fr/inriacwi/projects/non-parametric-sequential-prediction-project/

9.3.2. EduBand

Title: Educational Bandits

International Partner (Institution - Laboratory - Researcher):

Carnegie Mellon University (United States) - Department of Computer Science, Theory of computation lab - Emma Brunskill

Start year: 2015

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

Education can transform an individual's capacity and the opportunities available to him. The proposed collaboration will build on and develop novel machine learning approaches towards enhancing (human) learning. Massive open online classes (MOOCs) are enabling many more people to access education, but mostly operate using status quo teaching methods. Even more important than access is the opportunity for online software to radically improve the efficiency, engagement and effectiveness of education. Existing intelligent tutoring systems (ITSs) have had some promising successes, but mostly rely on learning sciences research to construct hand-built strategies for automated teaching. Online systems make it possible to actively collect substantial amount of data about how people learn, and offer a huge opportunity to substantially accelerate progress in improving education. An essential aspect of teaching is providing the right learning experience for the student, but it is often unknown a priori exactly how this should be achieved. This challenge can often be cast as an instance of decision-making under uncertainty. In particular, prior work by Brunskill and colleagues demonstrated that reinforcement learning (RL) and multi-arm bandit (MAB) can be very effective approaches to solve the problem of automated teaching. The proposed collaboration is thus intended to explore the potential interactions of the fields of online education and RL and MAB. On the one hand, we will define novel RL and MAB settings and problems in online education. On the other hand, we will investigate how solutions developed in RL and MAB could be integrated in ITS and MOOCs and improve their effectiveness.

9.3.3. Allocate

Participants: Pierre Perrault, Julien Seznec, Michal Valko, Émilie Kaufmann, Odalric Maillard.

Title: Adaptive allocation of resources for recommender systems

Inria contact: Michal Valko

International Partner (Institution - Laboratory - Researcher):

Univertät Potsdam, Germany A. Carpentier

Start year: 2017

We plan to improve a practical scenario of *resource allocation in market surveys*, such as product appraisals and music recommendation. In practice, the market is typically divided into segments: geographic regions, age groups, ...These groups are then queried for preference with some fixed rule of a number of queries per group. This testing is *costly and non-adaptive*. The reason is some groups are easier to estimate than others, but this is impossible to know a priori. Our challenge is **adaptively allocate the optimal number of samples** to each group and improve the efficient of market studies, by providing *sample-efficient* solutions.

9.3.4. Informal International Partners

Adobe Research

Branislav Kveton *Collaborator*

Zheng Wen *Collaborator*

Sharan Vaswani *Collaborator*

M. Valko collaborated with Adobe Research on online influence maximization in social networks. This led to a publication in NIPS 2017.

Massachusetts Institute of Technology

Victor-Emmanuel Brunel *Collaborator*

M. Valko collaborated with V.-E. Brunel on the estimation of low rank determinantal point processes useful for diverse recommender systems.

Univertät Potsdam

Alexandra Carpentier *Collaborator*

M. Valko collaborated with A. Carpentier on adaptive estimation of the block-diagonal matrices with application to market segmentations. This collaboration formalized in September 2017 by creating a north-european associate team.

University of California, Berkeley

Victor Gabillon *Collaborator*

M. Valko collaborated with V. Gabillon on the sample complexities in unknown type of environments.

University of Southern California

Haipeng Luo *Collaborator*

M. Valko collaborated with H. Luo on online submodular minimization.

Adobe Research

Mohammad Ghavamzadeh *Collaborator*

A. Lazaric collaborated with Adobe Research on active learning for accurate estimation of linear models. This led to a publication in ICML 2017.

Stanford University

Carlos Riquelme *Collaborator*

A. Lazaric collaborated with Carlos Riquelme on active learning for accurate estimation of linear models. This led to a publication in ICML 2017.

Stanford University

Emma Brunskill *Collaborator*

A. Lazaric collaborated with Emma Brunskill on exploration-exploitation with options in reinforcement learning. This led to a publication in NIPS 2017.

University of California, Irvine

Anima Anandkumar *Collaborator*

Kamyar Azzizade *Collaborator*

A. Lazaric collaborated with A. Anandkumar and K. Azzizade on exploration-exploitation with in reinforcement learning with state clustering. This led to a submission to AI&Stats 2018.

University of Leoben

Ronald Ortner *Collaborator*

A. Lazaric collaborated with R. Ortner on exploration-exploitation in reinforcement learning with regularized optimization. This will lead to a submission to ICML 2018.

Politecnico di Milano

Marcello Restelli *Collaborator*

Matteo Pirotta collaborate with M. Restelli on several topics in reinforcement learning. This will lead to publications to ICML 2017 and NIPS 2017.

Lancaster University

B. Balle *Collaborator*

O. Maillard collaborated on spectral learning of Hankel matrices. This led to a publication at ICML.

Mila, Université de Montréal

A. Courville *Collaborator*

F. Strub and O. Pietquin collaborate on deep reinforcement learning for language acquisition. This led to several papers at IJCAI, CVPR, and NIPS, as well as the guesswhat?! dataset and protocol, and the HOME dataset.

Uberlandia University, Brasil

C. Felicio *Collaborator*

Ph. Preux supervises this PhD on recommendation systems. This led to the defense of C. Felicio and a paper at UMAP.

9.3.5. International Initiatives

SequeL

Title: The multi-armed bandit problem

International Partner (Institution - Laboratory - Researcher):

University of Leoben (Austria) Peter Auer

Duration: 2014 - 2018

Start year: 2014

In a nutshell, the collaboration is focusing on nonparametric algorithms for active learning problems, mainly involving theoretical analysis of reinforcement learning and bandits problems beyond the traditional settings of finite-state MDPs (for RL) or i.i.d. rewards (for bandits). Peter Auer from University of Leoben is a worldwide leader in the field, having introduced the UCB approach around 2000, along with its finite-time analysis. Today, SequeL is likely to be the largest research group working in this field in the world, enjoying worldwide recognition. SequeL and P. Auer's group have been collaborating for a couple of years now; they have co-authored papers, visited each other (sabbatical stay, post-doc), coorganized workshops; the STREP Complacs partially funds this very active collaboration.

9.3.6. International Initiatives

Contextual multi-armed bandits with hidden structure

Title: Contextual multi-armed bandits with hidden structure

International Partner (Institution - Laboratory - Researcher):

IISc Bangalore (India) – Aditya Gopalan

Duration: 2015 - 2017

Recent advances in Multi-Armed Bandit (MAB) theory have yielded key insights into, and driven the design of applications in, sequential decision making in stochastic dynamical systems. Notable among these are recommender systems, which have benefited greatly from the study of contextual MABs incorporating user-specific information (the context) into the decision problem from a rigorous theoretical standpoint. In the proposed initiative, the key features of (a) sequential interaction between a learner and the users, and (b) a relatively small number of interactions per user with the system, motivate the goal of efficiently exploiting the underlying collective structure of users. The state-of-the-art lacks a wellgrounded strategy with provably near-optimal guarantees for general, low-rank user structure. Combining expertise in the foundations of MAB theory together with recent advances in spectral methods and low-rank matrix completion, we target the first provably near-optimal sequential low-rank MAB

9.4. International Research Visitors

9.4.1. Visits of International Scientists

9.4.1.1. Internships

- Harm de Vries, PhD stduent, University of Montreal, Canada, Jan-Jun 2017
- Mohammad Sadegh Talebi Mazraeh Shahi, PhD student, KTH Royal Institute of Technology, Sweden, Jun-Sep 2017
- Xuedong Shang, master student, ENS Rennes, Feb–Jun 2017
- Iuliia Olkhovskaia, master student, Moscow Institute of Physics and Technology, Russia, Feb–Jul 2017
- Georgios Papoudakis, master student, Aristotle University of Thessalnoniki, Greece, May–Sep 2017
- Subhojyoti Mukherjee, master student, Indian Institute of technology, Sep-Nov 2017
- Mahsa Asadi, Shiraz University, Iran, Sep-Dec 2017

SPIRALS Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Région Hauts-de-France

9.1.1.1. Citizen Awareness and Contribution to Air Quality Monitoring
Participants: Moncef Ouadia, Romain Rouvoy [correspondant], Lionel Seinturier, Antoine Veuiller.

This is a 3-year project (2015–17) in the context of the so-called "*Chercheur citoyen*" program. The partners are LISIC/Université Côte d'Opale (leader), ATMO Nord-Pas De Calais, Association Bâtisseurs d'Economie Solidaire. This project targets the distributed monitoring of air quality with crowd-sensing solutions obtained via sensors connected to smart devices. We aim at inciting citizens to perform their own measures, and to obtain thanks to GPS geo-localization a large-scale database and a dynamic fine-grained cartography of air quality. This project takes advantage of the APISENSE® crowdsensing platform.

9.1.1.2. CIRRUS
Participants: Yahya Al-Dhuraibi, Stéphanie Challita, Guillaume Fieni, Christophe Gourdin, Philippe Merle [correspondant], Romain Rouvoy, Lionel Seinturier, Faiez Zalila.

CIRRUS is an 3-year (2017–20) joint team with the Scalair cloud operator and architect company funded by the Hauts-de-France region. The CIRRUS joint team is developing novel solutions in the domains of the on demand configuration of heterogeneous cloud resources, the management of cloud elasticity for all deployed services (SaaS, PaaS, IaaS) in order to guarantee quality of service and user quality of experience, and the taming of financial costs of cloud infrastructures.

9.1.2. Inria Lille - Nord Europe

9.1.2.1. ADT LibRepair
Participants: Benjamin Danglot, Martin Monperrus, Lionel Seinturier [correspondant], Simon Urli.

ADT LibRepair (2016–18) is a technology development initiative supported by the Inria Lille - Nord Europe Center that aims at supporting the development of an integrated library of automated software repair algorithms and techniques. This ADT builds on our results about with the Astor, Nopol and NpeFix that have been obtained in the context of the defended PhD theses of Matias Martinez [65] and Benoit Cornu [54].

9.1.2.2. North European Lab LLEX
Participants: Martin Monperrus, Lionel Seinturier [correspondant].

North European Lab LLEX (2015–17) is an international initiative supported by the Inria Lille - Nord Europe Center that takes place in the context of a collaboration between Inria and University College London. LLEX deals with research on automatic diagnosis and repair of software bugs. Automatic software repair is the process of fixing software bugs automatically. An automatic software repair system fixes software bugs with no human intervention. The goal of automatic software repair is to save maintenance costs and to enable systems to be more resilient to bugs and unexpected situations. This research may dramatically improve the quality of software systems. The objective of the partnership is to work on the automated diagnosis of exceptions with a focus on null pointer exceptions.

9.2. National Initiatives

9.2.1. ANR

9.2.1.1. ANR BottleNet
Participants: Romain Rouvoy [correspondant], Walter Rudametkin Ivey, Lionel Seinturier.

BottleNet is a 48-month project (2015–19) funded by ANR. The objective of BottleNet is to deliver methods, algorithms, and software systems to measure Internet *Quality of Experience* (QoE) and diagnose the root cause of poor Internet QoE. Our goal calls for tools that run directly at users' devices. We plan to collect network and application performance metrics directly at users' devices and correlate it with user perception to model Internet QoE, and to correlate measurements across users and devices to diagnose poor Internet QoE. This data-driven approach is essential to address the challenging problem of modeling user perception and of diagnosing sources of bottlenecks in complex Internet services. BottleNet will lead to new solutions to assist users, network and service operators as well as regulators in understanding Internet QoE and the sources of performance bottleneck.

9.2.1.2. ANR SATAS
Participants: Philippe Merle [correspondant], Romain Rouvoy, Lionel Seinturier.

SATAS is a 48-month project (2015–19) funded by ANR. SATAS aims to advance the state of the art in massively parallel SAT solving with a particular eye to the applications driving progress in the field. The final goal of the project is to be able to provide a "pay as you go" interface to SAT solving services, with a particular focus on their power consumption. This project will extend the reach of SAT solving technologies, daily used in many critical and industrial applications, to new application areas, which were previously considered too hard, and lower the cost of deploying massively parallel SAT solvers on the cloud.

9.2.1.3. ANR Headwork
Participant: Pierre Bourhis [correspondant].

Headwork is a 48-month project (2016–21) funded by ANR. The main objective of Headwork is to develop data-centric workflows for programming crowd sourcing systems in flexible declarative manner. The problem of crowd sourcing systems is to fill a database with knowledge gathered by thousands or more human participants. A particular focus is to be put on the aspects of data uncertainty and for the representation of user expertise. This project is coordinated by D. Gross-Amblard from the Druid Team (Rennes 1). Other partners include the Dahu team (Inria Saclay), Sumo (Inria Bretagne), and Links (Inria Lille) with J. Nierhen and M. Sakho.

9.2.1.4. ANR Delta
Participant: Pierre Bourhis [correspondant].

Delta is a 48-month project (2016–21) funded by ANR. The project focuses on the study of logic, transducers and automata. In particular, it aims at extending classical framework to handle input/output, quantities and data. This project is coordinated by M. Zeitoun from LaBRI. Other partners include LIF (Marseille), IRIF (Paris-Diderot), and D. Gallois from the Inria Lille Links team.

9.2.2. Competitivity Clusters

9.2.2.1. FUI StoreConnect
Participants: Aurélien Bourdon, Julien Duribreux, Romain Rouvoy, Lionel Seinturier [correspondant], Antoine Veuiller.

StoreConnect is a 24-month project (2016–18) funded by FUI and labelled by the PICOM (Pôle des Industries du COMmerce) competitivity cluster. The partners are Tevolys, Ubudu (leader), Smile, STIME, Leroy Merlin, Insiteo, Inria Spirals, Inria Fun, Inria Stars. The goal of the project is to define a modular multi-sensors middleware platform for indoor geolocation.

9.2.3. Programme Investissement d'Avenir (PIA)

9.2.3.1. PIA OCCIware
Participants: Stéphanie Challita, Christophe Gourdin, Romain Rouvoy, Philippe Merle [correspondant], Lionel Seinturier, Faiez Zalila.

OCCIware is a 36-month project (2014–17) of the Programme Investissement d'Avenir Cloud Computing and Big Data 4th call for projects. The partners are Smile (leader), ActiveEon SA, Scalair, Institut Mines-Télécom/Télécom SudParis, Inria, Linagora GSO, Obeo, OW2 Consortium, and Université Grenoble Alpes. The project aims at defining a formal framework for managing every digital resources in the clouds, based on *Open Cloud Computing Interface* (OCCI) recommendations from *Open Grid Forum* (OGF).

9.2.4. Inria National Initiatives

9.2.4.1. Inria IPL BetterNet
Participants: Lakhdar Meftah, Romain Rouvoy [correspondant], Romain Sommerard, Antoine Veuiller.

BetterNet (2016–19) 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. Our observatory can be defined as a vantage point, where: (1) tools, models and algorithms/heuristics will be provided to collect data, (2) acquired data will be analyzed, and shared appropriately with scientists, stakeholders and civil society, and (3) new value-added services will be proposed to end-users. IPL BetterNet is led by Isabelle Chrisment (Inria Madynes), with the participation of the Diana, Dionysos, Inria Chile, Muse, and Spirals Inria project-teams, as well as the ARCEP French agency and the ip-label company.

9.2.5. Others

9.2.5.1. CNRS MASTODONS 2017 DoMaSQ'Air
Participants: Moncef Ouadia, Romain Rouvoy [correspondant].

DoMaSQ'Air is a 1-year project funded by the CNRS INS2I MASTODONS program on research in big data. This project gathers a pluridisciplinary team on the measurement and the continuous analysis of indoor and outdoor air quality. This project takes advantage of crowds of cheap and miniaturized sensors in relation with the Internet of Things and smart cities. In addition to the challenges raised by the massive amount of data generated by these cyber-physical systems, the project tackles questions related to the quality and privacy of data. DoMaSQ'Air is led by Romain Rouvoy with the participation of the PC2A laboratory on PhysicoChemistry of Combustion of the Atmosphere (CNRS/U. Lille) and the LISIC laboratory on Computer Science, Signal and Image (U. Côte d'Opale).

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

Program: H2020 ICT-10-2016.

Project acronym: STAMP.

Project title: Software Testing Amplification.

Duration: 36 months (2016–19).

Coordinator: Inria.

Other partners: ActiveEon (France), Atos (Spain), Engineering (Italy), OW2 (France), SINTEF (Norway), TellU (Norway), TU Delft (The Netherlands), XWiki (France).

Abstract: By leveraging advanced research in automatic test generation, STAMP aims at pushing automation in DevOps one step further through innovative methods of test amplification. It will reuse existing assets (test cases, API descriptions, dependency models), in order to generate more test cases and test configurations each time the application is updated. Acting at all steps of development cycle, STAMP techniques aim at reducing the number and cost of regression bugs at unit level, configuration level and production stage.

Participants: Benjamin Danglot, Martin Monperrus [correspondant].

Program: H2020 JU Shift2Rail.

Project acronym: X2Rail-1.

Project title: Start-up activities for Advanced Signalling and Automation System.

Duration: 36 months (2016–19).

Coordinator: Siemens.

Other partners: 19 partners, among others Bombardier, Siemens, Thales, IRT Railenium.

Abstract: Our contribution to the project is focused on adaptive communication middleware for cyber-physical railway systems.

Participants: Lionel Seinturier [correspondant].

9.3.2. Collaborations in European Programs, Except FP7 & H2020

Program: EUREKA Celtic-Plus.

Project acronym: SENDATE.

Project title: SEcure Networking for a DATa Center Cloud in Europe.

Duration: 36 months (2016–19).

Coordinator: Nokia.

Other partners: 50+ partners in Finland, France, Germany, Norway, and Sweden. Selected partners involved: Nokia, Orange.

Abstract: The project addresses the convergence of telecommunication networks and IT in the context of distributed data centers. We are involved in the TANDEM subproject that targets the infrastructure of such a distributed system. More specifically, we are studying new approaches in terms of software engineering and component-based solutions for enabling this convergence of network and IT.

Participants: Lionel Seinturier [correspondant].

9.4. International Initiatives

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

9.4.1.1. SOMCA

Title: Self-Optimization of Service Oriented Architectures for Mobile and Cloud Applications

International Partner (Institution - Laboratory - Researcher):

Université du Québec À Montréal (Canada) - LATECE - Naouel MOHA

Start year: 2017

See also: http://sofa.uqam.ca/somca.php

The long-term goal of this research program is to propose a novel and innovative methodology embodied in a software platform, to support the runtime detection and correction of anti-patterns in large-scale service-oriented distributed systems in order to continuously optimize their quality of service. One originality of this program lies in the dynamic nature of the service-oriented environments and the application on emerging frameworks for embedded and distributed systems (*e.g.*, Android/iOS for mobile devices, PaaS/SaaS for Cloud environments), and in particular mobile systems interacting with remote services hosted on the Cloud.

9.4.2. Participation in Other International Programs

9.4.2.1. PHC Zenon Cyprus - Project RRI-MobDev

Participants: Sarra Habchi, Lakhdar Meftah, Mohammad Naseri, Romain Rouvoy [correspondant], Walter Rudametkin Ivey, Romain Sommerard, Antoine Vastel.

RRI-MobDev (*Responsible Research and Innovation for Mobile Application Development*) is a 2-years (2017–2018) bilateral collaboration with UCLan Cyprus, an overseas campus of the University of Central Lancashire. Mobile applications are part of a complex ecosystem involving various stakeholders (developers, users, app stores, etc.) exposed to various threats, including not only malware, but also potential information leaks through the continuous interactions with remote servers. This project aims to study and alleviate this problem by intervening both with the users and the developers of mobile apps, with an aim of enabling a cleaner, safer and more responsible mobile app ecosystem.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Fernanda Madeiral Delfim, PhD Student from the Federal University of Uberlândia, Brazil, visited us from January to May 2017, and again in September 2017.

9.5.1.1. Internships

Mohammad Naseri, MSc. Student in Computer Science from Saarland University, Germany, is visiting us for 3 months, starting in November 2017.

Chaima Chakhava, MSc. Student in Computer Science from ESI Alger, Algeria, is visiting us for 6 months, starting in December 2017.

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

Thomas Durieux, PhD Student, spent 4 months from September to December 2017 in KTH, Sweden.