RESEARCH CENTER
Lille - Nord Europe

FIELD

Activity Report 2018

Section Partnerships and Cooperations

Edition: 2019-03-07

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

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

- ANR Transipedia: The purpose of Transipedia is to provide means of identifying relevant transcriptomic events within thousands of RNA sequencing experiments. This project will be achieved in collaboration with I2BC (principal investigator) in Paris Saclay and IRMB in Montpellier.
- 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 work package devoted to the computational analysis of sRNA-seq data, in coordination with the bioinformatics platform of Génopole Toulouse-Midi-Pyrénées.

7.1.2. ADT

- 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.

7.2. European Initiatives

7.2.1. 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.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

7.3.1.1. Internships

- Inria MITACS 3-month internship of D. Martchenko (PhD student, Trent University)

BONUS Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

- *CPER Data (2015-2019)*: in this project, that promotes research and software development related to advanced data science, the BONUS team is the scientific leader (N. Melab) of one of the three research lines of the project "Optimization and High-Performance Computing". In this context, a two-year (2018-2019) engineer (J-Y. Ji) is supported to develop a software demonstrator on decomposition-based big optimization. In addition, the team is co-leader of the workpackage/lever "Research infrastructures" related to the Grid'5000 nation-wide experimental testbed. This allowed to extend the testbed at Lille with a GPU-powered cluster highly important for the BONUS project. In addition, two engineers have been hired for the system & network administration of the testbed, user support and development.

- *CPER ELSAT (2015-2019)*: in this project, focused on ecomobility, security and adaptability in transport, the BONUS team is involved in the transversal research line: planning and scheduling of maintenance logistics in transportation. The team got support for a one-year (2017-2018) post-doc position (M. Rahimi).

9.2. National Initiatives

9.2.1. ANR

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

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

MARO: University of Mons (BELGIUM), Parallel surrogate-assisted optimization, large-scale exact optimization

University of Ceara (BRAZIL), Large-scale GPU-accelerated tree-based optimization

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 Coimbra and University of Lisbon (PORTUGAL), Exact and heuristic multi-objective search

University of Manchester (UNITED KINGDOM), Local optimality in multi-objective optimization

University of Elche and University of Murcia (SPAIN), Matheuristics for DEA

9.4. International Initiatives

9.4.1. Inria International Labs

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

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. Other IL projects

Title: Frontiers in Massive Optimization and Computational Intelligence

International Partner (Institution - Laboratory - Researcher): Shinshu University (JAPAN)

Start year: 2017

See also: https://sites.google.com/view/lia-modo/

Abstract: The aim of MODO is to federate French and Japanese researchers interested in the dimensionality, heterogeneity and expensive nature of massive optimization problems. The team receives a yearly support for international exchanges and shared manpower (joint PhD students).

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

Title: Three-fold decomposition in multi-objective optimization (D^3MO)

International Partner (Institution - Laboratory - Researcher): University of Exeter, UK

Start year: 2018

9.4.3. Inria International Partners

9.4.3.1. Informal International Partners

- Collaboration with Université de Mons (UMONS). The collaboration consists mainly in the joint supervision of two Phds (M. Gobert and G. Briffoteaux)
- University of Elche, Spain

9.4.4. Participation in Other International Programs

Title: **Evolutionary many-objective optimization: application to smart cities and engineering design**

International Partner (Institution - Laboratory - Researcher): CINVESTAV-IPN (MEXICO)

Start year: 2016

Abstract: The project is co-funded by ECOS Nord (FRANCE) and ANUIES (MEXICO). Abstract to be extended ...

Title: **Bridging the gap between exact methods and heuristics for multi-objective search (MOCO-Search)**

International Partner (Institution - Laboratory - Researcher): University of Coimbra and University of Lisbon, Portugal

Start year: 2018

Website: http://sites.google.com/view/moco-search/

Abstract: This international project for scientific cooperation (PICS), funded by CNRS and FCT, aims to fill the gap between exact and heuristic methods for multi-objective optimization. The goal is to establish the link between the design principles of exact and heuristic methods, to identify features that make a problem more difficult to be solved by each method, and to improve their performance by hybridizing search strategies. Special emphasis is given to rigorous performance assessment, benchmarking, and general-purpose guidelines for the design of exact and heuristic multi-objective search.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Kiyoshi Tanaka, Shinshu University (JAPAN), March 2018 and November 2018
- Hernan Aguirre, Shinshu University (JAPAN), Invited Professor Univ Lille, from March 2018 until April 2018
- Kalyan Deb, University of Michiga (USA), Oct 2018
- Rachid Ellaia, EMI University of Rabat, Morocco, April 2018

9.5.1.1. Internships

- Alexandre Jesus, University of Coimbra (Portugal)

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

- **INVENTOR** Innovative tool for soft robot design and its application for surgery. This project is financed by **I-Site ULNE EXPAND**, supported by "le programme d'Investissements d'Avenir" and "la Métropole Européenne de Lille". The objective of this project is to develop an innovative tool for the facilitation of soft robot design.

- **COMOROS** Control of deformable robots for surgery Duration april 2017 to march 2020

  Program: FEDER 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. National Initiatives

- **SIMILAR** Soft robotIc framework for modeling, simulation and control. This project is supported by **Inria ADT**, and the objective is to design new 3D interactive software to design soft-robots. This new software will be on the top of our existing software stack relying on SOFA for all numerical simulation aspects and 3D rendering aspects.

- **Tremplin ERC** Christian Duriez received 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.

9.3. European Initiatives

9.3.1. Collaborations in European Programs, Except FP7 & H2020

Meichun Lin was doing a project belonged to Interreg - 2 Seas Mers Zeeën on Cooperate Brachyther-apy(CoBra), it is a 4 years project which gathers the experts from the countries between English Channel and southern North Sea aiming on finding an advance method for curing prostate cancer. The project is divided by several fields which are - MR compatible robot design, radiation dose measurement, needle design and virtual real-time training tool development. Meichun was working on developing virtual real-time training tool with Defrost team. By using SOFA framework to simulate the soft tissue's deformation and the interaction with needle under the real-time, also with the Image Modelling of MRI, Organs and tissue Modelling and so on and so forth, the 3D rendering became more like the real procedure of the brachytherapy and better for training purpose.

9.4. International Initiatives

9.4.1. Inria International Labs

Christian Duriez realized a geographical mobility as part of the program Inria @ SiliconValley. More details in the Highlights section.

9.4.2. Inria International Partners

9.4.2.1. Declared Inria International Partners

Collaboration with the group of Allison Okamura at Stanford University

Christian Duriez was awarded of a Fulbright Grant for going 7 months (February to August 2018) at Stanford University to work with the group of Allison Okamura. One of a phD student of Stanford, Margaret Koehler, has been awarded of a Chateaubriand Grant for coming 6 months (September 2017 to February 2018) in our Group in Lille. The collaboration was about 2 projects. The first project is haptic rendering with deformable robotics device. The second project is about the modeling and simulation of the "vine robot" that is currently being designed at Stanford.

9.4.2.2. Informal International Partners

- Collaboration with Massachusetts Institute of Technology:

  Maxime Thieffry spent a month in the Distributed Robotics Laboratory, CSAIL, MIT, for a collaboration with Robert Katzschmann and Daniela Rus. This work led to a submission to the soft robotics conference, RoboSoft 2019.

- Collaboration with Dipartimento di Ingegneria Elettrica e delle Tecnologie dell'Informazione, Napoli:

  The project was on the control of manipulation tasks. Using the SoftRobots.Inverse plugin we allowed the control of the shape of a deformable object manipulated by a rigid hand. In the paper [20] we demonstrate the feasibility of the method.

9.5. International Research Visitors

- Prof. Shunjie LI from Nanjing University of Information Science and Technology (China) visited the team from May 10, 2018 to June 30, 2018.

9.5.1. Visits of International Scientists

9.5.1.1. Internships

Margaret Koehler, phD student at Stanford University, has been awarded of a Chateaubriand Grant for coming 6 months (September 2017 to February 2018) in our Group in Lille.

9.5.2. *Visits to International Teams*

9.5.2.1. Sabbatical programme

This year, Christian Duriez realized a geographical mobility, since he was invited for 7 months in the team of Allison Okamura (Stanford University). He worked on two projects: the creation of deformable haptic interfaces and the mechanical modeling of the "vine robot" (https://www.vinerobots.org). The trip was funded in part by a Fulbright scholarship.

In addition, a doctoral student of their team, Margaret Koehler, makes a stay of 6 months paid by a Chateaubriand Fellowship.

These exchanges are part of the program Inria @ SiliconValley. See the interview of C. Duriez and the interview of M. Koehler.

9.5.2.2. Research Stays Abroad

- Gang ZHENG has visited Nanjing University of Science and Technology (China) for two weeks in July 2018.

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FUN Project-Team

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9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. *StoreConnect*

Participants: Nathalie Mitton, Valeria Loscri [correspondant], Antonio Costanzo, Ibrahim Amadou.

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 yielded to several publications in 2018: [39], [38], [24], [40].

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 - Aug 2018

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 2018: [31], [19], [30].

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 [48] and a set of publications [18], [29], [28], [37], [11].

9.2.2. ADT

9.2.2.1. 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. It is lead in closed partnership with Inria Chile and Université of Strasbourg.

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.

9.3. European Initiatives

9.3.1. H2020 Projects

9.3.1.1. VESSEDIA

Participants: Rehan Malak, Nathalie Mitton, Allan Blanchard [correspondant].

- Title: VERIFICATION ENGINEERING OF SAFETY AND SECURITY CRITICAL DYNAMIC INDUSTRIAL APPLICATIONS
- Program: H2020
- Duration: January 2017 - Dec. 2019
- 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. This project yields to set of publications in 2018: [23], [47], [27].

9.4. International Initiatives

9.4.1. *Inria International Labs*

9.4.1.1. *Agrinet*

Participants: Abdoul Aziz Mbacke, Brandon Foubert, Valeria Loscri, Anjalalaina Jean Cristanel Razafimandimby, 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.

Publications issued from that project in 2018 are: [25], [45], [35].

9.4.2. Inria International Partners

9.4.2.1. 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.

9.4.2.2. 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 and joint publications.

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 2018 [14].

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 2018 [17], [21], [26], [36], [43], [45].

9.4.3. Participation in Other International Programs

9.4.3.1. CROMO

Participants: Valeria Loscri, Joao Batista Pinto Neto, 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 [22].

9.5. International Research Visitors

9.5.1. *Visits of International Scientists*

Several researchers have visited our group in 2018, mainly from our partner universities but not only:

- Gentian, Jakllari, ENSEEITH, France, January 2018
- Georgios Papadopoulos, IMT Atlantique, France, January 2018
- Bruno Quoitin, University of Mons, Belgium, January and March 2018
- Sebastien Bindel, Université de Haute Alsace, France, June 2018
- Karen Miranda Campos, Metropolitan Autonomous University Lerma Campus, Mexico, October 2018
- Zied Chtourou, University of Sfax, Tunisia, October 2018
- Fabrice Théoleyre, University of Strasbourg, October 2018
- Fabrice Valois, INSA Lyon, October 2018
- Miguel Elias Campista, Federal University of Rio de Janeiro (UFRJ), Brazil, December 2018
- Pranvera Kortoci, Aalto University, from Mar 2018 until Apr 2018
- Noura Mares Univ. Sfax, from Apr 2018 until Jul 2018
- Morgan O Kennedy, Stellenbosch University, from Jul 2018 until Sep 2018

9.5.1.1. Research Stays Abroad

- Jad Nassar visited Metropolitan Autonomous University Cuajimalpa Campus, Mexico in January-February 2018

GAIA Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

- *ANR project MSDOS* (Multidimensional System: Digression on Stability, coordinator: Nima Yeganefar (Poitiers University), 2014-2018) aimed at studying stability and stabilization problems for multidimensional systems by means of both analytic and algebraic methods. For more information, see https://www.lias-lab.fr/msdos/doku.php.
- *ANR TurboTouch* (High-performance touch interactions, coordinator: G. Casiez (MJOLNIR team, Inria), 2014–2019) develops methods and tools on transfer functions to allow high performance tactile interactions (e.g. high precision and low latency) adapted to the user and to the task. This research project is developed in collaboration with the Loki team, Inria Lille – Nord Europe (project leader). For more information, seehttp://mjolnir.lille.inria.fr/turbotouch/.
- *ANR WaQMoS* (Coastal waters Quality surveillance using bivalve Mollusk-based Sensors, coordinator: D. Efimov (Non-A Post, Inria), 2015–2020) develops a biosensor, based on measurements and interpretation of bi- valves mollusks behavior, for remote online detection of coastal water pollution and cli- mate change consequences. This research project is developed in collaboration with the Valse team, Inria Lille – Nord Europe (project leader). For more information, see https://team.inria.fr/non-a/anr-waqmos/.

9.2. European Initiatives

9.2.1. Collaborations with Major European Organizations

Mohamed Barakat: University of Siegen (Germany)
Effective module theory, effective homological algebra, algebraic analysis, computer algebra, implementation.
Georg Regensburger: Institute for Algebra, Johannes Kepler University Linz (Austria)
Rings of integro-differential-delay operators, computer algebra, implementation.
Daniel Robertz: University of Plymouth (United Kingdom)
Effective algebraic analysis, mathematical systems theory, computer algebra, implementation.

9.3. International Initiatives

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

WeCare, Inria Northern European Associate Team with the team of A. Medvedev from Uppsala University on effective algorithms for estimation and control in wearable devices for health and care, 2018–2020.

We participate in *HoTSMoCE*, an Inria Associated team with Non-A Post and the team of L. Fridman (UNAM, Mexico), on the development of algebraic and homogeneous tools for sliding mode control and estimation.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Thomas Cluzeau, XLIM, University of Limoges, May 2018.
- Marc Moreno Maza, University of Western Ontario, London, Ontario, Canada, September 2018.
- Alexander Medvedev, University of Uppsala (03–05/10/2018).
- Fredrik Olsson, University of Uppsala (26–30/11/2018).
- Elisa Hubert (Safran Tech) visited us twice (23–24/07/2018, 12–13/09/2018) to work on the problem of gear fault diagnostic based on algebraic and symbolic approaches.

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Lille

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).

9.1.2. Brussels

ValueBugs is a citizen participatory research project, funded by INNOVIRIS (2018-2020). The objective of ValueBugs is to collectively develop a method for decentralized insect production in cities while enhancing the value of food waste on a small scale. In practical terms, peelings are consumed by insect larvae that have reached the end of their development and offer many promising outlets: feed for hens, farmed fish, pets... and much more! This new, totally innovative sector will be a new tool to be put in the hands of every citizen: we must therefore imagine it collectively.

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 - 2019). 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. F.R.S.-FNRS (Belgium)

Bilevel optimization is a branch of mathematical optimization that deals with problems whose constraints embed an auxiliary optimization problem. The F.R.S.-FNRS research project "bilevel optimization" (2018-2019) will study such bilevel problems with bilinear objectives and simple second level problems. Each follower chooses one strategy in a given fixed set of limited size. Two classes of such problems will be studied: Pricing Problems and Stackelberg Security Games.

In pricing problems, prices for products must be determined to maximize the revenue of a leader given specific behaviors of customers (followers). More precisely, we will consider the single minded pricing problem and the rank pricing problem.

In Stackelberg games, mixed strategies to cover targets,must be determined in order to maximize the defender expected payoff given that attackers (followers) attack targets that maximize their own payoffs.

9.3. International Initiatives

9.3.1. Inria International Labs

Inria Chile

Associate Team involved in the International Lab:

9.3.1.1. 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.

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

9.3.2.1. LOBI

Title: Learning within Bilevel Optimization

International Partner (Institution - Laboratory - Researcher):

Polytechnique Montréal (Canada) - Institut de Valorisation des Données (IVADO) - Gilles Savard

Start year: 2018

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

The interplay between optimization and machine learning is one of the most important developments in modern computational science. Simultaneously there is a tremendous increase in the availability of large quantities of data in a multitude of applications, and a growing interest in exploiting the information that this data can provide to improve decision-making. Given the importance of big data in business analytics, its explicit integration into an optimization process is a challenge with high potential impact. The innovative project is concerned with the interconnection between machine learning approaches and a particular branch of optimization called bilevel optimization in this "big data" context. More precisely, we will focus on the development of new approaches integrating machine learning within bilevel optimization (LOBI: "Learning au sein de l'Optimisation BIniveau") for two important practical applications, the pricing problem in revenue management and the energy ressource aggregation problem in smart grids. The applications arise from current industry collaborations of the teams involved, and will serve as testbeds to demonstrate the potential impact of the proposed approach.

9.3.2.2. 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.

9.3.3. Inria International Partners

9.3.3.1. 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. International Research Visitors

9.4.1. Visits of International Scientists

9.4.1.1. Visiting Professors and Ph.D. students

Claudia Archetti, Professor at Universita de Brescia, December 2018.

Stein Wallace, Professor at NHH Norwegian School of Economics, October 2018.

Martin Schmidt, Professor at Erlangen University, August 2018.

Alejandro Jofre, Professor at Universidad de Chile, from June 2018 until July 2018.

Sebastián Dávila, Ph.D. student at Universidad de Chile, June 2018.

Vladimir Marianov, Professor at Pontificia Universidad Católica de Chile, June 2018.

Fernando Ordónez, Professor at Universidad de Chile, June 2018.

Alfredo Marin, Professor at Universidad de Murcia, March 2018.

Eduardo Alvarez Miranda, Professor at Universidad de Talca, January - February 2018.

9.4.1.2. Internships

Brou Koua, Esatic, Abidjan, Cote d'Ivoire, December 2018 - January 2019.

Lilian Lopez Vera, Autonomous University of Nuevo León, Monterrey, Mexico February-June 2018.

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

- Links is member of the CPER Data (2016-19).
- Lozano's PhD project (2016-19) is co-funded by the Region Nord-Pas de Calais.
- Sakho's PhD project is co-funded by the Region Nord-Pas de Calais.
- Gillot's PhD project (2017-20) is co-funded by the Region Nord-Pas de Calais.
- Crosetti's PhD project (2018-21) is co-funded by the Region Haut de France. This is joined work with J. Ramon from the Inria project Magnet.

9.2. National Initiatives

ANR Aggreg (2014-19): Aggregated Queries.

- Participants: J. Niehren [correspondent], P. Bourhis, A. Lemay, A. Boiret, F. Capelli.
- The coordinator is J. Niehren and the partners 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: J. Niehren, M. Sakho, N. Crosetti, F. Capelli.
- 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, S. Salvati, A. Lemay, 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.

9.3. European Initiatives

Oxford: A exchange project with the computer science lab of the University of Oxford is funded by the University of Lille via the Cristal Lab. Links' member produced many common publications over the years with Oxford. Links' contact is Paperman.

Wrazlaw: Staworko has regular exchange with the University of Wrazlaw. This has led to a publication at **PODS** [7] together with P. Wieczorek.

Saint Petersburg: Salvati and Niehren started a cooperation with the University of Saint Petersburg, via a 3 months visit of R. Azimov in 2018.

Oviedo: Boneva started a cooperation with the University of Oviedo, via a 3 months visit of H. Garcia Gonzalez in 2018.

9.4. International Initiatives

9.4.1. Informal International Partners

Santiago de Chile: S. Staworko started a collaboration with C. Riveros from the Pontificia Universidad Catolica de Chile in 2018.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Several researchers has visited us:

- Filip Mazowiecki, a researcher from Warsaw University and currently in post-doctorate in Bordeaux to work with Charles Paperman.
- Rustam Azimov, a Russian PhD students from Saint Petersburg State University, to collaborate with Sylvain Salvati and Joachim Niehren.
- Michaël Cadilhac, a researcher from Oxford University to work with Charles Paperman.
- Cristian Riveros, an Assistant Professor at the Department of Computer Science at the Pontificia Universidad Catolica de Chile.
- Henning Fernau, Professor at Universität Trier and Andreas Maletti, Professor at Universität Leipzig, visited us during the HDR defense of Aurelien Lemay.

9.5.1.1. Internships

- Nicolas Crosetti started an internship supervised by Florent Capelli, Joachim Niehren and Jan Ramon. His internship has evolved into the preparation of a PhD thesis.

- Chen Huan, from Centrale Lille, has done an internship under the supervision of Sylvain Salvati and Joachim Niehren.

9.5.2. Visits to International Teams

- Charles Paperman visited Michaël Cadilhac form the verification team of the University of Oxford.

- Joachim Niehren got invited by Hilal Zaid for a visit at the American University of Palestine in August 2018.

LOKI Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. GeneaLire (CPER MAuVE, 2018-2019)
Participants: Stéphane Huot, Thomas Pietrzak [correspondent].

Interactive tools for the interpretation of manuscripts

The goal of this project is to design, implement and evaluate interactive tools for helping transcription of scanned handwritten documents. Current solutions focus on automatic recognition, with recent advances thanks to deep learning methods. However these solutions still require a significant learning base that has to be made by hand. Not only this means that part of the work cannot be done automatically, but it also means that this technique is not a solution for small collections of documents. The tools we propose to create will ingeniously take advantage of interactive and automatic techniques. The interactive tools include a text selection techniques [27], as well as advanced annotation techniques that will support collaborative work. This tool will be invaluable for bootstrapping the transcription of large collections, as well as helping transcribing small collections. We will use user-centered design, in order to make sure the tool fits historians and genealogists activities and workflow.

Partners: Inria Saclay's AVIZ team, École Polytechnique de l'Université de Tours, Laboratoire de Démographie et d'Histoire Sociale at l'École des hautes études en sciences sociales, and Geneanet.

Related publication: [27]

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. TurboTouch (PRC, 2014-2019)
Participants: Géry Casiez [correspondent], Sylvain Malacria, Mathieu Nancel, Thomas Pietrzak.

High-performance touch interactions

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 in 2018: [28], [15], [23], [25]

8.2.1.2. Causality (JCJC, 2019-2023)
Participant: Mathieu Nancel [correspondent].

Integrating Temporality and Causality to the Design of Interactive Systems

The project addresses a fundamental limitation in the way interfaces and interactions are designed and even thought about today, an issue we call *procedural information loss*: once a task has been completed by a computer, significant information that was used or produced while processing it is rendered inaccessible regardless of the multiple other purposes it could serve. It hampers the identification and solving of identifiable usability issues, as well as the development of new and beneficial interaction paradigms. We will explore, develop, and promote finer granularity and better-described connections between the causes of those changes, their context, their consequences, and their timing. We will apply it to facilitate the real-time detection, disambiguation, and solving of frequent timing issues related to human reaction time and system latency; to provide broader access to all levels of input data, therefore reducing the need to "hack" existing frameworks to implement novel interactive systems; and to greatly increase the scope and expressiveness of command histories, allowing better error recovery but also extended editing capabilities such as reuse and sharing of previous actions.

Web site: http://loki.lille.inria.fr/causality/

8.2.2. Inria Project Labs

8.2.2.1. BCI-LIFT (2015-2019)
Participant: Géry Casiez [correspondent].

Brain Computer Interfaces: Learning, Interaction, Feedback, Training

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 publication in 2018: [12]

8.2.2.2. AVATAR (2018-2022)
Participants: Géry Casiez, Stéphane Huot, Thomas Pietrzak [correspondent].

The next generation of our virtual selves in digital worlds

This project aims at delivering the next generation of virtual selves, or *avatars*, in digital worlds. In particular, we want to push further the limits of perception and interaction through our avatars to obtain avatars that are better embodied and more interactive. Loki's contribution in this project consists in designing novel 3D interaction paradigms for avatar-based interaction and to design new multi-sensory feedbacks to better feel our interactions through our avatars.

Partners: Inria's GRAPHDECO, HYBRID, MIMETIC, MORPHEO & POTIOC teams, Mel Slater (Event Lab, University Barcelona, Spain), Technicolor and Faurecia.

Web site: https://avatar.inria.fr/

Related publication in 2018: [17]

8.2.3. Others

8.2.3.1. ParkEvolution (Carnot Inria - Carnot STAR, 2015-2019)
Participant: Géry Casiez [correspondent].

Longitudinal analysis of fine motor control for patients with Parkinson disease

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/

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

Andy Cockburn, University of Canterbury, Christchurch, NZ [19], [20]

Carl Gutwin, University of Saskatchewan, Saskatoon, CA [19], [20], [21], [22]

Nicolai Marquardt, University College London, London, UK

Antti Oulasvirta, Aalto University, Helsinki, FI [31]

Daniel Vogel, University of Waterloo, Waterloo, CA [21]

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Edward Lank, Professor at the University of Waterloo, has spent two years in our team until Aug. 2018 (funded by Région Hauts-de-France, Université Lille and Inria).

Marcelo Wanderley, Professor at McGill University, who has been awarded an Inria International Chair in our team in 2016, spent 3 months in our group this year (July to September).

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

Géry Casiez has spent four months in the Human Computer Interaction Lab at the University of Waterloo (September to December).

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

We conducted research in collaboration with J. Senechal from the department of law in Lille University. We are interested in studying the impact of technological choices regarding computation models in the perspective of the GDPR.

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

We initiated a collaboration with cognitive scientists (Angèle Brunellière and Jérémie Jozefowiez) from the psychology department, which resulted in a submission to a multidisciplinary Huma-Num project, to be funded by the Réseau National des Maisons des Sciences de l'Homme (RNMSH).

We started working with Christopher Fletcher (CNRS) from the History department.

These collaborations heavily rely on our work on distributional semantics and word embeddings to provide new insights into these different fields, hence also on the Mangoes toolkit developed in the team.

We 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, JAN RAMON, MAHSA ASADI

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 DEEP-Privacy (2019-2023)

Participants: MARC TOMMASI [correspondent], AURÉLIEN BELLET, PASCAL DENIS, JAN RAMON, BRIJ SRIVASTAVA

DEEP-PRIVACY proposes a new paradigm based on a distributed, personalized, and privacy-preserving approach for speech processing, with a focus on machine learning algorithms for speech recognition. To this end, we propose to rely on a hybrid approach: the device of each user does not share its raw speech data and runs some private computations locally, while some cross-user computations are done by communicating through a server (or a peer-to-peer network). To satisfy privacy requirements at the acoustic level, the information communicated to the server should not expose sensitive speaker information.

9.2.4. ANR-NFS REM (2016-2020)

Participants: PASCAL DENIS [correspondent], BO LI

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.

9.2.5. 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

> Program: H2020 ICT-29-2018 (RIA)
>
> Project acronym: COMPRISE
>
> Project title: Cost-effective, Multilingual, Privacy-driven voice-enabled Services
>
> Duration: Dec 2018- Nov 2021
>
> Coordinator: Emmanuel Vincent
>
> Other partners: Inria Multispeech, Ascora GmbH, Netfective Technology SA, Rooter Analysis SL, Tilde SIA, University of Saarland
>
> Participants: AURÉLIEN BELLET, MARC TOMMASI, BRIJ SRIVASTAVA
>
> Abstract: COMPRISE will define a fully private-by-design methodology and tools that will reduce the cost and increase the inclusiveness of voice interaction technologies.

9.3.2. Collaborations in European Programs, Except FP7 & H2020

9.3.2.1. 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)

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. 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 International Labs

Inria@SiliconValley

Associate Team involved in the International Lab:

9.4.1.1. LEGO

Title: LEarning GOod representations for natural language processing

International Partner (Institution - Laboratory - Researcher):

USC (United States), Prof. 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.

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

North-European Associate Team PAD-ML: Privacy-Aware Distributed Machine Learning.

International Partner: the PPDA team at the Alan Turing Institute.

Start year: 2018

In the context of increasing legislation on data protection (e.g., the recent GDPR), an important challenge is to develop privacy-preserving algorithms to learn from datasets distributed across multiple data owners who do not want to share their data. The goal of this joint team is to devise novel privacy-preserving, distributed machine learning algorithms and to assess their performance and guarantees in both theoretical and practical terms.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Tejas Kulkarni (University of Warwick) visited the team from May to August 2018 to work with AURÉLIEN BELLET, MARC TOMMASI and JAN RAMON on privacy-preserving computation of U-statistics.

- Larisa Soldatova (Brunel University) visited the team in June 2018 to work with JAN RAMON on probabilistic reasoning for biomedical applications.

- Raouf Kerkouche (Inria Privatics) visited the team for 2 weeks in July 2018 to work with AURÉLIEN BELLET and MARC TOMMASI on federated and decentralized learning from medical data.

- Guillaume Rabusseau (Université de Montréal) visited the team for 1 week in July 2018 to work with AURÉLIEN BELLET and MARC TOMMASI on multi-task distributed spectral learning.

- Daphner Ezer, Adrià Gascón, Matt Kusner, Brooks Paige (all from Alan Turing Institute) and Hamed Haddadi (Imperial College London) visited the team for 2 days in October 2018 for the kick-off of the PAD-ML associate team.

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

- D. Hovy (Bocconi Univ.): Retrofit Everything: Injecting External Knowledge into Neural Networks to Gain Insights from Big Data.

- A. Trask (OpenMined): OpenMined - Building Tools for Safe AI.

- C. Biemann (Univ. Hamburg): Adaptive Interpretable Language Technology.

- W. Daelemans (Univ. Antwerp): Profiling authors from social media texts.

9.5.1.1. Internships

- Igor Axinti explored several ways to compare word embeddings and studied the minimal corpus size for the comparison to be meaningful. He applied some of his findings to comparing two corpus in middle french from the 15th century, one originating from London and the other from Flanders. He produced a querying interface to allow Christopher Fletcher (IRHiS), who provided the data, explore and compare the embeddings spaces.

- Nicolas Crosetti (joint internship with Joachim Niehren and Florent Cappelli, Links) worked on dependency-weighted aggregation, i.e., aggregation where the elements to aggregate are weighted according to the extent where they correspond to independent observations.

- Arthur d'Azemar worked on decentralized recommender systems in collaboration with the WIDE team in Inria Rennes (François Taïani). Arthur has applied metric learning techniques in order to learn a K-nn graph for personalized and adaptive user-based recommendations.

- Antoine Capriski worked on the analysis of word semantic change in political texts in collaboration with Caroline Le Pennec (UC Berkeley). He used the techniques of word embeddings to analyze of corpus of political manifestos from the French general elections for the period 1958-1993.

- Most of the works on machine learning and privacy make the assumption that learners are honest but curious. Alexandre Huat worked on making protocols for private machine learning more robust again malicious attacks.

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

- FABIO VITALE is on leave at Department of Computer Science of Sapienza University (Rome, Italy) in the Algorithms Randomization Computation group with Prof. Alessandro Panconesi and Prof. Flavio Chierichetti. His current work on machine learning in graphs follows three directions:
    - designing new online reciprocal recommenders analyzing their performance both in theory and in practice,
    - clustering a finite set of items from pairwise similarity information in different learning settings,
    - introducing a new online learning framework encompassing several problems where the environment changes over time, and an efficient and very scalable unifying approach to solve the related general learning problem.

    Current (and unfinished) ongoing research also includes the following topics: low-stretch spanning trees, active learning in correlation clustering problems, hierarchical clustering.

- AURÉLIEN BELLET visited the Alan Turing Institute (London) and Amazon Research Cambridge for 1 week in February 2018. He worked with Adrià Gascón and Borja Balle on privacy-preserving machine learning.

<p align="center" style="color:red">MEPHYSTO-POST Team</p>

5. Partnerships and Cooperations

5.1. National Initiatives

5.1.1. ANR

A. de Laire is a member of the ANR ODA project.

> Title: Dispersive and random waves.
>
> ANR reference : ANR-18-CE40-0020-01.
>
> Coordinator: Nikolay Tzvetkov, Université de Cergy-Pontoise.

A. Hardy is a member of the ANR BoB project.

> Title: Inférence bayésienne à ressources limitées - données massives et modèles coûteux.
>
> Programme ANR: (DS0705) 2016.
>
> ANR reference: ANR-16-CE23-0003.
>
> Coordinator: R. Bardenet, CNRS & Université de Lille.
>
> Duration: October 2016 - October 2020.

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: C. Bernardin, Université de Nice.
>
> Duration: October 2014 - October 2019.

5.2. European Initiatives

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

> Title: Hydrodynamic Limits and Equilibrium Fluctuations: universality from stochastic systems
>
> Duration: May 2017 - April 2022
>
> Coordinator: P. Gonçalves, Instituto Superior Técnico, Lisbon.

5.3. International Research Visitors

5.3.1. Visits to International Teams

5.3.1.1. Research Stays Abroad

S. De Bièvre spent two months at the Centre de Recherche Mathématiques in Montréal as Simons Professor. M. Simon has been invited as Junior Scientific Leader of the Simons Semester "PDEs/SPDEs and Functional Inequalities" at IMPAN in Warsaw, Poland, for one month.

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

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Bilille partnership

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)
>
> C. Bellenguez, U1167
>
> M. Figeac, CBP / GFS
>
> D. Hot, TAG
>
> V. Leclère, Insitut Charles Viollette
>
> M. Lensink, UMR 8576.
>
> O. Sand, IFB-Core.

9.1.2. Bilille collaborations

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):

> CIIL, C. Faveeuw, Analysis of cytometry data
>
> CIIL, P. Brodin, Analysis of phenotypic screening data
>
> JPARC, J.M. Taymans, Analysis of translation chips
>
> JPARC, M.C. Chartier-Harlin, RNA-Seq meta-analysis
>
> JPARC, A. Vincent, Microarray analysis
>
> UMR 1167, F. Pinet, Analysis of proteomic data.

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

9.2.2. RHU PreciNASH

Participant: Guillemette Marot.

RHU PreciNASH

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

Abstract: 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 a 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. INS2I-CNRS project PEPS JCJC 2018 "PaRaFF"

Participant: Pascal Germain.

Projet PaRaFF: PAC-Bayesian Random Fourier Features

Coordinator: Emilie Morvant, Hubert Curien Lab, University Jean Monnet, Saint-Etienne

Year: 2018

Abstract: In data science, any method is based on a representation of the data. In this project, we study the learning of representation in the context of automatic learning methods called kernel methods. Our analysis is based on the Random Fourier Features, a method of approximating a kernel function based on a combination random attributes (combination defined by a probability distribution on the attributes). We aim to provide a theoretical understanding of this approach via PAC-Bayesian theory, and to propose a representation learning procedure by exploiting the specificities of this theory.

9.2.4. ANR

9.2.4.1. ANR APRIORI

Participants: Benjamin Guedj, Pascal Germain.

APRIORI 2019–2023, ANR PRC

PAC-Bayesian theory and algorithms for deep learning and representation learning.

Main coordinator of the project: Emilie Morvant, Université Jean Monnet.

Funding: 300k EUR.

2 partners - MODAL (Inria LNE), Hubert Curien Lab. (UMR CNRS 5516).

9.2.4.2. ANR BEAGLE
Participants: Benjamin Guedj, Pascal Germain.

BEAGLE 2019–2023, ANR JCJC

PAC-Bayesian theory and algorithms for agnostic learning

Main coordinator of the project: Benjamin Guedj

Funding: 180k EUR

The consortium also includes Pierre Alquier (ENSAE ParisTech), Peter Grünwald (CWI, The Netherlands), Rémi Bardenet (UMR CRIStAL 9189).

9.2.4.3. ANR SMILE
Participants: Christophe Biernacki, Vincent Vandewalle.

SMILE Project-2018-2022

ANR project (ANR SMILE - Statistical Modeling and Inference for unsupervised Learning at LargE-Scale)

Main coordinator of the project: Faicel Chamroukhi, LMNO, Université de Caen

4 partners - MODAL (Inria LNE), LMNO UMR CNRS 6139 (Caen), LMRS UMR CNRS 6085 (Rouen), LIS UMR CNRS 7020 (Toulon).

9.2.4.4. 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.

9.2.4.5. 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

Abstract: 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).

9.2.5. 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.

9.2.6. 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. European Initiatives

9.3.1. FP7 & H2020 Projects

Benjamin Guedj and Vincent Vandewalle are involved on the European H2020 porject PERF-AI

Program: H2020

Project acronym: PERF-AI

Project title: Enhance Aircraft Performance and Optimisation through utilisation of Artificial Intelligence

Duration: November 2018 - November 2020.

Coordinator: Safety Line

Other partners: Safety Line

Abstract: PERF-AI will apply Machine Learning techniques on flight data (parametric and non-parametric approaches) to accurately measure actual aircraft performance throughout its lifecycle.

Within current airline operations, both at flight preparation (on-ground) and at flight management (in-air) levels, the trajectory is first planned, then managed by the Flight Management System (FMS) using a single manufacturer's performance model that is the same for every aircraft of the same type, and also on weather forecast that is computed long before the flight. It induces a lack of accuracy during the planning phase with a flight route pre-established at specific altitudes and speeds to optimize fuel burn, from take-off to landing using aircraft performances that are not those of the real aircraft. Also, the actual flight will usually shift from the original plan because of Air Traffic Control (ATC) constraints, adverse weather, wind changes and tactical re-routing, without possibility for the flight crew, either using the FMS or through connected services to tactically recompute the trajectory in order to continuously optimize the flight path. This is in particular due to the limitations of the performance databases that the current systems are using.

Hence, PERF-AI is focusing on identifying adequate machine learning algorithms, testing their accuracy and capability to perform flight data statistical analysis and developing mathematical models to optimize real flight trajectories with respect to the actual aircraft performance, thus, minimizing fuel consumption throughout the flight.

The consortium consists of Safety-Line (FR) and Inria (FR), having full expertise at Aircraft Performance and Data Science, hence, able to fully propose, test and validate different statistical models that will allow to accurately solve some optimization challenges and implement them in an operational environment.

9.3.2. Collaborations with Major European Organizations

Sophie Dabo-Niang is vice-chair of EMS-CDC (European Mathematical Society-Committe of Developing Countries). She is also a member of the executive committee of CIMPA (International Centre of Pure and Applied Mathematics)

Alain Celisse is a member of a one-year EIT European project called SysBooster with ApSys and Nokia.

9.4. International Initiatives

9.4.1. Inria International Labs

IIL CWI-Inria

Associate Team involved in the International Lab:

9.4.1.1. 6PAC

Title: Making Probably Approximately Correct Learning Active, Sequential, Structure-aware, Efficient, Ideal and Safe

International Partner (Institution - Laboratory - Researcher):

CWI (Netherlands) - Machine Learning Group

PI: Benjamin Guedj

Consortium: Peter Grünwald (co-PI), Wouter Koolen (CWI), Emilie Kaufmann (Inria LNE EPI SequeL).

Start year: 2018 (until 2021)

Webpage: https://bguedj.github.io/6pac/index.html

This project roots in statistical learning theory, which can be viewed as the theoretical foundations of machine learning. The most common framework is a setup in which one is given n training examples, and the goal is to build a predictor that would be efficient on new (similar) data. This efficiency should be supported by PAC (Probably Approximately Correct) guarantees, e.g. upper bounds on the excess risk of a predictor that hold with high probability. Such guarantees however often hold under stringent assumptions which are typically never met in real-life application, e.g., independent, identically distributed data. More realistic modelling of data has triggered many research efforts in several directions: first, accommodating possible data (e.g., dependent, heavy-tailed), and second, in the direction of sequential learning, in which the predictor can be built on the fly, while new data is gathered. We believe that an ever more realistic paradigm is active learning, a setup in which the learner actively requests data (possibly facing constraints, such as storage, velocity, cost, etc.) and adapts its queries to optimize its performance. The 3-years objective of 6PAC (where 6 stands for Sequential, Active, Efficient, Structured, Ideal, Safe - the six research directions we intend to contribute to) is to pave the way to new PAC generalization and sample-complexity upper and lower bounds beyond batch learning. Our ambition is to contribute to several learning setups, ranging from sequential learning (where data streams are collected) to adaptive and active learning (where data streams are requested by the learning algorithm).

9.4.2. Participation in Other International Programs

Starting December 2018, Benjamin Guedj is on sabbatical leave at University College London, Computer Science department, to lead a research team within the UCL AI center.

9.4.2.1. SIMERGE

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

International Partner (Institution - Laboratory - Researcher):

UGB (Senegal) - LERSTAD - Abdou Ka Diongue

Serge Iovleff and Sophie Dabo-Niang are associated members of SIMERGE.

9.5. International Research Visitors

9.5.1. Visits to International Teams

9.5.1.1. Research Stays Abroad

Sophie Dabo-Niang visited the University of Kuala Lumpur, November 2018, the University of Melbourne (Australia), December 2018, and the University of Nador (Morroco), end of December 2018.

Serge Iovleff visited several institutions in Senegal (April 22 – May 18, 2018). He gave a lecture at University Gaston Berger (UGB) of Saint-Louis and collaborated with Cheikh Loucoubar, Seydou Nourou Syllla and Cheikh Loucoubar of the team G4BBM of the Pasteur Institute of Dakar.

<div align="center">

NON-A POST Team

</div>

8. Partnerships and Cooperations

8.1. Regional Initiatives

Non-A POST team hosts CPER Data ControlHub (an on-line laboratory for control system experimentation) and participates at ContrATech subprogram of CPER ELSAT.

8.2. National Initiatives

- Inria Project Lab (IPL) IPL COSY.
- 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, 2015-2020.
- ANR project TurboTouch (High-performance touch interactions), coordinator: G. Casiez (MJOL-NIR team, Inria), 2014-2019.
- ANR project DIGITSLID (DIGITal set-valued and homogeneous SLIding mode control and Differentiators: the implicit approach), coordinator: Bernard Brogliato (TriPOP team, Inria), 2018-2022.
- ANR project ROCC-SYS (Robust Control of Cyber-Physical Systems), coordinator: L. Hetel (CNRS, EC de Lille), 2013-2018.
- 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".

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

UCoCoS: the objectives of the project are to create a control-oriented framework for complex systems, and to define a common language, common methods, tools and software for the complexity scientist. The principal investigators are: W. Michiels, J.-P. Richard and H. Nijmeijer.

8.4. International Initiatives

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

8.4.1.1. HoTSMoCE

Title: Homogeneity Tools for Sliding Mode Control and Estimation

International Partner (Institution - Laboratory - Researcher):

UNAM (Mexico)

Prof. Leonid Fridman

2016–2018

The team *Non-A POST* 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.

8.4.2. *Inria North European Lab*

RECoT, "Robust Estimation and Control with Time Constraints", 2018–2020

International Partner: IBM Research, Dublin (Dr. Sergiy Zhuk)

Non-A Post team of Inria deals with control and estimation of on-line (dynamical) systems with applications to robotics, biological systems, human-machine interfaces and active ow control. The key feature of the developed algorithms is a robustness and a non-asymptotic convergence allowing to fulfill some time constraints. The main methodology is a homogeneity (dilation symmetry) approach. IBM Research team develops minimax algorithms for state estimation and identification of dynamical systems with applications to computational fluid dynamics and image assimilation problems. The key feature of the resulting algorithms is the exact or approximate description of the reachability set of the underlying dynamical system in finite or infinite dimensions. The methodology is relies upon duality and Lyapunov exponents. The objectives of the collaboration are an exchange of the scientific knowledge and the joint research of the following problems: homogeneous observers design using minimax approach; development of fast and consistent computational algorithms for digital implementation of homogeneous controllers and observers; extension of sliding mode control methodology to infinite-dimensional models using minimax approach; the minimax observer-based control design for turbulent flows.

8.4.3. *Informal International Partners*

- ITMO University, Saint-Petersburg, Russia
- Tel-Aviv University, Tel-Aviv, Israel
- CINVESTAV-IPN, Mexico, Mexico
- Hangzhou Dianzi University, Hangzhou, China
- Brandenburg University of Technology, Cottbus, Germany

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

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

C. Chainais-Hillairet is a member of the ANR MOONRISE project. 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: MOdels, Oscillations, and NumeRIcal SchEmes
>
> Type: Fondements du numérique (DS0705) - 2014
>
> ANR reference: ANR-14-CE23-0007
>
> Coordinator: F. Méhats (Université de Rennes 1)
>
> Duration: October 2014 - June 2019

C. Chainais-Hillairet and T. Rey are members of the ANR MOHYCON project. The MOHYCON project is related to the analysis and simulation of multiscale models of semiconductors. As almost all current electronic technology involves the use of semiconductors, there is a strong interest for modeling and simulating the behavior of such devices, which was recently reinforced by the development of organic semiconductors used for example in solar panels or in mobile phones and television screens (among others).

> Title: multiscale MOdels and HYbrid numerical methods for semiCONductors
>
> Type: Société de l'information et de la communication (DS07) - 2017
>
> ANR reference: ANR-17-CE40-0027
>
> Coordinator: M. Bessemoulin-Chatard (CNRS and Université de Nantes)
>
> Duration: January 2018 - December 2020

9.1.2. LabEx CEMPI

> Title: Centre Européen pour les Mathématiques, la Physique et leurs Interactions
>
> Coordinator: S. De Bièvre (Université de Lille)
>
> Duration: January 2012 - December 2019
>
> Partners: Laboratoire Paul Painlevé and Laser Physics department (PhLAM), Université de Lille

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.

9.2. International Research Visitors

9.2.1. *Visits of International Scientists*

The RAPSODI project-team invited several scientists in 2018. The following people came for long visits:

- J. Venel (Université Polytechnique Hauts-de-France) visited Inria Lille until July;
- J. Fuhrmann (WIAS Berlin) was invited for 1 month between May and June, thanks to a support of the LabEx CEMPI;
- A. Vasseur (UT Austin) was invited for 1 month in June, also thanks to a support of the LabEx CEMPI.

The following people came for shorter visits:

- S. Krell (Université de Nice) came in Lille on February 12-15;
- M. Rodrigues (Université de Rennes 1) came in Lille on December 3-7;
- M. Breden (TU Munich) came on December 17-21.

9.2.2. *Internships*

N. Staili, PhD student in the Faculté des Sciences de Meknès, came in Lille for a three-month visit between January and April.

9.2.3. *Visits to International Teams*

C. Cancès visited D. Matthes (TU Munich) during 1 week on December 3-7 to collaborate on the variational derivation of multiphase flow models.

9.2.4. *Research Stays Abroad*

A. Zurek spent 2 months (October-November) in the research team of A. Jüngel at TU Vienna to collaborate on the numerical simulation of a biofilm model. He was supported by the Institut Français d'Autriche and by EKINOX CNRS grant (Laboratoire Paul Painlevé).

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

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 collaborating in the Context of CPER Data since 2018.

9.1.2. CPER DATA

Participants: Marcus Denker, Stéphane Ducasse, Allex Oliveira with: L. Fabresse and N. Bouraqadi (IMT Douai)
From 2018, ongoing.

Funding to work one year on the PharoThings Platform. We are creating content for a website and a Demo in collaboration with IMT Douai.

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.

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.

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 2018.

9.4. International Initiatives

9.4.1. Inria International Partners

9.4.1.1. 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 Pleiad – 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

- Abdelghani Alidra [University of Skikda Algeria, from Nov 2018]
- Andy Amoordon [Utocat, from Oct 2018]
- Jan Bliznicenko [University of Prague , Mar 2018]
- Abdelhakim Bouremel [University of Skikda Algeria, May 2018]
- Thomas Dupriez [Ecole Normale Supŕieure Paris, Sep 2018]
- Christopher Fuhrman [Ecole de technologie superieure de montreal, from Oct 2018]
- Tomohiro Oda [Key Technology Laboratory, Japan, from Aug 2018 until Sep 2018]
- Giuseppe Antonio Pierro [University of Cagliari, from Aug 2018]
- Ronie Salgado Faila [niversity of Chile at Santiago, Chile, from Aug 2018 until Sep 2018]
- Serge Demeyer [Universiteit Antwerpen, Belgium, from Jun 2018 until Jul 2018

9.5.1.1. Internships

- Lionel Akue [Inria, from Jul 2018 until Sep 2018]
- Asbathou Biyalou Sama [Inria, from Apr 2018 until Aug 2018]
- Quentin Ducasse [Inria, from Jun 2018 until Aug 2018]
- Thomas Dupriez [Ecole Normale Supŕieure Cachan, until Feb 2018]
- Yoan Geran [Ecole Normale Supŕieure Paris, from Jun 2018 until Jul 2018]
- Pierre Tsapliayeu [Univ de Lille, from Apr 2018 until Aug 2018]
- Eleonore Wald [Univ de Lille, from Apr 2018 until Jul 2018]
- Oleksandr Zaitsev [Inria, from Oct 2018]
- Myroslava Romaniuk [Inria, from Jul 2018 until Sep 2018]

9.5.2. Visits to International Teams

- Marcus Denker: VUB Brussels in spring and fall 2018 (Lecture).

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

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR BoB

Participant: 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 favorably 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: Jérémie Mary, Michal Valko.

- *Title*: Extraction and Transfer of Knowledge in Reinforcement Learning
- *Type*: National Research Agency (ANR-9011)
- *PI*: M. Valko
- *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.

9.1.4. Grant of Fondation Mathématique Jacques Hadamard

Participants: Michal Valko, Matteo Pirotta, Alessandro Lazaric, Ronan Fruit.

- *Title*: Theoretically grounded efficient algorithms for high-dimensional and continuous reinforcement learning
- *Type*: PGMO-IRMO, funded by Criteo
- *PI*: M. Valko
- *Criteo contact*: Marc Abeille
- *Duration*: 2018-2020
- *Abstract*: While learning how to behave optimally in an unknown environment, a reinforcement learning (RL) agent must trade off the exploration needed to collect new information about the dynamics and reward of the environment, and the exploitation of the experience gathered so far to gain as much reward as possible. A good measure of the agent's performance is the regret, which measures the difference between the performance of optimal policy and the actual rewards accumulated by the agent. Two common approaches to the exploration-exploitation dilemma with provably good regret guarantees are the optimism in the face of uncertainty principle and Thompson Sampling. While these approaches have been successfully applied to small environments with a finite number of states and action (tabular scenario), existing approach for large or continuous environments either rely on heuristics and come with no regret guarantees, or can be proved to achieve small regret but cannot be implemented efficiently. In this project, we propose to make a significant contribution in the understanding of large and/or continuous RL problems by developing and analyzing new algorithms that perform well both in theory and practice. This research line can have a practical impact in all the applications requiring continuous interaction with an unknown environment. Recommendation systems belong to this category and, by definition, they can be modeled has a sequence of repeated interaction between a learning agent and a large (possibly continuous) environment.

9.1.5. 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, then Ecole Normale Supérieure de Lyon
  - E. Kaufmann collaborated with Aurélien Garivier on sequential testing and structured bandit problems.
- Centrale-Supélec Rennes
  - E. Kaufmann co-advises Lilian Besson, who works at CentraleSupélec with Christophe Moy on MAB for cognitive radio and Internet-of-Things communications.

- Participation to the Inria Project Lab (IPL) "HPC – Big Data". Started in 2018, this IPL gathers a dozen Inria team-projects, mixing researchers in HPC with researchers in machine learning and data science. SEQUEL contribution in this project is about how we can take advantage of HPC for our computational needs regarding deep learning and deep reinforcement learning, and also how such learning algorithms might be redesigned or re-implemented in order to take advantage of HPC architectures.

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 (mind reading) 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 education 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-in hand 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 Coordinator: 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 behavior 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. Inria Associate Teams Not Involved in an Inria International Labs

9.3.1.1. 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):

Otto-von-Guericke-Universität Magdeburg 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. In 2018 we made big advances that resulted in two new research results, currently under review.

9.3.2. Inria International Partners

9.3.2.1. Declared Inria International Partners

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.

9.3.2.2. CWI

We also collaborate with P. Grunwald, and W. Koolen through the associate team headed by Benjamin Guedj from Modal.

9.3.3. Participation in Other International Programs

In 2017, we mentioned many collaborations with: Adobe, MIT, Stanford, Leoben, ...

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.

Otto-von-Guericke-Universität Magdeburg

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. which results in two finished results.

Adobe Research

Y. Abbasi-Yadkori *Collaborator*

M. Valko collaborated on learning in unpredictable but potentially easy environment. This led to a publication in COLT 2018.

University of California, Berkeley

Peter Bartlett *Collaborator*

Victor Gabillon *Collaborator*

Alain Malek *Collaborator*

M. Valko collaborated with P.Barlett, V. Gabillon, and A. Malek on the sample complexities in unknown type of environments.

DeepMind London

Rémi Munos *Collaborator*

M. Valko collaborated with R. Munos on Brownian motion maximization, important for stock value predictions. This led to a publication in NIPS 2018.

Mila, Université de Montréal

A. Courville *Collaborator*

A. Touati *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.

M. Valko collaborates on faster learning in submodular learning with limited feedback. This setting has application in marketing when we want to select the inventory while maximizing the profit.

McGill University, Montreal

A. Durand, J. Pineau *Collaborator*

A. Durand and OA. Maillard collaborate on a project of structured bandits, with application in physics (calibration).

Northeastearn University, Boston

M. Aziz, J. Anderton, J. Aslam *Collaborator*

E. Kaufmann collaborate with M. Aziz, J. Anderton and J. Aslam on a project on infinite bandits, which led to an ALT 2018 publication. E. Kaufmann also collaborates with M. Aziz on bandits for phase I clinical trials. This led to the submission of a paper to the Biometrics journal.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Xiotian Yu, 1 week, the Chinese University of Hong-Kong
- Junpei Komiyama, 6 weeks, Tokyo University
- Abbas Mehrabian, 1 week, McGill University
- Audrey Durand, 2 weeks, McGill University
- Andrea Locatelli, 2 weeks, Otto-von-Guericke-Universität Magdeburg, Germany
- Jill-Jênn Vie, 1 week, RIKEN AIP, Tokyo, Japan
- Peter Grünwald, 2 times two days (8 hour lectures), CWI and Leiden University, Amsterdam, Netherlands
- Wouter Koolen, 1 week, CWI, Amsterdam, Netherlands

9.4.1.1. Internships

- Quentin Burthier, ENSTA ParisTech, from Jun 2018 until Aug 2018
- Edouard Dendauw, from May 2018 until Jul 2018
- Thibault Felicite, Jul 2018
- Robert Lindland, MIT, from May 2018 until Aug 2018
- Jian Qian, ENS, from May 2018 until Oct 2018
- Hassan Saber, Centrale Paris, from Apr 2018 until Aug 2018
- Benoit Schmitt, Centrale Nantes, from Mar 2018 until Aug 2018
- Han Shao, PhD student from the Chinese University in Hong-Kong, from Oct 2018 until Nov 2018
- Annie Yun, MIT, from May 2018 until Aug 2018
- Arnaud Fanthomme, ENS, from Apr 2018 until Aug 2018

9.4.2. Visits to International Teams

9.4.2.1. Other visits

- OA. Maillard: August, Visit of Aufrey Durand at Mc Gill University (2 weeks)
- OA. Maillard: Novembre, Invited visit of Junya Honda at Tokyo University (4 days)
- E. Kaufmann: March, April, Visit of Wouter Koolen at CWI, Amsterdam (2 times 1 week)

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Région Hauts-de-France

9.1.1.1. CIRRUS
Participants: Yahya Al-Dhuraibi, Stéphanie Challita, Guillaume Fieni, Alexandre Garnier, 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.

9.1.1.2. Alloy@Scale
Participants: Philippe Merle [correspondant], Romain Rouvoy, Lionel Seinturier, Zakaria Ournani.

Alloy@Scale is a 12-month project funded in the context of CPER Data program. Alloy@Scale aims at overcoming the limits of the formal verification of large software systems specified with the Alloy formal specification language. For that, the program combines the Grid'5000 infrastructure and the Docker container technology.

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 [57] and Benoit Cornu [46].

9.1.2.2. ADT FingerKit
Participants: Antoine Canda, Walter Rudametkin Ivey [correspondant], Antoine Vastel.

ADT FingerKit (2018–20) is a technology development initiative supported by the Inria Lille - Nord Europe Center that focuses on the design and development of a new and enhanced version of the AmIUnique platform. AmIUnique is a data collection and analysis platform to better understand, analyze and vulgarize the uses and threats of browser fingerprinting. This initiative led by Inria is a key asset to better understand novel techniques that threatens the user privacy on Internet. This ADT builds on our first results with the ongoing PhD thesis of Antoine Vastel.

9.1.2.3. ADT e-Lens
Participants: Arthur d'Azémar, Guillaume Fieni, Romain Rouvoy [correspondant].

ADT e-Lens (2018–20) is a technology development initiative supported by the Inria Lille - Nord Europe Center that aims at extending the PowerAPI energy monitoring library that we develop in the team since 2011. The extension deals with the integration of new power models (for GPU, disk, network interface), the implementation of a self-optimization algorithm, the port of the platform to embedded systems running with Raspberry Pi, ROS and Android, and the implementation of an active learning algorithm for power models. This ADT builds on our results with the defended PhD theses of Adel Nouredine [59] and Maxime Colmant [45], and with the ongoing PhD thesis of Guillaume Fieni.

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
Participants: Pierre Bourhis [correspondant], Marion Tommasi.

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 36-month project (2016–19) 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. Inria National Initiatives

9.2.3.1. 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.

9.2.4. CNRS Momentum

9.2.4.1. Manage Your Data Without Information Leakage

Participants: Pierre Bourhis [correspondant], Louis Jachiet.

"Gérer vos données sans fuite d'information" is a 3-year (2018–20) project granted in the context of the CNRS-Momentum call for projects. Data manipulated by modern applications are stored in large databases. To protect these pieces of data, security policies limit a user's access to what she is allowed to see. However, by using the semantics of the data, a user can deduce information that she was not supposed to have access to. The goal of this project is to establish methods and tools for understanding and detecting such data leaks.

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].

Program: EIT Digital.

Project acronym: MCS.

Project title: Multi-Cloud Studio.

Duration: 12 months (2018).

Coordinator: Inria.

Other partners: Santer Reply (Italy) and Scalair (France).

Abstract: The goal of this EIT Digital activity is to create the Xscalibur start-up and develop its first Multi-Cloud Studio product. This product is a model-driven graphical interface to design, deploy and administrate multi-cloud systems based on Amazon Web Service, OpenStack, and VMware.

Participants: Jamal Boudjaj, Rida Darmal, Julien Decaudin, Bénédicte Delcourt, Christophe Gourdin, Philippe Merle [correspondant].

Program: EIT Digital.

Project acronym: Bankable.

Project title: Bankable, Deliver the best mobile banking services and customer experience

Duration: 12 months (2018).

Coordinator: Alfstore.

Other partners: Inria, Cefriel

Abstract: BANKABLE helps consumer banks continuously deliver the best mobile banking experience. The platform will anonymously analyze data gathered from mobile sensors, user context and interactions. Enriched by online customers' feedbacks, the bank will find deeper insights & drive real-time actions.

Participants: Romain Rouvoy [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 an 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-year (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

Rajkumar Buyya, Redmond Barry Distinguished Professor and Director of the Cloud Computing and Distributed Systems (CLOUDS) Laboratory at the University of Melbourne, visited us in February 2018.

9.5.1.1. Internships

Mohammad Naseri, MSc. Student in Computer Science from Saarland University, Germany, visited us for 3 months, from November 2017 to January 2018.

Chaima Chakhaba, MSc. Student in Computer Science from ESI Alger, Algeria, visited us for 9 months, from December 2017 to August 2018.

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

Thomas Durieux, PhD Student, spent 3 months from April to June 2018 in KTH, Sweden.