RESEARCH CENTER

FIELD
Perception, Cognition and Interaction

Activity Report 2018

Section Partnerships and Cooperations

Edition: 2019-03-07

CEDAR Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- AIDE ("A New Database Service for Interactive Exploration on Big Data") is an ANR "Young Researcher" project led by Y. Diao, started at the end of 2016.
- CBOD ("Cloud-Based Organizational Design") is a 4-year ANR started in 2014, coordinated by prof. Ahmed Bounfour from UPS. Its goal is to study and model the ways in which cloud computing impacts the behavior and operation of companies and organizations, with a particular focus on the cloud-based management of data, a crucial asset in many companies.
- ContentCheck (2015-2018) is an ANR project in collaboration with U. Rennes 1 (F. Goasdoué), INSA Lyon (P. Lamarre), the LIMSI lab from U. Paris Sud, and the Le Monde newspaper, in particular their fact-checking team Les Décodeurs. Its aim is to investigate content management models and tools for journalistic fact-checking.

8.1.2. LabEx, IdEx

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

8.1.3. Others

- ODIN is a four-year project started (2014-2018) funded by the Direction Générale de l'Armement, between the SemSoft company, IRISA Rennes and Cedar. The project focused on developing a complete framework for analytics on Web data, in particular taking into account uncertainty, based on Semantic Web technologies such as RDF.
- The goal of the iCODA project is to develop the scientific and technological foundations for knowledge- mediated user-in-the-loop collaborative data analytics on heterogenous information sources, and to demonstrate the effectiveness of the approach in realistic, high-visibility use-cases. The project stands at the crossroad of multiple research fields—content analysis, data management, knowledge represen- tation, visualization—that span multiple Inria themes, and counts on a club of major press partners to define usage scenarios, provide data and demonstrate achievements. This is a project funded directly by Inria ("Inria Project Lab"), and is in collaboration with GraphIK, ILDA, LINKMEDIA (coordinator), as well as the press partners AFP, Le Monde (Les Décodeurs) and Ouest-France.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

- **IDEAA: Issue-Driven European Arena Analytics** is a project funded by the European Commission Union's Horizon 2020 research and innovation programme. The project started in July 2018 for a duration of two years. Its purpose is to allow citizens to easily explore the trove of publicly available data with the aim of building a viewpoint on specific issues. Its main strengths are: supply users with succinct and meaningful knowledge with respect to the issue they are interested in; allow users

to interact with the provided knowledge to refine their information need and advance understanding; suggest interesting or unexpected aspects in the data and support the comparison of knowledge discovered from different data sources. IDEAA is inspired by human-to-human dialogues, where questions are explorative, possibly imprecise, and answers may be a bit inaccurate but suggestive, conveying an idea that stimulates the interlocutor to further questions.

The project supports a two-years presence of Mirjana Mazuran as an experienced post-doc in our team.

8.3. International Initiatives

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

8.3.1.1. WebClaimExplain

Title: Mining for explanations to claims published on the Web

International Partner (Institution - Laboratory - Researcher):

AIST (Japan) - Julien Leblay

Start year: 2017

See also: https://team.inria.fr/cedar/projects/webclaimexplain/

The goal of this research is to create tools to find explanations for facts and verify claims made online. While this process cannot be fully automated, the main focus of our work will be explanation finding via trusted sources, based on the observation that one can only trust a statement if he/she can explain it through rules and proofs that can themselves be trusted. Our WebClaimExplain collaboration has been particularly fruitful this year in terms of publications [9], [7], [18], [16], [14].

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

We resumed our collaboration with Prof. Alin Deutsch from University of California in San Diego (UCSD), during his invited stay at U. Paris Sud. We have completed a work (started in 2015-2016) on efficient view-based query rewriting in polystores, and submitted it to a major international conference.

8.3.3. Participation in Other International Programs

8.3.3.1. AYAME

WebClaimExplain

Title: Mining for explanations to claims published on the Web

International Partner (Institution - Laboratory - Researcher):

AIST (Japan) - Leblay Julien

Duration: 2017 - 2019

Start year: 2017

See also: https://team.inria.fr/cedar/projects/webclaimexplain/

The goal of this research is to create tools to find explanations for facts and verify claims made online. While this process cannot be fully automated, the main focus of our work will be explanation finding via trusted sources, based on the observation that one can only trust a statement if he/she can explain it through rules and proofs that can themselves be trusted.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Sabbatical programme

Juliana Freire, a professor at NYU and the chair of the ACM SIGMOD chapter, has been a visitor on sabbatical in the team since September 2018.

8.4.1.2. Internships

Lars Kegel, a PhD student at the university of Dresden, has visited the team until August 2018. He has worked on characterizing and generating time series data for benchmarking time series management software.

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

Yanlei Diao spent three months at U. Massachussets at Amherst, USA.

GRAPHIK Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

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

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

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

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

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

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

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

8.1.3. Docamex (CASDAR project, 2017-2020)

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

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

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

8.1.4. Convergence Institute #DigitAg (2017-2023)

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

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

8.1.5. Informal National Partners

We continue to work informally with the following partners:

- Michael Thomazo (VALDA Inria team) on Ontology-Mediated Query Answering [37], [27].
- Jérôme Bonnet and Sarah Gouiziou, from the Center for Structural Biochemistry of Montpellier (CBS), on the encoding of Boolean functions in biological systems [15].
- Jean-Claude Léon (IMAGINE Inria team) on the developement of an ontology-mediated query answering system applied to the field of CAD (Computer Aided Design).
- Srdjan Vesic (CRIL) on logical argumentation systems [35], [28], [30], [31], [32] . In particular, Srdjan Vesic is a co-supervisor of Bruno Yun PhD thesis, started in Sept 2016.

8.2. European Initiatives

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

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

NoAW (No Agricultural Waste) is led by INRA-IATE. Driven by a "near zero-waste" society requirement, the goal of NoAW project is to generate innovative efficient approaches to convert growing agricultural waste issues into eco-efficient bio-based products opportunities with direct benefits for both environment, economy and EU consumer. To achieve this goal, the NoAW concept relies on developing holistic life cycle thinking able to support environmentally responsible R&D innovations on agro-waste conversion at different TRLs, in the light of regional and seasonal specificities, not forgetting risks emerging from circular management of agro-wastes (e.g. contaminants accumulation). GraphIK contributes on two aspects. On the one hand we participate in the annotation effort of knowledge bases (using the @Web tool). On the other hand we further investigate the interplay of argumentation with logically instantiated frameworks and its relation with social choice in the context of decision making.
http://cordis.europa.eu/project/rcn/203384_en.html

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

Participants: Patrice Buche, Pierre Bisquert, Madalina Croitoru.

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

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

Participants: Patrice Buche, Madalina Croitoru, Rallou Thomopoulos.

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

8.2.4. Informal International Partners

- University of Toronto (Canada): collaboration with Sheila McIlraith and her research group on temporal logics [22].
- Birkbeck College, University of London (UK): collaboration with Michael Zacharyaschev, Roman Kontchakov, and Stanislav Kikot on the complexity of ontology-mediated query answering [14].
- Patras University (Greece): collaboration with Nikolaos Karanikolas (formerly postdoc in the team) [16].

8.2.5. International Research Visitors

- David Carral (postdoc, TU Dresden, Germany) visited the group between 19-21 Dec. 2018.
- Joshua Sohn (PhD, DTU, Denmark) visited the group for a month in October 2018.
- Prof. Guillermo Simari (U. Nacional del Sur, Argentina) visited the group for a week in July 2018.

8.2.6. Visits to International Teams

- One-year stay (academic year 2017-2018) of Meghyn Bienvenu at University of Toronto, Computer Science Department, collaboration with Sheila McIlraith and KR group, focusing mainly on program synthesis with linear temporal logic (LTL) specifications, in particular, taking into account environment assumptions and user preferences.
- Marie-Laure Mugnier visited the Knowledge-Based Systems research group at TU Dresden (Markus Kroetzsch), mid July 2018.

LACODAM Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

- **Hyptser: Hybrid Prediction of Time Series**
  Participants: T. Guyet, S. Malinowski (LinkMedia), V. Lemaire (Orange)
  HYPTSER is a collaborative project between Orange Labs and LACODAM funded by the Fondation Mathématique Jacques Hadamard (PGMO program). It aims at developping new hybrid time series prediction methods in order to improve capacity planning for server farms. Capacity planning is the process of determining the infrastructure needed to meet future customer demands for online services. A well-made capacity planning helps to reduce operational costs, and improves the quality of the provided services. Capacity planning requires accurate forecasts of the differences between the customer demands and the infrastructure theoretical capabilities. The HYPTSER project makes the assumption that this information is captured by key performance indicators (KPI), that are measured continuously in the service infrastructure. Thus, we expect to improve capacity planning capabilities by making accurate forecasts of KPI time series. Recent methods about time series forecasting make use of ensemble models. In this project, we are interested in developing hybrid models for time series forecasting. Hybrid models aim at jointly partitioning the data, learning forecasting models in each partition and learning how to combine their outputs. We are currently developing two different approaches for that purpose, one based on the MODL framework and the other based on neural networks. We describe these approaches below:
  - MODL is a mathematical framework that turns the learning task into a model selection problem. It aims at finding the most probable model given the data. The MODL approach has been applied on numerous learning tasks. In all cases, this approach leads to a regularized optimization criterion. We formalize a new MODL criterion able to learn hybrid models on time series in order to: i) make a partition of time series; ii) learn local regression models. This approach formalizes these two steps in a unified way.
  - We are also developing an hybrid neural network structure that is able to learn automatically a soft partitioning of the data together with local models on each partition.

  In the next steps of this project, we will analyze the performance of this two strategies on KPI time series provided by Orange and compare them to classical ensemble methods.

9.1.1. ANR

- **#DigitAg: Digital Agriculture**
  Participants: A. Termier, V. Masson, C. Largouët, A.I. Graux
  #DigitAg is a “Convergence Institute” dedicated to the increasing importance of digital techniques in agriculture. Its goal is twofold: First, make innovative research on the use of digital techniques in agriculture in order to improve competitiveness, preserve the environment, and offer correct living conditions to farmers. Second, prepare future farmers and agricultural policy makers to successfully exploit such technologies. While #DigitAg is based on Montpellier, Rennes is a satellite of the institute focused on cattle farming.
  LACODAM is involved in the “data mining” challenge of the institute, which A. Termier co-leads. He is also the representative of Inria in the steering comittee of the institute. The interest for the team is to design novel methods to analyze and represent agricultural data, which are challenging because they are both heterogeneous and multi-scale (both spatial and temporal).

9.1.2. National Platforms

- **PEPS: Pharmaco-epidemiology for Health Products**
  Participants: Y. Dauxais, T. Guyet, V. Masson, R. Quinou, A. Samet
  The PEPS project (Pharmaco-epidemiology des Produits de Santé) is funded by the ANSM (National Agency for Health Security). The project leader is E. Oger from the clinical investigation center CIC-1414 INSERM/CHU Rennes. The other partners located in Rennes are the Institute of Research and Technology (IRT), B<>Com, EHESP and the LTSI. The project started in January 2015 and is funded for 4 years. The PEPS project consists of two parts: a set of clinical studies and a research program dedicated to the development of innovative tools for pharmaco-epidemiological studies with medico-administrative databases. Our contribution to this project will be to propose pattern mining algorithms and reasoning techniques to analyse the typical care pathways of specific groups of insured patients. Since last year we have been working on the design and development of algorithms [27], [26] to mine patterns on care pathways.

9.2. International Research Visitors

9.2.1. Internships

From May to August 2018 we hosted Devang Kulshreshtha, a computer science student from the Indian Institute of Technology (BHU) Varanasi, who worked on “Debugging Deep Learning Algorithms via Pattern Mining Methods”. His work aimed at mining patterns of neuron activation that precede misclassifications in deep neural networks (DNN). The goal of this effort is to predict when a DNN will likely err. This can be used e.g., to obtain hints on how to retrain the network to improve its accuracy.

LINKS Project-Team

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.

MAGNET Project-Team

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.

MOEX Project-Team

5. Partnerships and Cooperations

5.1. National Initiatives

5.1.1. ANR Elker

Program: ANR-PRC

Project acronym: ELKER

Project title: Extending link keys: extraction and reasoning

Duration: October 2017 - September 2021

Coordinator: LIG/Manuel Atencia

Participants: Manuel Atencia Arcas, Jérôme David, Jérôme Euzenat

Other partners: Inria Lorraine, Université de Vincennes

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

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

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

Project acronym: GINCO V3

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

Duration: November 2017 - December 2018

Coordinator: Jérôme David

Participants: Jérôme David, Jérôme Euzenat, Manuel Atencia Arcas

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

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

Project acronym: FNE

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

Duration: November 2017 - December 2018

Coordinator: Jérôme David

Participants: Jérôme David, Manuel Atencia Arcas, Jérôme Euzenat

Other partners: Bibliothèque nationale de France

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

ORPAILLEUR Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. AGREV-3

Participant: Jean-François Mari.

The AGREV 3 project (for "Agriculture Environment Vittel") is part of "Agrivair" –a subsidiary of Nestlé Waters– in actions to protect the natural resources of natural mineral water. We used ARPEnTAge to mine survey data about the Vittel-Contrexéville territory, which is suspected of groundwater quality risks [5]. This allowed to locate regions having the same behavior. In addition, this provided a more contrasted simulation by eliminating the influence of stable zones (forests, permanent grasslands) and a more precise definition of a "neutral" model.

8.1.2. Hydreos

Participants: Jean-François Mari, Chedy Raïssi.

Hydreos is a state organization, so-called "Pôle de compétitivité", aimed at monitoring and evaluating the quality of water and its delivery (http://www.hydreos.fr/fr). Actually, data about water resources rely on many agronomic variables, including land use successions. The data to be analyzed are obtained by surveys or by satellite images and describe the land use at the level of the agricultural parcel. Then there is a search for detecting changes in land use and for correlating these changes to groundwater quality. Accordingly, one main challenge in our participation in Hydreos is to process and analyze space-time data for reaching a better understanding of the changes in the organization of a territory. The systems ARPEnTAge and CarottAge are used in this context, especially by agronomists of INRA (ASTER Mirecourt http://www6.nancy.inra.fr/sad-aster).

On other aspects, we tested new deep graph convolutional learning over data provided by the SEDIF "Syndicat des eaux d'Île-de-France" to predict the likelihood of water leaks in a network of pipes and compared it with a master thesis where spatial point process techniques were used (master thesis of Nicolas Dante, M2 IMSD Nancy).

8.1.3. The Smart Knowledge Discovery Project

Participants: Jérémie Nevin, Amedeo Napoli, Chedy Raïssi.

The SKD project for "Smart Knowledge Discovery" aims at analyzing complex industrial data for troubleshooting and decision making, and is funded by "Grand Est Region". We are working on exploratory knowledge discovery with the Vize company, which is based in Nancy and specialized in visualization-based data mining. The data which are under study are provided by the Arcelor-Mittal Steel Company and are related to the monitoring of rolling mills. Data are complex time series and the problem is related to a so-called "predictive maintenance", or how to anticipate problems in the furnaces and avoid their stop. In this way, one main objective of SKD is to combine sequence mining and visualization tools for recognizing temperature problems in the furnaces, and thus preventing the occurrences of defects in the outputs of the rolling mills.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. Elker (2017–2020)

Participants: Nacira Abbas, Miguel Couceiro, Amedeo Napoli, Chedy Raïssi.

The objectives of the ELKER ANR Research Project is to study, formalize and implement the search for link keys in RDF data. Link keys generalize database keys in two independent directions, i.e. they deal with RDF data and they apply across two relation datasets. Then we study the automatic discovery of link keys and reasoning with link keys, in taking an FCA point of view. The projects relies on the competencies of Orpailleur in FCA for solving the problem using FCA and pattern structures algorithms, partition pattern structures which are related to the discovery of functional dependencies. This project involves the EPI Orpailleur at Inria Nancy Grand Est, the EPI MOEX at Inria Rhône Alpes, and LIASD at Université Paris 8.

8.2.1.2. PractiKPharma (2016–2020)

Participants: Adrien Coulet, Joël Legrand, Pierre Monnin, Amedeo Napoli, Malika Smaïl-Tabbone, Yannick Toussaint.

PractiKPharma for "Practice-based evidences for actioning Knowledge in Pharmacogenomics" is an ANR research project (http://practikpharma.loria.fr/) about the validation of domain knowledge in pharmacogenomics. Pharmacogenomics is interested in understanding how genomic variations related to patients have an impact on drug responses. Most of the available knowledge in pharmacogenomics (state of the art) lies in biomedical literature, with various levels of validation. An originality of PractiKPharma is to use Electronic Health Records (EHRs) to constitute cohorts of patients. These cohorts are then mined for extracting potential pharmacogenomics patterns to be then validated w.r.t. literature knowledge for becoming actionable knowledge units. More precisely, firstly we should extract pharmacogenomic patterns from the literature and secondly we should confirm or moderate the interpretation and validation of these units by mining EHRs. Comparing knowledge patterns extracted from the literature with facts extracted from EHRs is a complex task depending on the EHR language –literature is in English whereas EHRs are in French– and on knowledge level, as EHRs represent observations at the patient level whereas literature is related to sets of patients. The PractiKPharma involves three other laboratories, namely LIRMM in Montpellier, SSPIM in St-Etienne and CRC in Paris.

8.2.2. CNRS Mastodons Projects: HyQual, HyQualiBio and QCM-BioChem (2016–2018)

Participants: Nacira Abbas, Guilherme Alves Da Silva, Miguel Couceiro, Alain Gély, Nyoman Juniarta, Tatiana Makhalova, Amedeo Napoli, Chedy Raïssi, Justine Reynaud.

The HyQual project was proposed in 2016 in response to the Mastodons CNRS Call about data quality in data mining (see http://www.cnrs.fr/mi/spip.php?article819&lang=fr). This project is interested in the mining of nutritional data for discovering predictive biomarkers of diabetes and metabolic syndrome in elder populations. The considered data mining methods are hybrid, and they combine symbolic and numerical methods for mining complex and noisy metabolic data [77]. Regarding the mining process, we are interested in the quality of the data at hand and in the discovered patterns. In particular, we check the incompleteness of the data, the quality of the extracted rules and the possible existence of redescriptions.

Initially, the project involved researchers from the EPI Orpailleur, with researchers from LIRIS Lyon, ICube Strasbourg, and INRA Clermont-Ferrand. Then, the project was merged the other Mastodons project named QualiBioConsensus, about the "ranking of biological data using consensus ranking techniques". The joint Mastodons project was called "HyQualiBio". The year after, the project was a new time merged with the PEPS Decade project to form the new "QCM-BioChem" (https://www.lri.fr/~cohen/QCM-BioChem.html). The topics of interest for the participants are the mining of complex biological data, rankings and ties in rankings, and the search of dependencies in the web of data.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

8.3.1.1. CrossCult (H2020 Project, 2016-2020)

Participants: Miguel Couceiro, Nyoman Juniarta, Amedeo Napoli, Chedy Raïssi.

CrossCult aims at making reflective history a reality in the European cultural context, by enabling the re-interpretation of European (hi)stories through cross-border interconnections among cultural digital resources, citizen viewpoints and physical venues. The project has two main goals. The first goal is to lower cultural EU barriers and create unique cross-border perspectives, by connecting existing digital historical resources and by creating new ones through the participation of the public. The second goal is to provide long-lasting experiences of social learning and entertainment that will help for achieving a better understanding and re-interpretation of European history. To achieve these goals, CrossCult aims at using cutting-edge technology to connect existing digital cultural assets and to combine them with interactive experiences that all together are intended to increase retention, stimulate reflection and help European citizens appreciate their past and present in a holistic manner. CrossCult has to be implemented on four real-world flagship pilots involving a total of 8 sites across Europe.

The role of the Orpailleur Team (in conjunction with the LORIA Kiwi Team) is to work on knowledge discovery and recommendation. The focus is on the mining of visitor trajectories for analysis purposes [32], [33] and on the definition of a visitor profile in connection with domain knowledge for recommendation [31].

The numerous partners of the Orpailleur team in the CrossCult project are: Luxembourg Institute for Science and Technology and Centre Virtuel de la Connaissance sur l'Europe (Luxembourg, leader of the project), University College London (England), University of Malta (Malta), University of Peloponnese and Technological Educational Institute of Athens (Greece), Università degli Studi di Padova (Italy), University of Vigo (Spain), National Gallery (London, England), and GVAM Guìas Interactivas (Spain).

8.4. International Initiatives

8.4.1. Inria International Labs

Inria@SiliconValley
Associate Team involved in the International Lab:

8.4.1.1. Snowball

Title: Discovering knowledge on drug response variability by mining electronic health records

International Partner (Institution - Laboratory - Researcher):

Stanford (United States) - Department of Medicine, Stanford Center for Biomedical Informatics Research (BMIR) - Nigam Shah

Start year: 2017

See also: http://snowball.loria.fr/

Snowball (2017-2019) is an Inria Associate Team and the continuation of the preceding Associate Team called Snowflake (2014-2016). The objective of Snowball is to study drug response variability through the lens of Electronic Health Records (EHRs) data. This is motivated by the fact that many factors, genetic as well as environmental, imply different responses from people to the same drug. The mining of EHRs can bring substantial elements for understanding and explaining drug response variability.

Accordingly the objectives of Snowball are to identify in EHR repositories groups of patients which are responding differently to similar treatments, and then to characterize these groups and predict patient drug sensitivity. These objectives are complementary to those of the PractiKPharma ANR project. Moreover, it should be noticed that Adrien Coulet is continuing a two-years sabbatical stay in the lab of Nigam Shah at Stanford University since September 2017 (granted by an "Inria délégation").

Participants of the Snowball Associate Team have been awarded with a Grant Seed funded by Stanford University, to pursue their efforts in AI in Medicine. The granted project will particularly focus on the building of fair and equitable predictive models for medicine (see http://medicine.stanford.edu/news/current-news/standard-news/presenceannouncesseedgrantawardees.html).

8.4.2. Informal International Partners: Research Collaboration with HSE Moscow

Participants: Nacira Abbas, Guilherme Alves Da Silva, Miguel Couceiro, Alain Gély, Nyoman Juniarta, Tatiana Makhalova, Amedeo Napoli, Chedy Raïssi, Justine Reynaud.

An on-going collaboration involves the Orpailleur team and Sergei O. Kuznetsov at Higher School of Economics in Moscow (HSE). Amedeo Napoli visited HSE laboratory several times while Sergei O. Kuznetsov visits Inria Nancy Grand Est every year. The collaboration is materialized by the joint supervision of students (such as the thesis of Aleksey Buzmakov defended in 2015 and the on-going thesis of Tatiana Makhalova), and the the organization of scientific events, as the workshop FCA4AI with six editions between 2012 and 2018 (see http://www.fca4ai.hse.ru).

This year, we participated in the writing of common publications around the thesis work of Tatiana Makhalova and the organization of one main event, namely the sixth edition of the FCA4AI workshop in July 2018 at the ECAI-IJCAI Conference which was held in Stockholm, Sweden (see http://ceur-ws.org/Vol-2149, [58]).

8.4.3. Participation in other International Programs

8.4.3.1. A stay at NASA Frontier Development Lab

In July and August 2018, Chedy Raïssi visited NASA Ames and SETI Institute as part of the Frontier Development Lab, where he worked on mentoring teams and developing meaningful research opportunities, as well as support the work of the planetary defense community and show the potential of this kind of applied research methodology to deliver breakthrough of significant value.

During the eight-week research incubator he aimed at applying cutting-edge machine-learning algorithms to challenges in the space sciences. He worked with two machine-learning students (PhD and post-doc level) that were paired with two space-science researchers (post-doc level) on the improvement of machine-learning models for exoplanet transit classification. This small team started initially from a machine-learning model that classified signals based on straightforward local and global views of the light curves that was developed by Google Brain engineer Chris Shallue. To improve upon it, the team added scientific domain knowledge –staying true to the Orpailleur idea of injecting domain knowledge– that was provided by domain experts. Using the resulting model, the team managed to classify a Kepler data set with 97.5% accuracy and 98% average precision [2].

PETRUS Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR PerSoCloud (Jan 2017 - Dec 2020)

Partners: Orange Labs (coordinator), PETRUS (Inria-UVSQ), Cozy Cloud, U. of Versailles.
The objective of PerSoCloud is to design, implement and validate a full-fledged Privacy-by-Design Personal Cloud Sharing Platform. One of the major difficulties linked to the concept of personal cloud lies in organizing and enforcing the security of the data sharing while the data is no longer under the control of a central server. We identify three dimensions to this problem. Devices-sharing: assuming that the primary copy of user U1's personal data is hosted in a secure place, how to share and synchronize it with U1's multiple (mobile) devices without compromising security? Peers-sharing: how user U1 could exchange a subset of his-her data with an identified user U2 while providing to U1 tangible guarantees about the usage made by U2 of this data? Community-sharing: how user U1 could exchange a subset of his-her data with a large community of users and contribute to personal big data analytics while providing to U1 tangible guarantees about the preservation of his-her anonymity? In addition to tackling these three scientific and technical issues, a legal analysis will guarantee compliance of this platform with the security and privacy French and UE regulation, which firmly promotes the Privacy by Design principle, including the current reforms of personal data regulation.

9.1.2. PIA - PDP SECSi (May 2016 - Dec 2017)

Partners: Cozy Cloud (coordinator), Qwant, PETRUS (Inria-UVSQ), FING.
The objective of this PIA-PDP (Programme Investissement d'Avenir - Protection des Données Personnelles) SECSi project is to build a concrete Personal Cloud platform which can support a large scale deployment of Self Data services. Three major difficulties are identified and will be tackled in this project: (1) how to implement and enforce a fine control of the data flow when personal data are exploited by third party applications, (2) how to protect these same applications when processing is delegated to the personal cloud platform itself and (3) how to implement personalized search on the web without hurting user's privacy.

9.1.3. CityLab@Inria, Inria Project Lab (May 2014 - Oct 2018)

Inria Partners: ARLES-MIMOVE, CLIME, DICE, FUN, MYRIADS, OAK, PETRUS, URBANET, WILLOW.
External partners: UC Berkeley.
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. PETRUS contributes to Privacy-by-Design architectures for trusted smart objects so as to ensure privacy to citizens, which is critical for ensuring that urbanscale sensing contributes to social sustainability and does not become a threat. The PhD Thesis of Dimitris Tsoulovos, co-directed by MIMOVE and PETRUS, is funded by CityLab. http://citylab.inria.fr/

9.1.4. GDP-ERE, DATA-IA project (Sept. 2018 - Aug. 2021)

Partners: DANTE (U. of Versailles), PETRUS (Inria-UVSQ).

The role of individuals and the control of their data is a central issue in the new European regulation (GDPR) enforced on 25th May 2018. Data portability is a new right provided under those regulations. It allows citizens to retrieve their personal data from the companies and governmental agencies that collected them, in an interoperable digital format. The goals are to enable the individual to get out of a captive ecosystem, and to favor the development of innovative personal data services beyond the existing monopolistic positions. The consequence of this new right is the design and deployment of technical platforms, commonly known as Personal Cloud. But personal cloud architectures are very diverse, ranging from cloud based solutions where millions of personal cloud are managed centrally, to self-hosting solutions. These diversity is not neutral both in terms of security and from the point of view of the chain of liabilities. The GDP-ERE project tends to study those issues in an interdisciplinary approach by the involvement of jurists and computers scientists. The two main objectives are (i) to analyze the effects of the personal cloud architectures on legal liabilities, enlightened by the analysis of the rules provided under the GDPR and (ii) to propose legal and technological evolutions to highlight the share of liability between each relevant party and create adapted tools to endorse those liabilities. http://dataia.eu/actualites/linstitut-dataia-vous-presente-le-projet-gdp-ere-rgpd-et-cloud-personnel-de-lempowerment

9.2. International Research Visitors

9.2.1. Visits to International Teams

9.2.1.1. Research Stays Abroad

Iulian Sandu Popa has visited the Computer Science department of NJIT (New Jersey Institute of Technology) for two months (Mars to April) during 2018. Iulian has a long history of collaboration with this department at NJIT, this being his second long stay since 2011. In particular, he collaborates at NJIT with Professor Vincent Oria on topics related to spatiotemporal data management and with Professor Cristian Borcea on topics such as privacy-preserving mobile computing for location-based applications [5] and secure and distributed crowd-sensing for smart city applications. For the latter topic, a joint journal paper has been recently submitted (see Section 7.4).

TYREX Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Data-CILE

Title: Query Compilation

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

Duration: 2016-2018

Coordinator: Nabil Layaïda

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

BioQurate

Title: Querying and Curating Hierarchies of Biological Graphs

Funding: Fédération Informatique de Lyon (FIL)

Duration: 2018-2020

Coordinator: Angela Bonifati

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

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

7.2. National Initiatives

7.2.1. ANR

CLEAR

Title: Compilation of intermediate Languages into Efficient big dAta Runtimes

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

Duration: January 2017 – September 2021

Coordinator: Pierre Genevès

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

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

DataCert

Title: Coq deep specification of security aware data integration

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

Duration: January 2016 – January 2020

Participant: Angela Bonifati

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

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

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

QualiHealth

Title: Enhancing the Quality of Health Data

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

Duration: 2018-2022

Coordinator: Angela Bonifati

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

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

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

7.2.2. PERSYVAL-lab LabEx

Title: Mobile Augmented Reality Applications for Smart Cities

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

Duration: 2014 – 2018

Coordinators: Pierre Genevès and Nabil Layaïda

Others partners: NeCS team at GIPSA-Lab laboratory.

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

1. Finding and developing appropriate representations for describing the physical world (3D maps, indoor buildings, ways...), integrated advanced media types (3D, 3D audio, precisely geo-tagged pictures with lat., long. and orientation, video...)
2. Integrating the different abstraction levels of these data streams (ranging from sensors data to high level rich content such as 3D maps) and bridging the gap with Open Linked Data (the semantic World). This includes opening the way to query the environment (filtering), and adapt AR browsers to users' capabilities (e.g. blind people). The objective here is to provide an open and scalable platform for mobile-based AR systems (just like the web represents).
3. Increasing the reliability and accuracy of localization technologies. Robust and high-accuracy localization technologies play a key role in AR applications. Combined with geographical data, they can also be used to identify user-activity patterns, such as walking, running or being in an elevator. The interpretation of sensor values, coupled with different walking models, allows one to ensure the continuity of the localization, both indoor and outdoor. However, dead reckoning based on Inertial Navigation Systems (INS) or Step-and-Heading Systems (SHS) is subject to cumulative errors due to many factors (sensor drift (accelerometers, gyroscopes, etc.), missed steps, bad estimation of the length of each stride, etc.). One objective is to reduce such errors by merging and mixing these approaches with various external signals such as GPS and Wi-Fi or relying on the analyses of user trajectories with the help of a structured map of the environment. Some filtering methods (Kalman Filter, observer, etc.) will be useful to achieve this task.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

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

VALDA Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

Michaël Thomazo has obtained a 6k€ budget from the Île-de-France region (DIM RFSI – *Réseau Francilien en Sciences Informatiques*) entitled *ISORE: Indexation sémantique d'ontologies, le cas des règles existentielles.* The grant was awarded when Michaël Thomazo was part of the Inria Saclay Cedar team, but the budget was transferred to the Valda team.

7.2. National Initiatives

7.2.1. ANR

Valda has been part of two ANR projects in 2018:

- HEADWORK (budget managed by Inria), together with IRISA (Druid, coordinator), Inria Lille (Links & Spirals), and Inria Rennes (Sumo), and two application partners: MNHN (Cesco) and FouleFactory. The topic is workflows for crowdsourcing. See http://headwork.gforge.inria.fr/.
- BioQOP (budget managed by ENS), with Idemia (coordinator) and GREYC, on the optimization of queries for privacy-aware biometric data management. See http://bioqop.di.ens.fr/.

In addition, two ANR projects were accepted in 2018 and will start early 2019:

- CQFD (budget managed by Inria), with Inria Sophia (GraphIK, coordinator), LaBRI, LIG, Inria Saclay (Cedar), IRISA, Inria Lille (Spirals), and Télécom ParisTech, on complex ontological queries over federated and heterogeneous data.
- QUID (budget managed by Inria), LIGM (coordinator), IRIF, and LaBRI, on incomplete and inconsistent data.

7.3. International Initiatives

7.3.1. IIL projects

Valda has strong collaborations with the following international groups:

Univ. Edinburgh, United Kingdom: Peter Buneman and Leonid Libkin

Univ. Oxford, United Kingdom: Michael Benedikt, Evgeny Kharlamov, Dan Olteanu, and Georg Gottlob

TU Dresden, Germany: Markus Krötzsch and Sebastian Rudolph

Dortmund University, Germany: Thomas Schwentick

Warsaw University, Poland: Mikołaj Bojańczyk and Szymon Toruńczyk

Tel Aviv University, Israel: Daniel Deutch and Tova Milo

Drexel University, USA: Julia Stoyanovich

Univ. California San Diego, USA: Victor Vianu

National University of Singapore: Stéphane Bressan

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Victor Vianu, Professor at UC San Diego and holder of an Inria international chair, spent 3 months within Valda, employed as an ENS invited professor.

7.4.2. Visits to International Teams

7.4.2.1. Research Stays Abroad

- Michaël Thomazo and Pierre Senellart have spent respectively two weeks and one week at TU Dresden, collaborating with Markus Krötzsch and Sebastian Rudolph.
- Pierre Senellart has spent a cumulated time of around three weeks at National University of Singapore, co-advising Debabrota Basu, PhD student working under the co-supervision of Stéphane Bressan, visiting Stéphane Bressan and other researchers at NUS, and participating in the French–Singapore workshop on AI, where Olivier Cappé represented CNRS.

WIMMICS Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. ALDRAI UCA Project

At the center of the project, there is a triple ambition. The first is methodological and epistemological: it is a question of contributing to the development of the field of computational humanities via new tools of exploration of corpora, beyond the lexical approach (without excluding it, obviously, but in complementing) - it is a question of learning how to mobilize Artificial Intelligence to locate arguments, ideas and not simply terms, uses of terms, semantic fields. The second ambition is academic and transdisciplinary: the field studied in the project - administrative law from 1799 to today - concerns several disciplines (the history of law, administrative law, modern and contemporary history, philosophy, political science, administrative science) and the development of digital technology will make it possible to considerably widen the sources available for its study, both from the point of view of their analysis (thanks to the exploratory tools mentioned in the previous point) and from the point of view of their nature. The third ambition is professional: practitioners already use the available databases (such as ArianeWeb [0] - for administrative case law) but they need to be able to question them more finely, in relation to the theoretical questions they ask themselves. This need is all the stronger as the so-called *digital transformation of justice* is developing in the sense of automating decision-making processes, based on the disputes already settled through the implementation of systematic line of all court decisions (pursuant to the law of 7 October 2016 on the Digital Republic). Magistrates as lawyers therefore need new digital tools to work and several start-ups have appeared in the sector called Legal Tech.

Partners: UNS (faculté de lettres and faculté de droit), Inria, UCA, École Pratique des Hautes Études [0] and Institut des Systèmes Complexes de Paris IDF [0], duration: 2018-2019.

9.1.2. IADB UCA Project

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

9.1.3. INCERTIMMO UCA Project

INCERTIMMO, *Uncertainty in Real Estate Spatial Modeling in the City*[0], is a research and development partnership funded by UCA and Kinaxia [0] company. UCA partners are: I3S, ESPACE [0], and IMREDD [0].

9.2. National Initiatives

9.2.1. PIA GDN ANSWER

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

[0] http://arianeinternet.conseil-etat.fr/arianeinternet/
[0] https://www.ephe.fr/
[0] https://iscpif.fr/
[0] *Intégration et Apprentissage sur les Données Biomédicales*
[0] *Prise en compte de l'Incertitude pour une Modélisation Spatiale des Valeurs Immobilières dans la Ville*
[0] http://www.kinaxia.fr/
[0] http://univ-cotedazur.fr/laboratoires_old/espace
[0] http://imredd.fr/

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

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

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

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

The proposed innovations include:

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

9.2.2. DGA CONFIRMA

Participants: Elena Cabrio, Serena Villata.

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

9.2.3. Ministry of Culture: MonaLIA 1.0

Participants: Anna Bobasheva, Fabien Gandon.

The MonaLIA 1.0 project is a preliminary study on the coupling of learning methods (Deep Neural Networks) and knowledge-based methods (Semantic Web) for image recognition and the enhancement of descriptive documentary records. The approach is applied and evaluated on the collection and data in the Joconde database in order to identify the possibilities and challenges offered by this coupling in assisting in the creation and maintenance of such an annotated collection.

9.2.4. ANR WASABI

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

The ANR project WASABI started in January 2017 with IRCAM, Deezer, Radio France and the SME Parisson, consists in building a 2 million songs knowledge base of commercial popular music (rock, pop, etc.) Its originality is the joint use of audio-based music information extraction algorithms, song lyrics analysis algorithms (natural language processing), and the use of the Semantic Web. Web Audio technologies then explore these bases of musical knowledge and provide innovative applications for composers, musicologists, music schools and sound engineers, music broadcasters and journalists.

[0] https://project.inria.fr/answer/
[0] http://www.qwant.com

9.2.5. ANR SIDES 3.0

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

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

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

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

9.2.6. DBpedia.fr

Participants: Elmahdi Korfed, Fabien Gandon.

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

Web site: http://dbpedia.fr

9.2.7. Convention between Inria and the Ministry of Culture

Participant: Fabien Gandon.

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

9.2.8. Qwant-Inria Joint Laboratory

Participants: Fabien Gandon, Alain Giboin.

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

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

We identify possibilities of exploiting the Qwant search engine to improve the search for information in the digital cultural resources of the French Ministry of Culture. At the end of the project, some possibilities will be selected and will be the subject of research actions in the context a long-term project.

9.2.9. Inria Federated Query Scaler

Participant: Olivier Corby.

Federated Query Scaler is an Exploratory Research Project (PRE) funded by Inria, together with the Dyliss team at Inria Rennes. The topic of this project is the study of distributed SPARQL queries in the context of bioinformatics.

9.2.10. GDRI Zoomathia

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

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

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

As a continuation of the work initiated with the *Muséum National d'Histoire Naturelle* (MNHN) during the last three years, the TAXREF-LD linked data dataset, that we produced jointly with the MNHN, now appears in the Linked Open Data cloud [0] and is published on AgroPortal [0]. Relatedly, we have reflected on modelling principles for biodiversity Linked Data [45].

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

9.3. European Initiatives

9.3.1. CREEP EIT Project

The CREEP project (Cyberbulling Effects Prevention) aims at identifying and preventing the possible negative impacts of cyberbullying on young people. It seeks to realize advanced technologies for the early detection of cyberbullying phenomena through the monitoring of social media and the communication of preventive advices and personalized recommendations tailored to teenagers' needs through a virtual coaching system (chatbot). Partners: University of Trento, Fondazione Bruno Kessler, Inria, ExpertSystem, NeuroNation; duration: 2018-2020.

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

9.3.2. MIREL

MIREL, MIning and REasoning with legal text, is a Research and Innovation Staff Exchange (RISE) project, funded by Marie Skłodowska-Curie grant, duration: 2016-2019

The coordinator is Leendert van der Torre, University of Luxembourg

Other partners are: University of Bologna (Italy), University of Torino (Italy), University of Huddersfield (UK), Inria (France), APIS (Bulgaria), Nomotika s.r.l. (Italy), DLVSystem s.r.l. (Italy), Zhejiang University (China), Research Organization of Information and Systems (Japan), University of Cape Town (South Africa), National University of La Plata (Argentina), National University of Córdoba (Argentina), Universidad Nacional del Sur in Bahía Blanca (Argentina), National ICT Australia Ltd (Australia), Stanford University (USA).

The MIREL project will create an international and inter-sectorial network to define a formal framework and to develop tools for MIning and REasoning with Legal texts, with the aim of translating these legal texts into formal representations that can be used for querying norms, compliance checking, and decision support. MIREL addresses both conceptual challenges, such as the role of legal interpretation in mining and reasoning, and computational challenges, such as the handling of big legal data, and the complexity of regulatory compliance. It bridges the gap between the community working on legal ontologies and NLP parsers and the community working on reasoning methods and formal logic. Moreover, it is the first project of its kind to involve industrial partners in the future development of innovative products and services in legal reasoning and their deployment in the market. MIREL promotes mobility and staff exchange between SMEs to academies in order to create an inter-continental interdisciplinary consortium in Law and Artificial Intelligence areas including Natural Language Processing, Computational Ontologies, Argumentation, and Logic & Reasoning.

Web site: http://www.mirelproject.eu/

9.4. International Initiatives

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

MoReWAIS
MoReWAIS stands for Mobile Read Write Access and Intermittent to Semantic Web.

[0] http://lod-cloud.net/
[0] http://agroportal.lirmm.fr/ontologies/TAXREF-LD/

Partners: UGB (Senegal) - LANI - Moussa Lo; start year: 2016.

MoReWAIS proposes to explore the specificities (advantages and constraints) of mobile knowledge sharing. The mobile application targeted in MoReWAIS must allow communities and their users to enrich and access more easily the knowledge base using the user's context with its richness (e.g. location, other users close-by) and addressing its limitations (e.g. intermittent access, limited resources).

Web site: https://project.inria.fr/morewais/.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Christian Cardellino: PhD, Universidad de Córdoba, Argentina, May and July.
Andrei Ciortea: PostDoc, University of Saint Gallen, Switzerland, Labex UCN@Sophia grant, November-December.
Kaladzavi Guidedi: PostDoc CEA-MITIC University of Maroua, Cameroon, MoreWAIS grant, November-December.
Phan Hieu Ho: PhD, Polytechnic Institute, Danang, Vietnam, April-July.
Milagro Teruel: PhD, Universidad de Córdoba, Argentina, May-June.
Thuy Trieu: PhD, University of Timisoara, Romania, March-July.

9.5.2. Research Stays Abroad

- Fabien Gandon visited CSIRO, Brisbane, Australia from July to August 2018. In the context of the project MIREL he worked on the problem of aligning semantic Web schemas (argumentation and generic schemas) to support interoperable and linked arguments on the Web as an extension of Web annotation and Web provenance.
- Raphaël Gazzotti visited the Natural Language Processing research group of the Universidad Nacional de Córdoba, Argentina, for two months as a secondment of the MIREL H2020 Project, March-April. We carried out information retrieval of medical test results within free text in french Electronic Medical Records by a symbolic approach. In a future step, we could annotate automatically free texts with this method then train a machine learning algorithm in order to have a better generalization of this extraction process. We also worked on a sequential machine learning modelization suited to Electronic Medical Records. This model exploits the potential of Conditional Random Fields and consequently allows us to interpret the decision made by the algorithm across all the different consultations of a patient, moreover, all medical test results can be considered with this modelization.

ZENITH Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Labex NUMEV, Montpellier

URL: http://www.lirmm.fr/numev

We participate in the Laboratory of Excellence (labex) NUMEV (Digital and Hardware Solutions, Modelling for the Environment and Life Sciences) headed by University of Montpellier in partnership with CNRS, and Inria. NUMEV seeks to harmonize the approaches of hard sciences and life and environmental sciences in order to pave the way for an emerging interdisciplinary group with an international profile. The project is decomposed in four complementary research themes: Modeling, Algorithms and computation, Scientific data (processing, integration, security), Model-Systems and measurements.

9.1.2. Institute of Computational Biology (IBC), Montpellier

URL: http://www.ibc-montpellier.fr

IBC is a 6 year project (2012-2018) with a funding of 2Meuros by the MENRT (PIA program) to develop innovative methods and software to integrate and analyze biological data at large scale in health, agronomy and environment. Patrick Valduriez heads the workpackage on integration of biological data and knowledge.

9.2. National Initiatives

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

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

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

9.2.2. PIA (Projets Investissements d'Avenir) Floris'Tic (2015-2018), 430Keuro.

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

Floris'tic aims at promoting the scientific and technical culture of plant sciences through innovative pedagogic methods, including participatory initiatives and the use of IT tools such as the one built within the Pl@ntNet project. A. Joly heads the work package on the development of the IT tools. This is a joint project with the AMAP laboratory, the TelaBotanica social network and the Agropolis foundation.

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

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

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

9.2.4. Others

9.2.4.1. INRA/Inria PhD program, 100Keuros

Participant: Alexis Joly.

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

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. CloudDBAppliance

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

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

The project aims at producing a European Cloud Database Appliance for providing a Database as a Service able to match the predictable performance, robustness and trustworthiness of on premise architectures such as those based on mainframes. The cloud database appliance features: (i) a scalable operational database able to process high update workloads such as the ones processed by banks or telcos, combined with a fast analytical engine able to answer analytical queries in an online manner; (ii) an operational Hadoop data lake that integrates an operational database with Hadoop, so operational data is stored in Hadoop that will cover the needs from companies on big data; (iii) a cloud hardware appliance leveraging the next generation of hardware to be produced by Bull, the main European hardware provider. This hardware is a scale-up hardware similar to the one of mainframes but with a more modern architecture. Both the operational database and the in-memory analytics engine will be optimized to fully exploit this hardware and deliver predictable performance. Additionally, CloudDBAppliance will tolerate catastrophic cloud data centres failures (e.g. a fire or natural disaster) providing data redundancy across cloud data centres. In this project, Zenith is in charge of designing and implementing the components for analytics and parallel query processing.

9.4. International Initiatives

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

9.4.1.1. SciDISC

Title: Scientific data analysis using Data-Intensive Scalable Computing

International Partner (Institution - Laboratory - Researcher):

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

Start year: 2017

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

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

9.4.2. Inria International Partners

9.4.2.1. Informal International Partners

We have regular scientific relationships with research laboratories in

- North America: Univ. of Waterloo (Tamer Özsu), UCSB Santa Barbara (Divy Agrawal and Amr El Abbadi), Northwestern Univ. (Chicago), university of Florida (Pamela Soltis), Vikram Salatore (Manager of Artificial Intelligence Products Group at Intel Corporation).
- Asia: National Univ. of Singapore (Beng Chin Ooi, Stéphane Bressan), Wonkwang University, Korea (Kwangjin Park), Kyoto University (Japan)
- Europe: Univ. of Madrid (Ricardo Jiménez-Periz), UPC Barcelona (Josep Lluis Larriba Pey), HES-SO (Henning Müller), University of Catania (Concetto Spampinatto), Cork School of Music (Ireland), RWTH (Aachen, Germany), Chemnitz technical university (Stefan Kahl), Berlin Museum für Naturkunde (Mario Lasseck), Stefanos Vrochidis (Greece, ITI)
- Africa: Univ. of Tunis (Sadok Ben-Yahia), IMSP, Bénin (Jules Deliga)
- Australia: Australian National University (Peter Christen)
- Central America: Technologico de Costa-Rica (Erick Mata, former director of the US initiative Encyclopedia of Life)

9.4.3. Participation in Other International Programs

BD-FARM

Title: Big Data Management and Analytics for Agriculture and Farming

International Partner (Institution - Laboratory - Researcher):

Chubu University - International Digital Earth Applied Science Research Center (IDEAS), Kiyoshi Honda

Duration: 2016 - 2018

Start year: 2016

See also: https://team.inria.fr/zenith/bdfarm-2016-2018-stic-asia/

World population is still growing and people are living longer and older. World demand for food rises sharply and current growth rates in agriculture are clearly not sufficient. But extreme flood, drought, typhoon etc, caused by climate change, give severe damages on traditional agriculture. Today, an urgent and deep redesign of agriculture is crucial in order to increase production and to reduce environmental impact. In this context, collecting, managing and analyzing dedicated, large, complex, and various datasets (Big Data) will allow improving the understanding of complex mechanisms behind adaptive, yield and crop improvement. Moreover, sustainability will require detailed studies such as the relationships between genotype, phenotype and environment. In other words, data science and ICT for agriculture must help improving production. Moreover, it has to be done while getting properly adapted to soil, climatic and agronomic constraints as well as taking into account the genetic specificities of plants.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Several international scientists visited the team and gave seminars

- Vitor Silva (COPPE/UFRJ,Brazil): “A methodology for capturing and analyzing dataflow paths in computational simulations” on January 31.
- Dennis Shasha (NYU): “Reducing Errors by Refusing to Guess (Occasionally)” on June 1.
- Daniel de Oliveira (UFF, Brazil): “Parameter and Data Recommendation in Scientific Workflows based on Provenance” on June 5.
- Eduardo Ogasawara, (CEFET-RJ, Brazil): “Comparing Motif Discovery Techniques with Sequence Mining in the Context of Space-Time Series” on November 26.

ALICE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. EXPLORAGRAM

Inria exploratory project EXPLORAGRAM (in cooperation with MOKAPLAN): We explored new algorithms for computational optimal transport. The project allowed us to hire a post-doc for 18 months (Erica Schwindt). She worked on the semi-discrete algorithm, and its application to the simulation of fluid-structure interactions. The project allowed to strengthen the cooperation with MOKAPLAN. It also allowed us to start exploring new cooperations, with Institut d'Astrophysique de Paris, on early universe reconstruction. The results were published in [7].

8.1.2. ANR MAGA (2016-2020)

We participate in the ANR MAGA (ANR-16-CE40-0014) on the Monge Ampere equation and computational geometry. In this ANR project, we cooperate with Quentin Merigot and other researchers of the MOKAPLAN Inria team on new computational methods for optimal transport.

8.1.3. ANR ROOT (2016-2020)

We participate in the Young Researcher ANR ROOT (ANR-16-CE23-0009) on Optimal Transport for computer graphics, with Nicolas Bonneel (CNRS Lyon) as Principal Investigator. In the context of this project, we develop a new symmetric algorithm for semi-discrete optimal transport that optimizes for both the location of the samples and their Lagrange multipliers. An ENS training period will start in Jan. 2018 (Agathe Herrou), hosted in Nancy.

8.2. International Research Visitors

8.2.1. Visits of International Scientists

Oleksandr Bondarenko (KPI, Ukraine) visited the team from 19 October 2018 to 30 October 2018. The goal of the visit was to work on pendulum stabilization.

8.2.2. Visits to International Teams

8.2.2.1. Sabbatical programme

Dmitry Sokolov visited Kuban State University (Russia) from 1 August 2018 to 31 August 2018 for his CNRS sabbatical programme. As a result, two papers are being prepared for Mechantronics 2019 submission.

AVIZ Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

- Tobias Isenberg received an equipment grant from STIC, Paris-Saclay, for approx. EUR 5K

7.2. National Initiatives

- Naviscope Inria Project Lab on Image-guided NAvigation and VIsualization of large data sets in live cell imaging and microSCOPy; collaboration with several Inria project teams and external collaborators; this grant supports a PhD position and funds travel and equipment.

7.3. European Initiatives

7.3.1. FP7 & H2020 Projects

7.3.1.1. IVAN

Title: Interactive and Visual Analysis of Networks

Programm: CHIST-ERA

Duration: May 2018 - April 2021

Coordinator: Dr. Torsten Möller, Uni Wien, Austria

Partners:

EPFL, Switzerland

Inria France

Uni Wien, Austria

Inria contact: Jean-Daniel Fekete

The main goal of IVAN is to create a visual analysis system for the exploration of dynamic or time-dependent networks (from small to large scale). Our contributions will be in three principle areas:

1. novel algorithms for network clustering that are based on graph harmonic analysis and level-of-detail methods;
2. the development of novel similarity measures for networks and network clusters for the purpose of comparing multiple network clusterings and the grouping (clustering) of different network clusterings; and
3. a system for user-driven analysis of network clusterings supported by novel visual encodings and interaction techniques suitable for exploring dynamic networks and their clusterings in the presence of uncertainties due to noise and uncontrolled variations of network properties.

Our aim is to make these novel algorithms accessible to a broad range of users and researchers to enable reliable and informed decisions based on the network analysis.

7.3.2. Collaborations in European Programs, Except FP7 & H2020

- Illustrare project co-funded by ANR, France, and FWF, Austria, funding a PhD position and funds for travel and equipment. The project investigates integrative visual abstraction of molecular data and is a collaboration with TU Wien, Austria

7.4. International Initiatives

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

7.4.1.1. SEVEN

Title: Situated and Embedded Visualization for Data Analysis

International Partner (Institution - Laboratory - Researcher):

University of Calgary (Canada) - ILab - Wesley Willett

Start year: 2018

See also: http://aviz.fr/seven

The goal of this joint work between the Aviz team at Inria Saclay and the ILab at the University of Calgary is to develop and study situated data visualizations to address the limitations of traditional platforms of data analytics. In a situated data visualization, the data is directly visualized next to the physical space, object, or person it refers to. Situated data visualizations can surface information in the physical environment and allow viewers to interpret data in-context, monitor changes over time, make decisions, and act on the physical world in response to the insights gained. However, research on this topic remains scarce and limited in scope. We will build on our track record of successfull collaborations to jointly develop situated visualization as a novel research direction. The objective for the first year is to design and implement situated visualizations to support health and aging. Our joint work is expected generate benefits at multiple levels, including to society and industry (by empowering individuals and professionals with technology), to the scientific community (by developing a new research direction), to the academic partners (by reinforcing existing research links and establishing them as leaders on the topic), and to students (by providing them with unique training opportunities with a diverse team of world-class researchers).

7.4.2. Inria International Partners

7.4.2.1. Informal International Partners

- University of Maryland (USA), University of Roma (Italy), TU Darmstadt (Germany): Jean-Daniel Fekete Fekete collaborates with Leilani Battle, Giuseppe Santucci, Carsten Binnig and colleagues on the design of database benchmarks to better support visualization;
- University of Seoul (Korea): Jean-Daniel Fekete collaborates with Jaemin Jo and Jinwook Seoh on progressive algorithms and visualization techniques;
- University of Bari (Italy): Jean-Daniel Fekete collaborates with Paolo Buono on hypergraph visualization;
- Stanford University. Pierre Dragicevic and Jean-Daniel Fekete collaborate with Sean Follmer on swarm user interfaces.
- Hasso Plattner Institute. Pierre Dragicevic and Tobias Isenberg collaborate with Amir Semmo on stylization filters for facilitating the examination of disturbing visual content.
- University of Minnesota, USA: Tobias Isenberg is collaborating with Daniel F. Keefe on topics of the interactive exploration of 3D data.
- University of Granada, Spain: Tobias Isenberg is collaborating with Domingo Martin and German Arroyo on digital stippling.
- The University of Sydney, Australia. Steve Haroz collaborate with Alex Holcombe on analyzing open practices in vision science.
- Massachusetts Institute of Technology (CSAIL). Steve Haroz collaborates with Aude Oliva on investigating the impact of titles on memory of visualized data.
- University of Washington, University of Zurich and University of Toronto. Pierre Dragicevic and Steve Haroz collaborate with Matthew Kay and Chat Wacharamanotham on transparent statistical reporting and efficient statistical communication. Pierre Dragicevic collaborates with Matthew Kay and Fanny Chevalier on supporting research transparency with interactive research papers.

- University of Calgary. Pierre Dragicevic, Tobias Isenberg, and Petra Isenberg collaborate with Wesley Willett, Sheelagh Carpendale, and Lora Oehlberg on situated data visualization.
- Microsoft Research Redmond and University of Maryland. Petra Isenberg collaborate with Bongshin Lee, Mathieu Brehmer, and Eun Kyoung Choe on Mobile Visualization
- Microsoft Research Redmond. Petra Isenberg and Tanja Blascheck collaborate with Bongshin Lee on Micro Visualizations for Smartwatches

7.5. International Research Visitors

7.5.1. Visits of International Scientists

- Claudio Silva (August 2018 – June 2019): Sabbatical from New York University (USA). Also, invited professor through a DigiCosme grant for 3 months. Claudio Silva is spending one year with Aviz. We launched a bi-weekly seminar on explainable machine-learning with visualization.
- Michael McGuffin (October – November): visit from ETS Montreal (Canada). Michael McGuffin has spent a month with Aviz working on augmented reality and visualization, collaborating with Pierre Dragicevic, Jean-Daniel Fekete, and students.

7.5.1.1. Internships

- Jung Nam from the University of Minnesota visited for 3 months in the summer of 2018. His work centered on the use of storytelling mechanisms to support and communicate results of the exploration 3D data. This collaboration is still ongoing.

EX-SITU Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

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

Type: Ph.D. grant

Funding: DigiCosme Labex

Duration: 2015-2018

Coordinator: Olivier Rioul (Institut Mines Telecom)

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

Inria contact: Michel Beaudouin-Lafon

Abstract: The goal of this project is to conduct fundamental studies of aimed movements based on information theory. The project studies the interaction phenomena involved in pointing, in order to discover novel, more effective pointing techniques. This project funds Wanyu Liu, a joint Ph.D. student between the COMELEC and VIA groups at Institut Mines Telecom and ExSitu. Wanyu defended her thesis in November 2018 [35] and received an Honorable Mention award for her CHI 2018 paper [22].

8.1.2. An Augmented-Reality System for Collaborative Physical Modeling and Design

Type: Equipment

Funding: STIC Paris-Saclay

Duration: 2017-2018

Coordinator: Theophanis Tsandilas

Partners: Univ. Paris-Sud, Inria

Inria contact: Theophanis Tsandilas

Abstract: The goal of the project is to develop an augmented-reality system to support collaboration over 3D models and enhance digital-fabrication approaches. It is a collaboration with the AVIZ group and provides funding (8k) for equipment.

8.1.3. Le Plateau des Recherches Infinies

Type: Equipment and subcontracting

Funding: Learning Center Paris-Saclay

Duration: 2017-2018

Coordinator: Michel Beaudouin-Lafon

Partners: Univ. Paris-Sud

Inria contact: Michel Beaudouin-Lafon

Abstract: The goal of this project (30k) is to create an interactive installation presenting the portraits of a hundred researchers from Université Paris-Saclay. It is a collaboration with portrait photographer Didier Goupy. The installation is designed to be exhibited in various sites of Université Paris-Saclay until it is permanently installed in the Learning Center of Université Paris-Saclay. This project supported Swati Swati, an intern, for two months over the summer. The project was presented at the Fête de la Science in October, 2018, and will be permanently exhibited in the future Learning Center of Université Paris-Saclay.

8.1.4. Virtual Reality for Interacting with Building Information Model at Paris-Saclay

Type: Equipment and human resources

Funding: STIC Paris-Saclay

Duration: 2018-2019

Coordinator: Jean-Marc Vézien (LIMSI-CNRS)

Partners: CNRS, Univ. Paris-Sud

Inria contact: Cédric Fleury

Abstract: The goal of this project is to develop interactive tools for BIM application in virtual reality using a user-centered design approach. The project will use as a case study the interior design of the *Learning Center* building on Paris-Saclay campus.

8.2. National Initiatives

8.2.1. ANR

ELEMENT: Enabling Learnability in Human Movement Interaction

Type: Equipment and human resources

Funding: ANR

Duration: 2019-2022

Coordinator: Baptiste Caramiaux, Sarah Fdili Alaoui, Wendy Mackay

Partners: IRCAM, LIMSI

Inria contact: Baptiste Caramiaux

Abstract: The goal of this project is to foster innovation in multimodal interaction, from non-verbal communication to interaction with digital media/content in creative applications, specifically by addressing two critical issues: the design of learnable gestures and movements; and the development of interaction models that adapt to a variety of user's expertise and facilitate human sensorimotor learning.

8.2.2. Investissements d'Avenir

8.2.2.1. Digiscope - Collaborative Interaction with Complex Data and Computation

Type: EQUIPEX (Equipement d'Excellence)

Duration: 2011-2019

Coordinator: Michel Beaudouin-Lafon

Partners: Université Paris-Saclay (coordinator), Université Paris-Sud, CNRS, CEA, Inria, Institut Mines-Telecom, CentraleSupelec, Université Versailles - Saint-Quentin, ENS Paris-Saclay, Maison de la Simulation

Overall budget: 22.5 Meuros, including 6.7 Meuros public funding from ANR

Abstract: The goal of the project is to create ten high-end interactive rooms interconnected by high-speed networks and audio-video facilities to support remote collaboration across interactive visualization environments. The equipment will be open to outside users and targets four main application areas: scientific discovery, product lifetime management, decision support for crisis management, and education and training. Digiscope includes the existing WILD room, and funded the WILDER room. ExSitu contributes its expertise in the design and evaluation of advanced interaction techniques and the development of distributed software architectures for interactive systems. All ten rooms and the telepresence network are operational. The project was successfully evaluated by an international jury in June, 2017.

8.3. European Initiatives

8.3.1. European Research Council (ERC)

8.3.1.1. Creating Human-Computer Partnerships

Program: ERC Advanced Grant

Project acronym: CREATIV

Project title: Creating Human-Computer Partnerships

Duration: June 2013 - May 2019

Coordinator: Wendy Mackay

Abstract: CREATIV explores how the concept of co-adaptation can revolutionize the design and use of interactive software. Co-adaptation is the parallel phenomenon in which users both adapt their behavior to the system's constraints, learning its power and idiosyncrasies, and appropriate the system for their own needs, often using it in ways unintended by the system designer. A key insight in designing for co-adaptation is that we can encapsulate interactions and treat them as first class objects, called interaction instruments This lets us focus on the specific characteristics of how human users express their intentions, both learning from and controlling the system. By making instruments co-adaptive, we can radically change how people use interactive systems, providing incrementally learnable paths that offer users greater expressive power and mastery of their technology. The initial goal of the CREATIV project is to fundamentally improve the learning and expressive capabilities of advanced users of creative software, offering significantly enhanced methods for expressing and exploring their ideas. The ultimate goal is to radically transform interactive systems for everyone by creating a powerful and flexible partnership between human users and interactive technology.

8.3.1.2. Unified Principles of Interaction

Program: ERC Advanced Grant

Project acronym: ONE

Project title: Unified Principles of Interaction

Duration: October 2016 - September 2020

Coordinator: Michel Beaudouin-Lafon

Abstract: The goal of ONE is to fundamentally re-think the basic principles and conceptual model of interactive systems to empower users by letting them appropriate their digital environment. The project addresses this challenge through three interleaved strands: empirical studies to better understand interaction in both the physical and digital worlds, theoretical work to create a conceptual model of interaction and interactive systems, and prototype development to test these principles and concepts in the lab and in the field. Drawing inspiration from physics, biology and psychology, the conceptual model combines *substrates* to manage digital information at various levels of abstraction and representation, *instruments* to manipulate substrates, and *environments* to organize substrates and instruments into digital workspaces.

8.3.2. Marie Skiodowska-Curie Actions

8.3.2.1. Enhancing Motion Interaction through Music Performance

Program: Marie Curie grant

Project acronym: MIM

Project title: Enhancing Motion Interaction

Duration: 2016 - 2018

Coordinator: Baptiste Caramiaux

Abstract: The goal of the project to enhance Human Motion–Computer Interaction by leveraging fa multidisciplinary approach across experimental psychology, music technology and computational modelling. Firstly, the project examines skilled activities, in particular music performance, in order to understand fundamental cognitive and psychological aspects of control and expression in human motion. The project involves computational models of motor control and expressive variations built from music performance data collected during psychophysical studies. Secondly, the project broaches the implementation of these models in Digital Musical Instruments (DMI), thus creating a new type of digital instrument based on sensorimotor learning mechanisms. The resulting DMI is then assessed through a user study in which elements of exploration and engagement will be tested over several sessions. Therefore, the project contributes to two main uncharted research areas. Firstly it contributes to the fundamental understanding of sensorimotor learning processes by considering complex human motion, specifically motion in music performance. Secondly, it represents an original application of computational modelling by modelling expressive musical gestures and transferring these models to interactive systems.

8.4. International Initiatives

8.4.1. Inria International Labs

Inria@SiliconValley
Associate Team involved in the International Lab:

8.4.1.1. DECibel

Title: Discover, Express, Create – Interaction Technologies For Creative Collaboration

International Partner (Institution - Laboratory - Researcher):

University of California Berkeley (United States) - Electrical and Computer Engineering, Center for Magnetic Resonance Research - Bjoern Hartmann

Start year: 2016

The DECibel associated team includes Inria's ExSitu and the CITRIS Connected Communities Initiative (CCI) at UC Berkeley. ExSitu explores extreme interaction, working with creative professionals and scientists who push the limits of technology to develop novel interactive technologies that offer new strategies for creative exploration. ExSitu's research activities include: developing underlying theory (co-adaptive instruments and substrates), conducting empirical studies (participatory design with creative professionals), and implementing interactive systems (creativity support tools). The CITRIS Connected Communities Initiative investigates collaborative discovery and design through new technologies that enhance education, creative work, and public engagement. It develops interactive tools, techniques and materials for the rapid design and prototyping of novel interactive products, expertise sharing among designers, and citizen science investigations. DECibel will combine the strengths of these two groups to to investigate novel tools and technologies that support Discovery, Expressivity, and Creativity.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Joanne McGrenere, Professor at the University of British Columbia, Canada and Inria Chair, visited for two months, to work with Wendy Mackay, Carla Griggio, Jessalyn Alvina, Yi Zhang and John MacCallum.

8.5.1.1. Internships

Janin Koch, Ph.D. student from Aalto University, Finland, visited for three months to work with Wendy Mackay.

GRAPHDECO Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ADT PicPlay

Participants: Sebastien Bonopera, George Drettakis.

The Technology Development Action (ADT) PicPlay a technology tranfer pre-maturation project, supported by Inria and by UCA Jedi. The objective is to create a startup company based on image based rendering technologies, taking benefit from the team's research and experience over the last 8 years. At this early stage, we evaluated the market and produced several Proof-of-Concept demonstrations for potential clients. One of the demonstrations is our new asset streaming capability that allows the use for huge datasets. We also developed a new solution to improve rendering quality. This solution uses a 3D mesh for each view and refines it according to this view only, before blending each view. PicPlay involved the development of several tools for converting and processing datasets. During this year we established contacts with industrial partners in the automobile industry and in the construction/public works industry who expressed interest in using the technology in their projects for visualization and navigation of captured environments.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. ERC D3

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

Designers draw extensively to externalize their ideas and communicate with others. However, drawings are currently not directly interpretable by computers. To test their ideas against physical reality, designers have to create 3D models suitable for simulation and 3D printing. However, the visceral and approximate nature of drawing clashes with the tediousness and rigidity of 3D modeling. As a result, designers only model finalized concepts, and have no feedback on feasibility during creative exploration. Our ambition is to bring the power of 3D engineering tools to the creative phase of design by automatically estimating 3D models from drawings. However, this problem is ill-posed: a point in the drawing can lie anywhere in depth. Existing solutions are limited to simple shapes, or require user input to "explain" to the computer how to interpret the drawing. Our originality is to exploit professional drawing techniques that designers developed to communicate shape most efficiently. Each technique provides geometric constraints that help viewers understand drawings, and that we shall leverage for 3D reconstruction.

Our first challenge is to formalize common drawing techniques and derive how they constrain 3D shape. Our second challenge is to identify which techniques are used in a drawing. We cast this problem as the joint optimization of discrete variables indicating which constraints apply, and continuous variables representing the 3D model that best satisfies these constraints. But evaluating all constraint configurations is impractical. To solve this inverse problem, we will first develop forward algorithms that synthesize drawings from 3D models. Our idea is to use this synthetic data to train machine learning algorithms that predict the likelihood that constraints apply in a given drawing. In addition to tackling the long-standing problem of single-image 3D reconstruction, our research will significantly tighten design and engineering for rapid prototyping.

8.2.1.2. ERC FunGraph

Participants: Sébastien Morgenthaler, George Drettakis, Rada Deeb, Diolatzis Stavros.

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

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

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

8.2.1.3. Emotive

Participants: Julien Philip, Sebastiàn Vizcay, George Drettakis.

https://emotiveproject.eu/

Type: COOPERATION (ICT)

Instrument: Reseach Innovation Action

Objectif: Virtual Heritage

Duration: November 2016 - October 2019

Coordinator: EXUS SA (UK)

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

Inria contact: George Drettakis

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

GRAPHDECO contributes by developing novel image-based rendering techniques to help museum curators and archeologists provide more engaging experiences. In 2018, we developed a mixed reality plugin for Unity that allows the use of IBR in a VR experience used in one of the EMOTIVE user experiences using a VIVE HMD.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

We maintain close collaborations with international experts, including

- University College London (G. Brostow, P. Hedman)
- UC Berkeley (A. Efros)
- Purdue University (D. Aliaga)
- George Mason University (Y. Gingold)
- Tu Delft (M. Sypesteyn, J. W. Hoftijzer and S. Pont)

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Carol O'Sullivan, Trinity College Dublin, visited the group for one week in August.
- Peter Hedman, University College London, visited us for a few days in July.
- Miika Aittala, MIT, visited the group for one month in July.
- Yotam Gingold, George Mason University, visited the group for one month in June.

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

Several students and postdocs visited our international collaborators:

- Yulia Gryaditskaya and Valentin Deschaintre visited the research group of Fredo Durand at MIT for two weeks. They presented their work to several groups (HCI, geometry, computer graphics).
- Tibor Stanko spent two weeks at RWTH Aachen University, Germany, to collaborate with David Bommes.
- Johanna Delanoy did a 3-months internship at Adobe Research (San Francisco) to collaborate with Aaron Hertzmann.
- Julien Philip spent a week at University College London to visit Gabriel Brostow and five weeks at University of California, Berkeley, to visit Alexei A. Efros. During this visit, he presented his work to the computer graphics groups of Stanford and UC Berkeley.

HYBRID Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Labex Cominlabs SUNSET

Participants: Bruno Arnaldi, Valérie Gouranton [contact].

SUNSET is a 4-year Labex Cominlabs project (2016-2020). SUNSET partners are MediCIS-LTSI (coordinator), Hybrid, Hycomes (IRISA/Inria), and CHU Rennes. SUNSET aims at developing an innovative training software suite based on immersive and collaborative virtual reality technology for training and evaluating non-technical skills. This approach will be implemented and evaluated in the context of training neurosurgical scrub nurses. We will notably integrate methods and systems developed in the S3PM project (see bellow). By relying on Human Factors approaches, the project also addresses training and evaluation of interpersonal skills. Whereas the developed technologies and approaches will be generic and adaptable to any surgical specialty, the project will evaluate the developed system within training sessions performed with scrub nurses. We ambition to propose novel approaches for surgical non-technical skill learning and assessment, and to install the developed training factory at the University Hospital of Rennes, and evaluate it with real-scale user studies.

9.1.2. Labex Cominlabs HEMISFER

Participants: Mathis Fleury, Anatole Lécuyer [contact], Giulia Lioi.

HEMISFER is a 6-year project (2013-2019) funded by Labex CominLabs. It involves 4 Inria/IRISA teams (Hybrid, Visages (lead), Panama, Athena) and 2 medical centers: the Rennes Psychiatric Hospital (CHGR) and the Reeducation Department of Rennes Hospital (CHU Pontchaillou). The goal of HEMISFER is to make full use of neurofeedback paradigm in the context of rehabilitation and psychiatric disorders. The major breakthrough will come from the use of a coupling model associating functional and metabolic information from Magnetic Resonance Imaging (fMRI) to Electro-encephalography (EEG) to “enhance” the neurofeedback protocol. Clinical applications concern motor, neurological and psychiatric disorders (stroke, attention-deficit disorder, treatment-resistant mood disorders, etc).

9.1.3. Labex Cominlabs SABRE

Participants: Anatole Lécuyer [contact], Jussi Tapio Lindgren.

SABRE was a 4-year project (2014-2018) funded by Labex CominLabs. It involved 1 Inria/IRISA team (Hybrid) and 2 groups from TELECOM BREST engineering school. The goal of SABRE was to improve computational functionnalities and power of current real-time EEG processing pipelines. The project investigated innovative EEG solution methods empowered and speeded-up by ad-hoc, transistor-level, implementations of their key algorithmic operations.

9.1.4. IRT b<>com

Participants: Ferran Argelaguet, Bruno Arnaldi [contact], Valérie Gouranton, Anatole Lécuyer, Maud Marchal, Florian Nouviale.

b<>com is a French Institute of Research and Technology (IRT). The main goal of this IRT is to fasten the development and marketing of tools, products and services in the field of digital technologies. Our team has been regularly involved in collaborations with b<>com within various 3-year projects, such as ImData (on Immersive Interaction) and GestChir (on Augmented Healthcare) which both ended in 2016. Follow-up projects called NeedleWare (on Augmented Healthcare) and VUXIA (on Human Factors) have started respectively in 2016 and 2018.

9.1.5. CNPAO Project

Participants: Valérie Gouranton [contact], Ronan Gaugne.

CNPAO ("Conservatoire Numérique du Patrimoine Archéologique de l'Ouest") is an on-going research project partially funded by the Université Européenne de Bretagne (UEB) and Université de Rennes 1. It involves IRISA/Hybrid and CReAAH. The main objectives are: (i) a sustainable and centralized archiving of 2D/3D data produced by the archaeological community, (ii) a free access to metadata, (iii) a secure access to data for the different actors involved in scientific projects, and (iv) the support and advice for these actors in the 3D data production and exploration through the latest digital technologies, modeling tools and virtual reality systems. This project involves a collaboration with Quentin Petit (SED Inria Rennes).

9.1.6. ATT CONSORVIBE

Participants: Anatole Lécuyer [contact], Jussi Tapio Lindgren.

CONSORVIBE was a 6-month ATT Inria Project funded by Inria for supporting a prospective effort and the feasibility study of building a consortium of partners dedicated to the sustainability and promotion of the OpenViBE software.

9.2. National Initiatives

9.2.1. ANR

9.2.1.1. ANR LOBBY-BOT

Participants: Anatole Lécuyer [contact], Maud Marchal, Victor Mercado.

LOBBY-BOT is a 4-year project (2017-2021) funded by the French National Research Agency (ANR). The objective of LOBBY-BOT is to address the scientific challenges of encountered-type haptic devices (ETHD), which are an alternative category of haptic devices relying on a mobile physical prop, usually actuated by a robot, that constantly follows the user hand, and encounter it only when needed. The project follows two research axes: a first one dealing with robot control, and the second one dealing with interaction techniques adapted to ETHD. The involvement of Hybrid relates to the second research axis of the project. The final project prototype will be used to assess the benefits of ETHD when used in an industrial use-case : the perceived quality in an automotive interior.

9.2.2. Inria projects

9.2.2.1. Ilab CertiViBE

Participants: Anatole Lécuyer [contact], Jussi Tapio Lindgren, Thierry Gaugry, Cédric Riou.

CertiViBE was a 2-year "Inria Innovation Lab" (2015-2018) funded by Inria for supporting the development of OpenViBE software, and notably its evolution in order to enable and fasten the medical transfer and the medical certification of products based on OpenViBE. This joint lab involved two partners: Hybrid and Mensia Technologies startup company. The project aimed at setting up a quality environment, and developping a novel version of the software compliant with medical certification rules.

9.2.2.2. IPL BCI-LIFT

Participants: Anatole Lécuyer [contact], Jussi Tapio Lindgren, Hakim Si Mohammed.

BCI-LIFT is a 4-year "Inria Project Lab" initiative (2015-2019) funded by Inria for supporting a national research effort on Brain-Computer Interfaces. This joint lab involves several Inria teams: Hybrid, Potioc, Athena, Neurosys, Loki, Demar; as well as external partners: INSERM-Lyon, and INSA Rouen. This project aims at improving several aspects of Brain-Computer Interfaces: learning and adaptation of BCI systems, user interfaces and feedback, training protocols, etc.

9.2.2.3. IPL AVATAR

Participants: Anatole Lécuyer [contact], Ferran Argelaguet, Diane Dewez, Rebecca Fribourg.

AVATAR is a 4-year "Inria Project Lab" initiative (2018-2022) funded by Inria for supporting a national research effort on Avatars and Virtual Embodiment. This joint lab involves several Inria teams: Hybrid, Potioc, Loki, Mimetic, Graphdeco, Morpheo; as well as external partners: Univ. Bacelona, Faurecia and Technicolor companies. This project aims at improving several aspects of Avatars in immersive applications: reconstruction, animation, rendering, interaction, multi-sensory feedback, etc.

9.2.2.4. IPL NAVISCOPE

Participant: Ferran Argelaguet [contact].

NAVISCOPE is a 4-year "Inria Project Lab" initiative (2018-2022) funded by Inria for supporting a national research effort on image-guided navigation and visualization of large data sets in live cell imaging and microscopy. This joint lab involves several Inria teams: Serpico, Aviz, Beagle, Hybrid, Mosaic, Parietal, Morpheme; as well as external partners: INRA and Institute Curie. This project aims at improving visualization and machine learning methods in order to provide systems capable to assist the scientist to obtain a better understanding of massive amounts of information.

9.3. European Initiatives

9.3.1. H2020 Projects

9.3.1.1. IMAGINE

Title: IMAGINE - Robots Understanding Their Actions by Imagining Their Effects
Programm: H2020
Duration: January 2017 - December 2020
Coordinator: Univ. Innsbruck (Austria)
Partners:

- Univ. Innsbruck (Austria)
- Univ. Göttingen (Germany)
- Karlsruhe Institute of Technology (Germany)
- INSA Rennes (France)
- Institute of Robotics and Industrial Informatics (Spain)
- Univ. Bogazici (Turkey)
- Electro Cycling (Germany)

Inria contact: Maud Marchal

Abstract: Today's robots are good at executing programmed motions, but they do not understand their actions in the sense that they could automatically generalize them to novel situations or recover from failures. IMAGINE seeks to enable robots to understand the structure of their environment and how it is affected by its actions. "Understanding" here means the ability of the robot (a) to determine the applicability of an action along with parameters to achieve the desired effect, and (b) to discern to what extent an action succeeded, and to infer possible causes of failure and generate recovery actions. The core functional element is a generative model based on an association engine and a physics simulator. "Understanding" is given by the robot's ability to predict the effects of its actions, before and during their execution. This allows the robot to choose actions and parameters based on their simulated performance, and to monitor their progress by comparing observed to simulated behavior. This scientific objective is pursued in the context of recycling of electromechanical appliances. Current recycling practices do not automate disassembly, which exposes humans to hazardous materials, encourages illegal disposal, and creates significant threats to environment and health, often in third countries. IMAGINE will develop a TRL-5 prototype that can autonomously disassemble prototypical classes of devices, generate and execute disassembly actions for unseen instances of similar devices, and recover from certain failures. For robotic disassembly, IMAGINE will develop a multi-functional gripper capable of multiple types of manipulation without tool changes. IMAGINE raises the ability level of robotic systems in core areas of the work programme, including adaptability, manipulation, perception, decisional autonomy, and cognitive ability. Since only one-third of EU e-waste is currently recovered, IMAGINE addresses an area of high economical and ecological impact.

9.3.1.2. H-REALITY

Title: H-REALITY

Programm: H2020 - Fet Open

Duration: 2018 - 2021

Coordinator: Univ. Birmingham (UK)

Partners:

Univ. Birmingham (UK)

CNRS (France),

TU Delft (Netherlands),

ACTRONIKA (France),

ULTRAHAPTICS (UK)

Inria contact: Maud Marchal

Abstract: The vision of H-REALITY is to be the first to imbue virtual objects with a physical presence, providing a revolutionary, untethered, virtual-haptic reality: H-Reality. This ambition will be achieved by integrating the commercial pioneers of ultrasonic "non-contact" haptics, state-of-the-art vibrotactile actuators, novel mathematical and tribological modelling of the skin and mechanics of touch, and experts in the psychophysical rendering of sensation. The result will be a sensory experience where digital 3D shapes and textures are made manifest in real space via modulated, focused, ultrasound, ready for the unteathered hand to feel, where next-generation wearable haptic rings provide directional vibrotactile stimulation, informing users of an object's dynamics, and where computational renderings of specific materials can be distinguished via their surface properties. The implications of this technology will transform online interactions; dangerous machinery will be operated virtually from the safety of the home, and surgeons will hone their skills on thin air.

9.3.2. Collaborations in European Programs, Except FP7 & H2020

9.3.2.1. Interreg ADAPT

Program: Interreg VA France (Channel) England

Project acronym: ADAPT

Project title:Assistive Devices for empowering disAbled People through robotic Technologies

Duration: 01/2017 - 06/2021

Coordinator: ESIGELEC/IRSEEM Rouen

Other partners: INSA Rennes - IRISA, LGCGM, IETR (France), Université de Picardie Jules Verne - MIS (France), Pôle Saint Hélier (France), CHU Rouen (France), Réseau Breizh PC (France), Ergovie (France), Pôle TES (France), University College of London - Aspire CREATE (UK), University of Kent (UK), East Kent Hospitals Univ NHS Found. Trust (UK), Health and Europe Centre (UK), Plymouth Hospitals NHS Trust (UK), Canterbury Christ Church University (UK), Kent Surrey Sussex Academic Health Science Network (UK), Cornwall Mobility Center (UK).

Inria contact: Valérie Gouranton

Abstract: This project aims to develop innovative assistive technologies in order to support the autonomy and to enhance the mobility of power wheelchair users with severe physical/cognitive disabilities. In particular, the objective is to design and evaluate a power wheelchair simulator as well as to design a multi-layer driving assistance system.

9.4. International Initiatives

9.4.1. Informal International Partners

- Dr. Takuji Narumi and Prof. Michitaka Hirose from University of Tokyo (Japan), on "Virtual Embodiment"
- Dr. Hannes Kaufmann from Technical University Wien (Austria), on "3D Navigation in Virtual Environments"
- Prof. Reinhold Scherer from Graz University (Austria), on "Brain-Computer Interfaces and Augmented Reality"
- Prof. Jose Millan from Ecole Polytechnique Fédérale de Lausanne (Switzerland), on "Brain-Computer Interfaces and Sports"

9.4.2. Participation in Other International Programs

9.4.2.1. ANR-FRQSC INTROSPECT

Participants: Valérie Gouranton [contact], Bruno Arnaldi, Ronan Gaugne, Flavien Lécuyer.

INTROSPECT is a 3-year project funded by French ANR and "Fonds de Recherche Société et Culture" (FRQSC) from Quebec region, Canada. This international collaboration involves researchers in computer science and archeology from France and Canada : Hybrid (Inria-IRISA), CReAAH, Inrap, company Image ET, University Laval and INRS-ETE. INTROSPECT aims to develop new uses and tools for archaeologists that facilitate access to knowledge through interactive numerical introspection methods that combine computed tomography with 3D visualization technologies, such as Virtual Reality, tangible interactions and 3D printing. The scientific core of the project is the systematization of the relationship between the artefact, the archaeological context, the digital object and the virtual reconstruction of the archaeological context that represents it and its tangible double resulting from the 3D printing. This axiomatization of its innovative methods makes it possible to enhance our research on our heritage and to make use of accessible digital means of dissemination. This approach changes from traditional methods and applies to specific archaeological problems. Several case studies will be studied in various archaeological contexts on both sides of the Atlantic. Quebec museums are also partners in the project to spread the results among the general public.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Nami Ogawa (University of Tokyo, Japan) visited Hybrid for a 5-month collaboration on "Avatars and Virtual Embodiment" started in January 2018.

ILDA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

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

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

8.1.2. Inria - Ministère de la Culture

Visual Exploration of Linked Data on BnF's data portal (2017-2018) Funded by the French Ministère de la Culture and Inria. **65Keuros**. Participants: Emmanuel Pietriga (PI), Caroline Appert, Hande Gözükan, Marie Destandau, Léo Colombaro.

The project explores novel ways of visually navigating the data exposed by the Bibliothèque Nationale de France as linked data on http://data.bnf.fr.

8.1.3. Inria Project Lab (IPL)

ILDA participates to Inria Project Lab iCODA : Data Journalism : knowledge-mediated Content and Data Interactive Analytics, that started in 2017. A key issue in data science is the design of algorithms that enable analysts to infer information and knowledge by exploring heterogeneous information sources, structured data, or unstructured content. With journalism data as a landmark use-case, iCODA aims to develop the scientific and technological foundation for collaborative, heterogeneous data analysis, guided by formalized, user-centric knowledge. The project relies on realistic scenarios in data-journalism to assess the contribution of the project to this area. iCODA is at the crossroads of several research areas (content analysis, data management, knowledge representation, visualization) and is part of a club of partners of the world of the press. Equipes-projets Inria : Graphik, Ilda, Linkmedia, Cedar. Press partners: Le Monde, OuestFrance, AFP. Participants: Anastasia Bezerianos (PI), Emmanuel Pietriga, Tong Xue, Nicole Barbosa Sultanum.

8.1.4. CNRS - PEPS

VizGest. (2018) Funded by CNRS. In collaboration with LIMSI. **17Keuros**. Participants: C. Appert (PI).

Interacting with multi-display environments often involves using mid-air gestures that do not require any proximity between users and displays. However, mid-air gestures are not *visible* to users. VizGest aims at giving some visibility to mid-air gestures by means of annotations put in the physical environment thanks to augmented reality glasses.

8.2. European Initiatives

8.2.1. Collaborations with Major European Organizations

Deutsches Elektronen-Synchrotron (DESY): Scientific collaboration on the design and implementation of user interfaces for array operations monitoring and control for the Cherenkov Telescope Array (CTA) project, to be built in the Canary Islands (Spain) and in the Atacama desert (Chile), 2 years, contract started May 2018

8.3. International Initiatives

8.3.1. Inria International Labs

Inria Chile. From 2012 to 2015, Emmanuel Pietriga was the scientific leader of the Massive Data team at Inria Chile, working on projects in collaboration with the ALMA radio-telescope and the Millenium Institute of Astrophysics. He is now scientific advisor to Inria Chile's visualization projects, and is actively involved in the collaboration between Inria Chile and the LSST on the design and development of user interfaces for operations monitoring and control (see below), and the project between ESO and Inria Chile about the design and implementation of user interfaces for ALMA's Integrated Alarm System.

8.3.2. Inria International Partners

Association of Universities for Research in Astronomy (AURA): contract, jointly with Inria Chile, on the design and implementation of user interfaces for telescope operations monitoring and control for the Large Synoptic Survey Telescope (LSST) project, under construction in the Atacama desert (Chile), started 2017. Participants: Emmanuel Pietriga (ILDA), José Galaz (Inria Chile), Sebastian Pereira (Inria Chile), Grazia Prato (Inria Chile).

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

- Nicole Barbosa Sultanum, Univ. Toronto, Canada, Oct 2018-Jan 2019.
- José Galaz, María Grazia Prato,Sebastian Pereira, Inria Chile, Dec 2018.

IMAGINE Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Performance Lab (January 2018 - June 2021)

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

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

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

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

9.2. National Initiatives

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

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

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

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

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

Participants: Frédéric Devernay, Sandra Nabil Mahrous Yacoub.

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

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

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

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

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

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

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

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

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

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

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

Participants: Rémi Ronfard, Stefanie Hahmann, Pierre Casati.

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

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

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

Participant: Thomas Buffet.

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

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

9.2.7. ANR ANATOMY2020 (November 2017 - October 2020)

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

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

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

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).

MANAO Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

9.1.1.1. "Young Researcher" VIDA (2017-2021)

LP2N-CNRS-IOGS Inria
Leader R. Pacanowski (LP2N-CNRS-IOGS)
Participant P. Barla (Inria)
This project aims at establishing a framework for direct and inverse design of material appearance for objects of complex shape. Since the manufacturing processes are always evolving, our goal is to establish a framework that is not tied to a fabrication stage.

9.1.1.2. "Young Researcher" RichShape (2014-2018)

MANAO
Leader G. Guennebaud
This project aims at the development of novel representations for the efficient rendering and manipulation of highly detailed shapes in a multi-resolution context.

9.1.1.3. ISAR (2014-2018)

POTIOC, MANAO, LIG-CNRS-UJF, Diotasoft
Leader M. Hachet (POTIOC)
The ISAR project focuses on the design, implementation and evaluation of new interaction paradigms for spatial augmented reality, and to systematically explore the design space.

9.1.1.4. MATERIALS (2015-2019)

MAVERICK, LP2N-CNRS (MANAO), Musée d'Ethnographie de Bordeaux, OCÉ-Print
Leader N. Holzschuch (MAVERICK)
Local Leader R. Pacanowski (LP2N-CNRS)
Museums are operating under conflicting constraints: they have to preserve the artifacts they are storing, while making them available to the public and to researchers. Cultural artifacts are so fragile that simply exposing them to light degrades them. 3D scanning, combined with virtual reality and 3D printing has been used for the preservation and study of sculptures. The approach is limited: it acquires the geometry and the color, but not complex material properties. Current 3D printers are also limited in the range of colors they can reproduce. Our goal in this project is to address the entire chain of material acquisition and restitution. Our idea is to scan complex cultural artifacts, such as silk cloths, capturing all the geometry of their materials at the microscopic level, then reproduce them for study by public and researchers. Reproduction can be either done through 2.5D printing or virtual reality displays.

9.1.1.5. FOLD-Dyn (2017-2021)

IRIT, IMAGINE, MANAO, TeamTo, Mercenaries
Leader L. Barthe (IRIT)
Local Leader G. Guennebaud (Inria)

The FOLD-Dyn project proposes the study of new theoretical approaches for the effective generation of virtual characters deformations, when they are animated. These deformations are two-folds: character skin deformations (skinning) and garment simulations. We propose to explore the possibilities offered by a novel theoretical way of addressing character deformations: the implicit skinning. This method jointly uses meshes and volumetric scalar functions. By improving the theoretical properties of scalar functions, the study of their joint use with meshes, and the introduction of a new approach and its formalism - called multi-layer 3D scalar functions - we aim at finding effective solutions allowing production studios to easily integrate in their pipeline plausible character deformations together with garment simulations.

9.1.1.6. CaLiTrOp (2017-2021)

IRIT, LIRIS, MANAO, MAVERICK
Leader: M. Paulin (IRIT)
Local Leader X. Granier (Inria)
What is the inherent dimensionality, topology and geometry of light-paths space? How can we leverage this information to improve lighting simulation algorithms? These are the questions that this project wants to answer from a comprehensive functional analysis of light transport operators, with respect to the 3D scene's geometry and the reflectance properties of the objects, but also, to link operators with screen-space visual effects, with respect to the resulting picture.

9.2. International Research Visitors

9.2.1. Visits of International Scientists

Masatake Sawayama, Research Scientist, NTT Communication Science Laboratories, Japan

MAVERICK Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

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

8.2. National Initiatives

8.2.1. ANR: Materials

Participants: Nicolas Holzschuch [contact], Romain Vergne.

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

8.2.2. CDP: Patrimalp 2.0

Participants: Nicolas Holzschuch [contact], Romain Vergne.

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

8.2.3. ANR: CaLiTrOp

Participant: Cyril Soler [contact].

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

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

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

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

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

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

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

8.4. International Research Visitors

8.4.1. Visits to International Teams

8.4.1.1. Research Stays Abroad

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

MFX Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Project LUE

- Funding type: Lorraine Université d'Excellence.
- Title: Passive and active 3D printed orthosis: modeling, simulation and applications.
- Project Coordinator: Sylvain Lefebvre

This project is funded by *Lorraine Université d'Excellence* for three years. It is a collaboration between IJL (Jean Lamour Institute), LORIA (Lorraine Research Laboratory in Computer Science and its Applications), LRGP (Reaction and Process Engineering Laboratory), ERPI (Research Laboratory on Innovation Process), IRR Nancy (Regional Institute for Physical and Rehabilitation Medicine) and Nancy CHU (University Hospital). The project considers the creation of flexible plates with controlled elasticity for use in medical applications (orthoses, insoles). It exemplifies our approach of doing focused collaborations around application domains of our research, to ensure that our techniques answer actual practical challenges and maximize the chances that they are deployed in the near future.

The project funds a PhD student, Thibault Tricard, who started in October 2018. Thibault is co-advised by Sylvain Lefebvre and Didier Rouxel (IJL).

8.1.2. Project PIC

- Funding type: Pacte Lorraine.
- Title: Innovative Polymers and Composites
- Project Coordinator: Sylvain Lefebvre

The project PIC (*Innovative Polymers and Composites*) is a regional project between Inria, IJL (Jean Lamour Institute – materials science), ECN (surgery school) and the company *Les Ateliers Cini*. This collaboration aimed for the creation of new high performance composite materials usable in 3D printing. It began in 2016 (within ALICE) and ended in 2018 (within MFX). The project funded an engineer, Noémie Vennin.

MFX contributed on algorithm aspects of the 3D printer control. PEEK is a material that needs a strict control of temperature: it is extruded at 400 degrees, and cooling plays an important role in the final mechanical properties. During the project, we first developed the software possibilities, adding novel features to enable a finer control over deposition and temperature management. These improvements were implemented in our IceSL software and included thermal shields (see Figure 10), novel support structures, novel infill patterns and the ability to control all print parameters within the object (*e.g.*, varying temperature in different parts). This lead to a significant increase in part quality and accuracy. We also worked on improving the 3D printer jointly with other partners, upgrading the thermal capabilities with a better heating plate (+40°C) and side mounted heating patches, with a safety and control sensor.

We are now able to produce parts in PEEK material, using IceSL for generating printer instructions. For instance, we manufactured parts used by the surgery school for training sessions.

Nevertheless, despite improvements in print quality, it remains the case that parts should be designed or modified to achieve best results with PEEK filament deposition. The high temperature gradients and thermal behavior of PEEK remain very challenging and constrain the geometries that can be reliably produced.

Figure 10. 3D printed vase in PEEK material. Left: Vase breaking during fabrication due to thermal stresses. Right: Adding a thermal shield (not shown) results in a correct 3D print.

8.1.3. Project Colored FDM

- Funding type: CPER and LORIA
- Title: Color fused filament deposition
- Project Coordinator: Sylvain Lefebvre

This project is funded both by the CPER Cyber-entreprise (axis *algorithms for novel materials*) and the LORIA laboratory. As part of the CPER, we work closely with the *Reaction and Process Engineering Laboratory* (LRGP) in Nancy on this topic.

8.1.4. Regional PhD Funding

- Funding type: Région Grand-Est.

We secured two half-PhD fundings from Région Grand-Est in 2018. The first is co-funding Semyon Efremov (PhD student) in the context of the ANR MuFFin. Semyon is co-advised by Jonàs Martínez and Sylvain Lefebvre, he joined the team in October 2018.

The second is co-funding Jimmy Etienne (PhD student), co-advised by Cédric Zanni and Sylvain Lefebvre. The other half-funding is provided by local support from the LORIA laboratory. Jimmy Etienne's topic focuses on curved printing for additive manufacturing, he started in September 2018.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. Project MuFFin (2018-2021)

- Funding type: ANR JCJC (ANR-17-CE10-0002).
- Title: Procedural and stochastic microstructures for functional fabrication
- Project Coordinator: Jonàs Martínez

MuFFin aims at contributing a unified pipeline for the efficient and scalable synthesis, visualization, and modeling of additively manufactured microstructures with tailored macroscopic physical behavior. In an interdisciplinary effort, MuFFin will blend together computer and material science perspectives to deliver an integrated approach that is both computationally and physically sound.

This year we hired Semyon Efremov as a PhD student, starting from October 2018. We have interdisciplinary collaborations with researchers in topology optimization (Perle Geoffroy-Donders and Grégoire Allaire at École Polytechnique), and material science in the context of aeronautics (Mohamed amin Ben Lassoued and Guilhem Michon at ISAE-SUPAREO, Annie Ross at Polytechnique Montréal).

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

In 2018 we had collaborations with TU Delft [11], continued collaborations with Connelly Barnes (Adobe) [17] and Li-Yi Wei (Adobe) [17], [10]. We have ongoing projects with Bernhard Thomaszewski (University of Montreal), Daniele Panozzo (NYU), Marc Alexa (TU-Berlin), Charlie C.L. Wang (TU-Delft), Sara McMains (University of California) and Brian Wyvill (University of Victoria).

8.4. Visits of International Scientists

Brian Wyvill, professor at the University of Victoria, is a pioneer in the field of computer graphics. He visited us on May 10-11, 2018 and gave a seminar to the department.

Jean-Baptiste Labrune, designer and researcher in 4D printing visited on November 29, 2018. We organized an open seminar within LORIA.

MIMETIC Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

- SATT "Ouest valorisation" grant for the maturation of the Kimea software and projet (Franck Multon and Pierre Plantard). 12 months of three full-time people 300KE. Creation of the start-up company planned beginning of 2018.
- SATT "Ouest valorisation" grant for the maturation of the Populate software (Fabrice Lamarche). One full-time engineer (2017-2018).

9.2. National Initiatives

9.2.1. ANR

9.2.1.1. ANR PRCE Cineviz

Participants: Marc Christie [contact], Quentin Galvane.

Cineviz is a 3-year ANR LabCom project (2016-2019). Amount: 300kE. Parnters: SolidAnim, UR1.

The project is a bilateral collaboration with the SolidAnim company. The objective is to jointly progress on the design and implementation of novel tools for the preproduction in the film industry. The project will address the challenges related to (i) proposing expressive framing tools, (ii) integrating the technical aspects of shooting (how to place the cameras, lights, green sets) directly at the design stage), and (iii) novel interaction metaphors for designing and controlling the staging of lights in preproduction, using an example-based approach.

9.2.1.2. ANR JCJC Per2

Participants: Ludovic Hoyet [contact], Benjamin Niay, Anne-Hélène Olivier, Antonio Mucherino, Richard Kulpa, Franck Multon.

Per2 is a 42 month ANR JCJC project (2018-2022) entitled *Perception-based Human Motion Personalisation* (Budget: 280kE; website: https://project.inria.fr/per2/)

The objective of this project is to focus on how viewers perceive motion variations to automatically produce natural motion personalisation accounting for inter-individual variations. In short, our goal is to automate the creation of motion variations to represent given individuals according to their own characteristics, and to produce natural variations that are perceived and identified as such by users. Challenges addressed in this project consist in (i) understanding and quantifying what makes motions of individuals perceptually different, (ii) synthesising motion variations based on these identified relevant perceptual features, according to given individual characteristics, and (iii) leveraging even further the synthesis of motion variations and to explore their creation for interactive large-scale scenarios where both performance and realism are critical.

This work was performed in collabration with Julien Pettré from Rainbow team.

9.2.1.3. ANR PRCI HoBis

Participants: Franck Multon [contact], Armel Crétual, Georges Dumont, Charles Pontonnier, Anthony Sorel.

Hobis is a 42 month ANR collaborative (PRCI) project (2018-2022) entitled *HoBiS (Hominin BipedalismS): Exploration of bipedal gaits in Hominins thanks to Specimen-Specific Functional Morphology*. HoBis is leaded by the Museum Nationale d'Histoires Naturelles (CNRS), with CNRS/LAAS, and Antwerpen University (Belgium), with a total of 541KE budget (140KE for MimeTIC).

HoBiS (Hominin BipedalismS) is a pluridisciplinary research project, fundamental in nature and centred on palaeoanthropological questions related to habitual bipedalism, one of the most striking features of the human lineage. Recent discoveries (up to 7 My) highlight an unexpected diversity of locomotor anatomies in Hominins that lead palaeoanthropologists to hypothesize that habitual bipedal locomotion took distinct shapes through our phylogenetic history. In early Hominins, this diversity could reveal a high degree of locomotor plasticity which favoured their evolutionary success in the changing environments of the late Miocene and Pliocene. Furthermore, one can hypothesize based on biomechanical theory that differences in gait characteristics, even slight, have impacted the energy balance of hominin species and thus their evolutionary success. However, given the fragmented nature of fossil specimens , previous morphometric and anatomo-functional approaches developed by biologists and palaeoanthropologists, do not allow the assessment of the biomechanical and energetic impacts of such subtle morphological differences, and the manners in which hominin species walked still remains unknown. To tackle this problem, HoBiS proposes as main objective a totally new specimen-specific approach in evolutionary anthropology named Specimen-Specific Functional Morphology: inferring plausible complete locomotor anatomies based on fossil remains, to link these reconstructed anatomies and corresponding musculoskeletal models (MSM) with plausible gaits using simulations. Both sub-objectives will make use of an extensive comparative anatomical and gait biomechanical data bases (challenges). To this end, we will integrate anatomical and functional studies, tools for anatomical modelling, optimization and simulation rooted in informatics, biomechanics, and robotics, to build an in-silico decision-support system (DSS). This DSS will provide biomechanical simulations and energetic estimations of the most plausible bipedal gaits for a variety of hominin species based on available remains, from partial to well-preserved specimens. To achieve this main objective, the project will address the following sub-objectives and challenges

MimeTIC is Leader of WP3 "Biomechanical simulation", aiming at predicting plausible bipedal locomotion based on paleoanthropological heuristics and a given MSM.

9.2.2. National scientific collaborations

9.2.2.1. Cavaletic

Participant: Franck Multon [contact].

The Cavaletic collaborative project is leaded by University Bretagne Sud and also involves University Rennes2 (CREAD Lab.). It has been funded by the National IFCE (Institut Français du Cheval et de l'Equitation) in order to develop and evaluate technological assistance in horse riding learning, thanks to a user-centered approach. MimeTIC is involved in measuring expert and non-expert horse riders' motions in standardized situations in order to develop metrics to measure riders' performance. It will be used to develop a technological system embedded on users to evaluate their performance and provide them with real-time feedback to correct potential errors.

The project ended in 2018 but we are submitting a proposal to SATT Ouest Valorisation in order to finish the development of the technological prototype, and to evaluate the possibility to patent the process, and transfer it to private companies.

9.2.2.2. French Federation of Tennis

Participants: Richard Kulpa [contact], Benoit Bideau, Pierre Touzard.

An exclusive contract has been signed between the M2S laboratory and the French Federation of Tennis for three years. The goal is to perform biomechanical analyses of 3D tennis serves on a population of 40 players of the Pôle France. The objective is to determine the link between injuries and biomechanical constraints on joints and muscles depending on the age and gender of the players. At the end, the goal is to evaluate their load training.

9.2.2.3. ADT: Immerstar 2020

Participants: Ronan Gaugne [contact], Georges Dumont.

The ADT-Immerstar 2020 is driven by the SED and aims at developing new tools and facilities for the scientific community in order to develop demos and use the two immersive rooms in Rennes: Immersia and Immermove. The engineer (Quentin Petit, SED) has the responsibility of homogenizing the software modules and development facilities in each platform, of installing new upgrades and of developping collaborative applications between the two sites.

9.2.2.4. PRE

Participants: Franck Multon [contact], Ludovic Hoyet, Antonio Mucherino.

The Inria PRE projet entitled "Smart sensors and novel motion representation breakthrough for human performance analysis" aims at designing a new description for human motion in order to automatically capture, measure and transfer the intrinsic constraints of human motion. Current approached consisted in manually editing the constraints associated with a motion, to use classical skeleton representation with joint angles based on direct or indirect measurements, and then perform inverse kinematics to fulfill these constraints. We aim at designing a new representation to simplify this process pipeline and make it automatic, together with relevant motion sensors that could provide enough information to automatically extract these intrinsic constraints. To this end, this project has been jointly proposed with the Inria CAIRN team, which develops sensors based on joint orientations and distances between sensors. We aim at extending this type of device to measure new types of information that would help to simplify the above mentionned pipeline. A postdoc Zhiguang Liu arrived in November 2016 to jointly work with CAIRN.

Our results show that shape transfer could be used to transfer a pose from a source character to a target character while maintaining the contextual meaning of the original pose, even if the two characters have different morphology. The main contribution is the definition of a new data structre, named "context graph", to model relative Laplacian coordinates of sub-sampled surfaces points, enabling us to capture the topological relations betwen surfaces of the body.

We have obtained a proof of concept presented in ACM Motion in Games 2018, and we are planning to submit an extended version of the paper to IEEE TVCG.

9.2.2.5. AUTOMA-PIED

Participants: Anne-Hélène Olivier [contact], Armel Crétual, Anthony Sorel.

The AUTOMA-PIED project is driven by IFSTTAR. Using a set-up in virtual reality, the first objective of the project aims at comparing pedestrian behaviour (young and older adults) when interacting with traditional or autonomous vehicles in a street crossing scenario. The second objective is to identify postural cues that can predict whether or not the pedestrian is about to cross the street.

9.2.2.6. IPL Avatar

Participants: Ludovic Hoyet [contact], Franck Multon.

This project, led by Ludovic Hoyet, aims at design avatars (i.e., the user's representation in virtual environments) that are better embodied, more interactive and more social, through improving all the pipeline related to avatars, from acquisition and simulation, to designing novel interaction paradigms and multi-sensory feedback. It involves 6 Inria teams (GraphDeco, Hybrid, Loki, MimeTIC, Morpheo, Potioc), Prof. Mel Slater (Uni. Barcelona), and 2 industrial partners (Technicolor and Faurecia).

Website: http://avatar.inria.fr

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

- Program: Joint Program Initiative
- Project Acronym: SCHEDAR
- Project title: Safeguarding the Cultural HEritage of Dance through Augmented Reality
- Duration: June 2018-June 2021

- Coordinator: University of Cyprus
- Other partners: Algolysis LTD (Cyprus), University of Warwick (UK), University of Reims Champagne Ardennes (France)
- Abstract: Dance is an integral part of any culture. Through its choreography and costumes dance imparts richness and uniqueness to that culture. Over the last decade, technological developments have been exploited to record, curate, remediate, provide access, preserve and protect tangible CH. However, intangible assets, such as dance, has largely been excluded from this previous work. Recent computing advances have enabled the accurate 3D digitization of human motion. Such systems provide a new means for capturing, preserving and subsequently re-creating ICH which goes far beyond traditional written or imaging approaches. However, 3D motion data is expensive to create and maintain, encompassed semantic information is difficult to extract and formulate, and current software tools to search and visualize this data are too complex for most end-users. SCHEDAR will provide novel solutions to the three key challenges of archiving, re-using and re-purposing, and ultimately disseminating ICH motion data. In addition, we will devise a comprehensive set of new guidelines, a framework and software tools for leveraging existing ICH motion databases. Data acquisition will be undertaken holistically; encompassing data related to the performance, the performer, the kind of the dance, the hidden/untold story, etc. Innovative use of state-of-the-art multisensory Augmented Reality technology will enable direct interaction with the dance, providing new experiences and training in traditional dance which is key to ensure this rich culture asset is preserved for future generations. MimeTIC is responsible for WP3 "Dance Data Enhancement".

9.4. International Initiatives

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

9.4.1.1. FORMOSA

Title: Fostering Research on Models for Storytelling Applications

International Partner (Institution - Laboratory - Researcher):

NCCU (Taiwan) - Intelligent Media Lab (IML) - Tsai-Yen Li

Start year: 2016

See also: http://www.irisa.fr/mimetic/GENS/mchristi/EA-FORMOSA/

Interactive Storytelling is a new media which allows users to alter the content and outcome of narratives through role-playing and specific actions. With the quality, the availability and reasonable costs of display technologies and 3D interaction devices on one side, and the accessibility of 3D content creation tools on the other, this media is taking a significant share in entertainment (as demonstrated by the success of cinematographic games such as Heavy Rain or Beyond: two souls). These advances push us to re-think the way narratives are traditionally structured, explore new interactive modalities and provide new interactive cinematographic experiences. As a sequel of the first associate team FORMOSA 1, we propose to address new challenges pertained to interactive storytelling such as the use of temporal structures in narratives, interaction modalities and their impact in terms of immersion, and the adaptation of cinematographic real data to 3D environments. To achieve these objectives, the associate team will rely on the complementary skills of its partners and on the co-supervision of students.

9.4.2. Inria International Partners

9.4.2.1. Informal International Partners

- Dr. Rachel McDonnell, Trinity College Dublin, Ireland (on-going collaboration with Ludovic Hoyet)
- Prof. Carol O Sullivan, Trinity College Dublin, Ireland (on-going collaboration with Ludovic Hoyet)

- Prof Michael Cinelli, University Wilfrid Laurier, Waterloo, Canada (on-going collaboration with Anne-Hélène Olivier)
- Prof. Hannes Kaufmann, TU Wien, Austria (on-going collaboration with Anne-Hélène Olivier)
- Prof. Hui Huang, Shenzhen University (on-going collaboration with Marc Christie)
- Prof. Baoquan Chen, Pekin University (on-going collaboration with Marc Christie)
- Dr. Bin Wang, Beijing Film Academy University (on-going collaboration with Marc Christie)

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Prof. Pascal Madeleine, Aalborg Univeristy, Denmark, 1 week stay in may 2018 for collaborations with Georges Dumont and Charles Pontonnier about physical and cognitive load in virtual environments.
- Michael Cinelli, Associate Professor, Kinesiology and Physical Education, Wilfrid Laurier University, Canada, June 2018

9.5.1.1. Internships

- Victoria Rapos, Wilfrid Laurier University, Canada (Master supervisor: Michael Cinelli), 3 month internship from May to July 2018 with A.H. Olivier and A. Crétual about collision avoidance strategies in kids.
- Natalie Snyder, Wilfrid Laurier University, Canada (Master supervisor: Michael Cinelli), 3 month internship from May to July 2018 with A.H. Olivier and A. Crétual about collision avoidance strategies in previously concussed athletes.
- Ching Yu Kang, NCCU from July to September 2018 with Marc Christie on Virtual Staging techniques
- Wan Yu Lee, NCCU from July to September 2018 with Marc Christie on Drone Cinematography

POTIOC Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

HOBIT:

Funding: Aquitaine Science Transfer

Duration: 2018

Local coordinator: Martin Hachet

Partners: Université de Bordeaux

We are currently moving our platform HOBIT from his lab state to a commercial product.

Erlen:

Funding: Université de Bordeaux - Hacketafac program

Duration: 2018-2019

Local coordinator: Pierre-Antoine Cinquin

We won a grant from Université de Bordeaux to explore awareness of power consumption by way of tangible and ambient interfaces.

Neuroperf:

Funding: Idex Université Bordeaux

Duration: 2017-2019

Coordinator: Jean-Arthur Micoulaud Franci

Local coordinator: Fabien Lotte

Partners: SANPSY - Potioc

This project aims at studying EEG-based Neurofeedback to reduce fatigue symptoms in sleep-deprived individuals. See http://brain.labex.u-bordeaux.fr/Actualites/Selection-projets-recherche-Clinique-2017-i5064.html

9.2. National Initiatives

eTAC: Tangible and Augmented Interfaces for Collaborative Learning:

Funding: EFRAN

Duration: 2017-2021

Coordinator: Université de Lorraine

Local coordinator: Martin Hachet

Partners: Université de Lorraine, Inria, ESPE, Canopé, OpenEdge,

the e-TAC project proposes to investigate the potential of technologies ”beyond the mouse” in order to promote collaborative learning in a school context. In particular, we will explore augmented reality and tangible interfaces, which supports active learning and favors social interaction.

ANR Rebel:

Duration: 2016-2019

Coordinator: Fabien Lotte

Funding: ANR Jeune Chercheur Jeune Chercheuse Project

Partners: Disabilities and Nervous Systems Laboratory Bordeaux

Brain-Computer Interfaces (BCI) are communication systems that enable their users to send commands to computers through brain activity only. While BCI are very promising for assistive technologies or human-computer interaction (HCI), they are barely used outside laboratories, due to a poor reliability. Designing a BCI requires 1) its user to learn to produce distinct brain activity patterns and 2) the machine to recognize these patterns using signal processing. Most research efforts focused on signal processing. However, BCI user training is as essential but is only scarcely studied and based on heuristics that do not satisfy human learning principles. Thus, currently poor BCI reliability is probably due to suboptimal user training. Thus, we propose to create a new generation of BCI that apply human learning principles in their design to ensure the users can learn high quality control skills, hence making BCI reliable. This could change HCI as BCI have promised but failed to do so far.

Inria Project Lab BCI-LIFT:

Duration: 2015-2018

Partners: Inria team Athena (Inria Sophia-Antipolis), Inria team Hybrid (Inria Rennes), Inria team Neurosys (Inria Nancy), LITIS (Université de Rouen), Inria team DEMAR (Inria Sophia-Antipolis), Inria team MINT (Inria Lille), DyCOG (INSERM Lyon)

Coordinator: Maureen Clerc (Inria Sophia Antipolis)

Local coordinator: Fabien Lotte

The aim is to reach a next generation of non-invasive Brain-Computer Interfaces (BCI), more specifically BCI that are easier to appropriate, more efficient, and suit a larger number of people. With this concern of usability as our driving objective, we will build non-invasive systems that benefit from advanced signal processing and machine learning methods, from smart interface design, and where the user immediately receives supportive feedback. What drives this project is the concern that a substantial proportion of human participants is currently categorized "BCI-illiterate" because of their apparent inability to communicate through BCI. Through this project we aim at making it easier for people to learn to use the BCI, by implementing appropriate machine learning methods and developping user training scenarios.

website: http://bci-lift.inria.fr/

Inria Project Lab AVATAR:

Duration: 2018-2022

Partners: Inria project-teams: GraphDeco, Hybrid, Loki, MimeTIC, Morpheo

Coordinator: Ludovic Hoyet (Inria Rennes)

Local coordinator: Martin Hachet

This project aims at designing avatars (i.e., the user's representation in virtual environments) that are better embodied, more interactive and more social, through improving all the pipeline related to avatars, from acquisition and simulation, to designing novel interaction paradigms and multi-sensory feedback.

website: https://avatar.inria.fr

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

BrainConquest:

Program: ERC Starting Grant

Project title: BrainConquest - Boosting Brain-Computer Communication with High Quality User Training

Duration: 2017-2022

Coordinator: Fabien Lotte

Abstract: Brain-Computer Interfaces (BCIs) are communication systems that enable users to send commands to computers through brain signals only, by measuring and processing these signals. Making computer control possible without any physical activity, BCIs have promised to revolutionize many application areas, notably assistive technologies, e.g., for wheelchair control, and man-machine interaction. Despite this promising potential, BCIs are still barely used outside laboratories, due to their current poor reliability. For instance, BCIs only using two imagined hand movements as mental commands decode, on average, less than 80% of these commands correctly, while 10 to 30% of users cannot control a BCI at all. A BCI should be considered a co-adaptive communication system: its users learn to encode commands in their brain signals (with mental imagery) that the machine learns to decode using signal processing. Most research efforts so far have been dedicated to decoding the commands. However, BCI control is a skill that users have to learn too. Unfortunately how BCI users learn to encode the commands is essential but is barely studied, i.e., fundamental knowledge about how users learn BCI control is lacking. Moreover standard training approaches are only based on heuristics, without satisfying human learning principles. Thus, poor BCI reliability is probably largely due to highly suboptimal user training. In order to obtain a truly reliable BCI we need to completely redefine user training approaches. To do so, I propose to study and statistically model how users learn to encode BCI commands. Then, based on human learning principles and this model, I propose to create a new generation of BCIs which ensure that users learn how to successfully encode commands with high signal-to-noise ratio in their brain signals, hence making BCIs dramatically more reliable. Such a reliable BCI could positively change man-machine interaction as BCIs have promised but failed to do so far.

9.3.2. Collaborations in European Programs, Except FP7 & H2020

VISTE:

Program: Erasmus + Key Action 2: Cooperation for Innovation and Exchange of Good Practices

Project title: VISTE: Empowering spatial thinking of students with visual impairment

Duration: 01/09/2016 - 31/08/2019

Coordinator: Professor Marinos Kavouras (Vice-Rector, National Technical University of Athens and VISTE Project Leader)

Partners: National Technical University of Athens, Inria, Intrasoft International S.A., Casa Corpului Didactic Cluj, Eidiko Dimotiko Sxolio Tiflon Kallitheas, Liceul Special pentru Deficienti de Vedere Cluj-Napoca. External collaborators : IRSA, RealityTech

Abstract: Six partners from four European countries are working together to develop strategies, educational components and an ICT toolkit towards effective spatial thinking of students with VI, facilitating inclusion. The competence of spatial thinking, usage and interpretation of maps or other spatial tools is not self-evident for all; it is a dexterity which must be cultivated. For students experiencing disabilities, such as visual impairment (VI), spatial thinking proves to be an imperative skill for perceiving the world far beyond their immediate experience. Learning functional ways to utilize spatial experiences as an entirety and realize the relationships between objects in space and themselves is vital. Maps and other spatial representations are a splendid source of information for

portraying space and environment. By using tactile maps and innovative ICT technologies, children may deploy their spatial notion more effectively compared to proximate orientation experiences in accordance with verbal directions. Providing thus a concrete set of such tools would empower specific spatial thinking skills not only of those with VI but of all students. VISTE aims at empowering the spatial thinking skills of students with VI. This will be accomplished by providing an innovative methodological framework and a semantic and technical infrastructure for developing appropriate inclusive educational modules to foster spatial thinking. The project's main target groups are primary/secondary education students, as well as teachers, teachers' trainers, and staff involved in their education.

RSVP-BCI:

Program: DGA-DSTL Project
Project title: Assessing and Optimising Human-Machine Symbiosis through Neural signals for Big Data Analytics
Duration: 2014-2018
Coordinator: Damien Coyle and Fabien Lotte
Partners: Ulster University, UK, Potioc, France
Abstract: This project objective is to design new tools for Big Data analysis, and in particular visual analytics tools that tap onto human cognitive skills as well as on Brain-Computer Interfaces. The goal is to enable the user to identify and select relevant information much faster than what can be achieved by using automatic tools or traditional human-computer interfaces. More specifically, this project will aim at identifying in a passive way various mental states (e.g., different kinds of attention, mental workload, relevant stimulus perception, etc.) in order to optimize the display, the arrangement of the selection of relevant information.

9.3.3. Collaborations with Major European Organizations

Partner 1: Univ. Freiburg (Germany)
EEG signal processing and decoding using robust methods
Partner 2: TU Berlin (Germany)
EEG data generation and simulation

9.4. International Initiatives

9.4.1. Inria International Partners

9.4.1.1. Informal International Partners

Partner: RIKEN Brain Science Institute, Japan
Topic: BCI, Neurofeedback and EEG signal decoding

9.4.2. Participation in Other International Programs

Partner: University of Waterloo, Canada
Program: Idex Bordeaux collaboration grant
Duration: 2018
Coordinators: Edith Law (Canada), Pierre-Yves Oudeyer (France)
Topic: Curiosity

9.5. International Research Visitors

9.5.1. Visits of International Scientists

9.5.1.1. Internships

- Marie Gonzales, Universidad Chile
- Mehdi Bugallo, University of Minho, Portugal
- Satyam Kumar, IIT Kanpur, India

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

- RIKEN Brain Science Institute, Japan (Fabien Lotte)

TITANE Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

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

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

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

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

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

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

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

Participants: Nicolas Girard, Yuliya Tarabalka [PI].

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

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

Participants: Lionel Matteo, Yuliya Tarabalka.

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

9.1.1.5. BIOM: Building Indoor and Outdoor Modeling

Participants: Muxingzi Li, Pierre Alliez, Florent Lafarge.

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

9.2. European Initiatives

9.2.1. FP7 & H2020 Projects

9.2.1.1. TITANIUM - Software Components for Robust Geometry Processing

ERC Proof of concept grant TITANIUM "Software Components for Robust Geometry Processing" (2017-2018), total 150 KE. Principal investigator: Pierre Alliez. Partner: Inria Spin-off Geometry Factory. Participants: Florent Lafarge, Dmitry Anisimov, Simon Giraudot and Andreas Fabri. We developed a software demonstrator for geometry processing and 3D urban modeling, in order to facilitate the pre-commercialization of novel software components for the CGAL Library. The outcome of TITANIUM is a versatile method for semantic classification of 3D point clouds and for semantic-aware reconstruction of urban scenes (in preparation).

9.3. International Initiatives

9.3.1. Inria International Partners

9.3.1.1. Declared Inria International Partners

We collaborated with Mathieu Desbrun from Caltech, David Bommes from Bern University (Switzerland), Gianmarco Cherchi and Riccardo Scateni from University of Cagliary (Sardinia).

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Mathieu Desbrun, Professor at Caltech, visited us from September to mid November.
- Michael Hemmer, research engineer at Google, visited us in December.
- Jorg Peters, Professor at University of Florida, visited us in October.

9.4.1.1. Internships

- Tong Zhao (Ecole des ponts ParisTech): geometric descriptors and robust principal component analysis. In collaboration with Mathieu Desbrun from Caltech.
- Vasudha Varadarajan (Birla Institute of Technology and Science, India): shape reconstruction using binary programming.
- Andrew Khalel (Cairo University, Egypt): Multi-task deep learning for simultaneous satellite image segmentation and pan-sharpening. In collaboration with Guillaume Charpiat.
- Andrii Zhygallo (TUM, Germany): Using deep learning for change detection from remote sensing images.

ALMAnaCH Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- **ANR SoSweet** (2015-2019, PI J.-P. Magué, resp. ALMAnaCH: DS; Other partners: ICAR [ENS Lyon, CRNS], Dante [Inria]). Topic: studying sociolinguistic variability on Twitter, comparing linguistic and graph-based views on tweets
- **ANR ParSiTi** (2016-2021, PI Djamé Seddah, Other partners: LIMSI, LIPN). Topic: context-aware parsing and machine translation of user-generated content
- **ANR PARSE-ME** (2015-2020, PI. Matthieu Constant, resp. Marie Candito [ALPAGE, then LLF], ALMAnaCH members are associated with Paris-Diderot's LLF for this project). Topic: multi-word expressions in parsing
- **ANR Profiterole** (2016-2020, PI Sophie Prévost [LATTICE], resp. Benoit Crabbé [ALPAGE, then LLF], ALMAnaCH members are associated with Paris-Diderot's LLF for this project). Topic: modelling and analysis of Medieval French
- **ANR TIME-US** (2016-2019, PI Manuela Martini [LARHRA], ALMAnaCH members are associated with Paris-Diderot's CEDREF for this project). Topic: Digital study of remuneration and time budget textile trades in XVIIIth and XIXth century France
- **ANR BASNUM** (2018-2021, PI Geoffrey Williams [Université Grenoble Alpes], resp. ALMAnaCH: LR). Topic: Digitalisation and computational linguistic study of Basnage de Beauval's *Dictionnaire universel* published in 1701.

8.1.2. Competitivity Clusters

- **LabEx EFL** (2010-2019, PI Christian Puech [HTL, Paris 3], Sorbonne Paris Cité). Topic: empirical foundations of linguistics, including computational linguistics and natural language processing. ALPAGE was one of the partner teams of this LabEx, which gathers a dozen of teams within and around Paris whose research interests include one aspects of linguistics or more. BS serves as deputy head (and former head) of one of the scientific strands of the LabEx, namely strand 6 dedicated to language resources. BS and DS are in charge of a number of scientific "operations" within strands 6, 5 ("computational semantic analysis") and 2 ("experimental grammar"). BS, EVdLC and DS are now individual members of the LabEx EFL since 1st January 2017, and BS still serves as the deputy head of strand 6. Main collaborations are on language resource development (strands 5 and 6), syntactic and semantic parsing (strand 5, especially with LIPN [CNRS and U.Paris 13]) and computational morphology (strands 2 and 6, especially with CRLAO [CNRS and Inalco]).

8.1.3. Other National Initiatives

- **LECTAUREP project** (2017-2018): An explorative study has been launched in collaboration with the National Archives in France, in the context of the framework agreement between Inria and the Ministry of Culture, to explore the possibility of extracting various components from digitized 19th Century notary registers.
- **Nénufar (DGLFLF - Délégation générale à la langue française et aux langues de France)**: The projects is intended to digitize and exploit the early editions (beginning of the 20th Century) of the Petit Larousse dictionary. ALMAnaCH is involve to contribute to the automatic extraction of the dictionary content by means of GROBID-Dictionaries and define a TEI compliant interchange format for all results.

- **PIA Opaline**: The objective of the project is to provide a better access to published French literature and reference material for visually impaired persons. Financed by the Programme d'Investissement d'Avenir, it will integrate technologies related to document analysis and re-publishing, textual content enrichment and dedicated presentational interfaces. Inria participate to deploy the GROBID tool suite for the automatic structuring of content from books available as plain PDF files.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

- **H2020 Parthenos** (2015-2019, PI Franco Niccolucci [University of Florence]; LR is a work package coordinator) Topic: strengthening the cohesion of research in the broad sector of Linguistic Studies, Humanities, Cultural Heritage, History, Archaeology and related fields through a thematic cluster of European Research Infrastructures, integrating initiatives, e-infrastructures and other world-class infrastructures, and building bridges between different, although tightly interrelated, fields.
- **H2020 EHRI** "European Holocaust Research Infrastructure" (2015-2019, PI Conny Kristel [NIOD-KNAW, NL]; LR is task leader) Topic: transform archival research on the Holocaust, by providing methods and tools to integrate and provide access to a wide variety of archival content.
- **H2020 Iperion CH** (2015-2019, PI Luca Pezzati [CNR, IT], LR is task leader) Topic: coordinating infrastructural activities in the cultural heritage domain.
- **H2020 HIRMEOS**: HIRMEOS objective is to improve five important publishing platforms for the open access monographs in the humanities and enhance their technical capacities and services and rendering technologies, while making their content interoperable. Inria is responsable for improving integrating the entity-fishing component deplyed as an infrastructural service for the five platforms.
- **H2020 DESIR**: The DESIR project aims at contributing to the sustainability of the DARIAH infrastructure along all its dimensions: dissemination, growth, technology, robustness, trust and education. Inria is responsable for providing of a portfolio of text analytics services based on GROBID and entity-fishing.

8.2.2. Collaborations in European Programs, Except FP7 & H2020

- **ERIC DARIAH "Digital Research Infrastructure for the Arts and Humanities"** (set up as a consortium of states, 2014-2034; LR served president of the board of director until August 2018) Topic: coordinating Digital Humanities infrastructure activities in Europe (17 partners, 5 associated partners).
- **COST enCollect** (2017-2020, PI Lionel Nicolas [European Academy of Bozen/Bolzano]) Topic: combining language learning and crowdsourcing for developing language teaching materials and more generic language resources for NLP

8.2.3. Collaborations with Major European Organizations

Collaborations with institutions not cited above (for the SPMRL initiative, see below):

- Universität Zürich, Switzerland (Géraldine Walther) [computational morphology, lexicons]
- Berlin-Brandenburgische Akademie der Wissenschaften [Berlin-Brandenburg Academy of Sciences and Humanities], Berlin, Germany (Alexander Geyken) [lexicology]
- Österreichische Akademie der Wissenschaften [Austrian Academy of Sciences], Vienna, Austria (Karlheinz Moerth) [lexicology]
- University of Cambridge, United Kingdom (Ekaterina Kochmar) [text simplification]
- Univerza v Ljubljani [University of Ljubljana], Ljubljana, Slovenia (Darja Fišer) [wordnet development]

8.3. International Initiatives

8.3.1. Participation in International Programs

PHC Maimonide (2018-2019, PI Djamé Seddah, co-PI Yoav Goldberg (Bar Ilan University)). Topics: Building NLP resources for analyzing reactions to major events in Hebrew and French social media.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Dr. Ekaterina Kochmar (University of Cambridge), 3 days in June
- Dr. Teresa Lynn (Dublin City University), 2 stays of 1 week each.

COML Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Collaboration with the Willow Team:

- co-advising with J. Sivic and I. Laptev of a PhD student: Ronan Riochet.
- construction of a naive physics benchmark (www.intphys.com)

8.2. National Initiatives

8.2.1. ANR

- Transatlantic Platform "Digging into Data". Title: "Analysis of Children's Language Experiences Around the World. (ACLEW)"; (coordinating PI : M. Soderstrom; Leader of tools development and co-PI : E. Dupoux), (2017–2020. 5 countries; Total budget: 1.4M€)

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

- Johns Hopkins University, Baltimore, USA: S. Kudanpur, H. Hermanksy
- RIKEN Institute, Tokyo, Japan: R. Mazuka

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Internship of Diego Andai Castilla (partnership Inria-PUC-Inria Chile)

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

- E. Dupoux Visiting Researcher at Facebook AI Research, Paris (Feb-Mar 2018)
- E. Dupoux Visiting Researcher at Google & DeepMind, London (April-July 2018)

MULTISPEECH Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. CPER LCHN

Project acronym: CPER LCHN

Project title: CPER “Langues, Connaissances et Humanités Numériques”

Duration: 2015-2020

Coordinator: Bruno Guillaume (LORIA) & Alain Polguère (ATILF)

Participants: Dominique Fohr, Denis Jouvet, Odile Mella, Yves Laprie

Abstract: The main goal of the project is related to experimental platforms for supporting research activities in the domain of languages, knowledge and numeric humanities engineering.

MULTISPEECH contributes to automatic speech recognition, speech-text alignment and prosody aspects.

9.1.2. CPER IT2MP

Project acronym: CPER IT2MP

Project title: CPER “Innovation Technologique Modélisation et Médecine Personalisée”

Duration: 2015-2020

Coordinator: Faiez Zannad (Inserm-CHU-UL)

Participants: Romain Serizel, Emmanuel Vincent

Abstract: The goal of the project is to develop innovative technologies for health, and tools and strategies for personalized medicine.

MULTISPEECH will investigate acoustic monitoring using an array of microphones.

9.1.3. Dynalips

Project title: Control of the movements of the lips in the context of facial animation for an intelligible lipsync.

Duration: February 2017 - August 2018

Coordinator: Slim Ouni

Participants: Valerian Girard, Slim Ouni

Funding: SATT

Abstract: We proposed in this project the development of tools of lipsync which, from recorded speech, provide realistic mechanisms of animating the lips. These tools are meant to be integrated into existing 3D animation software and existing game engines. One objective was that these lipsync tools fit easily into the production pipeline in the field of 3D animation and video games. The goal of this maturation was to propose a product ready to be exploited in the industry whether by the creation of a start-up or by the distribution of licenses.

A first prototype of the lipsync system has been developed for French. From audio and text, the system allows animating a 3D model of the face (an avatar) realistically. This work has been presented at Annecy International Animation Film Festival.

9.2. National Initiatives

9.2.1. ANR DYCI2

Project acronym: DYCI2 (http://repmus.ircam.fr/dyci2/)

Project title: Creative Dynamics of Improvised Interaction

Duration: March 2015 - February 2018

Coordinator: Ircam (Paris)

Other partners: Inria (Nancy), University of La Rochelle

Participants: Ken Déguernel, Nathan Libermann, Emmanuel Vincent

Abstract: The goal of this project was to design a music improvisation system able to listen to the other musicians, to improvise in their style, and to modify its improvisation according to their feedback in real time.

MULTISPEECH was responsible for designing a system able to improvise on multiple musical dimensions (melody, harmony) across multiple time scales.

9.2.2. ANR ArtSpeech

Project acronym: ArtSpeech

Project title: Synthèse articulatoire phonétique

Duration: October 2015 - March 2019

Coordinator: Yves Laprie

Other partners: Gipsa-Lab (Grenoble), IADI (Nancy), LPP (Paris)

Participants: Ioannis Douros, Yves Laprie, Anastasiia Tsukanova

Abstract: The objective is to synthesize speech from text via the numerical simulation of the human speech production processes, i.e. the articulatory, aerodynamic and acoustic aspects. Corpus based approaches have taken a hegemonic place in text to speech synthesis. They exploit very good acoustic quality speech databases while covering a high number of expressions and of phonetic contexts. This is sufficient to produce intelligible speech. However, these approaches face almost insurmountable obstacles as soon as parameters intimately related to the physical process of speech production have to be modified. On the contrary, an approach which rests on the simulation of the physical speech production process makes explicitly use of source parameters, anatomy and geometry of the vocal tract, and of a temporal supervision strategy. It thus offers direct control on the nature of the synthetic speech.

Static MRI acquisition of vowels (images plus acoustic signal) have been carried out this year and their exploitation started to explore the impact of the articulatory modeling and the plane wave assumption. Manual delineations of approximately 1000 images have been done and used to generate speech signals with articulatory copy synthesis.

9.2.3. ANR JCJC KAMoulox

Project acronym: KAMoulox

Project title: Kernel additive modelling for the unmixing of large audio archives

Duration: January 2016 - September 2019

Coordinator: Antoine Liutkus (Inria Zenith)

Participants: Mathieu Fontaine, Antoine Liutkus

Abstract: The objective is to develop the theoretical and applied tools required to embed audio denoising and separation tools in web-based audio archives. The applicative scenario is to deal with large audio archives, and more precisely with the notorious “Archives du CNRS — Musée de l’homme”, gathering about 50,000 recordings dating back to the early 1900s.

9.2.4. PIA2 ISITE LUE

Project acronym: ISITE LUE

Project title: Lorraine Université d'Excellence

Duration: starting in 2016

Coordinator: Univ. Lorraine

Participants: Ioannis Douros, Yves Laprie

Abstract: The initiative aims at developing and densifying the initial perimeter of excellence, within the scope of the social and economic challenges, so as to build an original model for a leading global engineering university, with a strong emphasis on technological research and education through research. For this, we have designed LUE as an "engine" for the development of excellence, by stimulating an original dialogue between knowledge fields.

MULTISPEECH is mainly concerned with challenge number 6: "Knowledge engineering", i.e., engineering applied to the field of knowledge and language, which represent our immaterial wealth while being a critical factor for the consistency of future choices. This project funds the PhD thesis of Ioannis Douros.

9.2.5. E-FRAN METAL

Project acronym: E-FRAN METAL

Project title: Modèles Et Traces au service de l'Apprentissage des Langues

Duration: October 2016 - September 2020

Coordinator: Anne Boyer (LORIA)

Other partners: Interpsy, LISEC, ESPE de Lorraine, D@NTE (Univ. Versailles Saint Quentin), Sailendra SAS, ITOP Education, Rectorat.

Participants: Theo Biasutto-Lervat, Anne Bonneau, Vincent Colotte, Dominique Fohr, Denis Jouvet, Odile Mella, Slim Ouni, Anne-Laure Piat-Marchand, Elodie Gauthier, Thomas Girod

Abstract: METAL aims at improving the learning of languages (both written and oral components) through the development of new tools and the analysis of numeric traces associated with students' learning, in order to adapt to the needs and rythm of each learner.

MULTISPEECH is concerned by oral language learning aspects.

9.2.6. ANR VOCADOM

Project acronym: VOCADOM (http://vocadom.imag.fr/)

Project title: Robust voice command adapted to the user and to the context for ambient assisted living

Duration: January 2017 - December 2020

Coordinator: CNRS - LIG (Grenoble)

Other partners: Inria (Nancy), Univ. Lyon 2 - GREPS, THEORIS (Paris)

Participants: Dominique Fohr, Md Sahidullah, Sunit Sivasankaran, Emmanuel Vincent

Abstract: The goal of this project is to design a robust voice control system for smart home applications.

MULTISPEECH is responsible for wake-up word detection, overlapping speech separation, and speaker recognition.

9.2.7. ANR JCJC DiSCogs

Project acronym: DiSCogs

Project title: Distant speech communication with heterogeneous unconstrained microphone arrays

Duration: September 2018 – March 2022

Coordinator: Romain Serizel

Participants: Nicolas Furnon, Irina Illina, Romain Serizel, Emmanuel Vincent

Collaborators: Télécom ParisTech, 7sensing

Abstract: The objective is to solve fundamental sound processing issues in order to exploit the many devices equipped with microphones that populate our everyday life. The solution proposed is to apply machine learning methods based on deep learning to recast the problem of synchronizing devices at the signal level as a multi-view learning problem aiming at extracting complementary information from the devices at hand.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. COMPRISE

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 Magnet, Ascora GmbH, Netfective Technology SA, Rooter Analysis SL, Tilde SIA, University of Saarland

Participants: Irina Illina, Denis Jouvet, Emmanuel Vincent

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. AMIS

Program: CHIST-ERA

Project acronym: AMIS

Project title: Access Multilingual Information opinionS

Duration: Dec 2015- Nov 2018

Coordinator: Kamel Smaïli (LORIA)

Other partners: University of Avignon, University of Science and Technology Krakow, University of DEUSTO (Bilbao)

Participants: Dominique Fohr, Denis Jouvet, Odile Mella

Abstract: The idea of the project is to develop a multilingual help system of understanding without any human being intervention. This should help people understanding broadcasting news, presented in a foreign language and to compare it to a corresponding one available in the mother tongue of the user.

MULTISPEECH contributions concern mainly the speech recognition in French, English and Arabic videos.

9.4. International Initiatives

9.4.1. Inria International Partners

9.4.1.1. Informal International Partners

Jon Barker: University of Sheffield (UK)

Robust speech recognition [19]

Tomi Kinnunen: University of Eastern Finland (Finland)

Speaker verification and spoofing countermeasures for voice biometrics [47], [24], [32], [26], [41], [67]

Nicholas Evans: EURECOM (France)

Spoofing countermeasures for voice biometrics [47], [24], [32]

Hamid Eghbal-Zadeh: Johannes Kepler University (Austria)

Audio event detection [40]

Shinji Watanabe, Johns Hopkins University (USA)

Robust speech recognition [19]

Junichi Yamagishi, National Institute of Informatics (Japan)

Spoofing countermeasures for voice biometrics [47], [24], [32], [26]

PANAMA Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. Labex Comin Labs projects

ComInLabs is a Laboratoire d'Excellence funded by the PIA (Programme Investissements d'Avenir) in the broad area of telecommunications.

9.1.1.1. HEMISFER

Participant: Rémi Gribonval.

Acronym: HYBRID (Hybrid Eeg-MrI and Simultaneous neuro-feedback for brain Rehabilitation)

http://hemisfer.cominlabs.u-bretagneloire.fr/

Research axis: 3.1

CominLabs partners : VISAGES, HYBRID and PANAMA Inria project-teams;

External partners : EA 4712 team from University of Rennes I; ATHENA Inria project-team, Sophia-Antipolis;

Coordinator: Christian Barillot, VISAGES Inria project-team

Description: The goal of HEMISFER is to make full use of neurofeedback paradigm in the context of rehabilitation and psychiatric disorders. The major breakthrough will come from the use of a coupling model associating functional and metabolic information from Magnetic Resonance Imaging (fMRI) to Electro-encephalography (EEG) to "enhance" the neurofeedback protocol. We propose to combine advanced instrumental devices (Hybrid EEG and MRI platforms), with new man-machine interface paradigms (Brain computer interface and serious gaming) and new computational models (source separation, sparse representations and machine learning) to provide novel therapeutic and neuro-rehabilitation paradigms in some of the major neurological and psychiatric disorders of the developmental and the aging brain (stroke, attention-deficit disorder, language disorders, treatment-resistant mood disorders, ...).

Contribution of PANAMA: PANAMA, in close cooperation with the VISAGES team, contributes to a coupling model between EEG and fMRI considered as a joint inverse problem addressed with sparse regularization. By combining both modalities, one expects to achieve a good reconstruction both in time and space. This new imaging technique will then be used for improving neurofeedback paradigms in the context of rehabilitation and psychiatric disorders, which is the final purpose of the HEMISFER project.

9.1.1.2. TEPN

Participant: Rémi Gribonval.

Acronym: TEPN (Toward Energy Proportional Networks)

http://tepn.cominlabs.u-bretagneloire.fr/

Research axis: 3.1

CominLabs partners : IRISA OCIF - Telecom Bretagne; IETR SCN; IETR SCEE; PANAMA Inria project-team

Coordinator: Nicolas Montavont, IRISA OCIF - Telecom Bretagne

Description: As in almost all areas of engineering in the past several decades, the design of computer and network systems has been aimed at delivering maximal performance without regarding to the energy efficiency or the percentage of resource utilization. The only places where this tendency was questioned were battery-operated devices (such as laptops and smartphones) for which the users accept limited (but reasonable) performance in exchange for longer use periods. Even though the end users make such decisions on a daily basis by checking their own devices, they have no way of minimizing their energy footprint (or conversely, optimize the network resource usage) in the supporting infrastructure. Thus, the current way of dimensioning and operating the infrastructure supporting the user services, such as cellular networks and data centers, is to dimension for peak usage. The problem with this approach is that usage is rarely at its peak. The overprovisioned systems are also aimed at delivering maximal performance, with energy efficiency being considered as something desired, but non-essential. This project aims at making the network energy consumption proportional to the actual charge of this network (in terms of number of served users, or requested bandwidth). An energy proportional network can be designed by taking intelligent decisions (based on various constraints and metrics) into the network such as switching on and off network components in order to adapt the energy consumption to the user needs. This concept can be summarized under the general term of Green Cognitive Network Approach.

Contribution of PANAMA: PANAMA, in close cooperation with the SCEE team at IETR (thesis of Marwa Chafii, 2016), focuses on the design of new waveforms for multi carrier systems with reduced Peak to Average Power Ratio (PAPR).

9.1.2. ANR INVATE project with IRT b-com, Rennes

Participants: Rémi Gribonval, Nancy Bertin, Mohammed Hafsati.

Thesis on 3D audio scene decomposition for interactive navigation

Duration: 3 years (2016-2019)

Research axis: 3.2.2

Partners: IRT b<>com; Inria-Rennes; IRISA

Funding: ANR INVATE project (PIA)

The objective of this thesis is to develop tools to analyze audio scenes in order to identify, locate, and extract the sources present in the scene to re-spatialize them according to the user head orientation and the movement of the user in the targeted virtual scene.

9.1.3. ANR OATMIL project

Participants: Rémi Gribonval, Antoine Chatalic, Nicolas Courty.

Duration: 4 years (2017-2021)

Acronym: OATMIL (Bringing Optimal Transport and Machine Learning Together)

http://people.irisa.fr/Nicolas.Courty/OATMIL/

Research Axis 3.1

Partners: Obelix team and PANAMA Inria project-team, IRISA; LITIS, Rouen; Lagrange Laboratory, Nice; Technicolor R&I France, Rennes.

Coordinator: Nicolas Courty (Obelix team)

Description: The OATMIL project will propose novel concepts, methodologies, and new tools for exploiting large data collections. This will result from a cross-fertilization of fundamental tools and ideas from optimal transport (OT) and machine learning (ML). The main objective of OATMIL is to develop new techniques for large-scale machine learning, encompassing adaptability, scalability, and robustness, by a cross-fertilization of ideas coming from OT and ML. This cross-fertilization leads to two complementary scientific challenges : bringing OT to ML and bringing ML to OT.

Contribution of PANAMA: PANAMA will explore the use of dimension-reduction with sketching strategies in the context compressive optimal transport.

Funding: ANR

9.1.4. OSEO-FUI: voiceHome

Participants: Nancy Bertin, Frédéric Bimbot, Romain Lebarbenchon, Ewen Camberlein.

Duration: 3 years (2015-2017)

Research axis: 3.2

Partners: voicebox (formerly known as onMobile), Delta Dore, eSoftThings, Orange, Technicolor R&I France, LOUSTIC, Inria Nancy

Coordinator: voicebox

Description: The goal of the project was to design and implement a multi-channel voice interface for smart home and multimedia (set-top-box) appliances.

Contributions of PANAMA are focused on audio source localization and separation with distant microphones in real environments. This cooperation, which reached its end in November 2017, allowed us to make progress towards operational low-resource audio source localization and separation schemes, to disseminate software, collected data and scientific results published in 2018 in a journal paper [12], and to identify new research and development perspectives in adaptive microphone array processing for fast and robust audio scene analysis.

9.2. International Initiatives

9.2.1. Inria International Partners

9.2.1.1. Informal International Partners

PANAMA has strong recurrent collaborations with the LTS2 lab at EPFL, the Institute for Digital Communications at the University of Edimburgh, and the Institute for Mathematics of the Postdam University.

Nancy Bertin is "external collaborator" of the MERLIN project (project between the Acoustics Research Institute of the Austrian Academy of Sciences and the Signal Processing Laboratory at Brno University of Technology.)

9.3. International Research Visitors

9.3.1. Visits of International Scientists

- Gilles Blanchard, in Spring 2018, Professor, University of Potsdam, Germany
- Andreas Loukas, in January 2018 and December 2018, Post-doc, EPFL, Lausanne, Switzerland

9.3.1.1. Internships

- Roilhi Frajo Ibarra Hernandez, from March to August 2018, PhD Student at CICESE, Ensenada, Mexico

SEMAGRAMME Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. PLURAL

- Program: Langues et Numérique 2018 (DGLFLF: Délégation générale à la langue française et aux langues de France)
- Project acronym: PLURAL
- Project title: Production LUdique de Ressources Annotées pour les Langues de France (Gamified production of annotated resources for Languages of France)
- Duration: October 2017 - June 2018
- Coordinator: Bruno Guillaume
- Other partners: Université Paris-Sorbonne (Karën Fort, Alice Millour, André Thibault) and Université de Strasbourg (Delphine Bernhard).
- Abstract: The objective of the PLURAL project is to build linguistic resources with GWAPs (Game With A Purpose) for poorly endowed languages. Unlike other languages, poorly endowed languages lack freely available raw corpora. The goal of the PLURAL project is to provide a web interface to gather corpora in poorly endowed languages of France. First target languages are Alsacian and Guadeloupean creole. The main difficulty is to take into account orthographic diversity and regional diversity for these languages.

  Nicolas Lefebvre was employed as an engineer in the PLURAL project from October 2017 to March 2018.

7.2. International Initiatives

7.2.1. Informal International Partners

Maxime Amblard continues discussing with the Centre for Linguistic Theory and Studies in Probability (CLASP, University of Gothenburg, Sweden), especially with Robin Cooper, Ellen Breitholtz and Chris Howes. The discussions are about computational treatments of dialogues modelling. We have common issues about the management corpora and models of dialogue. As for now, ongoing discussions have not yet been turned into a formal project.

7.3. International Research Visitors

7.3.1. Visits to International Teams

7.3.1.1. Explorer programme

Maxime Amblard visited Gotenborg University, Sweden, from October 21 to October 26, 2018.

AUCTUS Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Woobot

The main objective of Woobot is to propose a methodology for designing and controlling a collaborative robotic system to assist and secure an operator's actions. The system must preserve the health and sensory expertise of the operator while guaranteeing his or her mobility. Motivated by a pilot case from carpentry, the determination of the behavior of the collaborative robot will be based on a human-centered approach and based on a precise ergonomic analysis of the task and the biomechanical performances and needs of the operator. Two scientific issues are important: the choice of the system architecture (type of collaborative robot, number of degrees of freedom, level of redundancy with respect to the task, type of interaction of the collaborative robot with the task and/or the human...), and the behavior of the collaborative robot that must be implemented in the control. To answer these questions, it is then necessary to consider in the same formalism the human and task constraints from the point of view of:

- of the performance necessary for the task (cutting forces, trajectories);
- of the operator's biomechanical performance (kinematics -i.e. dexterity; static -i.e. manipulability and human dynamics).
- ergonomic (task, work environment, human posture).

9.2. International Research Visitors

9.2.1. Visits of International Scientists

- Gionata Salvietti, Affiliated Researcher at IIT Central Research Lab Genova, Italy, visited the team on February 7-8, 2018 and gave a talk.
- Milan Hladík, Associate Professor at Charles University in Prague, Czech Republic, visited the team on August 21-24, 2018.
- Chee Yap, Professor at the Courant Institute of Mathematical Sciences at New York University, visited the team on December 6-7, 2018. He gave a talk entitled "New Approach to FIND-PATH: a Paradigmic Problem in Robotics, AI and SC".

Chroma Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

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

Participants: Laetitia Matignon, Olivier Simonin.

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

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

9.1.2. CORDES ADT Inria project, 2017-19

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

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

9.2. National Initiatives

9.2.1. ANR

9.2.1.1. ANR "Valet" (2016-18)

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

9.2.1.2. ANR "HIANIC" (2017-20)

The HIANIC project, led by A. Spalanzani, proposes to endow autonomous vehicles with smart behaviors (cooperation, negotiation, socially acceptable movements) that better suit complex SharedSpace situations. It will integrate models of human behaviors (pedestrian, crowds and passengers), social rules, as well as smart navigation strategies that will manage interdependent behaviors of road users and of cybercars. The consortium is made of 3 academic partners: Inria (RITS, Chroma, Pervasive Interaction teams), Lig Laboratory (Magma team) and LS2N laboratory (ARMEN and PACCE teams). A. Spalanzani is the leader of this project.

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

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

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

Program: ECSEL

Project acronym: ENABLE-S3

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

Duration: June 2016 – May 2019

Coordinator: AVL List GesmbH

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

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

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

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

9.3.2. Collaborations in European Programs, Except FP7 & H2020

9.3.2.1. PHC DRONEM

Program: PHC franco-roumain "Brandusi"

Project acronym: DRONEM

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

Duration: 01-2017 - 12-2018

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

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

9.3.3. Collaborations with Major European Organizations

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

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

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

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

Partner 3 : Vislab Parma (Italy)

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

9.4. International Initiatives

9.4.1. Inria International Labs

9.4.1.1. Informal International Partners

- UC Berkeley & Stanford University (CA, USA)

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

- NUS Singapore & NTU Singapore.

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

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

  Subject: Decentralized Control of Markov Decision Processes.

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

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Visit of 3 researchers (Maria-Iuliana Bocicor, Vlad-Sebastian Ionescu, Ioan-Gabriel Mircea) from University Babes-Bolyai, Cluj-Napoca (Romania). In the context of our PHC project "DRONEM" (2017-18) we worked with them, in Lyon (CITI lab), on Sept. 11-14 2018.
- Jorge Villagra, Senior Scientist at the Center for Automation and Robotics (CSIC-UPM) in Madrid, visited us and given a seminar in novembre 2018. He also co-organized with C.Laugier an Autonomous Vehicle Demonstration event at IEEE IROS 2018 in Madrid (October 2018).

9.5.2. Visits to International Teams

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

DEFROST Project-Team

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 Brachytherapy(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.

FLOWERS Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Perseverons

Perseverons
Program: eFran
Duration: January 2016 - December 2019
Coordinator: PY Oudeyer, Inria Flowers
Partners: Inria Flowers
Funding: 140 keuros

The Perseverons project (Perseverance with / by digital objects), coordinated by the university via the ESPE (Higher School of Teaching and Education) of Aquitaine, and by the Rectorat of Bordeaux via the DANE (Academic Delegation digital education), aims to measure the real effectiveness of digital techniques in education to improve school motivation and perseverance, and, in the long term, reduce dropout. The project proposes to analyze the real effects of the use of two types of objects, robots, tablets, by comparing the school and non-school contexts of the *fablabs*. It is one of the 22 winners http://www.gouvernement.fr/efran-les-22-laureats of the "E-Fran" call for projects (training, research and digital animation spaces), following the Monteil mission on digital education, as part of the Investissement d'Avenir 2 program http://ecolenumerique.education.gouv.fr/2016/09/23/1244/. Formed of 12 sub-projects, "perseverons" has many partnerships, especially with the Poppy Education project of Inria Flowers. It is funding the PhD of Thibault Desprez.

9.1.1.1. Partner schools

In 2018, we have 36 partner schools (show Fig 41). 15 directly from the Poppy Education project. 19 new establishments were equipped in September 2017 by the Perseverons project. 21 of these establishments are located in Gironde. We have 27 high schools, 5 middle school.

9.1.2. KidLearn and Region Aquitaine

KidLearn
Program: Région Aquitaine research grant
Duration: 2016 - 2018
Coordinator: PY Oudeyer and M Lopes, Inria Flowers
Partners: Inria Flowers
Funding: 140 keuros (PhD grant of Benjamin Clément)

We propose here a research project that aims at elaborating algorithms and software systems to help humans learn efficiently, at school, at home or at work, by adapting and personalizing sequences of learning activities to the particularities of each individual student. This project leverages recent innovative algorithmic models of human learning (curiosity in particular, developed as a result of ERC European project of the Flowers team), and combines it with state-of-the-art optimization algorithms and an original integration with existing expert knowledge (human teachers). Given a knowledge domain and a set of possible learning activities, it will be able to propose the right activity at the right time to maximize learning progress. It can be applied to many learning situations and potential users: children learning basic knowledge in schools and with the support of their teachers, older kids using educational software at home, of adults needing to acquire new skills through professional training ("formation professionnelle"). Because it combines innovations in computational sciences (machine learning and optimization) with theories of human cognition (theories of human learning and of education), this project is also implementing a strong cross-fertilization between technology and human sciences (SHS).

Attachement	Type	Name	Adresse	Tel	Web
Poppy Éducation	High School	Alfred Kastler	14 Avenue de l'Université,33402 Talence, France	+33 5 57 35 40 70	http://www.lyceekastler.fr/
Poppy Éducation	Middle School	Anatole France	28 Rue des Micocouliers,33410 Cadillac, France	+33 5 56 62 98 42	http://www.afcadillac.net/
PERSEVERONS	High School	André Malraux	3 Rue du 8 Mai 1945,64200 Biarritz, France	+33 5 59 01 20 40	http://lycee-malraux-biarritz.fr/
Poppy Éducation	High School	Camille Jullian	29 Rue de la Croix Blanche,33000 Bordeaux, France	+33 5 56 01 47 47	http://www.camillejullian.com/
Poppy Éducation	Middle School	de France	Rue du Cimetière Saint-Benoist,75005 Paris, France	+33 1 44 27 12 11	http://www.college-de-france.fr/
Poppy Éducation	High School	des Graves	238 Cours du Général de Gaulle,33170 Gradignan, France	+33 5 56 75 77 56	http://www.grandlebrun.com/
PERSEVERONS	High School	Élie Faure	63 Avenue de la Libération,33310 Lormont, France	+33 5 56 38 23 23	http://www.lyc-eliefaure.fr/
PERSEVERONS	High School	Elisée Reclus	7 Avenue de Verdun,33220 Pineuilh, France	+33 5 57 41 92 50	http://lycee-foyen.fr/
Poppy Éducation	High School	François Mauriac	1 Rue Henri Dunant,33000 Bordeaux, France	+33 5 56 38 52 82	http://lyceemauriac.fr/
PERSEVERONS	High School	Gaston Febus	20 Avenue Georges Moutet,64300 Orthez, France	+33 5 59 67 07 26	http://webetab.ac-bordeaux.fr/cite-gaston-febus-orthez/
PERSEVERONS	Middle School	Giraud de Borneil	10 Boulevard André Dupuy,24160 Excideuil, France	+33 5 53 62 21 16	http://www.gdeborneil.fr/
PERSEVERONS	High School	Grand Air	Avenue du Docteur Lorentz Monod,33120 Arcachon, France	+33 5 56 22 38 00	http://webetab.ac-bordeaux.fr/lycee-grand-air/
PERSEVERONS	High School	Gustave Eiffel	143 Rue Ferbos,33000 Bordeaux, France	+33 5 56 33 83 00	http://www.eiffel-bordeaux.org/
PERSEVERONS	High School	Jacques Monod	10 Rue du Parvis,64230 Lescar, France	+33 5 59 77 92 00	http://lyceejacquesmonod.fr/
Poppy Éducation	High School	Jean Moulin	Avenue de la République,33210 Langon, France	+33 5 56 63 62 30	http://webetab.ac-bordeaux.fr/lycee-jean-moulin-langon/
Poppy Éducation	Middle School	Jean Zay	41 Rue Henri Cochet,33380 Biganos, France	+33 5 57 17 01 70	http://collegebiganos.fr/
Poppy Éducation	High School	La Morlette	62 Rue du Docteur Roux,33150 Cenon, France	+33 5 57 80 37 00	http://lycee-lamorlette.fr/
PERSEVERONS	High School	Les Iris	13 Rue Sourbès,33310 Lormont, France	+33 5 57 80 10 60	http://www.lyceelesiris.fr/
PERSEVERONS	High School	Louis Barthou	2 Boulevard Barbanègre,64000 Pau, France	+33 5 59 98 98 00	http://www.cyberlycee.fr/
PERSEVERONS	High School	Louis de Foix	4 Avenue Jean Rostand,64100 Bayonne/Bayona/Baiona, France	+33 5 59 63 31 10	http://www.louisdefoix.com/
PERSEVERONS	High School	Maine de Biran	108 Rue Valette,24100 Bergerac, France	+33 5 53 74 50 00	http://webetab.ac-bordeaux.fr/lycee-maine-de-biran/
Poppy Éducation	Middle School	Mios	Route du Pujeau,33380 Mios, France	+33 5 56 03 00 77	http://www.villemios.fr/enfance-jeunesse/college/
PERSEVERONS	High School	Nord Bassin	128 Avenue de Bordeaux,33510 Andernos-les-Bains, France	+33 5 56 82 20 77	http://www.lyceenordbassin.com/
Forum Poppy	Primary School	Notre-Dame du Mur	19 Rue de Kermadiou,29600 Morlaix, France	+33 2 98 88 18 69	http://lycee.ecmorlaix.fr/
PERSEVERONS	High School	Pape Clément	1 Rue Léo Lagrange,33600 Pessac, France	+33 5 57 26 63 00	http://lyceepapeclement.fr/
PERSEVERONS	High School	Pays de Soule	Avenue Jean Monnet,64130 Chéraute, France	+33 5 59 28 22 28	http://www.lyceedupaysdesoule.fr/index.php
PERSEVERONS	High School	Pré De Cordy	5 Avenue Joséphine Baker,24200 Sarlat-la-Canéda, France	+33 5 53 31 70 70	http://lycee-predecordy-sarlat.com/
Poppy Éducation	High School	Raoul Follereau	9 Boulevard Saint-Exupéry,58000 Nevers, France	+33 3 86 60 36 00	http://lyc58-renardfollereau.ac-dijon.fr/
PERSEVERONS	High School	René Cassin	2 Rue de Lasseguette,64100 Bayonne/Bayona/Baiona, France	+33 5 59 58 42 00	http://webetab.ac-bordeaux.fr/lycee-rene-cassin/
PERSEVERONS	High School	Saint-Cricq	4 Piste Cyclable,64000 Pau, France	+33 5 59 30 50 55	http://www.lycee-saint-cricq.org/
Poppy Éducation	High School	Saint-Genès	160 Rue de Saint-Genès,33000 Bordeaux, France	+33 5 56 33 84 84	http://www.saint-genes.com/
PERSEVERONS	High School	Saint-John Perse	2 Chemin de Barincou,64000 Pau, France	+33 5 59 62 73 11	http://www.lycee-saint-john-perse.fr/
Poppy Éducation	High School	Sainte-Marie Grand Lebrun	164 Rue François Mauriac,33200 Bordeaux, France	+33 5 56 08 32 13	http://www.grandlebrun.com/
inria	High School	Sainte-Saintonge	12 Rue de Saintonge,33000 Bordeaux, France	+33 5 56 99 39 29	http://www.lyceesaintefamille.com/
Poppy Éducation	High School	Sud-Médoc	Piste du Médoc Bleu,33320 Le Taillan-Médoc, France	+33 5 56 70 10 10	http://www.lyceesudmedoc.fr/
Poppy Éducation	High School	Victor Louis	2 Rue de Mégret,33400 Talence, France	+33 5 56 80 76 40	http://lyceevictorlouis.fr/

Figure 41. List of partner schools

9.2. National Initiatives

9.2.1. Myoelectric prosthesis - PEPS CNRS

PY Oudeyer collaborated with Aymar de Rugy, Daniel Cattaert, Mathilde Couraud, Sébastien Mick and Florent Paclet (INCIA, CNRS/Univ. Bordeaux) about the design of myoelectric robotic prostheses based on the Poppy platform, and on the design of algorithms for co-adaptation learning between the human user and the prosthesis. This was funded by a PEPS CNRS grant.

9.2.2. Poppy Station structure

- Since 1 september 2017 until february 2019, PerPoppy and Poppy Station Projects : D. Roy, P.-Y. Oudeyer. These projects aim to perpetuate the Poppy robot ecosystem by creating an external structure from outside Inria, with various partners. After the Poppy Robot Project, the Poppy Education Project has ended and Poppy Station structure is born. PerPoppy is the project which is building the new structure, and Poppy Station is the name of the new structure. Poppy Station, which includes Poppy robot ecosystem (hardware, software, community) from the beginning, is a place of excellence to build future educational robots and to design pedagogical activities to teach computer science, robotics and Artificial Intelligence. https://www.poppystation.org
- Partners of Poppy Station : Inria, La Ligue de l'Enseignement, HESAM Université, SNCF Développement, IFÉ-ENS Lyon, MOBOTS – EPFL, Génération Robots, Pollen Robotics, KONEX-Inc.

9.3. European Initiatives

9.3.1. DREAM

Title: Deferred Restructuring of Experience in Autonomous Machines
Programm: H2020
Duration: January 2015 - December 2018
Coordinator: UPMC
Partners:

Armines (ENSTA ParisTech)
Edimbourgh (Scotland)
University of A Coruna (Spain)
Vrije University Amsterdam (Holland)

Contact: David Filliat

Abstract: A holy grail in robotics and artificial intelligence is to design a machine that can accumulate adaptations on developmental time scales of months and years. From infancy through adult- hood, such a system must continually consolidate and bootstrap its knowledge, to ensure that the learned knowledge and skills are compositional, and organized into meaningful hierarchies. Consolidation of previous experience and knowledge appears to be one of the main purposes of sleep and dreams for humans, that serve to tidy the brain by removing excess information, to recombine concepts to improve information processing, and to consolidate memory. Our approach – Deferred Restructuring of Experience in Autonomous Machines (DREAM) – incorporates sleep and dream-like processes within a cognitive architecture. This enables an individual robot or groups of robots to consolidate their experience into more useful and generic formats, thus improving their future ability to learn and adapt. DREAM relies on Evo- lutionary Neurodynamic ensemble methods (Fernando et al, 2012 Frontiers in Comp Neuro; Bellas et al., IEEE-TAMD, 2010) as a unifying principle for discovery, optimization, re- structuring and consolidation of knowledge. This new paradigm will make the robot more autonomous in its acquisition, organization and use of knowledge and skills just as long as they comply with the satisfaction of pre-established basic motivations. DREAM will enable robots to cope with the complexity of being an information-processing entity in domains that are open-ended both in terms of space and time. It paves the way for a new generation of robots whose existence and purpose goes far beyond the mere execution of dull tasks. http://www.robotsthatdream.eu

9.3.2. Collaborations in European Programs, except FP7 & H2020

9.3.2.1. IGLU

Title: Interactive Grounded Language Understanding (IGLU)

Programm: CHIST-ERA

Duration: October 2015 - September 2018

Coordinator: University of Sherbrooke, Canada

Partners:

University of Sherbrooke, Canada

Inria Bordeaux, France

University of Mons, Belgium

KTH Royal Institute of Technology, Sweden

University of Zaragoza, Spain

University of Lille 1 , France

University of Montreal, Canada

Inria contact: Pierre-Yves Oudeyer

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. IGLU will gather an interdisciplinary consortium composed of committed and experienced researchers in machine learning, neurosciences and cognitive sciences, developmental robotics, speech and language technologies, and multimodal/multimedia signal processing. We expect to have key impacts in the development of more interactive and adaptable systems sharing our environment in everyday life. http://iglu-chistera.github.io/

9.4. International Initiatives

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

9.4.1.1. NEUROCURIOSITY

Title: NeuroCuriosity

International Partner (Institution - Laboratory - Researcher):

Columbia Neuroscience (United States) - Cognitive Neuroscience - JACQUELINE GOTTLIEB

Start year: 2016

See also: https://flowers.inria.fr/neurocuriosity

Curiosity can be understood as a family of mechanisms that evolved to allow agents to maximize their knowledge of the useful properties of the world. In this project we will study how different internal drives of an animal, e.g. for novelty, for action, for liking, are combined to generate the rich variety of behaviors found in nature. We will approach such challenge by studying monkeys, children and by developing new computational tools.

9.4.1.2. Idex Bordeaux-Univ. Waterloo collaborative project on curiosity in HCI

Title: Curiosity

International Partner (Institution - Laboratory - Researcher):

University of Waterloo (Canada), Edith Law's HCI Lab and Dana Kulic's Robotics lab.

Start year: 2018

Pierre-Yves Oudeyer collaborated with Edith Law's HCI research group at University of Waterloo on the topic of "Curiosity in HCI system". They obtained a grant from Univ. Bordeaux to set up a project with Inria Potioc team and with Dana Kulic, Robotics lab, Univ. Waterloo. They organized several cross visits and collaborated on the design and experimentation of an educational interactive robotic system to foster curiosity-driven learning. This led to an article accepted at CHI 2019.

9.4.1.3. Informal International Partners

Pierre-Yves Oudeyer and Didier Roy have create a collaboration with LSRO EPFL and Pr Francesco Mondada, about Robotics and education. The two teams co-organize the annual conference "Robotics and Education"in Bordeaux. Didier Roy teaches "Robotics and Education" in EPFL several times a year.

Didier Roy has created a collaboration with HEP VAud (Teachers High School) and Bernard Baumberger and Morgane Chevalier, about Robotics and education. Scientific discussions and shared professional training.

Florian Golemo and PY Oudeyer have had an active collaboration with Aaron Courville from MILA Montreal to work on the IGLU project together.

William Schueller and PY Oudeyer continued to collaborate with Vittorio Loreto (CNR Rome and Sony CSL Paris).

A collaboration with Johan Lilius and Sebastien Lafond from Abo Akademi University, Turku (Finland) is ongoing to sign an Erasmus contract for researchers and students visits on the topic of autonomous boats.

Funding applications have been submitted jointly with Davide Maltoni and Vincenzo Lomonaco from University of Bologna (Italy) on the topic of continual learning. Also the project https://www.continualai.org/ is being further developed jointly and on the way to become a non-profit organization.

9.4.2. Participation in Other International Programs

David Filliat participates in the ITEA3 DANGUN project with Renault S.A.S. in france and partners in Korea. The purpose of the DANGUN project is to develop a Traffic Jam Pilot function with autonomous capabilities using low-cost automotive components operating in France and Korea. By incorporating low-cost advanced sensors and simplifying the vehicle designs as well as testing in different scenarios (France & Korea), a solution that is the result of technical cooperation between both countries should lead to more affordable propositions to respond to client needs in the fast moving market of intelligent mobility.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Bart de Boer, VUB Brussels (Dec 2018)
- Dan Dediu, Univ. Lyon (Dec 2018)
- Kenny Smith, Univ. Edinburgh (Dec 2018)
- Jochen Triesch, Univ. Frankfurt (Nov 2018)
- Vincenzo Lomonaco, University of Bologna, Italy (Aug. 2018)

9.5.2. Internships

- Ashley Hill, Univ. Paris-Sud, Paris Saclay.
- René Traoré, UPMC, Sorbonne Universite, Paris.
- Josias Lévi Alvarès, ENSC, Bordeaux.
- Sandy Manolios, Univ. de Lyon, Lyon.
- Rémy Portelas, UPMC, Paris.
- Chuan Qin, ENSTA, Paris Saclay.

HEPHAISTOS Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

- the HEPHAISTOS and CHORALE teams together with I3S have organized the 2-days workshop *Robopaca* supported by Inria and UCA. The purpose was to organize a meeting between academics, industry and end-users to examine together the possibility of structuring the robotic activities in PACA

9.2. National Initiatives

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

9.2.1. FHU

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

9.3. International Initiatives

9.3.1. Inria International Partners

9.3.1.1. Informal International Partners

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

- University of Bologna: 2 joint PhD student, publications
- University Innsbruck: joint conference organization
- Fraunhofer IPA, Stuttgart: joint conference organization
- Duisburg-Essen University: joint conference organization
- University of New-Brunswick: 1 joint PhD student
- University Laval, Québec: joint book
- University of Tokyo: joint conference organization
- Tianjin University, China: joint book

LARSEN Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Project PsyPhINe: Cogitamus ergo sumus

Title: Cogitamus ergo sumus

Program: PEPS CNRS

Duration: January 2016 - January 2018

Coordinator: MSH Lorraine (USR3261)

LARSEN member: Amine Boumaza

Psyphine is an interdisciplinary and exploratory project (see 9.1.1) between philosophers, psychologists and computer scientists. The goal of the project is related to cognition and behavior. Cognition is a set of processes that are difficult to unite in a general definition. The project aims to explore the idea of assignments of intelligence or intentionality, assuming that our intersubjectivity and our natural tendency to anthropomorphize play a central role: we project onto others parts of our own cognition. To test these hypotheses, our aim is to design a "non-verbal" Turing Test, which satisfies the definitions of our various fields (psychology, philosophy, neuroscience and computer science) using a robotic prototype. Some of the questions that we aim to answer are: is it possible to give the illusion of cognition and/or intelligence through such a technical device? How elaborate must be the control algorithms or "behaviors" of such a device so as to fool test subjects? How many degrees of freedom must it have?

Partner institutions: InterPsy (EA 4432), APEMAC, EPSaM (EA4360), Archives Henri-Poincaré (UMR7117), Inria Bordeaux Sud-Ouest, Loria (UMR7503) and MSH Lorraine (USR3261).

9.2. European Initiatives

9.2.1. FP7 & H2020 Projects

9.2.1.1. RESIBOTS

Title: Robots with animal-like resilience

Program: H2020

Type: ERC

Duration: May 2015 - April 2020

Coordinator: Inria

Inria contact: Jean Baptiste Mouret

Despite over 50 years of research in robotics, most existing robots are far from being as resilient as the simplest animals: they are fragile machines that easily stop functioning in difficult conditions. The goal of this proposal is to radically change this situation by providing the algorithmic foundations for low-cost robots that can autonomously recover from unforeseen damages in a few minutes. It is here contended that trial-and-error learning algorithms provide an alternate approach that does not require diagnostic, nor pre-defined contingency plans. In this project, we will develop and study a novel family of such learning algorithms that make it possible for autonomous robots to quickly discover compensatory behaviors.

9.2.1.2. ANDY

Title: Advancing Anticipatory Behaviors in Dyadic Human-Robot Collaboration

Programme: H2020

Type: ICT RIA (No. 731540)

Duration: January 2017 - December 2020

Coordinator: IIT

PI for Inria: Serena Ivaldi

Recent technological progress permits robots to actively and safely share a common workspace with humans. Europe currently leads the robotic market for safety-certified robots, by enabling robots to react to unintentional contacts. AnDy leverages these technologies and strengthens European leadership by endowing robots with the ability to control physical collaboration through intentional interaction.

To achieve this interaction, AnDy relies on three technological and scientific breakthroughs. First, AnDy will innovate the way of measuring human whole-body motions by developing the wearable AnDySuit, which tracks motions and records forces. Second, AnDy will develop the AnDyModel, which combines ergonomic models with cognitive predictive models of human dynamic behavior in collaborative tasks, which are learned from data acquired with the AnDySuit. Third, AnDy will propose the AnDyControl, an innovative technology for assisting humans through predictive physical control, based on AnDyModel.

By measuring and modeling human whole-body dynamics, AnDy provides robots with an entirely new level of awareness about human intentions and ergonomy. By incorporating this awareness online in the robot's controllers, AnDy paves the way for novel applications of physical human-robot collaboration in manufacturing, health-care, and assisted living.

AnDy will accelerate take-up and deployment in these domains by validating its progress in several realistic scenarios. In the first validation scenario, the robot is an industrial collaborative robot, which tailors its controllers to individual workers to improve ergonomy. In the second scenario, the robot is an assistive exoskeleton which optimizes human comfort by reducing physical stress. In the third validation scenario, the robot is a humanoid, which offers assistance to a human while maintaining the balance of both.

Partners: Italian Institute of Technology (IIT, Italy, coordinator), Josef Stefan Institute (JSI, Slovenia), DLR (Germany), IMK Automotive Gmbh (Germany), XSens (Netherlands), AnyBody Technologies (Denmark)

9.3. International Initiatives

9.3.1. Lifelong Learning Machines program (DARPA) — STELLAR project

Title: STELLAR (Super Turing Evolving Lifelong Learning ARchitecture)

Coordinator: HRL laboratory (Malibu, USA)

Coordinator for Inria: Jean-Baptiste Mouret

Partners: Stanford University (USA), University of California Irvine (USA), University of Texas Austin (USA), IT University of Copenhagen (Denmark), Loughborough University (United Kingdom), Inria – Nancy Grand Est

Objective: Develop a general-purpose neural super Turing machine for lifelong learning and demonstrate supra-human performance in a simulated autonomous driving context. Our Super Turing Evolving Lifelong Learning ARchitecture (STELLAR) system will power a self-driving agent that continually improves its performance and updates its knowledge unsupervised, rapidly adapts to unforeseen contexts, and learns and consolidates new tasks without forgetting old ones. The project involves deep world models, neuroevolution, quality diversity algorithms, and plastic neural networks.

9.3.1.1. Informal International Partners

- Oxford University (Shimon Whiteson): data-efficient robot learning[22]
- Union College (John Rieffel): resilient tensegrity robots [10]
- Italian Institute of Technology (Enrico Mingo-Hoffman, Daniele Pucci, Nikos Tsagarakis): whole-body control of humanoids [11], [24], [27]
- IT University Copenhagen (Sebastian Risi): quality diversity algorithms
- Imperial College (Antoine Cully): data-efficient learning and quality diversity
- Hochschule Bonn-Rhein-Sieg (Alexander Asteroth): surrogate modelling [17], [7]
- Kyushu Institute of Technology, Japan (Sozo Inoue, Moe Matsuki): activity recognition

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Enrico Mingo Hoffman (Post-doc, Italian Institute of Technology) – from Feb 2018 to Feb 2018
- Niels Justesen (PhD student, IT University Copenhagen, Denmark) – from Sep 2018 to Dec 2018
- Marie Charbonneau (PhD student, IIT, Italy) – from May 2018 to Oct 2018
- Moe Matsuki (PhD student, Kyushu Institute of Technology, Japan) –fom sept 2018 to Dec 2018

PERVASIVE Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

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

Participants: Thierry Fraichard, Rémi Paulin, Patrick Reignier.

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

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

9.1.2. ANR Project Involved

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

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

Dates: Jan 2015 to Dec 2018

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

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

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

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

Other Partners: Dept of NeuroCognition, CITEN, Bielefeld University

Dates: Jan 2016 to Dec 2019

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

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

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

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

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

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

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

Pervasive is involved in two research front of the project :

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

9.1.5. ANR VALET

Participant: Dominique Vaufreydaz.

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

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

9.1.6. ANR HIANIC

Participant: Dominique Vaufreydaz.

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

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

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

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

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

Dates: Nov 2016 to Nov 2019

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

9.1.8. Competitivity Clusters

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

9.2. European Initiatives

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

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

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

9.2.2. H2020 FET Flagship Humane AI

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

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

9.3. International Initiatives

9.3.1. Participation in Other International Programs

Vietnam

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

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

Cambodia

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

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

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

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

RAINBOW Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. ARED Locoflot

Participants: Ide Flore Kenmogne Fokam, Vincent Drevelle, Eric Marchand.

no Inria Rennes 9944, duration: 36 months.

This project funded by the Brittany council started in October 2015. It supports in part Ide Flore Kenmogne Fokam's Ph.D. about cooperative localization in multi-robot fleets using interval analysis (see Section 7.1.7).

9.1.2. ARED Mod4Nav

Participants: Aline Baudry, Marie Babel.

no INSA Rennes 2016/01, duration: 36 months.

This project funded by the Brittany council started in October 2016. It supports in part Aline Baudry's Ph.D. about wheelchair modeling.

9.1.3. Allocation d'installation scientifique

Participant: Claudio Pacchierotti.

no CNRS Rennes 17C0487, duration: 36 months.

This grant from "Rennes Métropole" has been obtained in July 2017 and supported the activities related to the teleoperation of drones (quadrotor UAVs) using wearable haptics interfaces.

9.1.4. IRT Jules Verne Mascot

Participants: François Chaumette, Fabien Spindler, Souriya Trinh.

no Inria Rennes 10361, duration: 36 months.

This project ended in December 2018. It was managed by IRT Jules Verne in Nantes and achieved in cooperation with LS2N, Airbus, Renault, Faurecia and GE. Our goal in this project was to perform screwing for various industrial applications by visual servoing. We also developed an application of rivet detection and 3D localisation on an aircraft cabin.

9.1.5. IRT Jules Verne Happy

Participant: François Chaumette.

no Inria Rennes 13521, duration: 36 months.

This project started in June 2018. It is managed by IRT Jules Verne in Nantes and achieved in cooperation with LS2N and Airbus. Its goal is to develop local sensor-based control methods for the assembly of large parts of aircrafts.

9.1.6. IRT b<>com NeedleWare

Participants: Hadrien Gurnel, Alexandre Krupa.

no Inria Rennes 9072, duration: 36 months.

This project started in October 2016. It supports Hadrien Gurnel's Ph.D. about the study of a shared control strategy fusing haptic and visual control for assisting manual steering of needles for biopsy or therapy purposes in a synergetic way (see Section 7.3.1).

9.1.7. Prisme

Participants: Solenne Fortun, Marie Babel.

no Insa Rennes 2017-0004, duration: 33 months.

This project started in January 2017 and is supported by Brittany region/BPI. This project aims at designing a fall prevention strategy based on the sensing collaboration of a smart wheelchair and a smart medical bed. Fall detection and automatic positioning of the wheelchair next to the bed issues are planned to be addressed (see Section 7.4.5).

9.1.8. Silver Connect

Participant: Marie Babel.

no Insa Rennes 2018-0076, duration: 24 months.

This project started in November 2018 and is supported by Brittany region/BPI as well as FEDER. This project aims at designing a fall detection framework by means of vision-based algorithms coupled with deep learning solutions.

9.2. National Initiatives

9.2.1. ANR JCJC SenseFly

Participants: Muhammad Usman, Paolo Robuffo Giordano.

no Irisa CNRS 50476, duration: 36 months.

The ANR "Jeune Chercheur" SenseFly project started in August 2015 and ended in December 2018. Its goal is to advance the state-of-the-art in multi-UAV in the design and implementation of fully decentralized and sensor-based group behaviors by only resorting to onboard sensing (mainly cameras and IMU) and local communication (e.g., Bluetooth communication, wireless networks). Topics such as individual flight control, formation control robust against sensor limitations (e.g., limited field of view, occlusions), distributed estimation of relative positions/bearings from local sensing, maintenance of architectural properties of a multi-UAV formation are studied in the project. Part of the platforms described in Section 6.6.6 has been purchased thanks to this grant.

9.2.2. ANR PLaTINUM

Participant: Vincent Drevelle.

no Inria Sophia 10204, duration: 42 months.

This project started in November 2015. It involves a consortium managed by Litis in Rouen with IGN Matis (Paris), Le2i (Le Creusot) and Rainbow group. It aims at proposing novel solutions to robust long-term mapping of urban environments.

9.2.3. Equipex Robotex

Participants: Fabien Spindler, François Chaumette.

no Inria Rennes 6388, duration: 9 years.

Rainbow is one of the 15 French academic partners involved in the Equipex Robotex network that started in February 2011. It is devoted to get and manage significant equipment in the main robotics labs in France. In the scope of this project, we have obtained the humanoid robot Romeo (see Section 6.6.5).

9.2.4. CNRS/INS2I - PEPS JCJC ShareHaptics

Participant: Claudio Pacchierotti.

no Inria Rennes 7991, duration: 12 months.

The project addresses the need of combining wearable haptics and shared control. Shared-control techniques will enable a single user to intuitively control the coordinated motion of several robots (e.g., a team of drones/manipulators). At the same time, multi-type multi-point wearable haptic devices will provide the necessary multi-faceted feedback information to the user.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. FP7 Space RemoveDEBRIS

Participants: Eric Marchand, François Chaumette.

Instrument: Specific Targeted Research Project

Duration: October 2013 - March 2019

Coordinator: University of Surrey (United Kingdom)

Partners: Surrey Satellite Technology (United Kingdom), Airbus (Toulouse, France and Bremen, Germany), Isis (Delft, The Netherlands), CSEM (Neuchâtel, Switzerland), Stellenbosch University (South Africa).

Inria contact: François Chaumette

Abstract: Our goal in this project is to validate model-based tracking algorithms on images acquired during an actual space debris removal mission [74],[73].

9.3.1.2. H2020 ICT Comanoid

Participants: Souriya Trinh, Fabien Spindler, François Chaumette.

Title: Multi-contact Collaborative Humanoids in Aircraft Manufacturing

Programme: H2020

Duration: January 2015 - December 2018

Coordinator: CNRS (Lirmm)

Partners: Airbus Group (France), DLR (Germany), Università Degli Studi di Roma La Sapienza (Italy), CNRS (I3S)

Inria contact: François Chaumette

Abstract: Comanoid investigates the deployment of robotic solutions in well-identified Airbus airliner assembly operations that are laborious or tedious for human workers and for which access is impossible for wheeled or rail-ported robotic platforms. As a solution to these constraints a humanoid robot is proposed to achieve the described tasks in real-use cases provided by Airbus Group. At a first glance, a humanoid robotic solution appears extremely risky, since the operations to be conducted are in highly constrained aircraft cavities with non-uniform (cargo) structures. Furthermore, these tight spaces are to be shared with human workers. Recent developments, however, in multi-contact planning and control suggest that this is a much more plausible solution than current alternatives such as a manipulator mounted on multi-legged base. Indeed, if humanoid robots can efficiently exploit their surroundings in order to support themselves during motion and manipulation, they can ensure balance and stability, move in non-gaited (acyclic) ways through narrow passages, and also increase operational forces by creating closed-kinematic chains. Bipedal robots are well suited to narrow environments specifically because they are able to perform manipulation using only small support areas. Moreover, the stability benefits of multi-legged robots that have larger support areas are largely lost when the manipulator must be brought close, or even beyond, the support borders. COMANOID aims at assessing clearly how far the state-of-the-art stands from such novel technologies. In particular the project focuses on implementing a real-world humanoid robotics solution using the best of research and innovation. The main challenge are to integrate current scientific and technological advances including multi-contact planning and control; advanced visual-haptic servoing; perception and localization; human-robot safety, and the operational efficiency of cobotics solutions in airliner manufacturing.

This year, we published [75] in the scope of this project (see Section 7.1.3). Short stays have been achieved at DLR and LIRMM for the integration of our visual tracking and visual servoing methods on the humanoid robots Toro and HRP-4.

9.3.1.3. H2020 ICT Romans

Participants: Firas Abi Farraj, Marco Cognetti, Marco Aggravi, Fabrizio Schiano, Pol Mordel, Fabien Spindler, François Chaumette, Claudio Pacchierotti, Paolo Robuffo Giordano.

Title: Robotic Manipulation for Nuclear Sort and Segregation

Programme: H2020

Duration: May 2015 - October 2018

Coordinator: University of Birmingham

Partners: NLL (UK), CEA (France), Univ. Darmstadt (Germany)

CNRS contact: Paolo Robuffo Giordano

Abstract: The goal of the RoMaNS (Robotic Manipulation for Nuclear Sort and Segregation) project has been to advance the state of the art in mixed autonomy for tele-manipulation, to solve a challenging and safety-critical "sort and segregate" industrial problem, driven by urgent market and societal needs. Cleaning up the past half century of nuclear waste, in the UK alone (mostly at the Sellafield site), represents the largest environmental remediation project in the whole of Europe. Most EU countries face related challenges. Nuclear waste must be "sorted and segregated", so that low-level waste is placed in low-level storage containers, rather than occupying extremely expensive and resource intensive high-level storage containers and facilities. Many older nuclear sites (>60 years in UK) contain large numbers of legacy storage containers, some of which have contents of mixed contamination levels, and sometimes unknown contents. Several million of these legacy waste containers must now be cut open, investigated, and their contents sorted. This can only be done remotely using robots, because of the high levels of radioactive material. Current state-of-the-art practice in the industry, consists of simple tele-operation (e.g. by joystick or teach-pendant). Such an approach is not viable in the long-term, because it is prohibitively slow for processing the vast quantity of material required. The project aimed at: 1) Develop novel hardware and software solutions for advanced bi-lateral master-slave tele-operation. 2) Develop advanced autonomy methods for highly adaptive automatic grasping and manipulation actions. 3) Combine autonomy and tele-operation methods using state-of-the-art understanding of mixed initiative planning, variable autonomy and shared control approaches. 4) Deliver a TRL 6 demonstration in an industrial plant-representative environment at the UK National Nuclear Lab Workington test facility.

9.3.1.4. H2020 ICT CrowdBot

Participants: Julien Legros, Javad Amirian, Fabien Grzeskowiak, Ceilidh Hoffmann, Marie Babel, Jean Bernard Hayet, Julien Pettré.

Title: Robot navigation in dense crowds

Programme: H2020

Duration: Jan 2018 - Jun 2021

Coordinator: Inria

Partners: UCL (UK), SoftBank Robotics (France), Univ. Aachen (Germany), EPFL (Switzerland), ETHZ (Switzerland), Locomotec (Germany)

Inria contact: Julien Pettré

Abstract: CROWDBOT will enable mobile robots to navigate autonomously and assist humans in crowded areas. Today's robots are programmed to stop when a human, or any obstacle is too close, to avoid coming into contact while moving. This prevents robots from entering densely frequented areas and performing effectively in these high dynamic environments. CROWDBOT aims to fill in the gap in knowledge on close interactions between robots and humans during navigation tasks. The project considers three realistic scenarios: 1) a semi-autonomous wheelchair that must adapt its trajectory to unexpected movements of people in its vicinity to ensure neither its user nor the pedestrians around it are injured; 2) the commercially available Pepper robot that must navigate in a dense crowd while actively approaching people to assist them; 3) the under development robot cuyBot will adapt to compact crowd, being touched and pushed by people. These scenarios generate numerous ethical and safety concerns which this project addresses through a dedicated Ethical and Safety Advisory Board that will design guidelines for robots engaging in interaction in crowded environments. CROWDBOT gathers the required expertise to develop new robot capabilities to allow robots to move in a safe and socially acceptable manner. This requires achieving step changes in a) sensing abilities to estimate the crowd motion around the robot, b) cognitive abilities for the robot to predict the short term evolution of the crowd state and c) navigation abilities to perform safe motion at close range from people. Through demonstrators and open software components, CROWDBOT will show that safe navigation tasks can be achieved within crowds and will facilitate incorporating its results into mobile robots, with significant scientific and industrial impact. By extending the robot operation field toward crowded environments, we enable possibilities for new applications, such as robot-assisted crowd traffic management.

9.3.1.5. H2020 FET-OPEN H-Reality

Participants: Claudio Pacchierotti, Paolo Robuffo Giordano, François Chaumette, Anatole Lécuyer [Hybrid], Maud Marchal [Hybrid].

Title: Mixed Haptic Feedback for Mid-Air Interactions in Virtual and Augmented Realities

Programme: H2020

Duration: October 2018 - September 2021

Coordinator: Univ. Birmingham (UK)

Partners: Univ. Birmingham (UK, coordinator), TU Delft (NL), Ultrahaptics (UK) and Actronika SAS (France)

CNRS contact: Claudio Pacchierotti

Abstract: Digital content today remains focused on visual and auditory stimulation. Even in the realm of VR and AR, sight and sound remain paramount. In contrast, methods for delivering haptic (sense of touch) feedback in commercial media are significantly less advanced than graphical and auditory feedback. Yet without a sense of touch, experiences ultimately feel hollow, virtual realities feel false, and Human-Computer Interfaces become unintuitive. Our vision is to be the first to imbue virtual objects with a physical presence, providing a revolutionary, untethered, virtual-haptic reality: H-Reality. The ambition of H-Reality will be achieved by integrating the commercial pioneers of ultrasonic "non-contact" haptics, state-of-the-art vibrotactile actuators, novel mathematical and tribological modelling of the skin and mechanics of touch, and experts in the psychophysical rendering of sensation. The result will be a sensory experience where digital 3D shapes and textures are made manifest in real space via modulated, focused, ultrasound, ready for the untethered hand to feel, where next-generation wearable haptic rings provide directional vibrotactile stimulation, informing users of an object's dynamics, and where computational renderings of specific materials can be distinguished via their surface properties. The implications of this technology will be far-reaching. The computer touch-screen will be brought into the third dimension so that swipe gestures will be augmented with instinctive rotational gestures, allowing intuitive manipulation of 3D data sets and strolling about the desktop as a virtual landscape of icons, apps and files. H-Reality will transform online interactions; dangerous machinery will be operated virtually from the safety of the home, and surgeons will hone their skills on thin air.

9.3.2. Collaborations in European Programs, Except FP7 & H2020

9.3.2.1. Interreg Adapt

Participants: Nicolas Le Borgne, Marie Babel.

Programme: Interreg VA France (Channel) England

Project acronym: Adapt

Project title: Assistive Devices for empowering disAbled People through robotic Technologies

Duration: Jan 2017 - Jun 2021

Coordinator: ESIGELEC/IRSEEM Rouen

Other partners: INSA Rennes - IRISA, LGCGM, IETR (France), Université de Picardie Jules Verne - MIS (France), Pôle Saint Hélier (France), CHU Rouen (France), Réseau Breizh PC (France), Pôle TES (France), University College of London - Aspire CREATE (UK), University of Kent (UK), East Kent Hospitals Univ NHS Found. Trust (UK), Health and Europe Centre (UK), Plymouth Hospitals NHS Trust (UK), Canterbury Christ Church University (UK), Kent Surrey Sussex Academic Health Science Network (UK), Cornwall Mobility Center (UK).

Abstract: This project aims to develop innovative assistive technologies in order to support the autonomy and to enhance the mobility of power wheelchair users with severe physical/cognitive disabilities. In particular, the objective is to design and evaluate a power wheelchair simulator as well as to design a multi-layer driving assistance system.

9.3.3. Collaborations with Major European Organizations

9.3.3.1. ANR Opmops

Participants: Florian Berton, Julen Bruneau, Julien Pettré.

Programme: ANR

Project acronym: Opmops

Project title: Organized Pedestrian Movement in Public Spaces: Preparation and Crisis Management of Urban Parades and Demonstration Marches with High Conflict Potential

Duration: June 2017 - June 2020

Coordinator: Université de Haute Alsace (for France), Technische Universität Kaiserslautern (for Germany)

Other partners: Gendarmerie Nationale, Hochschule München, ONHYS S.A.S, Polizei Rheinland-Pfalz, Universität Koblenz-Landau, VdS GmbH

Abstract: This project is about parades of highly controversial groups or of political demonstration marches that are considered as a major threat to urban security. Due to the movement of the urban parades and demonstration marches (in the following abbreviated by UPM) through large parts of cities and the resulting space and time dynamics, it is particularly difficult for forces of civil security (abbreviated in the following by FCS) to guarantee safety at these types of urban events without endangering one of the most important indicators of a free society. In this proposal, partners representing the FCS (police and industry) will cooperate with researchers from academic institutions to develop a decision support tool which can help them both in the preparation phase and crisis management situations of UPMs. Specific technical issues which the French-German consortium will have to tackle include the following: Optimization methods to plan UPM routes, transportation to and from the UPM, location and personnel planning of FCS, control of UPMs using stationary and moving cameras, and simulation methods, including their visualization, with specific emphasis on social behavior.

9.3.3.2. iProcess

Participants: Agniva Sengupta, François Chaumette, Alexandre Krupa, Eric Marchand, Fabien Spindler.

Project acronym: i-Process

Project title: Innovative and Flexible Food Processing Technology in Norway

Duration: January 2016 - December 2019

Coordinator: Sintef (Norway)

Other partners: Nofima, Univ. of Stavanger, NMBU, NTNU (Norway), DTU (Denmark), KU Leuven (Belgium), and about 10 Norwegian companies.

Abstract: This project is granted by the Norwegian Government. Its main objective is to develop novel concepts and methods for flexible and sustainable food processing in Norway. In the scope of this project, the Rainbow group is involved for visual tracking and visual servoing of generic and potentially deformable objects (see Section 7.1.2). Agniva Sengupta spent a 2-month visit at Sintef from March to April 2018.

9.3.3.3. activeVISION

Participants: Alexandre Krupa, François Chaumette, Eric Marchand, Agniva Sengupta, Fabien Spindler.

Project acronym: activeVISION

Project title: Active perception and 3D pose estimation of compliant deformable objects applicable to agricultural and ocean space sector

Duration: January 2018 - December 2018

Coordinator: Inria Rennes - Bretagne Atlantique and Sintef (Norway)

Abstract: This project is granted by the PHC Aurora 2018 program that provides travel funds for exchange between France and Norway. It concerns the development of active perception methodology by means of visual servoing for localization and exploration of the scene and the object(s) of interest. Alexandre Krupa and Fabien Spindler spent a 1-week visit at Sintef in Trondheim in March 2018. Prof. Ekrem Misimi from Sintef spent a 3-month visit in Rainbow from May to July 2018.

9.4. International Initiatives

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

9.4.1.1. ISI4NAVE

Title: Innovative Sensors and adapted Interfaces for assistive NAVigation and pathology Evaluation

International Partner (Institution - Laboratory - Researcher):

UCL London (United Kingdom) - Aspire CREATe laboratory - Tom Carlson

Duration: Jan 2016 – Dec 2018

See also: https://team.inria.fr/isi4nave/

Abstract: The global ageing population, along with disability compensation constitute major challenging societal and economic issues. In particular, achieving autonomy remains a fundamental need that contributes to the individual's wellness and well-being. In this context, innovative and smart technologies are designed to achieve independence while matching user's individual needs and desires.

Hence, designing a robotic assistive solution related to wheelchair navigation remains of major importance as soon as it compensates partial incapacities. This project will then address the following two issues. First, the idea is to design an indoor / outdoor efficient obstacle avoidance system that respects the user intention, and does not alter user perception. This involves embedding innovative sensors to tackle the outdoor wheelchair navigation problem. The second objective is to take advantage of the proposed assistive tool to enhance the user Quality of Experience by means of biofeedback. Indeed, adapted interfaces should improve the understanding of people that suffer from cognitive and/or visual impairments.

The originality of the project is to continuously integrate medical validation as well as clinical trials during the scientific research work in order to match user needs and acceptation.

9.4.2. Participation in Other International Programs

9.4.2.1. ACRV

François Chaumette is one of the five external experts of the Australian Center for Robotic Vision (see http://roboticvision.org). This center groups QUT in Brisbane, ANU in Canberra, Monash University and Adelaide University. In the scope of this project, Agniva Sengupta and Axel Lopez Gandia received a grant to participate to the 2018 Robotic Vision Summer School in Kioloa (New South Wales) and spent a 1-week visit at QUT in March 2018.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

9.5.1.1. Visiting Researchers

- Claudia Elvira Esteves Jaramillo (University of Guanajuato, Mexico) from Jan 2018 until Dec 2018

9.5.1.2. Internships

- Giuseppe Sirignano (Univ. Salerno, Italy), until March 2018
- Mario Selvaggio (Univ. Naples, Italy), from October 2018 until December 2018
- Catalin Stefan Teodorescu (UCL London, UK) from November 2018 until December 2018 in the scope of the Inria Associate team ISI4NAVE (see Section 9.4.1.1)
- Noe Aldana Murillo (CIMAT, Mexico), from Sep 2018
- Jiuyang Bai (Inria), Jun 2018
- Marco Ferro (University of Rome “La Sapienza”, Italy) from Feb 2018 until Aug 2018
- Kaixiang Zhang (University of Zhejiang, China) until Jul 2018

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

- Firas Abi-Farraj spent a 6-month visit at the Institute of Robotics and Mechatronics of DLR (Münich, Germany) where he worked on the humanoid robot TORO in the scope of his Ph.D. (see [50]).
- Agniva Sengupta spent a 2-month visit at Sintef in Trondheim where he worked on the tracking of deformable objects using a RGB-D camera in the scope of his Ph.D. (see Section 7.1.2).

RITS Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

9.1.1.1. VALET

Title: Redistribution automatique d'une flotte de véhicules en partage et valet de parking

Instrument: ANR

Duration: January 2016 - December 2018

Coordinator: Fawzi Nashashibi

Partners: Inria, Ecole Centrale de Nantes (IRCCyN), AKKA Technologies

Inria contact: Fawzi Nashashibi

Abstract: The VALET project proposes a novel approach for solving car-sharing vehicles redistribution problem using vehicle platoons guided by professional drivers. An optimal routing algorithm is in charge of defining platoons drivers' routes to the parking areas where the followers are parked in a complete automated mode. The main idea of VALET is to retrieve vehicles parked randomly on the urban parking network by users. These parking spaces may be in electric charging stations, parking for car sharing vehicles or in regular parking places. Once the vehicles are collected and guided in a platooning mode, the objective is then to guide them to their allocated parking area or to their respective parking lots. Then each vehicle is assigned a parking place into which it has to park in an automated mode.

9.1.1.2. Hianic

Title: navigation autonome dans les foules inspirée par les humains (Human Inspired Autonomous Navigation In Crowds)

Instrument: ANR

Duration: January 2018 - December 2020

Coordinator: Anne Spalanzani (Inria Rhône-Alpes, Chroma research team)

Partners: Inria Rhône-Alpes, Inria Paris, LIG Laboratoire d'Informatique de Grenoble, LS2N - ECN Laboratoire des Sciences du Numérique de Nantes

Inria contact: Fawzi Nashashibi

Abstract: The HIANIC project will try to address some problems that will arise when these cars are mixed with pedestrians. The HIANIC project will develop new technologies in term of autonomous navigation in dense and human populated traffic. It will explore the complex problem of navigating autonomously in shared-space environments, where pedestrians and cars share the same environment.

Such a system will contribute both to urban safety and intelligent mobility in "shared spaces". Negotiation will help to avoid frozen situations increasing the vehicle's reactivity and optimizing the navigable space. Negotiation, Human-Aware Navigation and Communication will contribute to a better public acceptance of such autonomous systems and facilitate their penetration in the transportation landscape.

9.1.2. FUI

9.1.2.1. Sinetic

Title: Système Intégré Numérique pour les Transports Intelligents Coopératifs

Instrument: FUI

Duration: December 2014 - January 2018

Coordinator: Thomas Nguyen (Oktal)

Partners: Oktal, ALL4TEC, CIVITEC, Dynalogic, Inria, EURECOM, Renault, Armines, IFSTTAR, VEDECOM

Inria contact: Jean-Marc Lasgouttes

Abstract: The purpose of the project SINETIC is to create a complete simulation environment for designing cooperative intelligent transport systems with two levels of granularity: the system level, integrating all the components of the system (vehicles, infrastructure management centers, etc.) and its realities (terrain, traffic, etc.) and the component-level, modeling the characteristics and behavior of the individual components (vehicles, sensors, communications and positioning systems, etc.) on limited geographical areas, but described in detail.

9.1.2.2. PAC V2X

Title: Perception augmentée par coopération véhicule avec l'infrastructure routière

Instrument: FUI

Duration: September 2016 - August 2019

Coordinator: SIGNATURE Group (SVMS)

Partners: DigiMobee, LOGIROAD, MABEN PRODUCTS, SANEF, SVMS, VICI, Inria, VEDECOM

Inria contact: Raoul de Charette

Abstract: The objective of the project is to integrate two technologies currently being deployed in order to significantly increase the time for an automated vehicle to evolve autonomously on European road networks. It is the integration of technologies for the detection of fixed and mobile objects such as radars, lidars, cameras ... etc. And local telecommunication technologies for the development of ad hoc local networks as used in cooperative systems.

9.1.3. Competitivity Clusters

RITS team is a very active partner in the competitivity clusters, especially MOV'EO and System@tic. We are involved in several technical committees like the DAS SUR of MOV'EO for example.
RITS is also the main Inria contributor in the VEDECOM institute (IEED). VEDECOM financed the PhD theses of Mr. Fernando Garrido and Mr. Zayed Alsayed.

9.2. European Initiatives

9.2.1. FP7 & H2020 Projects

9.2.1.1. AUTOCITS

Title: AUTOCITS Regulation Study for Interoperability in the Adoption of Autonomous Driving in European Urban Nodes

Program: CEF- TRANSPORT Atlantic corridor

Duration: November 2016 - March 2019

Coordinator: Indra Sistemas S.A. (Spain)

Partners: Indra Sistemas S.A. (Spain); Universidad Politécnica de Madrid (UPM), Spain; Dirección General de Tráfico (DGT), Spain; Inria (France); Instituto Pedro Nunes (IPN), Portugal; Autoridade Nacional de Segurança Rodoviária (ANSR), Portugal; Universidade de Coimbra (UC), Portugal.

Inria contact: Fawzi Nashashibi, Mohammad Abualhoul

Abstract: The aim of the Study is to contribute to the deployment of C-ITS in Europe by enhancing interoperability for autonomous vehicles as well as to boost the role of C-ITS as catalyst for the implementation of autonomous driving. Pilots will be implemented in 3 major Core Urban nodes (Paris, Madrid, Lisbon) located along the Core network Atlantic Corridor in 3 different Member States. The Action consists of Analysis and design, Pilots deployment and assessment, Dissemination and communication as well as Project Management and Coordination.

9.2.2. Collaborations with Major European Organizations

RITS is member of the **euRobotics AISBL** (Association Internationale Sans But Lucratif) and the Leader of "People transport" Topic. This makes from Inria one of the rare French robotics representatives at the European level. See also: http://www.eu-robotics.net/

RITS is a full partner of **VRA – Vehicle and Road Automation**, a support action funded by the European Union to create a collaboration network of experts and stakeholders working on deployment of automated vehicles and its related infrastructure. VRA project is considered as the cooperation interface between EC funded projects, international relations and national activities on the topic of vehicle and road automation. It is financed by the European Commission DG CONNECT and coordinated by ERTICO – ITS Europe. See also: http://vra-net.eu/

9.3. International Initiatives

9.3.1. Inria International Partners

9.3.1.1. Informal International Partners

RITS has signed 3 MoU with the following international laboratories:

- Vehicle Dynamics and Control Laboratory, Seoul National University (SNU), S. Korea: international cooperation agreement for Graduate-Level Academic and Research Collaboration
- MICA Lab, Hanoi University of Science and Technology, Vietnam: cooperation agreement for research collaboration and PhD students co-supervision
- Integrated Industrial Design Lab (INDEL) of the Department of Product and Systems Design Engineering, University of the Aegean, Greece: international cooperation agreement for Graduate-Level Academic and Research Collaboration

9.3.2. Participation in International Programs

Samuel de Champlain Québec-France collaboration program: "Vision par ordinateur en conditions difficiles", cooperation between Raoul de Charette and Jean-François Lalonde from Laval University.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

Jean-François Lalonde from Laval University in October 2018 within the framework of Samuel de Champlain Québec-France collaboration program.

9.4.1.1. Internships

Shirsendu Halder, June-December 2018.

Nabila Arib, April-September 2018

9.4.2. Visits to International Teams

9.4.2.1. Research Stays Abroad

Maximilian Jaritz was at UC San Diego, visiting SU Lab directed by Hao Su, from October 1st 2018 to February 15th 2019.

LINKMEDIA Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CominLabs Project Linking Media in Acceptable Hypergraphs (LIMAH)

Participants: Vincent Claveau, Guillaume Gravier, Pascale Sébillot.

Duration: 4.5 years, started in April 2014
Partners: Telecom Bretagne (IODE), Univ. Rennes II (CRPCC, PREFics), Univ. Nantes (LINA/TAL)
URL: http://limah.irisa.fr

LIMAH aims at exploring hypergraph structures for multimedia collections, instantiating actual links reflecting particular content-based proximity—similar content, thematic proximity, opinion expressed, answer to a question, etc. Exploiting and developing further techniques targeting pairwise comparison of multimedia contents from an NLP perspective, LIMAH addresses two key issues: How to automatically build from a collection of documents an hypergraph, i.e., a graph combining edges of different natures, which provides exploitable links in selected use cases? How collections with explicit links modify usage of multimedia data in all aspects, from a technology point of view as well as from a user point of view? LIMAH studies hypergraph authoring and acceptability taking a multidisciplinary approach mixing ICT, law, information and communication science as well as cognitive and ergonomy psychology.

8.1.2. CominLabs Project BigCLIN

Participants: Vincent Claveau, Ewa Kijak, Clément Dalloux.

Duration: 3 years, started in September 2016
Partners: STL-CNRS, Inserm/CHU Rennes, Inria
URL: https://bigclin.cominlabs.u-bretagneloire.fr/fr

Data collected or produced during clinical care process can be exploited at different levels and across different domains. Yet, a well-known challenge for secondary use of health big data is that much of detailed patient information is embedded in narrative text, mostly stored as unstructured data. The project proposes to address the essential needs when reusing unstructured clinical data at a large scale. We propose to develop new clinical records representation relying on fine-grained semantic annotation thanks to new NLP tools dedicated to French clinical narratives. To efficiently map this added semantic information to existing structured data for further analysis at big scale, the project also addresses distributed systems issues: scalability, management of uncertain data and privacy, stream processing at runtime, etc.

8.1.3. Computer vision for smart phones (MobilAI)

Participants: Yannis Avrithis, Mateusz Budnik.

Duration: 2 years, started in September 2018
Partners: Lamark, Quai des Apps, AriadNext

The ability of our mobile devices to process visual information is currently not limited by their camera or computing power but by the network. Many mobile apps suffer from long latency due to data transmitted over the network for visual search. MobilAI aims to provide fast visual recognition on mobile devices, offering quality user experience whatever the network conditions. The idea is to transfer efficient deep learning solutions for image classification and retrieval onto embedded platforms such as smart phones. The intention is to use such solutions in B2B and B2C application contexts, for instance recognizing products and ordering online, accessing information about artifacts in exhibitions, or identifying identity documents. In all cases, visual recognition is performed on the device, with minimal or no access to the network.

8.2. National Initiatives

8.2.1. ANR Project IDFRAud

Participant: Teddy Furon.

Duration: 3 years, started in Feb. 2015
Partners: AriadNext, IRCGN, École Nationale Supérieure de Police

The IDFRAud project consists in proposing an automatic solution for ID analysis and integrity verification. Our ID analysis goes through three processes: classification, text extraction and ID verification. The three processes rely on a set of rules that are externalized in formal manner in order to allow easy management and evolving capabilities. This leads us to the ID knowledge management module. Finally, IDFRAud addresses the forensic link detection problem and to propose an automatic analysis engine that can be continuously applied on the detected fraud ID database. Cluster analysis methods are used to discover relations between false IDs in their multidimensional feature space. This pattern extraction module will be coupled with a suitable visualization mechanism in order to facilitate the comprehension and the analysis of extracted groups of inter-linked fraud cases.

8.2.2. FUI 19 NexGenTV

Participants: Vincent Claveau, Guillaume Gravier, Ewa Kijak, Anne-Lyse Minard.

Duration: 2.5 years, started in May 2015
Partners: Eurecom, Avisto Telecom, Wildmoka, Envivio-Ericsson

Television is undergoing a revolution, moving from the TV screen to multiple screens. Today's user watches TV and, at the same time, browses the web on a tablet, sends SMS, posts comments on social networks, searches for complementary information on the program, etc. Facing this situation, NexGen-TV aims at developing a generic solution for the enrichment, the linking and the retrieval of video content targeting the cost-cutting edition of second screen and multiscreen applications for broadcast TV. The main outcome of the project will be a software platform to aggregate and distribute video content via a second-screen edition interface connected to social media. The curation interface will primarily make use of multimedia and social media content segmentation, description, linking and retrieval. Multiscreen applications will be developed on various domaine, e.g., sports, news.

8.2.3. Inria Project Lab Knowledge-driven data and content collaborative analytics (iCODA)

Participants: Laurent Amsaleg, Vincent Claveau, Cheikh Brahim El Vaigh, Guillaume Gravier, Pascale Sébillot.

Duration: 4.5 years, started in April 2017
Partners: Inria project-teams Linkmedia, CEDAR, GraphIK and ILDA, with Ouest-France, Le Monde and AFP

One of today's major issues in data science is the design of algorithms that allow analysts to efficiently infer useful information and knowledge by collaboratively inspecting heterogeneous information sources, from structured data to unstructured content. Taking data journalism as an emblematic use-case, the goal of the project is to develop the scientific and technological foundations for knowledge- mediated user-in-the-loop collaborative data analytics on heterogenous information sources, and to demonstrate the effectiveness of the approach in realistic, high-visibility use-cases. The project stands at the crossroad of multiple research fields—content analysis, data management, knowledge representation, visualization—that span multiple Inria themes, and counts on a club of major press partners to define usage scenarios, provide data and demonstrate achievements.

8.2.4. Inria-BNF: Classification d'images patrimoniales (CIP)

Participants: Laurent Amsaleg, Guillaume Gravier, Ewa Kijak, Yannis Avrithis.

Duration: 1 year, started in Dec 2018

This project is within the context of the collaborations between Inria and the French Ministry of Culture. In that context, we have started a collaboration with the French National Library (BNF) which collects, preserves and makes known the national documentary heritage. This collaboration aims at facilitating the automatic classification of heritage images through the use of recent deep-learning techniques. Such images are quite specific: they are not at all similar with what deep-learning techniques are used to work with, that is, the classification of heritage images does not target modern categories such as planes, cars, cats and dogs because this is irrelevant and because heritage collections do not include images of contemporary objects. Furthermore, heritage images come in vast quantities, but they are little annotated and deep-learning techniques can hardly rely on massive annotations to easily learn. Last, the learning has to be continuous as curators may need to add or modify existing classes, without re-learning everything from scratch.

The techniques of choice to reach that goal include the semi-supervised learning, low-shot learning techniques, knowledge transfer, fine tuning existing models, etc.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, Except FP7 & H2020

Program: CHIST ERA

- Project acronym: ID_IOT
- Project title: Identification for the Internet of things
- Duration: 3 years, started in Oct 2016.
- Coordinator: Boris Skoric (Eindhoven Univ. of Technology (NL))
- Other partners: Inria-RBA (Teddy Furon, Marzieh Gheisari), Univ. of Geneva (CH)
- Abstract: The IoT will contain a huge number of devices and objects that have very low or nonexistent processing and communication resources, coupled to a small number of high-power devices. The weakest devices, which are most ubiquitous, will not be able to authenticate themselves using cryptographic methods. This project addresses these issues using physical unclonable functions (PUFs). PUFs, and especially quantum readout PUFs, are ideally suited to the IoT setting because they allow for the authentication and identification of physical objects without requiring any crypto or storage of secret information.

  Furthermore, we foresee that back-end systems will not be able to provide security and privacy via cryptographic primitives due to the sheer number of IoT devices. Our plan is to address these problems using privacy preserving database structures and algorithms with good scaling behaviour. Approximate nearest neighbour (ANN) search algorithms, which have remarkably good scaling behaviour, have recently become highly efficient, but do not yet have the right security properties and have not yet been applied to PUF data. Summarised in a nutshell, the project aims to improve the theory and practice of technologies such as PUFs and ANN search in the context of generic IoT authentication and identification scenarios.

Program: Joint Programming Initiative Cultural Heritage

- Project acronym: READ-IT
- Project title: Reading Europe: Advanced Data Investigation Tools
- Duration: June 2018 - May 2021
- Coordinator: Le Mans Université, Institute of Human and Social Sciences-Digital Humanities (FR)
- Other partners: CNRS, Institut de Recherche in Informatique et Systèmes Aléatoires (FR); The Open University (UK); Utrecht University, Digital Humanities Lab (NL); Czech Litterature Institute (CZ)

- Abstract: READ-IT will build a unique large-scale, user-friendly, open access, semantically-enriched investigation tool to identify and share groundbreaking evidence about 18th-21st century Cultural Heritage of reading in Europe. The interdisciplinary collaboration between digital humanists, human & social sciences scholars and computer researchers will investigate innovative ways of gathering new resources through crowdsourcing and web-crawling as well as linking and reusing preexisting datasets.

8.4. International Initiatives

8.4.1. NSFC Project: Using transfer learning to understand visual objects and their relationships

Participant: Miaojing Shi.

Duration: 2 years, start in Jan 2019
Partners: Tongji University, China

This project is supported by China National Joint Research Fund for Overseas Chinese Scholars. Machine Perception tasks have flourished since the advent of deep learning techniques. Next key problem lies on visual scene understanding. To make sense of visual scenes, we need to rely on the visual object relationships inside. The challenge for this task is that 1) the training data is limited, on particular those unusual seen objects/object relationships; 2) visual relationships become complicated and diverse with an increase of object numbers. This research shall employ the transfer learning methods to transfer available knowledge of visual relationships to new objects with unknown relationships. The significance of this research is not just to enhance the machine perception ability; it allows us to leverage a relatively small amount of expensively annotated images to detect new objects and their relationships in a much larger dataset without or with only cheap image-level labels.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

- Peking University, China
- Sichuan University, China
- Czech Technical University, Czech Republic
- Computer Science Department, IT University of Copenhagen, Denmark
- Tampere University of Technology, Finland
- National Institute of Informatics, Tokyo, Japan

8.4.3. Participation in Other International Programs

- STIC-AMSUD Project : TRANSFORM
  Participants: Simon Malinowski, Guillaume Gravier, Laurent Amsaleg.

  TRANSFORM is a research project that involves Linkmedia Team, PUC Minas, Brazil and Univ. of Chile. It aims at studying complex transformations of multimedia data in order to facilitate its manipulation. TRANSFORM focuses on transforming multimedia data into compact representations that are suited for indexing and retrieval purposes.

- ConFAP-CNRS Project: FIGTEM
  Participants: Vincent Claveau, Ewa Kijak, Clément Dalloux.

  FIGTEM is a research project that involves STL-CNRS, CHU Rennes, PUC Parana, Curitiba and led by LinkMedia. This project aims at developing natural language processing methods, including information extraction and indexing, dedicated to the clinical trial domain. The goal is to populate a formal representation of patients (via their electronic patient records) and clinical trial data in different languages (French, English, Portuguese).

- NSFC Project : Perception and self-learning of service robot in dynamic scenarios
  Participant: Miaojing Shi.

  This project is the Key Program of National Natural Science Foundation of China, which involves Miaojing Shi from Linkmedia and is led by Tongji University. It aims at improving the perception of service robot in dynamic scenarios through self-learning.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

Zenilton Kleber (PUC Minas, Brazil), November 2018, 2 days
Silvio Guimaraes (PUC Minas, Brazil), December 2018, 10 days
Michael Houle (National Institute of Informatics), July 2018, 7 days

8.5.1.1. Internships

Yohann Gumiel and Lucas Oliveira, PhD students at PUC Parana, Curitiba, Brazil, stayed 3 months (June-August 2018), in Rennes in the framework of the FIGTEM project.
Yanlin Qian, PhD student at Tampere University of Technology, 3 months (Jun-August 2018)

8.5.2. Visits to International Teams

8.5.2.1. Research Stays Abroad

- Guillaume Gravier & Simon Malinowski, PUC Minas, Brazil, March 2018, 1 week.
- Vincent Claveau, PUC Parana, Curitiba, Brazil, November 2018, 1 week, in the framework of the FIGTEM project.
- Miaojing Shi, Tongji University, China, March 2018, 1 week.
- Miaojing Shi, Xian Jiaotong University, China, April 2018, 1 week.
- Yannis Avrithis, National and Kapodistrian University of Athens, 3 visits on February, May and October 2018, 1 week each.
- Laurent Amsaleg & Teddy Furon, National Institute of Informatics, March 2018, 1 week

MAGRIT Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- The project *Imagerie et Robotique Médicale Grand Est (IRMGE)* started in early january 2018. Clinical and interventional imagery is a major public health issue. Teams from the Grand-Est region involved in medical imaging have thus proposed a research project to broaden and strenghten cooperation. The three axis of the project are about optic imagery, nuclear imagery and medical image processing. The Magrit team is especially involved in the third axis, with the aim to improve interventional procedures.
- Lorraine regional project about AR for liver surgery (2015-2018).
  The MAGRIT and the MIMESIS teams have been working for several years on the use of augmented reality for deformable organs and especially on liver surgery. The PhD of Jaime Garcia Guevara started in October 2015 and is funded by the Région Lorraine. It follows on from our past works and aims at improving the reliability and the robustness of AR-based clinical procedures.

8.2. National Initiatives

8.2.1. Projet RAPID EVORA

Participants: M.-O. Berger, V. Gaudillière, G. Simon.
This 3-year project is supported by DGA/DGE and led by the SBS-Interactive company. The objective is to develop a prototype for location and object recognition in large-scale industrial environments (factories, ships...), with the aim to enrich the operator's field of view with digital information and media. The main issues concern the size of the environment, the nature of the objects (often non textured, highly specular...) and the presence of repeated patterns. Use cases will be provided by industrial partners such as DCNS and Areva. A class of officer cadets and professors of the Merchant Marine School will also be associated to judge the pedagogical interest of such a tool. A PhD student, Vincent Gaudillière, has been recruited to work on this project and his contract started in December 2016.

8.2.2. AEN Inria SOFA-InterMedS

Participants: R. Anxionnat (CHU Nancy), M.-O. Berger, E. Kerrien.
The SOFA-InterMedS large-scale Inria initiative is a research-oriented collaboration across several Inria project-teams, international research groups and clinical partners. Its main objective is to leverage specific competences available in each team to further develop the multidisciplinary field of Medical Simulation research. Our action within the initiative takes place in close collaboration with both the MIMESIS team and the Department of diagnostic and therapeutic interventional neuroradiology of Nancy University Hospital. Two PhD students - R. Trivisonne and J. Guarcia Guevara- are currently co-supervised by the Magrit and the MIMESIS teams.

8.3. International Initiatives

8.3.1. Inria International Labs

Inria@EastCoast
Associate Team involved in the International Lab:

8.3.1.1. CURATIVE

Title: CompUteR-based simulAtion Tool for mItral Valve rEpair

International Partner (Institution - Laboratory - Researcher):

Harvard University (United States) - Harvard Biorobotics Lab (HBL) - Robert Howe

Start year: 2017

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

The mitral valve of the heart ensures one-way flow of oxygenated blood from the left atrium to the left ventricle. However, many pathologies damage the valve anatomy producing undesired backflow, or regurgitation, decreasing cardiac efficiency and potentially leading to heart failure if left untreated. Such cases could be treated by surgical repair of the valve. However, it is technically difficult and outcomes are highly dependent upon the experience of the surgeon.

One way to facilitate the repair is to simulate the mechanical behavior of the pathological valve with subject-specific data. Our main goal is to provide surgeons with a tool to study solutions of mitral valve repairs. This tool would be a computer-based model that can simulate a potential surgical repair procedure in order to evaluate its success. The surgeons would be able to customize the simulation to a patient and to a technique of valve repair. Our methodology will be to realistically simulate valve closure based on segmentation methods faithful enough to capture subject-specific anatomy and based on a biomechanical model that can accurately model the range of properties exhibited by pathological valves.

8.3.1.2. Informal International Partners

- Pierre-Frédéric Villard is a co-investigator in the INVIVE project (http://www.it.uu.se/research/scientific_computing/project/rbf/biomech) funded by the Swedish Research Council and realized within a collaboration with Uppsala University and Karolinska Institute. Within this project, he is the co-supervisor of Igor Tominec (Uppsala University) with Elisabeth Larsson (Uppsala University) as the Main advisor.
- With Gabriele Steidl (Technische Universität Kaiserslautern, Germany), we have worked about the removal of Cauchy noise in natural images. This work has led with a publication in *Journal of Mathematical Imaging and Vision* in 2018. The extension of this technique for structured data (on Riemanian variety for instance) will be considered in future works.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Pete Hammer, a senior researcher at Harvard University (http://www.childrenshospital.org/researchers/peter-e-hammer), visited the MAGRIT team from 06/04/18 to 06/10/18. He gave a talk to the Department 1 in Loria, he helped out with mechanical modeling of the mitral valve and he provided advice to Daryna Panicheva supervision during one week.
- Rob Howe, a full professor at Harvard University (http://people.seas.harvard.edu/~howe/), visited the MAGRIT team from 06/16/18 to 06/20/18. He gave a talk to the Department 1 in Loria, he helped out with science understanding of the valve and he helped Daryna Panicheva supervision during one week.

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

Pierre-Frederic Villard spent one month (May 2018) at Uppsala University working on the INVIVE project. His work there includes supervising PhD student Igor Tominec, meeting with a physiologist expert in respiration muscles and working on an implicit surface representation of the diaphragm.

MORPHEO Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

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

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

9.1.1.2. ANR project Achmov – Accurate Human Modeling in Videos

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

9.1.2. Competitivity Clusters

9.1.2.1. FUI project Creamove

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

9.1.2.2. FUI24 SPINE-PDCA

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

PERCEPTION Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. VHIA

Title: Vision and Hearing in Action

EU framework: FP7

Type: ERC Advanced Grant

Duration: February 2014 - January 2019

Coordinator: Inria

Inria contact: Radu Horaud

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

7.1.2. VHIALab

Title: Vision and Hearing in Action Laboratory

EU framework: H2020

Type: ERC Proof of Concept

Duration: February 2018 - January 2019

Coordinator: Inria

Inria contact: Radu Horaud

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

7.2. International Research Visitors

7.2.1. Visits of International Scientists

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

SIROCCO Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. ICON 3D - Interactive COding for Navigation in 3D scenes

Participant: Thomas Maugey.

- Title : Interactive COding for Navigation in 3D scenes
- *Partners*: Inria-Rennes (Sirocco) and I3S Sophia-Antipolis (M. Antonini)
- *Funding*: CNRS GDR ISIS
- Period : Sept.2017-Sept.2018.

The project ICON 3D, funded by the GdR-Isis, aims at developing new geometry prediction algorithms for surface meshes. Given a part of a mesh, the prediction algorithm should be able to estimate a neighboring mesh subset corresponding to the one newly visible after user viewpoint angle change.

9.1.2. CominLabs InterCom project

Participants: Aline Roumy, Thomas Maugey.

- Title : Interactive Communication (INTERCOM): Massive random access to subsets of compressed correlated data .
- Research axis : 7.4.1
- Partners : Inria-Rennes (Sirocco team and I4S team); LabSTICC, IMT-Atlantique, Signal & Communications Department; External partner: M. Kieffer L2S.
- Funding : Labex CominLabs.
- Period : Oct. 2016 - Nov. 2019.

This project aims to develop novel compression techniques allowing massive random access to large databases. Indeed, we consider a database that is so large that, to be stored on a single server, the data have to be compressed efficiently, meaning that the redundancy/correlation between the data have to be exploited. The dataset is then stored on a server and made available to users that may want to access only a subset of the data. Such a request for a subset of the data is indeed random, since the choice of the subset is user-dependent. Finally, massive requests are made, meaning that, upon request, the server can only perform low complexity operations (such as bit extraction but no decompression/compression). Algorithms for two emerging applications of this problem are being developed: Free-viewpoint Television (FTV) and massive requests to a database collecting data from a large-scale sensor network (such as Smart Cities).

9.2. European Initiatives

9.2.1. FP7 & H2020 Projects

9.2.1.1. ERC-CLIM

Participants: Pierre Allain, Pierre David, Elian Dib, Simon Evain, Christian Galea, Christine Guillemot, Laurent Guillo, Xiaoran Jiang, Jinglei Shi.

- Title : Computational Light field Imaging.
- Research axis : 7.1.2 , 7.1.3 , 7.2.1 , 7.2.3 , 7.2.4 , 7.3.1 , 7.3.2 , 7.3.3
- Partners : Inria-Rennes
- Funding : European Research Council (ERC) advanced grant
- Period : Sept. 2016 - Aug. 2021.

Light fields yield a rich description of the scene ideally suited for advanced image creation capabilities from a single capture, such as simulating a capture with a different focus and a different depth of field, simulating lenses with different apertures, for creating images with different artistic intents or for producing 3D views. Light fields technology holds great promises for a number of application sectors, such as photography, augmented reality, light field microscopy, but also surveillance, to name only a few.

The goal of the ERC-CLIM project is to develop algorithms for the entire static and video light fields processing chain, going from compact sparse and low-rank representations and compression to restoration, high quality rendering and editing.

9.3. International Initiatives

9.3.1. Inria International Labs

9.3.1.1. EPFL-Inria

- Title: Graph-based Omnidirectional video Processing
- International Partner: Ecole Polytechnique Fédérale de Lausanne (Switzerland), LTS4, Pascal Frossard
- Period: 2017-2018

Due to new camera types, the format of the video data has become more complex than simple 2D images or videos as it was the case a few years ago. In particular, the omnidirectional cameras provide pixels on a whole sphere around a center point and enable a vision in 360 degrees. In addition to the fact that the data size explodes with such cameras, the inherent structure of the acquired signal fundamentally differs from the 2D images, which makes the traditional video codec obsolete. In parallel of that, an important effort of research has been led recently, especially at EPFL, to develop new processing tools for signals lying on irregular structures (graphs). It enables in particular to build efficient coding tools for new types of signals. The project studies how graphs can be built for defining a suitable structure on one or several omnidirectionnal videos and then used for compression.

9.3.2. Inria International Partners

9.3.2.1. Informal International Partners

We have international collaborations with:

- Reuben Farrugia, Prof. at the University of Malta, with whom we continue collaborating on light field super-resolution.The collaboration started during the sabbatical year (Sept. 2015-Aug. 2016) he spent within the team.
- Ehsan Miandji and Prof. Jonas Unger from Linkoping Univ. with whom we collaborate on compressive sampling of light fields.
- Mikael Le Pendu and Prof. Aljosa Smolic from Trinity College Dublin on HDR light field recovery from multiple exposures.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Reuben Farrugia, Prof. at the University of Malta, spent 2 weeks in the team (June 2018).
- Alexander Sagel, assistant researcher at the Technical University Munich (Oct.-Nov. 2018).
- Mikael Le Pendu and Martin Alain, postdocs at Trinity College Dublin (Nov. 2018).

STARS Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

9.1.1.1. ENVISION

Program: ANR JCJC

Project acronym: ENVISION

Project title: Computer Vision for Automated Holistic Analysis of Humans

Duration: October 2017-September 2020.

Coordinator: Antitza Dantcheva (STARS)

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

9.1.2. FUI

9.1.2.1. Visionum

Program: FUI

Project acronym: Visionum

Project title: Visonium.

Duration: January 2015- December 2018.

Coordinator: Groupe Genious

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

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

9.1.2.2. StoreConnect

Program: FUI

Project acronym: StoreConect.

Project title: StoreConnect.

Duration: September 2016 - September 2018.

Coordinator: Ubudu (Paris).

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

Abstract: StoreConnect is an FUI project started in 2016 and will end in 2018. The goal is to improve the shopping experience for customers inside supermarkets by adding new sensors such as cameras, beacons and RFID. By gathering data from all the sensors and combining them, it is possible to improve the way to communicate between shops and customers in a personalized way. StoreConnect acts as a middleware platform between the sensors and the shops to process the data and extract interesting knowledge organized via ontologies.

9.1.2.3. ReMinAry

Program: FUI

Project acronym: ReMinAry.

Project title: ReMinAry.

Duration: September 2016 - September 2019.

Coordinator: GENIOUS Systèmes,

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

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

9.2. International Initiatives

9.2.1. International Initiatives

FER4HM

Title: Facial expression recognition with application in health monitoring

International Partner (Institution - Laboratory - Researcher):

Chinese Academy of Sciences (China) Institute of Computing Technology - Hu HAN

Duration: 2017 - 2019

Start year: 2017

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

The proposed research aims to provide computer vision methods for facial expression recognition in patients with Alzheimer's disease. Most importantly though, the work seeks to be part of a paradigm shift in current healthcare, in efficiently and cost effectively finding objective measures to (a) assess different therapy treatments, as well as to (b) enable automated human-computer interaction in remote large-scale healthcare- frameworks. Recognizing expressions in severely demented Alzheimer's disease (AD) patients is essential, since such patients have lost a substantial amount of their cognitive capacity [1-3], and some even their verbal communication ability (e.g., aphasia)2. This leaves patients dependent on clinical staff to assess their verbal and non-verbal language, in order to communicate important messages, as of discomfort associated to potential complications of the AD [9, 10]. Such assessment classically requires the patients' presence in a clinic, and time consuming examination involving medical personnel. Thus, expression monitoring is costly and logistically inconvenient for patients and clinical staff, which hinders among others large-scale monitoring. Approaches need to cater to the challenging settings of current medical recordings,

which include continuous pose variations, occlusions, camera-movements, camera-artifacts, as well as changing illumination. Additionally and importantly, the (elderly) patients exhibit generally less profound facial activities and expressions in a range of intensities and predominantly occurring in combinations (e.g., talking and smiling). Both, Inria-STARS and CAS-ICT have already initiated research activities related to the here proposed topic. While both sides have studied facial expression recognition, CAS-ICT has explored additionally the use of heart rate monitoring sensed from a webcam in this context.

SafEE

Title: Safe Easy Environment

International Partner (Institution - Laboratory - Researcher):

Duration: 2018 - 2020

Start year: 2018

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

9.3. International Research Visitors

9.3.1. Visits to International Teams

Antitza Dantcheva visited Wael Abd-Almageed's laboratory at the Information Sciences Institute of the University of Southern California Viterbi School of Engineering in August 2018.

Antitza Dantcheva, Abhijit Das and Yaohui Wang visited the Institute of Computing Technology (ICT) at the Chinese Academy of Sciences (CAS) in August 2018.

THOTH Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. DeCore (Deep Convolutional and Recurrent networks for image, speech, and text)

Participants: Jakob Verbeek, Maha Elbayad.

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

9.1.2. PEPS AMIES AuMalis POLLEN

Participant: Karteek Alahari.

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

9.2. National Initiatives

9.2.1. ANR Project Macaron

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

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

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

9.2.2. ANR Project DeepInFrance

Participants: Jakob Verbeek, Adria Ruiz Ovejero.

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

9.2.3. ANR Project AVENUE

Participant: Karteek Alahari.

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

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. ERC Advanced grant Allegro

Participants: Cordelia Schmid, Pavel Tokmakov, Konstantin Shmelkov, Vladyslav Sydorov, Daan Wynen, Mikita Dvornik, Xavier Martin.

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

9.3.1.2. ERC Starting grant Solaris

Participants: Julien Mairal, Ghislain Durif, Andrei Kulunchakov, Alberto Bietti, Dexiong Chen, Gregoire Mialon.

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

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

9.4. International Initiatives

9.4.1. Inria International Labs

Inria@EastCoast

Associate Team involved in the International Lab:

9.4.1.1. GAYA

Title: Semantic and Geometric Models for Video Interpretation

International Partner (Institution - Laboratory - Researcher):

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

Start year: 2016

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

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

9.4.2. Inria International Partners

9.4.2.1. Informal International Partners

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

9.4.3. Participation in Other International Programs

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

9.5. International Research Visitors

9.5.1. Visits of International Scientists

9.5.1.1. Internships

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

WILLOW Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. DGA - RAPID project DRAAF

Participant: Ivan Laptev.

DGA DRAAF is a two-year collaborative effort with University of Caen (F. Jurie) and the industrial partner EVITECH (P. Bernas) focused on modelling and recognition of violent behaviour in surveillance videos. The project aims to develop image recognition models and algorithms to automatically detect weapons, gestures and actions using recent advances in computer vision and deep learning to provide an affordable real-time solution reducing effects of threats in public places.

9.2. European Initiatives

9.2.1. European Research Council (ERC) Starting Grant: “Activia" - Ivan Laptev

Participant: Ivan Laptev.

WILLOW will be funded in part from 2013 to 2018 by the ERC Starting Grant "Activia" awarded to Ivan Laptev by the European Research Council.

‘Computer vision is concerned with the automated interpretation of images and video streams. Today’s research is (mostly) aimed at answering queries such as ’Is this a picture of a dog?’, (classification) or sometimes ’Find the dog in this photo’ (detection). While categorisation and detection are useful for many tasks, inferring correct class labels is not the final answer to visual recognition. The categories and locations of objects do not provide direct understanding of their function i.e., how things work, what they can be used for, or how they can act and react. Such an understanding, however, would be highly desirable to answer currently unsolvable queries such as ’Am I in danger?’ or ’What can happen in this scene?’. Solving such queries is the aim of this proposal. My goal is to uncover the functional properties of objects and the purpose of actions by addressing visual recognition from a different and yet unexplored perspective. The main novelty of this proposal is to leverage observations of people, i.e., their actions and interactions to automatically learn the use, the purpose and the function of objects and scenes from visual data. The project is timely as it builds upon the two key recent technological advances: (a) the immense progress in visual recognition of objects, scenes and human actions achieved in the last ten years, as well as (b) the emergence of a massive amount of public image and video data now available to train visual models. ACTIVIA addresses fundamental research issues in automated interpretation of dynamic visual scenes, but its results are expected to serve as a basis for ground-breaking technological advances in practical applications. The recognition of functional properties and intentions as explored in this project will directly support high-impact applications such as detection of abnormal events, which are likely to revolutionise today’s approaches to crime protection, hazard prevention, elderly care, and many others.’

9.2.2. European Research Council (ERC) Starting Grant: "Leap" - Josef Sivic

Participant: Josef Sivic.

The contract has begun on Nov 1st 2014. WILLOW will be funded in part from 2014 to 2018 by the ERC Starting Grant "Leap" awarded to Josef Sivic by the European Research Council.

'People constantly draw on past visual experiences to anticipate future events and better understand, navigate, and interact with their environment, for example, when seeing an angry dog or a quickly approaching car. Currently there is no artificial system with a similar level of visual analysis and prediction capabilities. LEAP is a first step in that direction, leveraging the emerging collective visual memory formed by the unprecedented amount of visual data available in public archives, on the Internet and from surveillance or personal cameras - a complex evolving net of dynamic scenes, distributed across many different data sources, and equipped with plentiful but noisy and incomplete metadata. The goal of this project is to analyze dynamic patterns in this shared visual experience in order (i) to find and quantify their trends; and (ii) learn to predict future events in dynamic scenes. With ever expanding computational resources and this extraordinary data, the main scientific challenge is now to invent new and powerful models adapted to its scale and its spatio-temporal, distributed and dynamic nature. To address this challenge, we will first design new models that generalize across different data sources, where scenes are captured under vastly different imaging conditions such as camera viewpoint, temporal sampling, illumination or resolution. Next, we will develop a framework for finding, describing and quantifying trends that involve measuring long-term changes in many related scenes. Finally, we will develop a methodology and tools for synthesizing complex future predictions from aligned past visual experiences. Our models will be automatically learnt from large-scale, distributed, and asynchronous visual data, coming from different sources and with different forms of readily-available but noisy and incomplete metadata such as text, speech, geotags, scene depth (stereo sensors), or gaze and body motion (wearable sensors). Breakthrough progress on these problems would have profound implications on our everyday lives as well as science and commerce, with safer cars that anticipate the behavior of pedestrians on streets; tools that help doctors monitor, diagnose and predict patients' health; and smart glasses that help people react in unfamiliar situations enabled by the advances from this project.'

9.3. International Initiatives

9.3.1. IMPACT: Intelligent machine perception

Participants: Josef Sivic, Jean Ponce, Ivan Laptev.

IMPACT is a 5-year collaborative project with Czech Technical University, Center for Robotics, Informatics and Cybernetics (CIIRC) (2017-2022). The IMPACT project focuses on fundamental and applied research in computer vision, machine learning and robotics to develop machines that learn to perceive, reason, navigate and interact with complex dynamic environments. For example, people easily learn how to change a flat tire of a car or perform resuscitation by observing other people doing the same task. This involves advanced visual intelligence abilities such as interpreting sequences of human actions that manipulate objects to achieve a specific task. Currently, however, there is no artificial system with a similar level of cognitive visual competence. Breakthrough progress in intelligent machine perception will have profound implications on our everyday lives as well as science and commerce, with smart assistive robots that automatically learn new skills from the Internet, safer cars that autonomously navigate in difficult changing conditions, or intelligent glasses that help people navigate never seen before environments.

9.3.2. Associate team GAYA

Participants: Jean Ponce, Matthew Trager.

GAYA is a joint research team bringing together two Inria project-teams (Thoth, Grenoble and WILLOW, Paris) and Carnegie Mellon University, USA. It focuses on two research themes: (i) semantic structured interpretation of videos, and (ii) studying the geometric properties of object shapes to enhance state-of-the-art object recognition approaches.

Interpreting videos semantically in a general setting, involving various types of video content like home video clips, news broadcasts, feature films, which contain a lot of clutter, non-rigid motion, many "actors" performing actions, person-object and person-person interactions, varying viewpoints, is challenging. This task is being examined increasingly over the past decade, with the availability of large video resources, e.g., YouTube. Despite this progress, an effective video representation for recognizing actions is still missing.

To address this critical challenge, we propose a joint optimization framework, wherein we learn the video representation and also develop models for action recognition. Specifically, we aim to exploit the spatio-temporal relations among pixels in a video through graphical models and novel deep learning feature representations.

The second research theme explores geometric aspects of computer vision, in particular how to model three-dimensional objects from their two-dimensional projections, and how the appearance of these objects evolves with changes in viewpoint. Beyond its theoretical interest, this work is critical for developing object recognition algorithms that take into account the three-dimensional nature of the visual world and go beyond the template-matching approaches dominant today. Duality is an important concept in this area, and we are investigating its application to the construction of visual hulls as well as the characterization of the topology of image contours using the Gauss map. Existing results are essentially limited to the Euclidean setting, and we are investigating their generalization to the general projective case.

Partners: CMU (Deva Ramanan, Martial Hebert, Abhinav Gupta, Gunnar Sigurdsson), Inria Thoth (Cordelia Schmid, Karteek Alahari, Pavel Tokmakov).

9.4. International Research Visitors

9.4.1. Visits of International Scientists

Alexei Efros (Professor, UC Berkeley, USA) visited Willow during May-June. Ramazan Cinbis (Middle East Technical University) and David Fouhey (University of Michigan) visited Willow in July-August and September-November, respectively. Akihiko Torii (Tokyo Institute of Technology) spent sabbatical at Willow from Apr to August 2018. Finally, Pierre-Yves Masse (post-doc, Czech Technical University) spent 50% of his time at Sierra (F. Bach) and Willow teams as a visiting post-doc within the framework of collaboration with the Intelligent Machine Perception project lead by J. Sivic at the Czech Technical University in Prague.