RESEARCH CENTER

FIELD
Perception, Cognition and Interaction

Activity Report 2019

Section Partnerships and Cooperations

Edition: 2020-03-21

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.
- ContentCheck (2015-2018) is an ANR project led by I. Manolescu, 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.
- CQFD (2019-2022) is an ANR project coordinated by F. Ulliana (U. Montpellier), in collaboration with U. Rennes 1 (F. Goasdoué), Inria Lille (P. Bourhis), Institut Mines Télécom (A. Amarilli), Inria Paris (M. Thomazo) and CNRS (M. Bienvenu). Its research aims at investigating efficient data management methods for ontology-based access to heterogeneous databases (polystores).

8.1.2. Others

- 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.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

- We collaborate with Alin Deutsch and Rana Al-Otaibi from the University of California in San Diego, on the topic of efficient data management in polystore sytems.
- We collaborate with Helena Galhardas from the University of Lisbon on the topic of efficiently interconnecting heterogeneous data sources for journalistic applications.
- We collaborate with Anna Liu from U. Massachussets at Amherst; she co-advises PhD thesis of several students in the group (E. Huang and L. Di Palma).

8.3.3. Participation in 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/connectionlens/

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

We have hosted from January to July 2019 the sabbatical visit of Juliana Freire, a professor at the New York University and the president of the prestigious ACM SIGMOD scientific association.

GRAPHIK Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

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

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

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

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

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

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

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

8.1.3. Docamex (CASDAR project, 2017-2020)

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

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

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

8.1.4. Convergence Institute #DigitAg (2017-2023)

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

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

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

Participant: Rallou Thomopoulos.

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

8.1.6. Informal National Partners

We continue to work informally with the following partners:

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

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

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

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

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

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

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

Participants: Patrice Buche, Pierre Bisquert, Madalina Croitoru.

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

8.2.2. Collaborations in European Programs, Except FP7 & H2020

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

Participants: Patrice Buche, Madalina Croitoru, Rallou Thomopoulos.

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

8.3. International Research Visitors

8.3.1. Visits of International Scientists

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

8.3.2. Visits to International Teams

8.3.2.1. Research Stays Abroad

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

LACODAM Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

- **HyAIAI: Hybrid Approaches for Interpretable AI**
  Participants: E. Fromont (leader), A. Termier, L. Galárraga
  The Inria Project Lab HyAIAI is a consortium of Inria teams (Sequel, Magnet, Tau, Orpailleur, Multispeech, and LACODAM) that work together towards the development of novel methods for machine learning, that combine numerical and symbolic approaches. The goal is to develop new machine learning algorithms such that (i) they are as efficient as current best approaches, (ii) they can be guided by means of human-understandable constraints, and (iii) its decisions can be better understood.
- **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.
- **#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).

9.1.1. ANR

- **FAbLe: Framework for Automatic Interpretability in Machine Learning**
  Participants: L. Galárraga (holder), C. Largouët
  How can we fully automatically choose the best explanation for a given use case in classification?. Answering this question is the raison d'être of the JCJC ANR project FAbLe. By "best explanation" we mean the explanation that yields the best trade-off between interpretability and fidelity among a universe of possible explanations. While fidelity is well-defined as the accuracy of the explanation w.r.t the answers of the black-box, interpretability is a subjective concept that has not been formalized yet. Hence, in order to answer our prime question we first need to answer the question: "How can we formalize and quantify interpretability across models?". Much like research in automatic machine learning has delegated the task of accurate model selection to computers [26], FAbLe aims at fully delegating the selection of interpretable explanations to computers. Our goal is to produce a suite of algorithms that will compute suitable explanations for ML algorithms based on our insights of what is interpretable. The algorithms will choose the best explanation method based on the data, the use case, and the user's background. We will implement our algorithms so that they are fully compatible with the body of available software for data science (e.g., Scikit-learn).

9.1.2. National Platforms

- **PEPS: Pharmaco-epidemiology for Health Products**
  Participants: J. Bakalara, 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 [25], [24] to mine patterns on care pathways.

9.2. International Research Visitors

9.2.1. Internships

From September to December 2019 we hosted Vaishnavi Bhargava, a computer science student from the Birla Institute of Technology and Science in Pilani, who worked on "Automatic Neighborhood Design for Localized Model-interpretation". Her work aimed at finding a set of metrics and procedures to determine the best parameterization of the method LIME for local post-hoc interpretability of machine learning models. The goal of this effort is to inform users of the parameter values (if any) for which a LIME explanation should be trusted because it can faithfully reproduce the behavior of the black-box it tries to explain.

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
- Gallot'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: Joachim Niehren [correspondent], Aurélien Lemay, Adrien Boiret [University of Mons, Belgium], Florent Capelli.

- The coordinator is J. Niehren and the partners are the Université Paris 7 (A. Durand) including members of the Inria project DAHU (L. Ségoufin), the Université de Marseille (N. Creignou) and Université de 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: Joachim Niehren [correspondent], Aurélien Lemay, Sophie Tison, Adrien Boiret [University of Mons, Belgium], Vincent Hugot [INSA Centre-Val de Loire], Nicolas Bacquey [Twig], Paul Gallot, Sylvain Salvati.

- The coordinator is R. Treinen from the Université 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: Iovka Boneva [correspondent], Sophie Tison, Jose Martin Lozano.

- Partners: The coordinator is E. Contejean from the Université Paris-Sud and the other partner is the Université de 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: Joachim Niehren [correspondent], Momar Sakho, Nicolas Crosetti, Florent 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: Joachim Niehren [correspondent], Sylvain Salvati, Aurélien Lemay, Nicolas Bacquey [Twig], Lily 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):
Participant: Sylvain Salvati [correspondent].

- Scientific Partners: The coordinator is Jérôme Leroux from LaBRI, Université de 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, UK: An exchange project with the computer science lab of the University of Oxford is funded by the Université de Lille via the CRIStAL Lab. Links' members produced many common publications over the years with Oxford. Links' contact is C. Paperman.

Wroclaw, Poland: S. Staworko has regular exchange with the University of Wroclaw. This has led to a publication at *PODS* [10] together with P. Wieczorek.

Saint-Petersburg, Russia: S. Salvati and J. Niehren started a cooperation with the Saint-Petersburg State University, via a month-long visit by R. Azimov and S. Grigorev.

Oviedo, Spain: I. Boneva has an active cooperation with the University of Oviedo.

9.4. International Initiatives

9.4.1. Informal International Partners

Santiago de Chile, Chile: S. Staworko and I. Boneva have a collaboration with C. Riveros from the Pontifical Catholic University of Chile since 2018.

MAGNET Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

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.

MAGNET also has various collaborations with research groups in linguistics and psycholinguistics at Université de Lille, in particular UMR STL (with an ongoing joint ANR project) and UMR SCALab (co-supervision of students).

8.2. National Initiatives

8.2.1. 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/

8.2.2. 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/

8.2.3. 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.

8.2.4. ANR-NFS REM (2016-2020)

Participants: PASCAL DENIS [correspondent], BO LI, MATHIEU DEHOUCK

With colleagues from the linguistics departments at Université de Lille and University of 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 (Université de Lille) 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.

8.3. European Initiatives

8.3.1. FP7 & H2020 Projects

Participants: Aurelien Bellet, Marc Tommasi, Brij Mohan Lal Srivastava.

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 [Inria Nancy - Grand Est]

Other partners: Inria Multispeech, Ascora GmbH, Netfective Technology SA, Rooter Analysis SL, Tilde SIA, University of Saarland

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.

8.3.2. Collaborations in European Programs, Except FP7 & H2020

Program: Bilateral ANR project with Luxembourg

Project acronym: SLANT

Project title: Spin and Bias in Language Analyzed in News and Texts

Duration: Dec 2019 - June 2023

Coordinator: Philippe Muller [Université Paul Sabatier]

Other partners: IRIT (Toulouse), SnT (Luxembourg)

Abstract: There is a growing concern about misinformation or biased information in public communication, whether in traditional media or social forums. While automating fact-checking has received a lot of attention, the problem of fair information is much larger and includes more insidious forms like biased presentation of events and discussion. The SLANT project aims at characterizing bias in textual data, either intended, in public reporting, or unintended in writing aiming at neutrality. An abstract model of biased interpretation using work on discourse structure, semantics and interpretation will be complemented and concretized by finding relevant lexical, syntactic, stylistic or rhetorical differences through an automated but explainable comparison of texts with different biases on the same subject, based on a dataset of news media coverage from a diverse set of sources. We will also explore how our results can help alter bias in texts or remove it from automated representations of texts.

8.4. International Initiatives

8.4.1. Inria International Labs

Inria@SiliconValley
Associate Team involved in the International Lab:

8.4.1.1. LEGO

Title: LEarning GOod representations for natural language processing

International Partner (Institution - Laboratory - Researcher):

University of Southern California (United States) - Theoretical and Empirical Data Science (TEDS) research group Department of Computer Science - Fei Sha

Start year: 2019

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 text data and how to learn them in a robust and transferable way? How to apply such representations to solve real-world NLP tasks, specifically in scenarios where linguistic resources are scarce? The past years have seen an increasing interest in learning continuous vectorial embeddings, which can be trained together with the prediction model in an end-to-end fashion, as in recent sequence-to-sequence neural models. However, they are unsuitable to low-resource languages as they require massive amounts of data to train. They are also very prone to overfitting, which makes them very brittle, and sensitive to bias present in the original text as well as to confounding factors such as author attributes. LEGO strongly relies on the complementary expertise of the two partners in areas such as representation learning, structured prediction, graph-based learning, multi-task/transfer learning, and statistical NLP to offer a novel alternative to existing techniques. Specifically, we propose to investigate the following two research directions: (a) optimize the representations to make them robust to bias and adversarial examples, and (b) learn transferable representations across languages and domains, in particular in the context of structured prediction problems for low-resource languages. We will demonstrate the usefulness of the proposed methods on several NLP tasks, including multilingual dependency parsing, machine translation, question answering and text summarization.

8.4.2. 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.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

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

- A. Korba (University College London, UK): Two families of (non-parametric) methods for label ranking
- M. Perrot (Max Planck Institute, Germany): Comparison-Based Learning: Hierarchical Clustering and Classification

8.5.2. Visits to International Teams

8.5.2.1. Research Stays Abroad

- FABIO VITALE was 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 and published the following papers [6], [12], [10].
- AURÉLIEN BELLET and CÉSAR SABATER visited the Alan Turing Institute (London, UK) for one week in March 2019. They worked with Adrià Gascón, Brooks Paige, Daphne Ezer and Matt Kusner on privacy-preserving machine learning and privacy attacks in genomics.

MOEX Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Elker

Program: ANR-PRC

Project acronym: ELKER

Project title: Extending link keys: extraction and reasoning

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

Duration: October 2017 - September 2021

Coordinator: LIG/Manuel Atencia

Participants: Manuel Atencia Arcas, Jérôme David, Jérôme Euzenat

Other partners: Inria Lorraine, Université de Vincennes+Université Paris 13

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.

7.1.2. PEPS RegleX-LD

Program: Projets Exploratoires Premier Soutien (CNRS, INS2I)

Project acronym: REGLEX-LD

Project title: Découverte de règles expressives de correspondances complexes et de liage de données

Duration: January 2019 – December 2019

Coordinator: IRIT/Cássia Trojahn

Participants: Manuel Atencia Arcas, Jérôme David, Jérôme Euzenat

Other partners: IRIT Toulouse, INRA Paris, LRI Orsay

Abstract: RegleX-LD aims at discovering expressive ontology correspondences and data interlinking patterns using unsupervised or weakly supervised methods.

7.2. International Research Visitors

7.2.1. Visits of International Scientists

7.2.1.1. Internships

- Nacira Abbas (U. Lorraine) visited mOeX between 2019-02-04 and 2019-02-15 in the framework of the Elker project, working on link keys extraction with formal concept analysis.
- Hiba Belhadi, PhD student at Université des Sciences et de la Technologie Houari Boumediene (UTHB), Algiers, visited mOeX between 2019-10-15 and 2019-11-15 to work on selecting and matching properties for data interlinking.

ORPAILLEUR Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

9.1.1.1. ANR ELKER (2017–2020)

Participants: Nacira Abbas, Miguel Couceiro, Amedeo Napoli.

The objectives of the ELKER ANR Research Project (https://project.inria.fr/elker/) are to study, formalize, and implement the search for link keys in RDF data [2]. Link keys generalize database keys in two independent directions, as firstly they deal with RDF data and secondly they apply across two relation datasets. In this project, we study the discovery of link keys and reasoning with link keys, being based on the FCA formalism. The ELKER project relies on the competencies of the Orpailleur Team in FCA and pattern structure algorithms, and also in 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 Grenoble Rhône Alpes, and LIASD at Université Paris 8.

9.1.1.2. ANR PractiKPharma (2016–2020)

Participants: Miguel Couceiro, Adrien Coulet, Pierre Monnin, Amedeo Napoli, 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. While most of the available knowledge in pharmacogenomics –state of the art knowledge– lies in the biomedical literature, with various levels of validation, an originality of PractiKPharma is to use Electronic Health Records (EHRs) to constitute cohorts of patients where to discover knowledge units. Indeed, these cohorts are mined for discovering potential pharmacogenomics patterns to be then validated w.r.t. literature knowledge for becoming actionable knowledge units. More precisely, firstly we have to discover 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 –the literature is in English whereas EHRs are in French– and on knowledge level, as EHRs represent observations at the patient level whereas the 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.

9.1.1.3. ANR AstroDeep (2019–2022)

Participants: Miguel Couceiro, Amedeo Napoli, Claire Theobald.

Astronomical surveys planned for the coming years will produce data that present analysis challenges not only because of their scale (hundreds of petabytes), but also by the complexity of the measurement challenges on very deep images (for instance subpercent-level measurement of colors or shapes on blended objects). New machine learning techniques appear very promising: once trained, they are very efficient and excel at extracting features from complex images. In the AstroDeep project, we aim at developing such machine learning techniques that can be applied directly on complex images without going through the traditional steps of astronomical image processing, that lose information at each stage. The developed techniques will help to leverage the observation capabilities of future surveys (LSST, Euclid, and WFIRST), and will allow a joint analysis of data.

The AstroDeep ANR Project involves three labs, namely APC Paris ("Astroparticules et Cosmologie Paris"), the Orpailleur Team at Inria Nancy Grand Est/LORIA, and "Département d'Astrophysique CEA Saclay".

9.1.2. Inria Project Labs, Exploratory Research Actions, and Technological Development Actions

Participants: Guilherme Alves Da Silva, Alexandre Bazin, Miguel Couceiro, Nyoman Juniarta, Tatiana Makhalova, Amedeo Napoli, Laureline Nevin, Abdelkader Ouali, Claire Theobald, Georgios Zervakis.

HyAiAI (IPL 2019-2022) Recent progress in Machine Learning (ML) and especially in Deep Learning has made ML present and prominent in a wide range of applications. However, current and efficient ML approaches rely on complex numerical models. Then, the decisions which are proposed may be accurate but cannot be easily explained to the layman, especially in some cases where complex and human-oriented decisions should be made, e.g. to get a loan or not, to obtain a chosen enrollment at university. The objectives of the HyAIAI IPL are to study the problem of making ML methods interpretable. For that, we will design hybrid ML approaches that combine state of the art numerical models (e.g. neural networks) with explainable symbolic models (e.g. pattern mining). More precisely, one goal is to integrate high level domain constraints into ML models, to provide model designers information on ill-performing parts of the model, and to give the layman/practitioner understandable explanations on the results of the ML model.

The HyAIAI IPL project involves seven Inria Teams, namely Lacodam in Rennes (project leader), Magnet and SequeL in Lille, Multispeech and Orpailleur in Nancy, and TAU in Saclay.

Ordem (ADT 2019-2020) One of the outputs of the former Hybride ANR project was the Orphamine system which aims at information retrieval and diagnosis aid in the domain of "rare diseases". The Orphamine system is based on domain knowledge, and in particular on medical ontologies such as ORDO ("Orphanet Rare Diseases Ontology") and HPO ("Human Phenotype Ontology"). In this way, the objective of the "Ordem" ADT is to update Orphamine, in making the system more accessible and more open. This requires many developments for developing the connections with domain knowledge, graph mining methods for retrieving relevant units in knowledge graphs, actual visualization tools, pattern mining, statistical decision tools for decision making (in particular log-linear models), and as well text mining tools for analyzing expert queries and medical literature about rare diseases. Such developments are and will be carried out until the end of next year, for making the system robust and publicly accessible through a web interface.

HyGraMi (PRE Inria 2018-2020) Finally, the so called "projet de recherche exploratoire" (PRE) HyGraMi for "Hybrid Graph Mining for the Design of New Antibacterials" is about the fight against resistance of bacteria to antibiotics. The objective of HyGraMi is to design a hybrid data mining system for discovering new antibacterial agents. This system should rely on a combination of numeric and symbolic classifiers, that will be guided by expert domain knowledge. The analysis and classification of the chemical structures is based on an interaction between symbolic methods e.g. graph mining techniques, and numerical supervised classifiers based on exact and approximate matching. This year we work on a method based on tree decomposition for performing feature selection and improving data lining of such complex molecular structures [49].

9.2. European Initiatives

9.2.1. The H2020 CrossCult Project (2016-2019)

Participants: Miguel Couceiro, Nyoman Juniarta, Amedeo Napoli.

The H2020 CrossCult [0] project 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, (i) to lower cultural EU barriers and create unique cross-border perspectives, by connecting existing digital historical resources and by creating new ones through public participation, (ii) to create long-lasting experiences of social learning and entertainment that will provide a better understanding and re-interpretation of European history. To achieve

[0] http://www.crosscult.eu/

this, CrossCult aims at connecting and combining existing digital cultural assets, at increasing integration, interaction, and reflection about European past and present history. CrossCult was implemented w.r.t. four real-world pilots including cities, museums, and cultural sites. The role of the Orpailleur Team, in conjunction with the LORIA Kiwi Team, was to work on data mining –actually sequence mining– and recommendation, with a focus on the mining visitor trajectories in a museum or a touristic site, and on the definition of a visitor profile in connection with domain knowledge.

The CrossCult project involved many teams, namely Luxembourg Institute for Science and Technology and Centre Virtuel de la Connaissance sur l'Europe (Luxembourg, leaders 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), and the Kiwi Team from LORIA together with the Orpailleur team.

9.3. International Initiatives

9.3.1. Inria International Labs

Inria@SiliconValley

Associate Team involved in the International Lab:

9.3.1.1. Snowball

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

International Partner (Institution - Laboratory - Researcher):

University of 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). This is motivated by the fact that many factors, genetic as well as environmental, contribute to 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, Adrien Coulet finished in September 2019 a two-years sabbatical stay in the lab of Nigam Shah at Stanford University initiated in September 2017 (and partly granted by an "Inria délégation").

9.3.2. Informal International Partners: Research Collaboration with HSE Moscow

Participants: Alexandre Bazin, Nacira Abbas, Guilherme Alves Da Silva, Miguel Couceiro, Nyoman Juniarta, Tatiana Makhalova, Amedeo Napoli, Justine Reynaud.

An ongoing 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 ongoing thesis of Tatiana Makhalova), and the the organization of scientific events, as the workshop FCA4AI with seven editions between 2012 and 2019 (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 seventh edition of the FCA4AI workshop in August 2019 at the IJCAI Conference which was held in Macao China.

PETRUS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. 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.

8.1.2. GDP-ERE, DATA-IA project (Sept. 2018 - Jan. 2022)

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

8.1.3. Postdoc DIM RFSI, Ile-de-France Region (2019 - 2020)

Partners: Inria (PETRUS).
This project is a continuation of Julien Loudet's Phd thesis. Julien finalized a CIFRE thesis defended in October 2019. This thesis is the result of a solid collaboration (another CIFRE thesis was defended in 2018) between the PETRUS team and the startup Cozy Cloud, which is also working on the personal cloud issue. The project finances 8 months of postdoc for Julien. The objective is to enforce the collaboration with Cozy Cloud by allowing the postdoc (i) to submit an extended journal paper on his last results (DISPERS protocol), (ii) to realize a detailed specification of the distributed protocols developed during his PhD for their implementation in the Cozy Cloud platform and (iii) to collaborate with a future PhD candidate of a new thesis in collaboration with Cozy Cloud exploring decentralized automatic learning techniques in the personal cloud context.

TYREX Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

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.

VALDA Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

The ISORE project from the Île-de-France region (6k€ grant, DIM RFSI), which started in 2019, was completed in 2020.

Leonid Libkin received funding from FSMP through his *Chaire d'Excellence*, in the fall of 2019.

Pierre Senellart is a recipient of a Chair of the PaRis Artificial Intelligence Research InstitutE, PRAIRIE, sarting in the fall of 2019.

9.2. National Initiatives

9.2.1. ANR

Valda has been part of four ANR projects in 2019:

HEADWORK (2016–2021; 38 k€ for Valda, 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 (2017–2020; 66 k€ for Valda, 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/.

CQFD (2018–2022; 19 k€ for Valda, 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. See http://www.lirmm.fr/cqfd/.

QUID (2018–2022; 49 k€ for Valda, budget managed by Inria), LIGM (coordinator), IRIF, and LaBRI, on incomplete and inconsistent data. See https://quid.labri.fr/home.html.

Camille Bourgaux is participating in the AI Chair of Meghyn Bienvenu on *INTENDED (Intelligent handling of imperfect data)* to start in 2020.

9.3. European Initiatives

9.3.1. Collaborations in European Programs, Except FP7 & H2020

A bilateral French–German ANR project, entitled *EQUUS – Efficient Query answering Under UpdateS* was accepted in 2019. It will start in 2020. It involves CNRS (CRIL, CRIStAL, IMJ), Télécom Paris, HU Berlin, and Bayreuth University, in addition to Inria Valda.

9.4. International Initiatives

9.4.1. Informal International Partners

Valda has strong collaborations with the following international groups:

Univ. Edinburgh, United Kingdom: Paolo Guagliardo, Andreas Pieris

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

TU Dresden, Germany: Markus Krötzsch and Sebastian Rudolph

Dortmund University, Germany: Thomas Schwentick

Free Univ. Bozen-Bolzano, Italy: Ana Ozaki

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

Pontifical Catholic University of Chile: Marcelo Arenas, Pablo Barceló

National University of Singapore: Stéphane Bressan

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Victor Vianu, Professor at UC San Diego and former holder of an Inria international chair, spent 6 months within Valda, as a University Paris-Diderot and ENS invited professor.

Thomas Schwentick, Professor at TU Dortmund, spend 1 month within Valda in May–June.

WIMMICS Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

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

9.2. National Initiatives

9.2.1. PIA GDN ANSWER

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

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

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

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

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

The proposed innovations include:

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

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

9.2.2. DGA CONFIRMA

Participants: Elena Cabrio, Serena Villata.

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

9.2.3. Ministry of Culture: MonaLIA 2.0

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

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

9.2.4. ANR WASABI

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

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

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

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

9.2.5. ANR SIDES 3.0

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

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

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

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

9.2.6. ANR D2KAB

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

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

Partners: LIRMM, INRA, IRD, ACTA

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

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

9.2.7. Smart Enseigno

Participant: Catherine Faron Zucker.

Partner: Educlever, Ludotic, Cabrilog, IFE

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

9.2.8. DBpedia.fr

Participants: Elmahdi Korfed, Fabien Gandon.

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

Web site: http://dbpedia.fr

9.2.9. Convention between Inria and the Ministry of Culture

Participant: Fabien Gandon.

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

9.2.10. Qwant-Inria Joint Laboratory

Participant: Fabien Gandon.

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

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

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

9.2.11. GDRI Zoomathia

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

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

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

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

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

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

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

9.3.2. Collaborations in European Programs, Except FP7 & H2020

MIREL Project

Program: RISE

Project acronym: MIREL

Project title: MIning and REasoning with Legal texts

Duration: January 2016 - December 2019

Coordinator: University of Luxembourg

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

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

CREEP EIT Project

Program: KIC EIT Digital 2018

Project acronym: CREEP

Project title: Cyberbulling Effects Prevention

Duration: January 2018 - December 2019

Coordinator: Fondazione Bruno Kessler

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

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

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

9.4. International Research Visitors

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

9.4.1. Visits to International Teams

9.4.1.1. Research Stays Abroad

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

ZENITH Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

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

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

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

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

Participants: Julien Champ, Hervé Goëau, Alexis Joly.

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

9.1.3. Others

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

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

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

9.1.3.2. Ministry of Culture, 130 Keuro

Participants: Alexis Joly, Jean-Christophe Lombardo.

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

9.1.3.3. INRA/Inria PhD program, 100 Keuro

Participant: Alexis Joly.

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

9.2. European Initiatives

9.2.1. FP7 & H2020 Projects

9.2.1.1. CloudDBAppliance

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

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

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

9.2.1.2. Cos4Cloud

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

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

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

9.3. International Initiatives

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

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

9.3.1. Inria International Labs

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

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

9.3.2.1. SciDISC

Title: Scientific data analysis using Data-Intensive Scalable Computing

International Partner (Institution - Laboratory - Researcher):

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

Start year: 2017

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

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

9.3.3. Inria International Partners

9.3.3.1. Informal International Partners

We have regular scientific relationships with research laboratories in

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

9.3.4. Participation in Other International Programs

9.3.4.1. Inria International Chairs

Dennis Shasha (NYU)

Title: Data Science in a Dynamic World

International Partner: New York University (NYU), USA

Duration: 2015 - 2019

Start year: 2015

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

9.3.5. Visits of International Scientists

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

ALICE Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

- We coordinate a work package for the CPER CyberEntreprise 2017–2020 ($\approx$ 30k euros). The application goal is to develop modelling methods, which are of interest to oil companies in order to optimize oil production.
  Program: CPER (Contrat de Plan État Région)
  Project title: Cyber-Entreprises
  Duration: 01/07/2015 – 31/12/2020
  Participants: Bruno Lévy, Dmitry Sokolov and Nicolas Ray
  Coordinator: Emmanuel Thomé and Marc Jungers (CRAN)

AVIZ Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

- PCR ANR project EMBER "Situated Visualizations for Personal Analytics". Duration: 48 months. Total funding: 712 k€. Partners: Inria Saclay, Inria Bordeaux, Sorbonne Université. Coordinator: Pierre Dragicevic. See website: http://ember.inria.fr/.
- 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.

9.2. European Initiatives

9.2.1. Collaborations in European Programs, Except FP7 & H2020

Program: ANR PRCI

Project acronym: MicroVis

Project title: Micro visualizations for pervasive and mobile data exploration

Duration: 11/2019 - 08/2022

Coordinator: Petra Isenberg

Other partners: University of Stuttgart

Abstract: The goal of this joint Franco-German project is to study very small data visualizations, micro visualizations, in display contexts that can only dedicate minimal rendering space for data representations. We will study human perception of and interaction with micro visualizations given small as well as complex data. The increasing demand for data visualizations on small mobile devices such as fitness tracking armbands, smart watches, or mobile phones drives our research. Given this usage context, we focus on situations in which visualizations are used "on the go," while walking, riding a vehicle, or running. It is still unclear to which extent our knowledge of desktop-sized visualizations transfers to contexts that involve minimal display space, diverse viewing angles, and moving displays.

Program: 2016 FWF–ANR Call for French-Austrian Joint Projects

Project acronym: ILLUSTRARE

Project title: Integrative Visual Abstraction of Molecular Data

Duration: 48 months

Coordinator: Tobias Isenberg and Ivan Viola

Other partners: TU Wien, Austria

Abstract: The essential building block of visualization is the phenomenon of visual abstraction. While visual abstraction is intuitively understood, there is no scientific theory associated with it that would be useful in the visualization synthesis process. Our central aim of this project is thus to gain better understanding of the visual abstraction characteristics. We lay down a hypothetical initial basis of theoretical foundations of visual abstractions in the proposal. We hypothesize that visual abstraction is a multidimensional phenomenon that can be spanned by axes of abstraction. Besides abstractions associated with a static structure we take a closer look at abstractions related to dynamics, procedures, and emergence of the structure. We also study abstraction characteristics related to multi-scale phenomena defined both in space and in time. This hypothetical basis is either supported or rejected by means of exemplary evidence from the specific application domain of

structural biology. Structural biology data is very complex, it includes the aspect of emergence and it is defined over multiple scales. Furthermore, abstraction has led to key discoveries in biology, such as the organization of the DNA. We study the multiscale visual abstraction characteristics on the visualization of long nucleic strands and the abstractions that convey emerging phenomena on visualization of molecular machinery use cases. From these two fields we work toward a theory of visual abstraction in a bottom-up manner, investigating the validity of the theory in other application domains as well.

Program: CHIST-ERA

Project acronym: IVAN

Project title: Interactive and Visual Analysis of Networks

Duration: May 2018 - April 2021

Coordinator: Dr. Torsten Möller, Uni Wien, Austria

Other partners: EPFL, Switzerland, Inria France, Uni Wien, Austria

Abstract: 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 principal 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.

9.2.2. Collaborations with Major European Organizations

The Bauhaus-Universität Weimar (Germany)

Steve Haroz collaborates with Florian Echtler to analyze research transparency in human-computer interaction.

Hasso Plattner Institute (Germany)

Pierre Dragicevic and Tobias Isenberg collaborate with Amir Semmo on stylization filters for facilitating the examination of disturbing visual content.

University of Zurich (Switzerland)

Pierre Dragicevic and Steve Haroz collaborate with Chat Wacharamanotham on transparent statistical reporting and efficient statistical communication.

KU Leuven (Belgium)

Pierre Dragicevic collaborates with Andrew Vande Moere on a survey on data physicalization.

Linköping University (Sweden)

Tobias Isenberg, Xiyao Wang, and Mickael Sereno collaborate with Lonni Besançon on interaction with 3D visualization.

University of Granada (Spain)

Tobias Isenberg collaborates with Domingo Martin and German Arroyo on digital stippling.

University of Roma (Italy), TU Darmstadt (Germany)

Jean-Daniel Fekete Fekete collaborates with Giuseppe Santucci, Carsten Binnig and colleagues on the design of database benchmarks to better support visualization;

University of Bari (Italy)

Jean-Daniel Fekete collaborates with Paolo Buono on hypergraph visualization;

University of Konstanz (Germany)

Petra Isenberg collaborated with Johannes Fuchs and Anastasia Bezerianos on visualization for teaching clustering algorithms.

9.3. International Initiatives

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

9.3.1.1. 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 to 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).

9.3.2. Inria International Partners

9.3.2.1. Informal International Partners

Microsoft Research: Petra Isenberg, Tobias Isenberg, and Tanja Blascheck regularly collaborate with Bongshin Lee on topics related to non-desktop visualizations such as mobile visualization, ubiquitous visualization, or touch interaction for visualization.
University of Maryland: Catherine Plaisant regularly collaborates with various team members on projects related to temporal exploratory visualization.

9.3.3. Participation in Other International Programs

9.3.3.1. Inria International Chairs

IIC PLAISANT Catherine

Title: Visual Analytics for Exploratory Data Analysis

International Partner (Institution - Laboratory - Researcher):

University of Maryland (United States) - HCIL - Catherine Plaisant

Duration: 2018 - 2022

Start year: 2018

Visual Analytics for Exploratory Data Analysis: The project leverages Dr. Plaisants 30 years of experience in the design and evaluation of novel user interface and the longstanding synergies between my research activities and those of the AVIZ lab. It also builds on early collaborative activities having taken place between Maryland and Inria during a 2017 summer visit. The joint work particularly focuses on: event analysis, network analysis, and novel evaluation methods for visual analytics.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- Catherine Plaisant (June–July): Invited professor from the University of Maryland, USA. Invited through a DigiCosme grant, Catherine Plaisant has spent two months with Aviz. We have launched two research projects, one on hypergraph visualization and one on tracing users to understand their use of visualization. Catherine Plaisant has interacted with all of the Aviz students and post-doctoral fellows, as well as with the permanent researchers.
- Paolo Buono, from the University of Bari, Italy (August–September): Paolo Buono has spent two months with Aviz working on the visualization of dynamic networks. He has collaborated with Paoa Valdivia, Catherine Plaisant, and Jean-Daniel Fekete for that project. He has also interacted with all the members of Aviz.
- 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.
- Wesley Willett and Lora Oehlberg (June): as part of the associated team SEVEN both professors came for a three-day workshop to Aviz during which we discussed designs for the noise project sensors and the associated data displays. We also worked in more depth on a survey article we plan to publish.

EX-SITU Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. 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.

8.1.2. Projet numérique du Learning Center de l'Université

Type: Equipment and subcontracting

Funding: Learning Center Paris-Saclay

Duration: 2019

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 Ph.D. students 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. The project was presented at the Ph.D. graduation ceremony of Université Paris-Saclay in June, 2019, and at the Fête de la Science in October, 2019, and will be permanently exhibited in the future Learning Center of Université Paris-Saclay.

8.1.3. Living Archive

Type: Equipment and human resources

Funding: STIC department grant

Duration: 2019-2020

Coordinator: Sarah Fdili Alaoui

Partners: Learning Center

Inria contact: Sarah Fdili Alaoui

Abstract: The project's ambition is to design interactive systems that allow practioners to easily document their dance using their own methods and personal artifacts emphasizing a first-person perspective and minimizing imposed choices from academic researchers.

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.

8.3.1.3. Humane AI (801)

Title: Toward AI Systems That Augment and Empower Humans by Understanding Us, our Society and the World Around Us

Program: FET Flagships

Duration: March 2019 - February 2020

Coordinator: DFKI (Germany)

Partners:

Aalto Korkeakoulusaatio SR (Finland)

Agencia Estatal Consejo Superior De Investigaciones Cientificas (Spain)

Albert-ludwigs-universitaet Freiburg (Germany)

Athina-erevnitiko Kentro Kainotomias Stis Technologies Tis Pliroforias, Ton Epikoinonion Kai Tis Gnosis (Greece)

Consiglio Nazionale Delle Ricerche (Italy)

Deutsches Forschungszentrum Fur Kunstliche Intelligenz GMBH (Germany)

Eidgenoessische Technische Hochschule Zürich (Switzerland)

Fondazione Bruno Kessler (Italy)

German Entrepreneurship GMBH (Germany)

INESC TEC - Instituto De Engenharia De Sistemas E Computadores, Tecnologia E Ciencia (Portugal)
ING Groep NV (Netherlands)
Institut Jozef Stefan (Slovenia)
Institut Polytechnique De Grenoble (France)
Knowledge 4 All Foundation LBG (United Kingdom)
Kobenhavns Universitet (Denmark)
Kozep-europai Egyetem (Hungary)
Ludwig-maximilians-universitaet Muenchen (Germany)
Max-planck-gesellschaft Zur Forderung Der Wissenschaften EV (Germany)
Technische Universitaet Kaiserslautern (Germany)
Technische Universitaet Wien (Austria)
Technische Universitat Berlin (Germany)
Technische Universiteit Delft (Netherlands)
Thales SIX GTS FRANCE SAS (France)
The University Of Sussex (United Kingdom)
Universidad Pompeu Fabra (Spain)
Universita Di Pisa (Italy)
Universiteit Leiden (Netherlands)
University College Cork - National University Of Ireland, Cork (Ireland)
Uniwersytet Warszawski (Poland)
Volkswagen AG (Germany)

Inria contact: Wendy Mackay

The presence and capabilities of artificial intelligence (AI) have grown significantly and will continue to do so. The Humane AI Flagship will develop the scientific foundations and technological breakthroughs needed to shape the ongoing AI revolution. The goal is to deploy AI systems that enhance human capabilities and empower individuals and societies, and ultimately extend human intelligence (rather than replace it). With 35 partners from 17 countries, Humane AI is undertaking a preparatory action to draft an ambitious research agenda to provide competitive advantages to European industry and substantial benefits to society. Partners are united by the vision of a new generation of ethical, value-oriented, and human-centric European approach to AI.

8.4. International Initiatives

8.4.1. Participation in Other International Programs

8.4.1.1. Inria International Chairs

IIC MCGRENERE Joanna

Title: Personalization through Co-Adaptive Human-Computer Interaction

International Partner (Institution - Laboratory - Researcher):

University of British Columbia (Canada) - Dept of Computer Science - Joanna McGrenere

Duration: 2017 - 2021

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 and Michel Beaudouin-Lafon.

Susanne Bødker, Professor at Aarhus University, Denmark, visited for a week to work with Wendy Mackay and Michel Beaudouin-Lafon.

8.5.1.1. Internships

Injung Lee, Ph.D. student from KAIST, South Korea, visited for five months to work with Michel Beaudouin-Lafon.

GRAPHDECO Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. EpicNPoc

Participants: Bastien Wailly, Adrien Bousseau.

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

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

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

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

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

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

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

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

8.2.1.2. ERC FunGraph

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

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

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

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

8.2.1.3. Emotive

Participants: Julien Philip, Sebastiàn Vizcay, George Drettakis.

https://emotiveproject.eu/

Type: COOPERATION (ICT)

Instrument: Reseach Innovation Action

Objectif: Virtual Heritage

Duration: November 2016 - October 2019

Coordinator: EXUS SA (UK)

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

Inria contact: George Drettakis

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

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

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Informal International Partners

We maintain close collaborations with international experts, including

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

8.3.1.2. Inria International Chairs

Fredo Durand, Massachusetts Institute of Technology (United States)

Duration: 2016 - 2020

8.4. International Research Visitors

8.4.1. Visits of International Scientists

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

8.4.1.1. Internships

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

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

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

HYBRID Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Labex Cominlabs SUNSET

Participants: Bruno Arnaldi, Valérie Gouranton [contact], Alexandre Audinot, Adrien Reuzeau.

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 RobotX

Participants: Bruno Arnaldi, Valérie Gouranton [contact], Alexandre Audinot.

RobotX (ROBOT for Intelligent Collaborative Surgery) is a one year Labex Cominlabs project (2019). The partners are MediCIS team from LTSI (INSERM and University of Rennes 1), Hybrid, Rainbow and Hycomes teams from IRISA and Inria Rennes, LP3C Lab - University Rennes 2, REV, ROMAS and PACCE teams from LS2N - Nantes, CHU Rennes, CHU Nantes, ICO (Institut de Cancerologie de l'Ouest). The objective of this exploratory action RobotX was to explore this issue and study initial feasibility of some methodological solutions. The long-term is to develop a new generation of intelligent and collaborative safe surgical robots.

Our contribution in the project was to study the development of Virtual Reality based simulated environments for surgical robotic systems for helping designing, evaluation and training of such systems. The objective was also to evaluate simulations of both technical and non technical. We developed a prototype of the Da Vinci robot with an haptic interface and different simulated tasks. We second studied the relevance of the software environments (#5 and #7) developed in previous projects (S3PM and SUNSET). We set up interactions by adding #5 semantics, which allow the robot arm to pick up objects. We also implemented a "Pick and place" exercise. A #7 scenario has been added to manage the user's actions and know when the exercise is over (Fig. 20).

9.1.3. 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).

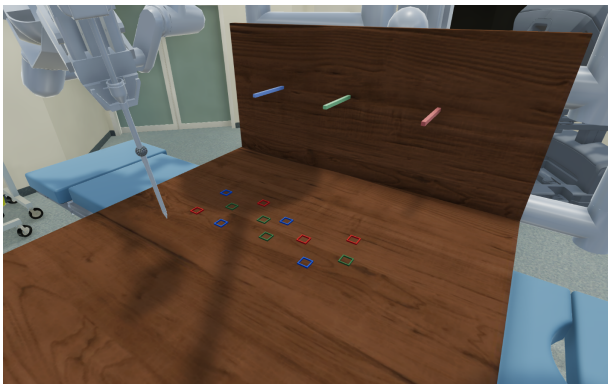

Figure 20. Pick and place exercise using #5 and #7 software

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).

9.2. 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. IPL BCI-LIFT

Participants: Anatole Lécuyer [contact], 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.

9.2.2.2. 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.

9.2.2.3. IPL NAVISCOPE

Participants: Ferran Argelaguet [contact], Gwendal Fouché.

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. FP7 & H2020 Projects

9.3.1.1. IMAGINE

Participants: Maud Marchal [contact], Thierry Gaugry, Romain Lagneau, Antonin Bernardin.

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

Participants: Anatole Lécuyer, Maud Marchal [contact], Thomas Howard, Gerard Gallagher.

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.

9.3.1.3. TACTILITY

Participants: Ferran Argelaguet [contact], Anatole Lécuyer, Maud Marchal, Sebastian Vizcay.

Title: Tactility

Programm: H2020 - ICT 25

Duration: July 2019 - June 2022

Coordinator: Fundación Tecnalia Research and Innovation (Spain)

Partners:

Aalborg University (Netherlands)
Universita Degli Studi di Genova (Itali),
Tecnalia Servia (Servia),
Universitat de Valencia (Spain),
Manus Machinae B.V. (Netherlands),
Smartex S.R.L (Italy),
Immersion (France)

Inria contact: Ferran Argelaguet

Abstract: TACTILITY is a multidisciplinary innovation and research action with the overall aim of including rich and meaningful tactile information into the novel interaction systems through technology for closed-loop tactile interaction with virtual environments. By mimicking the characteristics of the natural tactile feedback, it will substantially increase the quality of immersive VR experience used locally or remotely (tele-manipulation). The approach is based on transcutaneous electro-tactile stimulation delivered through electrical pulses with high resolution spatio-temporal distribution. To achieve it, significant development of technologies for transcutaneous stimulation, textile-based multi-pad electrodes and tactile sensation electronic skin, coupled with ground-breaking research of perception of elicited tactile sensations in VR, is needed. The key novelty is in the combination of: 1) the ground-breaking research of perception of electrotactile stimuli for the identification of the stimulation parameters and methods that evoke natural like tactile sensations, 2) the advanced hardware, that will integrate the novel high-resolution electrotactile stimulation system and state of the art artificial electronic skin patches with smart textile technologies and VR control devices in a wearable mobile system, and 3) the novel firmware, that handles real-time encoding and transmission of tactile information from virtual objects in VR, as well as from the distant tactile sensors (artificial skins) placed on robotic or human hands. Proposed research and innovation action would result in a next generation of interactive systems with higher quality experience for both local and remote (e.g., tele-manipulation) applications. Ultimately, TACTILITY will enable high fidelity experience through low-cost, user friendly, wearable and mobile technology.

9.3.1.4. Interreg ADAPT

Participants: Valérie Gouranton [contact], Bruno Arnaldi, Ronan Gaugne, Florian Nouviale, Yoren Gaffary, Alexandre Audinot.

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: The ADAPT 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.

Collaboration with Rainbow team.

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"
- Dr. Mai Otsuki from AIST (Japan) on "Mixed Reality for Cultural Heritage"
- Dr. Karina Rodriguez Echavarria from University of Brighton (UK) on "Mixed Reality for Cultural Heritage"
- Prof. Franz Fischnaller from Albertina Academia of Fine Art of Torino (Italy) on "Immersive Art"
- Dr. Yuta Itoh from Tokyo Institute of Technology (Japan) on "Perception in Augmented Reality"

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, Adrien Reuzeau.

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

- Visit from Yutaro Hirao, Master Student at University of Tokyo (topic: “Virtual Embodiment”). Feb. 2019.
- Visit from Felix Putze, Researcher at University of Bremen (topic: “BCI and AR”). Feb. 2019.

- Visit from Franz Fischnaller, Professor at Academia of Fine Arts Albertina, Torino, Italy (topic: “Cultural Heritage”). From Jun. until Jul. 2019
- Visit from Marie-Anne Paradis, Master Student at University Laval, Québec, Canada (topic: “Cultural Heritage”). From Sept. 2018 until Mar. 2019.
- Visit from Nadia Zenati, Researcher at CDTA, Algeria (topic: “VR and AR”). Oct. 2019

9.5.2. Visits to International Teams

- Jean-Marie Normand spent 2 weeks (1 week in July 2019 and 1 week in September 2019) in the Augmented Vision Laboratory, Tokyo Institute of Technology, Tokyo, Japan.
- Valérie Gouranton and Ronan Gaugne spent 2 weeks, in May 2019, in the Eau-Terre-Environment laboratory of INRS, Québec, Canada where they presented INTROSPECT results in the GMPCA conference organized by the University of Montreal, and in the days of the Canadian Association of Archaeology, organized by the University Laval of Québec.

9.5.2.1. Research Stays Abroad

- Etienne Peillard spent 4 months (from June to October 2019) in the Augmented Vision Laboratory, Tokyo Institute of Technology, Tokyo, Japan.
- Flavien Lécuyer spent 3 months (From May to August 2019) in Vision and Numeric Systems Laboratory (LVSN), Québec, Canada.

ILDA Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. 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, Vanessa Peña-Araya, Nicole Barbosa Sultanum.

9.2. European Initiatives

9.2.1. 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.

9.3. International Initiatives

9.3.1. 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.

9.3.2. 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), Sebastian Fehlandt (Inria Chile), José Galaz (Inria Chile), Sebastian Pereira (Inria Chile), Grazia Prato (Inria Chile).

9.3.2.1. Informal International Partners

We have had multiple collaboration projects with Microsoft Research in Redmond, USA. Hugo Romat visited the EPIC team for three months, and this collaboration led to the following publications at CHI 2018 [75], CHI 2019 [22] and UIST 2019 [9]. Anastasia Bezerianos also continues working with that team on topics related to smartwatch interaction and visualization that appeared in TVCG 2019 (InfoVis 2018) [11].

Our long-term collaboration with University of Konstanz, Germany continues. After publications at TVCG/InfoVis in 2014 and 2018 [46], [47], Anastasia Bezerianos has co-authored a paper at Eurographics 2019 with these colleagues [18].

Finally, our ongoing collaboration with Northwestern University, USA continues. Anastasia Bezerianos and past PhD student Evanthia Dimara (PhD defended in 2017) have worked on publications in TVCG 2019 [12] [42].

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, IMAGINE 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 entirely re-designed for supporting ultra high definition video. 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 was also designed, tested and evaluated with the Litt&Arts team at Univ. Grenoble Alpes, as part of CDP project Performance Lab.

9.2.2. 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), was a follow-up and a generalization of Dynam’it and Collodi 1. The goal was 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 was 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. Three short animations were created for this purpose by a professional animator from film examples of dancers (Gene Kelly in "Singing in the rain", Fred Astaire and Cyd Charisse in "The band wagon"). Those examples demonstrate that sketch-based animation can be used to create complex character animation even in very challenging situations. Those results were presented during the two final reviews of the COLLODI2 project in Valence and Paris in December 2019 and published as a research report.

9.2.3. 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.

9.2.4. 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.

9.2.5. 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.

9.2.6. 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 Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. GeneaLire (CPER MAuVE, 2018-2020)

Participants: Stéphane Huot, Thomas Pietrzak [contact person].

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 technique [32], 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.

9.2. National Initiatives

9.2.1. ANR

9.2.1.1. TurboTouch (PRC, 2014-2019)

Participants: Géry Casiez [contact person], 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 VALSE team (formerly NON-A) and the "Perceptual-motor behavior group" from the Institute of Movement Sciences.

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

Related publications in 2019: [13], [12]

9.2.1.2. Causality (JCJC, 2019-2023)

Participants: Géry Casiez, Stéphane Huot, Sylvain Malacria, Mathieu Nancel [contact person], Philippe Schmid.

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/

9.2.1.3. Discovery (JCJC, 2020-2024)

Participant: Sylvain Malacria [contact person].

Promoting and improving discoverability in interactive systems

This project addresses a fundamental limitation in the way interactive systems are usually designed, as in practice they do not tend to foster the discovery of their input methods (operations that can be used to communicate with the system) and corresponding features (commands and functionalities that the system supports). Its objective is to provide generic methods and tools to help the design of discoverable interactive systems: we will define validation procedures that can be used to evaluate the discoverability of user interfaces, design and implement novel UIs that foster input method and feature discovery, and create a design framework of discoverable user interfaces. This project investigates, but is not limited to, the context of touch-based interaction and will also explore two critical timings when the user might trigger a reflective practice on the available inputs and features: while the user is carrying her task (discovery in-action); and after having carried her task by having informed reflection on her past actions (discovery on-action). This dual investigation will reveal more generic and context-independent properties that will be summarized in a comprehensive framework of discoverable interfaces. Our ambition is to trigger a significant change in the way all interactive systems and interaction techniques, existing and new, are thought, designed, and implemented with both performance and discoverability in mind.

Web site: http://ns.inria.fr/discovery/

Related publications in 2019: [21].

9.2.2. Inria Project Labs

9.2.2.1. BCI-LIFT (2015-2019)

Participant: Géry Casiez [contact person].

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 2019: [24]

9.2.2.2. AVATAR (2018-2022)

Participants: Géry Casiez, Stéphane Huot, Thomas Pietrzak [contact person].

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 2019: [19], [14]

9.2.3. Others

9.2.3.1. ParkEvolution (Carnot Inria - Carnot STAR, 2015-2019)

Participant: Géry Casiez [contact person].

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/

9.2.3.2. IRDICS (Projets Exploratoires Premier Soutien CNRS, 2018-2019)

Participants: Géry Casiez, Stéphane Huot, Sylvain Malacria, Thomas Pietrzak [contact person].

Interface de recueil de données imparfaites pour le crowd-sourcing

Many crowdsourcing studies involve asking hundreds of participants to answer questionnaires. There is typically a trade-off between precision and certitude of participants. Usually, investigators prefer participants to be certain, at the cost of precision. The idea is that the lack of precision can be compensated by the high number of answers. In this project we are interested in studying this trade-off. We performed a first study, in which we asked participants to rate their confidence in their answer. In the next studies, we will allow participants to give several answers, but make sure the right answer is among them. In the last study, participants will be able to rank their answers based on confidence.

Partners: IRISA's DRUID team.

Related publication in 2019: [31]

9.3. International Initiatives

9.3.1. Inria International Partners

9.3.1.1. Informal International Partners

Andy Cockburn, University of Canterbury, Christchurch, NZ [25], [23]
Carl Gutwin, University of Saskatchewan, Saskatoon, CA [25]
Nicolai Marquardt, University College London, London, UK [18]
Antti Oulasvirta, Aalto University, Helsinki, FI
Daniel Vogel, University of Waterloo, Waterloo, CA
Audrey Girouard, Carleton University, Ottawa, CA

9.3.2. Participation in Other International Programs

9.3.2.1. Inria International Chairs

Expert interaction with devices for musical expression

Marcelo M. Wanderley – *Professor at Schulich School of Music/IDMIL, McGill University (Canada)*

Period: 2017 - 2021

The main topic of this project is the expert interaction with devices for musical expression and consists of two main directions: *the design of digital musical instruments* (DMIs) and *the evaluation of interactions with such instruments*. It will benefit from the unique, complementary expertise available at the Loki Team, including the design and evaluation of interactive systems, the definition and implementation of software tools to track modifications of, visualize and haptically display data, as well as the study of expertise development within human-computer interaction contexts. The project's main goal is to bring together advanced research on devices for musical expression (IDMIL – McGill) and cutting-edge research in Human-computer interaction (Loki Team).

Rich, Reliable Interaction in Ubiquitous Environments
Edward Lank – *Professor at Cheriton School of Computer Science, University of Waterloo (Canada)*

Period: 2019 - 2023

The objectives of the research program are:

1. Designing Rich Interactions for Ubiquitous and Augmented Reality Environments
2. Designing Mechanisms and Metaphors for Novices, Experts, and the Novice to Expert Transition
3. Integrating Intelligence with Human Action in Richly Augmented Environments.

9.3.2.2. Université de Lille - International Associate Laboratory

Reappearing Interfaces in Ubiquitous Environments (Réapp)
with Edward Lank, Daniel Vogel & Keiko Katsuragawa at University of Waterloo (Canada) - Cheriton School of Computer Science

Duration: 2019 - 2023

The LIA Réapp is an International Associated Laboratory between Loki and Cheriton School of Computer Science from the University of Waterloo in Canada. It is funded by the University of Lille to ease shared student supervision and regular inter-group contacts. The University of Lille will also provide a grant for a co-tutelle PhD thesis between the two universities.

We are at the dawn of the next computing paradigm where everything will be able to sense human input and augment its appearance with digital information without using screens, smartphones, or special glasses—making user interfaces simply disappear. This introduces many problems for users, including the discoverability of commands and use of diverse interaction techniques, the acquisition of expertise, and the balancing of trade-offs between inferential (AI) and explicit (user-driven) interactions in aware environments. We argue that interfaces must reappear in an appropriate way to make ubiquitous environments useful and usable. This project tackles these problems, addressing (1) the study of human factors related to ubiquitous and augmented reality environments, and the development of new interaction techniques helping to make interfaces reappear; (2) the improvement of transition between novice and expert use and optimization of skill transfer; and, last, (3) the question of delegation in smart interfaces, and how to adapt the trade-off between implicit and explicit interaction.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

Edward Lank, Professor at the University of Waterloo, who has been awarded an Inria International Chair in our team in 2019, spent 4 months in our group this year (September to December).

Marcelo M. Wanderley, Professor at McGill University, who has been awarded an Inria International Chair in our team in 2017, spent 2 months in our group this year (July to August).

9.4.1.1. Internships

Carola Trahms, PhD student, Christian-Albrecht University of Kiel, Sep. 2019.

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
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. MATERIALS (2015-2019)

MAVERICK, LP2N-CNRS (MANAO), Musée d'Ethnographie de Bordeaux, OCÉ-Print
Leader N. Holzschuch (MAVERICK)
Participant A. Lucat
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.

9.1.1.3. FOLD-Dyn (2017-2021)

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

9.1.1.4. CaLiTrOp (2017-2021)

IRIT, LIRIS, MANAO, MAVERICK
Leader: M. Paulin (IRIT)
Participant D. Murray

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 (from March 2019 until October 2019)

MAVERICK Project-Team

7. Partnerships and Cooperations

7.1. 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.

7.2. National Initiatives

7.2.1. 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.

7.2.2. 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.

7.2.3. 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.

7.3. European Initiatives

Together with Stefanie Hahmann and Melina Skouras from project-team IMAGINE, Georges-Pierre Bonneau is part of the H2020 FET-Open Challenging Current Thinking project $ADAM^2$, grant ID 862025, accepted in June 2019 and starting officially January 1st 2020. The Imagine and Maverick teams at Inria are in charge of modelling of micro-structured geometries and design of meta-metarials. More information is available at www.adam2.eu.

7.4. International Initiatives

7.4.1. ASICIAO: Erasmus+ capacity building project

Joëlle Thollot is an active member of the ASICIAO Erasmus+ project. In this project four European higher education institutions support six schools from Senegal and Togo in their pursuit of autonomy by helping them to develop their own method of improving quality in order to obtain the CTI accreditation and the EUR-ACE label and, by doing so, to reach international standards.

7.5. International Research Visitors

7.5.1. Visits of International Scientists

7.5.1.1. Internships

Anmol Hanagodimath spent 6 months of internship in our team as part of his master thesis of Delft university. He was supervised by Romain Vergne and Joëlle Thollot in Grenoble and Elman Eisemann in Delft.

MFX Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Project Orthosis4D (2019-2022)

- Acronym: Orthosis4D.
- Title: Passive and active 3D printed orthosis: modeling, simulation and applications.
- Duration: 2019-2022.
- Funding: Lorraine Université d'Excellence.
- Coordinator: Sylvain Lefebvre.
- Participants: SylvainLefebvre, ThibaultTricard, Pierre-AlexandreHugron, Jean-BaptisteAustruy
- Other partners: IJL, LRGP, ERPI, IRR and Nancy CHU
- Abstract: 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. On our side the project funds a PhD student, Thibault Tricard, who started in October 2018, a project manager, Jean-Baptiste Austruy, who started in May 2019 and a design engineer, Pierre-Alexandre Hugron, who started in April 2019.

  The project resulted in several publications this year [17], [11], [14]. We are also actively working with Bernhard Thomaszewski (University of Montréal) and Mélina Skouras (Inria Grenoble) within the scope of this project.

  Pierre-Alexandre Hugron started to interact with the medical partners, following the manufacturing process of orthopedic insoles at the IRR Louis Pierquin as well as producing and discussing 3D printed samples with practitioners to better understand their expectations and requirements. In particular, extensive tests have been conducted on the fabrication of different structures and density samples to mimic the current materials of insoles. Some of these samples are currently reviewed by the CHRU. These tests have resulted in an optimization of our 3D printing processes for a better accuracy and speed.

9.2. National Initiatives

9.2.1. ANR

9.2.1.1. Project MuFFin

- Acronym: MuFFin.
- Title: Procedural Stochastic Microstructures for Functional Fabrication.
- Duration: 2018-2021.
- Funding: ANR JCJC.
- Coordinator: Jonàs Martínez.
- Participants: Jonàs Martínez, Sylvain Lefebvre, Samuel Hornus, Semyon Efremov.

- Abstract:

  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.

  We have ongoing interdisciplinary collaborations with researchers in topology optimization (Perle Geoffroy-Donders and Grégoire Allaire at École Polytechnique), material science in the context of aeronautics (Mohamed amin Ben Lassoued, Ahmed Abbad, and Guilhem Michon at ISAE-SUPAREO, Annie Ross at Polytechnique Montréal), and deformable robotics (Félix Vanneste and Olivier Goury in the DEFROST Inria team).

9.2.1.2. Project IMPRIMA

- Acronym: IMPRIMA.
- Title: Implicit modeling for additive manufacturing.
- Duration: 2019-2023.
- Funding: ANR JCJC.
- Coordinator: Cédric Zanni.
- Participants: Cédric Zanni, Sylvain Lefebvre, Melike Aydinlilar.
- Abstract:

  Project IMPRIMA seek to explore novel implicit representations in order to provide a unified approach for the modeling and slicing of both macro geometry, microstructures and gradient of material. Additionally, this research aims at a complete, tight integration of both standard boundary representations and novel implicit volume representations, allowing the best choice of representation for different parts of a design.

  We have hired Melike Aydinlilar as a PhD student, starting from November 2019. We have an ongoing collaboration on skeleton-based implicit surfaces with Évelyne Hubert and Alvaro Fuentes in the AROMATH Inria team.

9.3. International Initiatives

9.3.1. Inria International Partners

9.3.1.1. Informal International Partners

We continued our informal international collaborations, in particular with Bernhard Thomaszewski (University of Montréal) on clay support structures [13] and microstructure design [14].

We are pursuing our joint research effort on slicing and curved 3D printing [11] with Charlie C.L. Wang (The Chinese University of Hong Kong), Sara McMains (University of California Berkeley), Brian Wyvill (University of Victoria), Daniele Panozzo (NYU), and Marc Alexa (TU-Berlin).

We have an ongoing collaboration with Tim Kuipers (TU Delft/Ultimaker) on algorithms for process planning.

9.3.2. Visits of International Scientists

We have invited Tim Kuipers, a developer at Ultimaker in the Netherlands, and a PhD student at TU Delft, to join us on an ongoing project in which Samuel Hornus and Sylvain Lefebvre are involved together with the GAMBLE team of Inria Nancy. Tim visited us in Nancy for 3 weeks in September.

MIMETIC Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Liv-Lab Breizh Digital Sport

Participants: Richard Kulpa [contact], Benoit Bideau, Franck Multon.

Our project aims, through new virtual reality and augmented reality technologies, to bring people who do not practice physical activity back into sport, whether for economic reasons, or for issues related to social and/or geographical isolation. To achieve this, the Brittany Region, accompanied by identified partners with complementary skills, proposes the development and networking of dedicated rooms at regional level. These existing rooms are chosen to be as close as possible to the target population, i.e. in priority areas: in the City Political District (QPV) for Rennes and Brest, and in the Rural Area to be Revitalized (ZRR) for Auray and Rostrenen. They will be redesigned to integrate these new technologies and attract target populations through the development of remote entertainment and collaborative applications. Indeed, the rooms will be connected to each other allowing participants to train together and create a community of practitioners. They will be equipped with simple sensors to evaluate their practices using a multidisciplinary cross-disciplinary approach, with biomechanical, physiological and psychological analyses (M2S/MimeTIC, CREAD and VIPS^2 laboratories). These evaluations will be used to propose physical activities that are progressive and adapted to the level of the practitioner. Access to objective data on their performance will be an additional motivating factor to keep these target audiences active. Support to local structures will allow them to extend their sporting experience after leaving Liv-Lab. Finally, subjects suffering from pathologies that are too disabling will be redirected to a health network, such as Rennes in the Living Lab ISAR (Innovation Santé Autonomie Rennes).

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 PRC Capacities

Participants: Charles Pontonnier [contact], Georges Dumont, Pierre Puchaud, Claire Livet, Anthony Sorel.

This project is leaded by Christophe Sauret, from INI/CERAH. The project objective is to build a series of biomechanical indices characterizing the biomechanical difficulty for a wide range of urban environmental situations. These indices will rely on different biomechanical parameters such as proximity to joint limits, forces applied on the handrims, mechanical work, muscle and articular stresses, etc. The definition of a more comprehensive index, called Comprehensive BioMechanical (CBM) cost, including several of the previous indices, will also be a challenging objective. The results of this project would then be used in the first place in VALMOBILE application to assist MWC users in selecting optimal route in Valenciennes agglomeration (project founded by the French National Agency for Urban Renewal and the North Department of France). The MimeTIC team is involved on the musculoskeletal simulation issues and the biomechanical costs definition.

9.2.1.3. ANR JCJC Per2

Participants: Ludovic Hoyet [contact], Benjamin Niay, Anne-Hélène Olivier, 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 is performed in collaboration with Julien Pettré from Rainbow team.

9.2.1.4. 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 *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.

9.2.1.5. Labex CominLabs : Moonlight

Participants: Guillaume Nicolas [contact], Nicolas Bideau.

Moonlight is a 2-year Labex Cominlabs project (2018-2019). Amount: 55kE (including a one-year postdoctoral fellowship). Partners: Granit Team IRISA (http://www-granit.irisa.fr/fr/), M2S Lab.

The Moonlight project is part of an effort to transpose the tools and methodologies used in motion capture from optoelectronic equipment to inertial unit devices. More specifically, the overall objective of Moonlight project is to design a new embedded system in order to analyze cyclists' movements in real conditions, i.e. outside of the laboratory. This requires to estimate reliable 3D joint angles, lower limb kinematics and pedals orientation. IMUs are used as an alternative to optoelectronical motion capture but some challenges have to be addressed as regards to sensor-to-segment misalignment and drift. Indeed, a real time accurate orientation of the crank is necessary to get limb position. To achieve this goal, data fusion algorithms between IMU data and pedal orientation are implemented. A wireless sensor network with accurate time synchronization mechanism is needed to process data fusion from all sensor's nodes on a tablet. Finally, the system deals with size, energy consumption and ease-to-use constraints.

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 funded by IFCE ended in 2018 but we got a 30K€ budget from 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. This project is in collaboration with LEGO lab. in University Bretagne Sud, and CAIRN Inria team.

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 training load.

9.2.3. Chaire Safran-Saint-Cyr "the enhanced soldier in the digital battlefield"

Participants: Charles Pontonnier [contact], Pierre Puchaud.

The chaire has the goal to answer to scientific questions accompanying the evolution of the technologies equipping the soldiers in mission. In this scheme, the MimeTIC team is involved in generic and specific musculoskeletal models for the prototyping of load carriage assistive devices (exoskeletons). Chair sponsored by SAFRAN group, led by Yvon Erhel (Professor, Ecoles de Sainr-Cyr Coëtquidan).

9.2.4. 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.

9.2.5. IPL Avatar

Participants: Ludovic Hoyet [contact], Franck Multon.

This project 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 (InterDigitak and Faurecia).

Website: http://avatar.inria.fr

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. H2020 ICT-25 PRESENT

Participants: Marc Christie, Ludovic Hoyet [contact], Anne-Hélène Olivier, Alberto Jovane, Adèle Colas.

This European project aims at creating virtual characters that are realistic in looks and behaviour, and who can act as trustworthy guardians and guides in the interfaces for AR, VR and more traditional forms of media. It is conducted in collaboration with industrial partners The Framestore Ltd, Cubic Motion Ltd, InfoCert Spa, Brainstorm Multimedia S.L., Creative Workers - Creatieve Werkers VZW, and academic partners Universidad Pompeu Fabra and Universität Augsburg.

9.3.1.2. JPI-CH SCHEDAR

Participants: Franck Multon [contact], Richard Kulpa.

SCHEDAR (Safeguarding the Cultural HEritage of Dance through Augmented Reality) is a Joint Program Initiative for preserving immaterial cultural heritage. The project started in June 2018 and will finish December 2021. It is coordinated by University of Cyprus, in collaboration with Algolysis LTD (Cyprus), University of Warwick (UK), University of Reims Champagne Ardennes (France).

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. BEAR

Title: from BEhavioral Analysis to modeling and simulation of interactions between walkeRs

International Partner: Michael Cinelli (Wilfrid Laurier University, Canada) and Michael Barnett Cowann (University of Waterloo, Canada)

Start year: 2019

See also: https://sites.google.com/view/inriabearproject/home

Interactions between individuals are by definition at the very core of our society since they represent the basic synergies of our daily life. When walking in the street or in more dynamical and strategic situations such as sports motion, we take in information about our surrounding environment in order to interact with people, move without collision, alone or in a group, intercept, meet or escape other people. In this context, the BEAR project is a collaboration between researchers from Inria Rennes (Computer Sciences) and Waterloo universities (Kinesiology-Neuroscience). The project aims at providing more realistic models and simulations of interactions between pedestrians, for various applications such as rehabilitation, computer graphics, or robotics. The originality of the project is to investigate the complexity of human interactions from a human motor control perspective, considering the strong coupling between pedestrians' visual perception and their locomotor adaptations. We will investigate how people gather the relevant information to control their motion. To provide generic models considering the inter-individual variability of humans, we will consider both normal populations and specific populations (children, older adults, injured, diseased ...) for whom an altered perception can modify their motion. The strength of this project is the complementarity of theinvolved teams. While all researchers will equally perform experiments on interactions between pedestrians, the researchers from Waterloo will take the lead to identify the relevant behavioral variables that will be used mainly by the researchers from Rennes to design the new models and simulations.

9.4.2. International Mobility Grant

- Mitacs Globalink grant: Perception-Action Integration in Collision Avoidance in Older Adults, Robyn Grundberg, University Wilfrid Laurier, Canada (April-July 2019)
- Mitacs Globalink grant: Influence of walking speed and trunk sway on collision avoidance with a virtual human, Sheryl Bourgaize, University Wilfrid Laurier, Canada (April-July 2019).

9.4.3. Inria International Partners

9.4.3.1. 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 Michael Barnet-Cowann, University of Waterloo, Waterloo, Canada (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

- Michael Barnett-Cowan (from Waterloo University, Canada): Visiting Professor, Research Chair of America, Rennes 2 (September 2019): multisensory integration of perceptual information.
- Kristoffer Larsen Norheim (from Aalborg University, Denmark): Doctoral stay (September-November 2019): biomechanical analysis of virtual hammering tasks.

9.5.1.1. Internships

- Sheryl Bourgaize, PhD Student, Wilfrid Laurier University, Canada (April-July 2019)
- Robyn Grunberg, Master Student, Wilfrid Laurier University, Canada (April-July 2019)

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

- Simon Hilt: doctoral stay at Aalborg University Denmark (May-July 2019): biomechanical analysis of hammering tasks.

POTIOC Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

HOBIT:

Funding: Program STEP - (Soutien à la Transformation et l'Expérimentation Pédagogiques)

Duration: 2019-2020

Local coordinator: Martin Hachet

Partners: Université de Bordeaux

The objective is to transform traditional practices for the teaching of optics in more innovative approaches based on augmented reality and tangible interaction. To this end, we continue improving and testing our HOBIT platform.

Echelles Celestes:

Funding: Idex - Université de Bordeaux - Art and Sciences program

Duration: 2019-2020

Local coordinator: Martin Hachet

Partners: Université de Bordeaux

We explore interactive artistic installations based on the combination of physical and virtual elements.

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: Labex BRAIN / Université de Bordeaux

Duration: 2017-2019

Coordinator: Jean-Arthur Micoulaud Franchi

Local coordinator: Fabien Lotte

A project aimed at exploring EEG-based neurofeedback for improving daytime alertness.

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.
website: http://e-tac.univ-lorraine.fr/index

ANR Project EMBER:

Duration: 2020-2023
Partners: Inria/AVIZ, Sorbonne Université
Coordinator: Pierre Dragicevic (Inria Saclay)
Local coordinator: Martin Hachet
The goal of the project will be to study how embedding data into the physical world can help people get insights into their own data. While the vast majority of data analysis and visualization takes place on desktop computers located far from the objects or locations the data refers to, in situated and embedded data visualizations, the data is directly visualized near the physical space, object, or person it refers to.
website: https://ember.inria.fr

ANR Project REBEL:

Duration: 2016-2019
Partners: Potioc, Handicap Activity Cognition Health lab (Univ. Bordeaux)
Coordinator: Fabien Lotte
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.
website: https://team.inria.fr/potioc/collaborative-projects/rebel/

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.

9.4. International Initiatives

9.4.1. Inria International Labs

9.4.1.1. Informal International Partners

- Univ. Ulster UK (Pr. Damien Coyle) on RSVP-BCI
- NTNU, Norway (Pr. Marta Molinas, Dr. Alejandro Torres Garcia) on colour-based BCI
- EPFL, Switzerland (Dr Ricardo Chavarriaga) on Negative Results for BCI

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Dr. Alejandro Torres Garcia, postdoc from NTNU, Norway, August 2019
- Ahmed Azab, PhD student, Univ. Sheffield, UK, August 2019
- Pr. Stephanie Enriquez-Geppert, University of Groningen, the Netherlands, April 2019
- Pr. Stephan Debener, Univ. Oldenburg, Germany, May 2019
- Pr. Jordi Solé-Casal, Univ. Vic, Spain and Pr. Feng Duan, Univ. Nankai, China, December 2019

9.5.1.1. Internships

- Sayu Yamamoto, Tokyo Univ. of Agriculture and Technology, Japan - from September 2019 to March 2020

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

- Fabien Lotte was a visiting associate Professor at the Tokyo University of Agriculture and Technology (TUAT), Japan, for 2 weeks in February and for the whole month on November 2019. He worked on BCI and EEG signal processing in the lab of Pr. Toshihisa Tanaka.
- Jelena Mladenovic was a scientific visitor at the Serbian Academy of Science and Arts, Institute of Mathematics, with Dragan Urosevic, from 20th of February to 25th of March 2019.

TITANE Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

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

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

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

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

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

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

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

Participants: Nicolas Girard, Yuliya Tarabalka [PI].

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

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

Participants: Lionel Matteo, Yuliya Tarabalka [contact].

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

9.1.1.5. BIOM: Building Indoor and Outdoor Modeling

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

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

9.2. International Initiatives

9.2.1. Inria International Partners

9.2.1.1. Declared Inria International Partners

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

9.3. International Research Visitors

9.3.1. Visits of International Scientists

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

9.3.2. Visits to International Teams

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

ALMANACH Project-Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. 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.

9.1.2. Competitivity Clusters and Thematic Institutes

- **PRAIRIE institute** (2019-2024, Dir.: Isabelle Ryl). Benoît Sagot was granted a Chair in this newly created research institute dedicated to Artificial Intelligence.
- **GDR LiFT** (2019-): LiFT is a CNRS-funded national coordination structure (GDR) involving many French teams involved in computational, formal and descriptive linguistics, in order to facilitate the emergence of fruitful collaborations. ALMAnaCH is involved in the GDR.
- **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]).

9.1.3. Other National Initiatives

- **LECTAUREP project** (2017-2019): A preliminary 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 digitised 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** (2017-2020): 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.

9.2. European Initiatives

9.2.1. 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.

9.2.2. 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

9.2.3. Collaborations with Major European Organizations

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

- 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]

- Bar Ilan University (Yoav Goldberg, Hila Gonen) [non-canonical text processing]
- Dublin City University, Ireland (Teresa Lynn) [low-resource languages, user-generated content]
- University of Sheffield, United Kingdom (Lucia Specia, Carolina Scarton, Fernando Alva-Manchego) [text simplification]
- Univerza v Ljubljani [University of Ljubljana], Ljubljana, Slovenia (Darja Fišer) [wordnet development]

9.3. International Initiatives

9.3.1. Participation in Other International Programs

ANR-NSF project MCM-NL "Petit Prince" (2016-2020, PI John Hale [Cornell University, USA], resp. for Inria Paris/ALMAnaCH: Éric de La Clergerie) Topic: exploring correlations between data from neuro-imagery (fMRI, EEG) and data from NLP tools (mostly parsers). The data will come from "Le Petit Prince" read in French and English, and parsed with different parsers. Other partners: Cornell Univ., Univ. Michigan, Paris Saclay/Neurospin, Univ. Paris 8. Grant for ALMAnaCH: 108,500 euros

PHC Maïmonide (2018-2019, PI Djamé Seddah, co-PI Yoav Goldberg [Bar Ilan University]). Topics: Building NLP resources for analysing reactions to major events in Hebrew and French social media. Amount of the grant for the French side: 59,000 euros (89,000 euros for the whole project).

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 (http://www.intphys.com)

Collaboration with the Almanach Team:

- co-advising with B. Sagot a PhD student: Robin Algayres.
- co-advising with B. Sagot a Master student: Charlotte Rochereau

8.2. National Initiatives

8.2.1. ANR

- **ANR-Transatlantic Platform Digging into Data - ACLEW** (2017–2020. 5 countries; Total budget: 1.4M€; coordinating PI : M. Soderstrom; Local PI: A. Cristia; Leader of tools development and co-PI : E. Dupoux) - Constructing tools for the Analysis of Children's Language Experiences Around the World.
- **CNRS Prematuration - BabyCloud**. (2018-2019; coordinating PIs : E. Dupoux and X.-N. Cao; 100€) - Enable the construction of a fully functionnal Baby Logger prototype; perform a market analysis and prepare the launch of a startup.
- **ANR GEOMPHON**. (2018-2021; coordinating PI : E. Dunbar; 299K€) - Study the effects of typologically common properties of linguistic sound systems on speech perception, human learning, and machine learning applied to speech.

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

Justine Cassell (CMU, ARP, PRAIRIE Chair starting from Oct 2019)

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

+ E. Dupoux, Research Scientist, JSALT Workshop, Montreal (July, 2019)

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 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 is to develop innovative technologies for health, and tools and strategies for personalized medicine. MULTISPEECH will collect data for distant-microphone voice commands.

9.1.3. Com-Medic ALOE

Company: Com-Medic (France)

Duration: Mar 2019 – August 2020

Participants: Denis Jouvet, Vincent Colotte, Slim Ouni, Louis Delebecque

Abstract: ALOE is a method of reading relying on a specific representation of sounds. Our involvement in the project is to develop tools to translate automatically and align text sentences into phone sequences as required by the ALOE system, and to provide audio and video tutoring examples.

9.2. National Initiatives

9.2.1. ANR ArtSpeech

Project acronym: ArtSpeech

Project title: Synthèse articulatoire phonétique

Duration: October 2015 - August 2020

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 via the numerical simulation of the human speech production processes, i.e. the articulatory, aerodynamic and acoustic aspects. Articulatory data comes from MRI and EPGG acquisitions.

9.2.2. 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

Abstract: The objective is to develop theoretical and applied tools to embed audio denoising and separation tools in web-based audio archives. The applicative scenario is to deal with the notorious audio archive "*Archives du CNRS — Musée de l'Homme*", gathering recordings dating back to the early 1900s.

9.2.3. PIA2 ISITE LUE

Project acronym: ISITE LUE

Project title: Lorraine Université d'Excellence

Duration: 2016 - 2020

Coordinator: Univ. Lorraine

Participants: Ioannis Douros, Yves Laprie

Abstract: LUE (Lorraine Université d'Excellence) was designed as an "engine" for the development of excellence, by stimulating an original dialogue between knowledge fields. Within challenge number 6: "Knowledge engineering" this project funds the PhD thesis of Ioannis Douros on articulatory modeling.

9.2.4. OLKI LUE

Project acronym: OLKI LUE

Project title: Open Language and Knowledge for Citizens, Lorraine Université d'Excellence

Coordinator: Christophe Cerisara (LORIA)

Participants: Tulika Bose, Dominique Fohr, Irène Illina

Abstract: The initiative aims at developing new algorithms that improve the automatic understanding of natural language documents, and a federated language resource distribution platform to enable and facilitate the sharing of open resources. This project funds the PhD thesis of Tulika Bose on the detection and classification of hate speech.

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, Elodie Gauthier, Thomas Girod, Denis Jouvet, Odile Mella, Slim Ouni, Leon Rohrbacher

Abstract: METAL aims at improving the learning of languages (written and oral) through development of new tools and analysis of numeric traces associated with students' learning. 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 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, Irène 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 deep learning approaches to recast the problem of synchronizing devices at the signal level as a multi-view learning problem.

9.2.8. ANR DEEP-PRIVACY

Project acronym: DEEP-PRIVACY

Project title: Distributed, Personalized, Privacy-Preserving Learning for Speech Processing

Duration: January 2019 - December 2022

Coordinator: Denis Jouvet

Other partners: LIUM (Le Mans), MAGNET (Inria Lille), LIA (Avignon)

Participants: Pierre Champion, Denis Jouvet, Emmanuel Vincent

Abstract: The objective is to elaborate a speech transformation that hides the speaker identity for an easier sharing of speech data for training speech recognition models; and to investigate speaker adaptation and distributed training.

9.2.9. ANR ROBOVOX

Project acronym: ROBOVOX

Project title: Robust Vocal Identification for Mobile Security Robots

Duration: Mar 2019 – Mar 2023

Coordinator: Laboratoire d'informatique d'Avignon (LIA)

Other partners: Inria (Nancy), A.I. Mergence

Participants: Antoine Deleforge, Sandipana Dowerah, Denis Jouvet, Romain Serizel

Abstract: The aim is to improve speaker recognition robustness for a security robot in real environment. Several aspects will be particularly considered such as ambiant noise, reverberation and short speech utterances.

9.2.10. ANR LEAUDS

Project acronym: LEAUDS

Project title: Learning to understand audio scenes

Duration: Apr 2019 - Sep 2022

Coordinator: Université de Rouen Normandie

Other partners: Inria (Nancy), Netatmo (Paris)

Participants: Mauricio Michel Olvera Zambrano, Romain Serizel, Emmanuel Vincent, and Christophe Cerisara (CNRS - LORIA)

Abstract: LEAUDS aims to make a leap towards developing machines that understand audio input through breakthroughs in the detection of thousands of audio events from little annotated data, the robustness to "out-of-the lab" conditions, and language-based description of audio scenes. MULTISPEECH is responsible for research on robustness and for bringing expertise on natural language generation.

9.2.11. Inria Project Lab HyAIAI

Project acronym: HyAIAI

Project title: Hybrid Approaches for Interpretable AI

Duration: Sep 2019 - Aug 2023

Coordinator: Inria LACODAM (Rennes)

Other partners: Inria TAU (Saclay), SEQUEL, MAGNET (Lille), MULTISPEECH, ORPAILLEUR (Nancy)

Participants: Irène Illina, Emmanuel Vincent, Georgios Zervakis

Abstract: HyAIAI is about the design of novel, interpretable artificial intelligence methods based on hybrid approaches that combine state of the art numeric models with explainable symbolic models.

9.2.12. ANR BENEPHIDIRE

Project acronym: BENEPHIDIRE

Project title: Stuttering: Neurology, Phonetics, Computer Science for Diagnosis and Rehabilitation

Duration: March 2019 - December 2023

Coordinator: Praxiling (Toulouse)

Other partners: LORIA (Nancy), INM (Toulouse), LiLPa (Strasbourg).

Participants: Yves Laprie, Slim Ouni, Shakeel Ahmad Sheikh

Abstract: This project brings together neurologists, speech-language pathologists, phoneticians, and computer scientists specializing in speech processing to investigate stuttering as a speech impairment and to develop techniques for diagnosis and rehabilitation.

9.2.13. ANR HAIKUS

Project acronym: HAIKUS

Project title: Artificial Intelligence applied to augmented acoustic Scenes

Duration: Dec 2019 - May 2023

Coordinator: Ircam (Paris)

Other partners: Inria (Nancy), IJLRA (Paris)

Participants: Antoine Deleforge, Emmanuel Vincent

Abstract: HAIKUS aims to achieve seamless integration of computer-generated immersive audio content into augmented reality (AR) systems. One of the main challenges is the rendering of virtual auditory objects in the presence of source movements, listener movements and/or changing acoustic conditions.

9.2.14. ANR Flash Open Science HARPOCRATES

Project acronym: HARPOCRATES

Project title: Open data, tools and challenges for speaker anonymization

Duration: Oct 2019 - Mar 2021

Coordinator: Eurecom (Nice)

Other partners: Inria (Nancy), LIA (Avignon)

Participants: Denis Jouvet, Md Sahidullah, Emmanuel Vincent

Abstract: HARPOCRATES will form a working group that will collect and share the first open datasets and tools in the field of speech privacy, and launch the first open challenge on speech privacy, specifically on the topic of voice de-identification.

9.2.15. ATT Dynalips & ATT Dynalips-2

Project acronym: DYNALIPS

Project title: Automatic Lip synchronization with speech

Duration: Jul 2018 - Dec 2019

Coordinator: Slim Ouni

Participants: Valerian Girard, Slim Ouni

Abstract: This is a technology transfer project of our research solution that aims to synchronize precisely and automatically the movement of the mouth of a 3D character with speech. We address 3D animation and video game industries.

9.2.16. InriaHub Carnot Technologies Vocales

Project title: InriaHub Carnot Technologies Vocales

Duration: Jan 2019 - Dec 2020

Coordinator: Denis Jouvet

Participants: Mathieu Hu, Denis Jouvet, Dominique Fohr, Vincent Colotte, Emmanuel Vincent, Romain Serizel

Abstract: This project aims to adjust and finalize the speech synthesis and recognition modules developed for research purposes in the team, so that they can be used in interactive mode.

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, Saarland University, Tilde SIA

Participants: Irène Illina, Denis Jouvet, Imran Sheikh, Brij Mohan Lal Srivastava, Mehmet Ali Tugtekin Turan, 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.

9.3.1.2. AI4EU

Program: ICT-26-2018-2020

Project acronym: AI4EU

Project title: European Artificial Intelligence On-Demand Platform and Ecosystem

Duration: 2019–2021

Coordinator: THALES

Other partners: 80 partners from 22 countries

Participants: Seyed Ahmad Hosseini, Slim Ouni

Abstract: The aim of AI4EU is to develop a European Artificial Intelligence ecosystem, from knowledge and algorithms to tools and resources.

9.3.1.3. CPS4EU

Program: PSPC-ECSEL

Project acronym: CPS4EU

Project title: Cyber-physical systems for Europe

Duration: June 2019 – June 2022

Coordinator: CEA

Other partners: 42 partners from 6 countries

Participants: Antoine Deleforge, Romain Serizel

Abstract: CPS4EU aims to develop key enabling technologies, pre-integration and development expertise to support the industry and research players' interests and needs for emerging interdisciplinary cyber-physical systems (CPS) and securing a supply chain around CPS enabling technologies and products.

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 2019

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, Mohamed Amine Menacer

Abstract: The idea is to develop a multilingual system to help people understand broadcast news in a foreign language and compare them to corresponding news available in the user's mother tongue. MULTISPEECH contributions concern mainly the speech recognition in French, English and Arabic videos.

9.3.2.2. M-PHASIS

Program: ANR-DFG

Project acronym: M-PHASIS

Project title: Migration and Patterns of Hate Speech in Social Media - A Cross-cultural Perspective

Duration: March 2019 - Feb 2022

Coordinators: Angeliki Monnier (CREM) and Christian Schemer (Johannes Gutenberg university)

Partners: CREM (UL), LORIA (UL), JGUM (Johannes Gutenberg-Universität), SAAR (Saarland University)

Participants: Irène Illina, Dominique Fohr, Ashwin Geet D'sa

Abstract: Focusing on the social dimension of hate speech, M-PHASIS seeks to study the patterns of hate speech related to migrants, and to provide a better understanding of the prevalence and emergence of hate speech in user-generated content in France and Germany. MULTISPEECH contributions concern mainly the automatic detection of hate speech in social media.

9.4. International Initiatives

9.4.1. Inria International Partners

9.4.1.1. Informal International Partners

- Alessio Brutti & Maurizio Omologo, Fondazione Bruno Kessler (Italy)
  speech enhancement and speaker recognition [60]
- Samuele Cornell & Stefano Squartini, Università Politecnica delle Marche (Italy)
  speech enhancement and speaker recognition [59], [60]
- Tomi Kinnunen, University of Eastern Finland (Finland)
  speaker recognition & spoofing countermeasures [35], [12], [51], [54], [46].
- Justin Salamon, Adobe Research (USA)
  Sound event detection [48], [61]
- Junichi Yamagishi, National Institute of Informatics (Japan)
  speaker recognition & spoofing countermeasures [51], [46].

9.5. International Research Visitors

9.5.1. Visits to International Teams

9.5.1.1. Research Stays Abroad

- 2019 Sixth Frederick Jelinek Memorial Summer Workshop (Jun.–Aug. 2019, M. Pariente, S. Sivasankaran)

PANAMA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. Labex Comin Labs projects

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

- **HEMISFER (2014-2017) and HEMISFER-CLINICAL (2018-2019)**
  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 : EMPENN, 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, EMPENN 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 EMPENN 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.

- **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).

- **FAWI** (2019-2020)
  Fourier Adaptive Waveform Implementation
  Participant: Rémi Gribonval.
  - This project is a follow-up to TEPN. Its main goal is to implement a prototype demonstrating concretely the feasibility of the new Fourier Adaptive Waveform modulation which has been patented [62].
  - Contribution of PANAMA: to provide initial training to the recruited engineer in charge of the implementation.
  - *Partners: PANAMA, IETR.*
  - Funding: 18 months of engineer, hosted by IETR.
- **SPARSE** (2019)
  Sparse representations in continuous dictionaries
  Participants: Rémi Gribonval, Clément Elvira, Clément Merdrignac.
  - This short exploratory action aims to explore the new paradigm of sparse representations in "continuous" dictionaries.
  - Contribution of PANAMA: to design algorithms for the sparse representation problem in continuous dictionaries with theoretical success guarantees.
  - *Partners: PANAMA, SIMSMART (Inria-Rennes), ENSTA Bretagne, IMT Atlantique.*
  - Funding: 5.6kEuros (internship + travel)

8.1.2. 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.

8.1.3. 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

8.1.4. Collaboration with 5th dimension – dynamic separation of localized sound sources

Participants: Nancy Bertin, Ewen Camberlein, Romain Lebarbenchon.

Duration: 1 year (2018-2019)

Research axis: 3.2

Partner: 5^{th} dimension (https://5dimo.com/)

Funding: LABEX AMIEX (https://www.agence-maths-entreprises.fr/a/)

After a first phase of this contract which involved porting in C++ a subset of our source localization library Multichannel BSS Locate (Oct.-Nov. 2018, in collaboration with InriaTech), a second phase was realized in 2019 with support from LABEX AMIES. We specified and recorded new data adapted to the partner's use case (microphones on glasses temples) and investigated the interplay between localization and separation, using the FASST library, on simulated and real data recorded with a prototype.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

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.)

8.3. International Research Visitors

8.3.1. Visits of International Scientists

8.3.1.1. Internships

- Pavel Záviška and Ondřej Mokrý, visiting students from Brno University of Technology, in December 2018 (within the MERLIN collaboration).
- Andersen Man Shun Ang, visiting student from University of Mons, in February 2019.

SEMAGRAMME Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

CPER LCHN

Langues, Connaissances et Humanités Numériques (Languages, Knowledge and Digital Humanities)

Duration: 2015 - 2020 Coordinator: Bruno Guillaume

Other partners: Université de Lorraine, Région Grand-Est, France

Participants: Maxime Amblard, Karën Fort, Bruno Guillaume

Abstract: This initiative is an interdisciplinary project which involves several laboratories in the Université de Lorraine. It aims to strengthen the University de Lorraine University in the areas of management and access to digital content. A huge part of the project concerns researches on language. The initiative combines national and regional funding which mainly supports equipment purchase. It proposes to set up scientific experimentation platforms to strengthen cooperation between Lorraine's partners thus enabling Lorraine to acquire significant visibility through national platforms for the dissemination of resources. Most of the online tools built in the team (https://zombiludik.org, http://match.grew.fr for instance) are available through virtual machines funded by the CPER.

8.2. National Initiatives

ODiM

Outils informatisés d'aide au Diagnostic des Maladies mentales

2019 - 2022

Coordinator: Maxime Amblard

Participants: Maxime Amblard, Vincent-Thomas Barrouillet, Samuel Buchel, Amandine Lecomte, Chuyuan Li, Michel Musiol

Abstract:

ODiM is an interdisciplinary project, at the interface of psychiatry-psychopathology, linguistics, formal semantics and digital sciences. It aims to replace the paradigm of Language and Thought Disorders (LTD) as used in the Mental Health sector with a semantic-formal and cognitive model of Discourse Disorders (DD). These disorders are translated into pathognomonic signs, making them complementary diagnostic tools as well as screening for vulnerable people before the psychosis's trigger. The project has three main components.

The work is based on real data from interviews with patients with schizophrenia. A data collection phase in partner hospitals and with a control group, consisting of interviews and neuro-cognitive tests, is therefore necessary.

The data collection will allow the development of the theoretical model, both in psycholinguistic and semantic formalization for the identification of diagnostic signs. The success of such a project requires the extension of the analysis methodology in order to increase the model's ability to identify sequences with symptomatic discontinuities.

If the general objective of the project is to propose a methodological framework for defining and understanding diagnostic clues associated with psychosis, we also wish to equip these approaches by developing software to automatically identify these clues, both in terms of discourse and language behaviour.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, Except FP7 & H2020

EnetCollect

European Network for Combining Language Learning with Crowdsourcing Techniques

2015- 2025

Coordinator: Lionel Nicolas and Verena Lyding (Chair & Grant Holder)

Participants: Karën Fort, Bruno Guillaume

Abstract:

Karën Fort and Bruno Guillaume participate in the EnetCollect [0] COST action. EnetCollect aims at performing the groundwork to set into motion a Research and Innovation trend combining the well-established domain of Language Learning with recent and successful crowdsourcing approaches.

- Karën Fort co-organized with Rodrigo Agerri (Univ. of the Basque Country) the first Hackathon (named Crowdfest) in January in Brussels,
- Karën Fort and Bruno Guillaume participated in the 3rd Annual Action meeting in Lisbon in March,
- Karën Fort participated to a Workgroup meeting in Malta in November.

Karën Fort pariticipates in the COST action NexusLinguarum [0]. The main aim of this action is to promote synergies across Europe between linguists, computer scientists, terminologists, and other stakeholders in industry and society, in order to investigate and extend the area of linguistic data science.

8.4. International Initiatives

8.4.1. Participation in other International Programs

Common work and a common workshop was held in Gothenburg with the Centre for Linguistic Theory and Studies in Probability (CLASP, University of Gothenburg, Sweden), especially with Robin Cooper, Ellen Breitholtz and Chris Howes on the topic of dialogical reasoning in patients with schizophrenia and formal approaches to (in)coherence and dynamics in dialogue. The visit was supported by the French Institute in Sweden (*Programme Galan*).

[0] https://enetcollect.eurac.edu/
[0] https://www.cost.eu/actions/CA18209

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).

Other partners: Région Nouvelle-Aquitaine, BTP CFA Blanquefort [0], Aerospline [0]

9.1.2. Portage

The global objective of this project is to develop a semi-autonomous carrier dedicated to the transport of heavy structures in industrial factories. The Auctus team has been assigned the role of task analysis and human systems interactions analysis in order to determine the best interface, to improve ergonomics, to reduce risks and to account for acceptability. A postdoctoral student, Charles Fage, has been recruited for the first year of the study.

A 2-years contract (2019-2021) has been signed with AKKA Technologies as part of a consortium, which included two other companies, IIDRE and Ez-Wheel, and another research team from IMS laboratory.

9.2. European Initiatives

Program: COVR (https://safearoundrobots.com/)

Project acronym: HARRY^2

Project title: **H**ighly s**A**fe **R**obot integ**R**ation for the industr**Y** throug**H** an **A**dvanced cont**R**ol and monito**R**ing strateg**Y**

Duration: 2019/07 – 2020/03

Coordinator: Vincent Padois

Other partners: RoBioSS [0], PPRIME (Poitiers, France), Fuzzy Logic Robotics [0] (Paris France)

Abstract: he objective of the HARRY2 project is to attain more advanced workspace sharing capabilities through fully exploiting the collaborative possibilities defined by ISO TS 15066. We will achieve this by:

[0] http://www.btpcfa-aquitaine.fr
[0] https://www.aerospline.eu
[0] https://www.pprime.fr/?q=fr/robioss
[0] https://www.flr.io

- Developing PLC software and motion controllers using robot-agnostic industrially-rated components to ease and standardize the development of safe robotic applications with workspace sharing.
- Integrating state-of-the-art energy-based control algorithms using these industrial hardware components, so that safety is no longer treated as an exception but considered as a constraint when computing the control solution in real-time.
- Enabling the use of high-level and intuitive teaching interfaces reducing robot programming time and difficulty.
- Developing a systematic and practical methodology for quantitative safety evaluation.

9.3. International Initiatives

9.3.1. Inria International Partners

- Vincent Padois is collaborating with Alessandro Saccon from TU Eindhoven regarding research activities on the modeling and control of robots physically interacting with their environments and more specifically on impact models for such interactions. A ICRA 2020 paper has been submitted based on this collaboration [21].
- Jean-Marc Salotti worked with Ephraim Suhir, Departments of Mechanical and Materials Engineering and Electrical and Computer Engineering, Portland State University. Ephraim Suhir is a world expert in systems reliability. He and Jean-Marc Salotti worked on human-in-the-loop issues and published a paper in an IEEE conference [14].

CHORALE Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. SPHERE ADT Inria project, 2019-20

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

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

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

8.1.3. Local initiatives

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

8.2. National Initiatives

8.2.1. ANR Platinum (14-19)

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

8.2.2. ANR Mobi-Deep (17-22)

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

8.2.3. ANR CLARA (19-22)

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

8.2.4. Collaboration with LS2N-ARMEN

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

8.2.4.1. ANR Valet (15-19)

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

8.2.4.2. ANR Hianic (18-21)

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

8.2.4.3. ANR SESAME (19-22)

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

8.2.5. Collaboration with VIBOT

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

8.2.6. Collaboration with RAINBOW Inria Team

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

8.3. FP7 & H2020 Projects

Program: H2020

Project acronym: CROWDBOT

Project title: Safe Navigation of Robots in Dense Human Crowds

Duration: Jan 2018 - Jun 2021

Coordinator: Julien Pettré

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

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

8.4. International Initiatives

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

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

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

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

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

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

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

8.5. Visits of International Scientists

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

8.5.1. Visits to International Teams

8.5.1.1. Research Stays Abroad

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

CHROMA Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Inria ADT 'CORDES' (2017-19) & 'COLOC' (2019-20)

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

The COLOC ADT, which follows the CORDES ADT, aims to coordinate a team of UAVs using both SLAM techniques and communication-based localization, considering outdoor urban environments. These ADT are coordinated by Olivier Simonin. They fund an Inria expert engineer position in Chroma (Vincent Le Doze, 10/17-11/20) focusing on UAVs control and localization. The project provides both a 3D simulator of UAV fleets (SimuDronesGR) and a new experimental platform exploiting IntelAero UAVs.

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

Participants: Laetitia Matignon, Olivier Simonin.

Project between two teams of two laboratories from Lyon : 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.

9.1.3. WIFI-Drones project, FIL (Federation d'Informatique de Lyon), 2019-21

Participants: Remy Grunblatt, Isabelle Guerin-Lassous [Inria/Lyon1 Dante team], Olivier Simonin.

Project between two teams of two laboratories from Lyon : DANTE (LIP) and CHROMA (CITI), entitled "*Performances des communications Wi-Fi dans les réseaux de drones : une approche expérimentale*", 2019-2021. Leader : I. Guerin-Lassous & O. Simonin.

The project aims to experimentally evaluate the Wireless communication in UAVs fleet scenarios. We consider the recent version of Wi-Fi based on 802.11n and 802.11 ac. Experimental measures will be used to build propagation models in order to be integrated in UAVs fleet simulations (in particular with Gazebo and NS3 simulators).

9.2. National Initiatives

9.2.1. ANR

9.2.1.1. ANR JCJC "Plasma" (2019-2023)

The ANR JCJC Plasma, led by Jilles S. Dibangoye, aims at developing a general theory and algorithms with provable guarantees to treat planning and (deep) RL problems arising from the study of multi-agent sequential decision-making, which may be described as Partially Observable Stochastic Games (POSG), see Figure 1. We shall contribute to the development of theoretical foundations of the fields of intelligent agents and MASs by characterizing the underlying structure of the multi-agent decision-making problems and designing scalable and error-bounded algorithms. The research group is made of four senior researchers, O. Simonin, C. Wolf (INSA Lyon), F. Charpillet (Inria Nancy) and O. Buffet (Inria Nancy), and two junior researchers Jilles S. Dibangoye and A. Saffidine (Univeristy of New South Whales). We plan to hire one PhD and one post-doc for two years as well as internships. We received a support for 42-months starting in March 2020 with a financial support of about 254 269,80 euros.

9.2.1.2. ANR "Delicio" (2019-2023)

The ANR Delicio, led by C. Wolf (INSA Lyon, LIRIS), proposes fundamental and applied research in the areas of Machine Learning and Control with applications to drone (UAV) fleet control. The consortium is made of 3 academic partners: INSA-Lyon/LIRIS (C. Wolf and L. Matignon), INSA-Lyon/CICI (J. Dibangoye, O. Simonin, and I. Redko), University Lyon 1/LAGEPP (M. Nadri, V. Andrieu, D. Astolfi, L. bako, and G. Casadei), and ONERA (S. Bertrand, J. Marzat, H. Piet-Lahanier). We plan to hire two Ph.D and two post-doc for one year as well as interships. We received a support for 48-months starting in October 2019 with a financial support of about 540 000 euros.

9.2.1.3. ANR "Valet" (2016-19)

The ANR VALET, led by A. Spalanzani, proposes a novel approach for solving the 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 Irccyn Ecole Centrale de Nantes and the AKKA company. The PhD student (Pavan Vashista) recruited in this project focuses 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, codirected by D. Vaufreydaz (Inria/PervasiveInteraction), has been defended in June 2019.

9.2.1.4. ANR "HIANIC" (2017-21)

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 (Hawai team) and LS2N laboratory (ARMEN and PACCE teams).

9.2.1.5. 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.

9.2.2. FUI Projects

9.2.2.1. FUI Tornado (2017 – 2020)

Participants: Rabbia Asghar, Anne Spalanzani, Christian Laugier, Olivier Simonin.

The project Tornado is coordinated by Renault. The academic partners of the project are Inria Grenoble-Rhône Alpes, UTC, Institut Pascal, University of Pau, IFSTTAR. The industrial and application partners are Renault, Easymile, Neavia, Exoskills, 4D-Virtualiz, MBPC and Rambouillet Territoires. The objective of the project is to demonstrate the feasibility of a mobility service systems operating in the commercial zone of Rambouillet and on some public roads located in its vicinity, with several autonomous cars (Autonomous Renault Zoe). The *IRT Nanoelec* is also involved in the project as a subcontractor, for testing the perception, decision-making, navigation and controls components developed in the project.

9.2.2.2. FUI STAR (2018 – 2021)

Participants: Andres Gomez Hernandez, Olivier Simonin, Christian Laugier.

The Project STAR is coordinated by IVECO. The academic partners of the project are Inria Grenoble-Rhône-Alpes, IFSTTAR, ISAE-Supaéro. The industrial and application partners are IVECO, Easymile, Transpolis, Transdev and Sector Groupe. The goal of the project is to build an autonomous bus that will operate on a safe lane Inria is involved in helping design situation awareness perception, especialy in special case like docking at the bus stop and handling dynamicity of any obstacle. The *IRT Nanoelec* is also involved in the project as a subcontractor, for testing the perception, decision-making, navigation and controls components developed in the project.

9.2.3. DGA/Inria AI projects

9.2.3.1. "DYNAFLOCK" (2019-2023)

The DYNAFLOCK project, led by O. Simonin, aims to extend flocking-based decentralized control of swarm of UAVs by considering the link quality between communicating entities. The consortium is made of 2 Inria teams from Lyon : Chroma and Dante (involving Prof. I. Guerin-Lassous). The PhD student (Alexandre Bonnefond) recruited in this project aims at defining dynamic flocking models based on the link quality. In 2020, an engineer will be recruited to conduct experiments with a quadrotors platform.
Funding of Dynaflock : $\sim$ 250 K€.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. ICT Robotics project "BugWright2" (2020-23)

Success for European H2020 ICT Robotics project application 'BugWright2' (9M€), led by C. Pradalier (CNRS, GeorgiaTech Metz). Chroma is partner and responsible of WP6.

Title : Autonomous Robotic Inspection and Maintenance on Ship Hulls and Storage Tanks

1/01/2020 - 31/12/2023

O. Simonin leads the Multi-Robot Systems work-package (WP6). Chroma will work on multi-robot planning and experiment under environmental constraints. The Agora team is also involved (H. Rivano, O. Iova) to work on robot localization based on the Ultra-WideBand technology.

Funding for Chroma & Agora teams : 600K€

http://dream.georgiatech-metz.fr/research-projects/bugwright2/

9.3.2. Collaborations with Major European Organizations

- ETHZ, Zurich, Autonomous System laboratory, (Switzerland)
- University of Zurich, Robotics and Perception Group (Switzerland) Vision and IMU data Fusion for 3D navigation in GPS denied environment.
- Karlsruhe Institut fur Technologie (KIT, Germany) Autonomous Driving.
- University of Babes-Bolyai, Cluj-Napoca (Romania). Multi-robot patrolling and Machine Learning (PHC "DRONEM" 2017-18).
- Vislab Parma (Italy) Embedded Perception & Autonomous Driving (visits, projects submissions, and book chapter in the new edition of the Handbook of Robotics).

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.
- The PhD Thesis of Félix Vanneste is half-funded by the Hauts-de-France region.

9.2. National Initiatives

- **ROBOCOP**: Robotization of Cochlear implant. This is a 4-year project, supported by the ANR (French National Agency for Research) in the framework of PRCE, starting from 1 October 2019 until 30 September 2023. ROBOCOP aims at creating a new prototype of cochlear implant, and robotize (i.e. actuate and control) its insertion process to facilitate the work of surgeon, to increase the success ratio, and to decrease the probability of trauma.
- **SIMILAR** Soft robotIcs 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. (see more details on https://cobra-2seas.eu/) The project is divided by several fields which are - MR compatible robot design, radiation dose measurement, steerable needle design, mimic soft-tissue (phantom) design and virtual reality real-time training tool development etc. Meichun was working on developing virtual reality real-time training tool with Defrost team. The aim is to have a interactive platform for human and the robot. By using SOFA framework to simulate the soft tissue’s deformation and the interaction with needle insertion under the real-time, also with the Image modelling of MRI and soft-tissue modelling and so on and so forth.

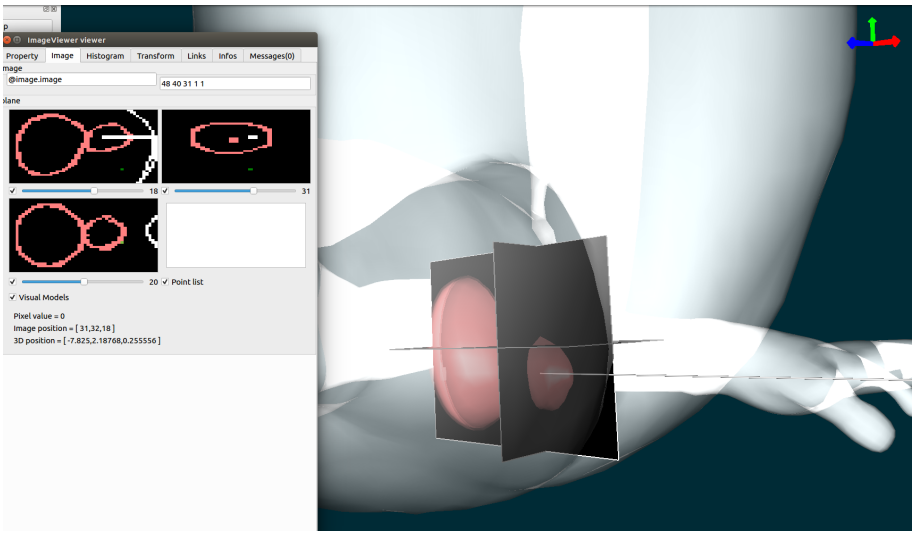

Figure 8. The virtual reality real-time simulation of the CoBra project

9.4. International Initiatives

9.4.1. Inria International Labs

9.4.1.1. AC/DC: A Charm lab / Defrost team Collaboration

Inria@SiliconValley Associate Team

Defrost team (Deformable Robotic Software, Inria Lille – Nord Europe) and the Charm Lab (Collaborative HAptics and Robotics in Medicine Lab, Stanford University, USA) on the topic of soft robots. On this topic, these two entities are very complementary because the Charm Lab is interested in the new design, the realization, the planning and the experimentation and the Defrost team is more centered on mechanical modeling, simulation and the algorithms of control. The collaboration is based on two axes: (1) the creation of flexible robots whose position and rigidity can be controlled, (2) the mechanical modeling and simulation of a robot that navigates in an environment through growth.

- Partner: Allison Okamura at the Department of Mechanical Engineering of Stanford University, USA
- Start year: 2019
- See also: https://team.inria.fr/defrost/collaboration-with-charm-lab-stanford/

9.5. International Research Visitors

9.5.1. Visits of International Scientists

Federico Renda from Khalifa University of Abu Dhabi visited the DEFROST team for a month to work on the implementation of a Cosserat Implementation for Beam simulation in the SOFA framework.

9.5.2. Internships

- Van Pho Nguyen, PhD Candidate from Japan Advanced Institute of Science and Technology (JAIST), visited the team for 6 months to work on the topic of underwater robots.
- Margaret Koehler from the Charm Lab, Stanford University, USA, visited the team for a month to work on the simulation of a soft haptic device.

9.5.3. Visits to International Teams

9.5.3.1. Research Stays Abroad

- Gang Zheng has visited Nanjing University of Science and Technology (China) for 1 month in July 2019.

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 39). 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.

9.2. 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.poppy-station.org

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 39. List of partner schools

- 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, Mobsya, CERN Microclub, LINE Lab (Université Nice), Stripes, Canopé Martinique, Rights Tech Women, Editions Nathan.

9.2.3. Adaptiv'Math

Adaptiv'Math

Program: PIA

Duration: 2019 - 2020

Coordinator: EvidenceB

Partners:

EvidenceB

Nathan

APMEP

LIP6

Inria

ISOGRAD

Daesign

Schoolab

BlueFrog

The solution Adaptiv'Math comes from an innovation partnership for the development of a pedagogical assistant based on artificial intelligence. This partnership is realized in the context of a call for projects from the Ministry of Education to develop a pedagogical plateform to propose and manage mathematical activities intended for teachers and students of cycle 2. The role of Flowers team is to work on the AI of the proposed solution to personalize the pedagogical content to each student. This contribution is based on the work done during the Kidlearn Project and the thesis of Benjamin Clement [69], in which algorithms have been developed to manage and personalize sequence of pedagogical activities. One of the main goal of the team here is to transfer technologies developed in the team in a project with the perspective of industrial scaling.

9.3. European Initiatives

9.3.1. Collaborations in European Programs, except FP7 & H2020

9.3.1.1. 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/neurocuriosityproject/

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 two articles accepted at CHI 2019 and CHI2020 (see new results section).

To continue this collaborative research, a new proposal on « Curiosity-driven learning and personalized (re-)education technologies across the lifespan » have been successfully submitted to UB-UW IDEX call regarding the projects in the field of AI and health sciences (PI: E. Law, PY Oudeyer ; co-PI : M. Fernandes, H. Sauzéon & F. Lotte)

9.4.1.3. Idex Bordeaux-Univ. Waterloo collaborative project on Virtual realty-based study on spatial learning in aging

Title: Spatial learning with aging

International Partner (Institution - Laboratory - Researcher):

University of Waterloo (Canada), Myra Fernandes, Cognitive neurosciences Lab.

Start year: 2016 (end year 2019)

Helene Sauzéon collaborated with Myra Fernandes's cognitive neuroscience Lab at University of Waterloo on the topic of "VR based study of spatial learning in older adults". They obtained a grant from Univ. Bordeaux to set up a project with Quincy Almeida, head of Movement Disorders Research and Rehabilitation Centre, Laurier University. They organized several cross visits and collaborated on the design and experimentation of a virtual reality application allowing to investigate intrinsic motivation (i.e., Active exploration) as cognitive support for older adults' spatial learning. This led to an article published in Brain Science in 2019 (see new results section).

9.4.1.4. Informal International Partners

Pierre-Yves Oudeyer and Didier Roy have created 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.

Didier Roy has created a collaboration with Biorob - EPFL, LEARN - EPFL, and Canton de Vaud, about Robotics and Computer Science education. Scientific discussions and shared professional training.

Didier Roy has created a collaboration with Mauritius Research Council, Mauritius Education Institute and AUF, about Robotics, AI and Computer Science projects, teaching and learning. Scientific discussions and shared professional training. With Gérard Giraudon (Advisor to the President of Inria, with in particular a mission on "Digital & Training").

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.

Natalia Díaz Rodríguez collaborates with the Abo Akademi University in Turku, Finland on the autonomous navigation systems project, involving the sailing schools of Novia and Naval Group (France). She also collaborates with the Andalusian Research Institute in Data Science and Computational Intelligence https://dasci.es (DaSCI) and the University of Granada (Spain) on explainable AI.

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Kevvyn Collins-Thompson, Univ. Michigan (sept.-dec. 2019)
- Franck Guerin, Univ. Aberyswith (dec 2019)
- Justus Piater, Univ. Innsbrucj (dec 2019)
- Verena Hafner, Univ. Berlin (dec 2019)
- Jochen Triesch, Univ. Frankfurt (dec 2019)
- Nivedita Mani, Univ. Gottingen (dec 2019)
- Oksana Hagen, Plymouth University (Oct. 2019)

9.5.2. Internships

- Medhi Alaimi [Inria, until Jul 2019]
- Timothee Anne [Inria, from Feb 2019 until Jun 2019]
- Anouche Banikyan [Inria, from Feb 2019 until Jul 2019]
- Lucie Galland [Ecole Normale Supérieure Paris, from Jun 2019 until Aug 2019]
- Tallulah Gilliard [Inria, from Feb 2019 until Jul 2019]
- Marion Schaeffer [Inria, from Jul 2019 until Sep 2019]
- Martin Serret [Inria, from Feb 2019 until Aug 2019]
- Maria Teodorescu [Inria, from Sep 2019]

HEPHAISTOS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

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

8.1.1. FHU

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

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Informal International Partners

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

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

8.3. International Research Visitors

8.3.1. Visits of International Scientists

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

8.4. Transfert

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

LARSEN Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. LUE C-Shift

Program: LUE Impact (Lorraine Université d'Excellence)

Project acronym: C-Shift

Project title: Cobots in the Service of Human activity at work In consistence with the challenges of Industry of the FuTure

Duration: October 2019 - December 2022

Coordinator: Benoit Iung (University of Lorraine)

PI for Inria/Loria: Serena Ivaldi

Abstract:

Le projet IMPACT « C-SHIFT » (Cobots in the Service of Human activity at work In consistence with the challenges of Industry of the FuTure) labélisé LUE (Lorraine Université d'Excellence) en collaboration avec les laboratoires de recherches LORIA, CRAN, CEREFIGE, PErSEUS, DevAH, LGIPM et les centres d'expertise et ressources AIPL-SMART et Ergosim et qui vise à étudier l'impact de la mise en œuvre de dispositifs collaboratifs intelligents tels que les cobots dans le cadre des défis de l'industrie du futur.

9.1.2. LUE Acceptability

Program: LUE PhD program (Lorraine Université d'Excellence)

Project title: elderly-technology interaction: accessibility and acceptability of assistive technology at home

Partners : Inria-Loria and Psychology and neuroscience lab - EA7489 (2LPN)

participants : Jérome Dinet, François Charpillet, Eloïse Zehner

Duration: October 2018 - September 2021

Abstract:

This PhD program is funded by the LUE PhD program, which among other has the objective to strength cooperation with associated institutions or companies supporting one of the six socio-economic challenges, here "Ageing and Health" challenge. This Ph.D. thesis, is aiming:

- at identifying sustainable actions to promote seniors' quality of life, intended to investigate this kind of interaction in terms of accessibility and acceptability that senior citizen experience with technological devices autonomy at home;
- at understanding more of technology use by older people. We have insight in the actual situation on older people's use and acceptance of technology, but locally and segmented, and more descriptive than explanatory. Most attention goes to the role of technology in the home with a particular focus on the interaction between people and assistive robots.

9.1.3. Project Psyphine Hors les Murs

Title: Psyphine Hors les Murs

Program: PEPS blanc 2019 de l'INS2I

Duration: January 2017 - January 2019

Coordinator: LORIA UMR (UMR 7503)

LARSEN member: Amine Boumaza

Psyphine is an interdisciplinary and exploratory project that gathers philosophers, psychologists, ethnologist, and computer scientists. The long term goal of the project is to explore the idea of assignments of intelligence or intentionality. Assuming that our intersubjectivity and our natural tendency to anthropomorphize plays a central role in this process, the project members investigate the elements that drive humans to attribute intelligence to robotic devices. Some of the questions that we aim to answer are: is it possible to give the illusion of cognition and/or intelligence through a technical device? How elaborate must be the control algorithms or "behaviors" of such a device so as to fool the observer? How many degrees of freedom must it have?

Partner institutions: InterPsy (EA 4432), ATILF (UMR 7118), Archives Henri-Poincaré (UMR7117), Inria Bordeaux Sud-Ouest, Loria (UMR7503) and MSH Lorraine (USR3261).

9.2. National Initiatives

9.2.1. ANR : The Flying Co-Worker

Program: ANR

Project acronym: Flying Co-Worker

Project title: Flying Co-Worker

Duration: October 2019 - october 2023

Coordinator: Daniel Sidobre (Laas Toulouse)

PI for Inria: François Charpillet

Abstract: Bringing together the recent progresses in physical and decisional interaction between humans and robots with the control of aerial manipulators, this project addresses the flying coworker, an aerial manipulator robot that act as a teammate of a human worker to transport a long bar or to realise complex tasks. Safety and human-aware robot abilities are at the core of the proposed research to progressively build robots capable to do cooperative handling and to assist a worker by notably delivering objects directly in a safe, efficient, pertinent and acceptable manner. The methodologies developed for ground manipulators cannot be directly used for aerial manipulator systems because of the floating base, of a limited payload, and of strong actuation and energy constraints. From the perception and the interpretation of the human activity, the objective of the project is to build an aerial manipulator capable to plan and control human aware motions to achieve collaborative tasks.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. 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.

9.3.1.2. 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)

9.3.2. Collaborations in European Programs, Except FP7 & H2020

9.3.2.1. HEAP

- Program: CHIST-ERA
- Project acronym: HEAP
- Project title: HEAP: Human-Guided Learning and Benchmarking of Robotic Heap Sorting
- Duration: March 2019–Feb. 2022

- Coordinator: Gerhard Neumann (Univ. of Lincoln, UK)
- PI for Inria: Serena Ivaldi
- Other partners: Italian Insitute of Technology (Italy), Technische Universitat Wien (Austria), Idiap Research Institute (Switzerland), Inria
- This project will provide scientific advancements for benchmarking, object recognition, manipulation and human-robot interaction. We focus on sorting a complex, unstructured heap of unknown objects –resembling nuclear waste consisting of a set of broken deformed bodies– as an instance of an extremely complex manipulation task. The consortium aims at building an end-to-end benchmarking framework, which includes rigorous scientific methodology and experimental tools for application in realistic scenarios. Benchmark scenarios will be developed with off-the-shelf manipulators and grippers, allowing to create an affordable setup that can be easily reproduced both physically and in simulation. We will develop benchmark scenarios with varying complexities, i.e., grasping and pushing irregular objects, grasping selected objects from the heap, identifying all object instances and sorting the objects by placing them into corresponding bins. We will provide scanned CAD models of the objects that can be used for 3D printing in order to recreate our benchmark scenarios. Benchmarks with existing grasp planners and manipulation algorithms will be implemented as baseline controllers that are easily exchangeable using ROS. The ability of robots to fully autonomously handle dense clutters or a heap of unknown objects has been very limited due to challenges in scene understanding, grasping, and decision making. Instead, we will rely on semi-autonomous approaches where a human operator can interact with the system (e.g. using tele-operation but not only) and giving high-level commands to complement the autonomous skill execution. The amount of autonomy of our system will be adapted to the complexity of the situation. We will also benchmark our semi-autonomous task execution with different human operators and quantify the gap to the current SOTA in autonomous manipulation. Building on our semi-autonomous control framework, we will develop a manipulation skill learning system that learns from demonstrations and corrections of the human operator and can therefore learn complex manipulations in a data-efficient manner. To improve object recognition and segmentation in cluttered heaps, we will develop new perception algorithms and investigate interactive perception in order to improve the robot's understanding of the scene in terms of object instances, categories and properties.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

This year we had the visit of Professor Sozo Inoue from Kyushu Institute of Technology (https://sozolab.jp) for one week in September. He was accompanied with one PhD student and two Master students, and a Postdoc. The objective was to organise together the collection of a Dataset and propose an international challenge for testing action and activity recognition algorithms.

9.4.1.1. Internships

- Luan Wei (University of Osnabrück, Germany), 5 months (supervisor: Jean-Baptiste Mouret)
- Ivan Bergonzi (University of Roma — La Sapienza, Italy), 5 months (supervisor: Jean-Baptiste Mouret)
- Lorenzo Vianello (University of Roma — La Sapienza, Italy), 6 months (supervisor: Serena Ivaldi)
- Andrea Macrí (University of Roma — La Sapienza, Italy), 5 months (supervisor: Serena Ivaldi)
- Lina Achaji (University Lebanese University – Faculty of Engineering – Tripoli), 3 months (supervision: François Charpillet)
- Niyati Rawal (Rovira i Virgili University & Open University of Catalonia (Spain)), 5 months (supervision: Francis Colas, Serena Ivaldi, Vincent Thomas)
- Yang You (Cranfield University), 5 months (supervision Vincent Thomas, Olivier Buffet, François Charpillet).

9.4.2. PhD students

- Niels Justesen (IT University of Copenhagen), 3 months (supervisor: Jean-Baptiste Mouret)
- Anji Ma (Bejing Institute of Technology), 1 year (supervisor: Serena Ivaldi)
- Moe Matsuki (Kyushu Institute of Technology) 2 weeks (supervisor: François Charpillet).

PERVASIVE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. LabEx Persyval, Project RHUM, Robots in Human Environments

Participants: Thierry Fraichard, 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.

8.1.2. ExpeSigno

Participants: Patrick Reignier, Amr Al-Zouhri Al-Yafi, Amine Awada.

Projet Région Pack Ambition Recherche EXPESIGNO : Expérimentation de la réactivité des ménages aux signaux des opérateurs de systèmes énergétiques
Other Partners : Laboratoire Gaël, Laboratoire G2ELAb, laboratoire G-Scop
Dates : 2018 - 2022

Buildings represent 66% of electricity consumption and they can act as nodes in a network of consumption, storage and energy production. In this case, it can be understood that buildings and their inhabitants will change from a passive consumer to an active consumer (the so called “pro-sumer”) who can respond quickly to price changes on the network and / or signals from operators, or even other pro-sumers offering energy production and storage solutions using solar panels or electric cars. To achieve this goal, energy systems must send consumers the right signal to induce appropriate local and global behavior. The introduction of equipment such as Smart Meters or interactive consumption management devices is decisive because they are considered as the solution to turn residential consumers into active users of their electricity or energy consumption. Nudges are an interesting way to induce lasting changes in consumer behavior. The idea of nudges is to set up environments of choice that help people make the choices that are best for them. During this project, we are going to deploy sensors within 4 volunteer families in order to study the impact of nudges on electricity consumption through a detailed analysis of the practices carried out. The objective is to establish the links between the sensor data and the activities declared by each household and to measure how nudges influence their activities.

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

Participants: Thomas Guntz, James Crowley, Dominique Vaufreydaz, Raffaella Balzarini.

Other Partners : Dept of NeuroCognition, CITEN, Bielefeld University
Dates : Jan 2016 to Dec 2019

The ANR CEEGE project 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 have observed 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 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 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 has been used to determine and model the degree to which a player understands the game situation in terms of abstract configurations of chess pieces. This provides a structured environment that use for experimental evaluation of current theories of mental modeling and emotional response during problem solving and social interaction.

The project have been organized in two phases. During the first phase, we will observed individual players of different levels of chess expertise solving known chess problems. We correlated scan-path from eye tracking and other information about visual attention to established configurations of pieces and known solutions to chess problems. We constructed 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 have observed the attention and face expressions of pairs of players of different levels of chess ability solving problems followed by verbal self reports. We have used 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.

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

Participants: Patrick Reignier, James Crowley, Raffaella Balzarini, Amr Al-Zouhri Al-Yafi.

Funding : UGA Idex Cross disciplinary project
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

8.1.5. 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.

8.1.6. 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.

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

Participants: Emmanuel Mazer, Raphael Frisch.

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.

8.1.8. 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.

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. AI4EU - A European AI On-Demand Platform and Ecosystem

Call: H2020 ICT-26-2018-2020
Coordinateur: Thales Systems
Partners: 79 European institutions
Dates: Jan 2019 through Dec 2021

AI4EU will build a comprehensive European AI-on-demand Platform that provides innovators in all areas of society with access to expertise, knowledge, algorithms and tools for developing, deploying and funding innovations based on Artificial Intelligence.

The aim is to empower actors across a broad spectrum of commercial, industrial and societal sectors in Europe with tools for innovation through AI Technologies. By bringing together a whole ecosystem of researchers, innovators, SMEs, large corporations, students and many others, around a single access point to AI resources, we will lower the barriers to education, research and innovation. Moreover, the AI4EU Platform will embrace on European values, respect European laws and support a human-centric approach providing a competitive advantage for European players.

8.2.1.2. H2020 FET Human AI

Call: H2020 FETFLAG-01-2018
Coordinateur: DFKI
Partners: 49 European institutions
Dates:1 March 2019 to 31 May 2020.

Humane AI has been funded to create a European network of centers of excellence for Artificial Intelligence technologies that synergistically work with humans, seamlessly fit in with our complex social settings and dynamically adapt to changes in our environment. The project seeks to develop world-leading insights and AI technologies, from fundamental algorithms, through methods specific to concrete applied AI domains such as Computer Vision, Robotics, IoT, Language Technologies and multi Agent Systems all the way up to disruptive AI applications and broadly usable platforms. Core innovations include (1) tools for enhancing human cognitive capabilities, channeling human creativity, inventiveness and intuition and empowering humans to make important decisions in a more informed way, (2) AI systems that can intelligently interact with and within complex social settings and seamlessly adapt to changing, open-ended environments, (3) explainable, transparent, validated and thus trustworthy AI systems that will help us more effectively deal with the complexity of a networked globalized world and (4) ways to embed values, ethics, privacy and security as core design considerations in all AI systems and applications.

To ensure broad and lasting socio-economic impact in areas which are important to Europe and its citizens on top of the basic research we will implemented dedicated impact-oriented work packages in domains such as Society and Policy, Industry 4.0, Sustainability and Energy, Finance, Science and Education, Health and Mobility/Automotive. To realize the Humane AI vision the consortium has lined up key European players and brought the relevant community on board to mobilize the critical mass needed for success. Many of the partners have strong interdisciplinary research track records, and several PIs on this project hold ERC grants, documenting scientific excellence. With their capability, networks and experience, we have a solid plan to bring the remaining players into the flagship activity during the preparatory action phase.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

8.3.1.1. Sethserey Sam, Vice-Président NIPTICT, Phnom Penh

Position: Vice-Président en charge de la recherche et des relations internationales du NIPTICT, Phnom Penh, Cambodge (et son assistante)
Date: Du 14 au 17 Avril 2019

8.3.1.2. Dr. Dao Trung Kien

Position: Directeur adjoint de l'Institut MICA, HUST, Hanoi, Vietnam
Date: novembre et décembre 2019
Travail sur la thématique de la localisation indoor de personnes grâce aux technologies sans fil et à la fusion intelligente de données hétérogènes.

RAINBOW Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. SAD WH-DRONE

Participants: Marco Aggravi, Claudio Pacchierotti.

no CNRS Rennes 181089, duration: 24 months.

This project funded by the Brittany council started in January 2019. It supports in part Marco Aggravi's research on using wearable interfaces for flying swarms of drones.

8.1.2. 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 supports the activities related to the teleoperation of drones (quadrotor UAVs) using wearable haptics interfaces.

8.1.3. 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.

8.1.4. Prisme

Participants: Solenne Fortun, François Pasteau, Marie Babel.

no Insa Rennes 2017-0004, duration: 36 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 addressed (see Section 6.2.14).

8.1.5. Silver Connect

Participant: Marie Babel.

no Insa Rennes 2018-0076, duration: 34 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.

8.1.6. Cartam

Participants: Noura Neji, Fabien Spindler, François Chaumette.

no Inria 13954 and 14041, duration: 36 months.

This project started in January 2019 and is supported by Brittany region and FEDER. It is managed by Triskalia with Unilet, Copeeks, Neotec Vision, Rainbow group, and our start-up Dilepix. It aims at designing a vision system able to detect adventices in a field. We are in charge of tracking the adventices once they are detected and of building a mosaic of the field for locating them.

8.2. National Initiatives

8.2.1. 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 Inria (Chorale group in Sophia-Antipolis and Rainbow). The project is focused on robust long-term mapping of urban environments. Map building consists in the acquisition of a textured 3-D model of urban environment, and automatic semantic labelling of the environment features (roads, buildings, cars, etc.). From this model, an optimal representation is generated and made available in the cloud, in the form of a network of RGB-D-L spheres storing photometry, geometry (depth) and object labels. Mobile agents are able to determine their position and navigate in the sphere graph using dense matching. Agents upload significant environment changes to the sphere server in cloud, for map update purposes.

8.2.2. ANR Sesame

Participant: François Chaumette.

no Inria 13722, duration: 48 months.

This project started in January 2019. It involves a consortium managed by LS2N (Nantes) with LIP6 (Paris) and Rainbow group. It aims at analysing singularity and stability issues in visual servoing.

8.2.3. 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 in 2015.

8.3. European Initiatives

FP7 & H2020 Projects

8.3.1. 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: A huge amount of debris have progressively been generated since the beginning of the space era. Most of the objects launched into space are still orbiting the Earth and today these objects and their by-products represent a threat both in space and on Earth. In Space, debris lead to collisions and therefore to damages to operational satellites. For both issues, a credible solution has emerged over the recent years: actively removing heavy debris objects by capturing them and then either disposing them by destructive re-entry in Earth atmosphere or disposing them in graveyard orbits. The RemoveDEBRIS project aimed to demonstrate key technologies for ADR in three main domains by performing in-orbit demonstrations representative of an ADR mission. The specific key technologies that have been demonstrated as part of this project are: (i) Capture technologies such as nets and harpoons (ii) De-orbiting technologies such as electric propulsion and drag augmentation (iii) Proximity Rendezvous operations technologies based on vision-based navigation. The technology demonstrations has been carried in orbit using a micro satellite test-bed, a world's first. The micro satellite has carried the ADR payloads together with two deployable nanosatellites (CubeSats). Through a series of operations, the nanosatellites have been ejected, re-captured, inspected and de-orbited, thereby demonstrating the ADR key technologies [16], [8], [7]. Our goal in this long project was to develop and validate model-based tracking algorithms on images acquired during the actual space debris removal mission [47].

8.3.2. H2020 ICT Comanoid

Participants: Fabien Spindler, François Chaumette.

Title: Multi-contact Collaborative Humanoids in Aircraft Manufacturing

Programme: H2020

Duration: January 2015 - February 2019

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 investigated 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 was 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 suggested 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 aimed at assessing clearly how far the state-of-the-art stands from such novel technologies. In particular the project focused on implementing a real-world humanoid robotics solution using the best of research and innovation. The main challenge was 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 [21].

8.3.3. H2020 ICT CrowdBot

Participants: Javad Amirian, Fabien Grzeskowiak, Solenne Fortun, Marie Babel, Julien Pettré, Fabien Spindler.

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.

8.3.4. H2020 ICT PRESENT

Participants: Adèle Colas, Alberto Jovane, Claudio Pacchierotti, Julien Pettré.

Title: Photoreal REaltime Sentient ENTity

Programme: H2020

Duration: Sep 2019 - Aug 2022

Coordinator: Univ Pompeu Fabra (Spain)

Partners: The Framestore Ltd (UK), Cubic Motion Ltd (UK), InfoCert Spa (Italy), Brainstorm Multimedia S.L. (ES), Creative Workers - Creatieve Werkers VZW (Belgium), Universitaet Augsburg (Germany), Inria (France)

Inria contact: Julien Pettré

Abstract: PRESENT is a three-year Research and Innovation project to create virtual digital companions—embodied agents—that look entirely naturalistic, demonstrate emotional sensitivity, can establish meaningful dialogue, add sense to the experience, and act as trustworthy guardians and guides in the interfaces for AR, VR and more traditional forms of media.

There is no higher quality interaction than the human experience when we use all our senses together with language and cognition to understand our surroundings and—above all—to interact with other people. We interact with today's Ïntelligent Personal Assistantsprimarily by voice; communication is episodic, based on a request-response model. The user does not see the assistant, which does not take advantage of visual and emotional clues or evolve over time. However, advances in the real-time creation of photorealistic computer generated characters, coupled with emotion recognition and behaviour, and natural language technologies, allow us to envisage virtual agents that are realistic in both looks and behaviour; that can interact with users through vision, sound, touch and movement as they navigate rich and complex environments; converse in a natural manner; respond to moods and emotional states; and evolve in response to user behaviour.

PRESENT will create and demonstrate a set of practical tools, a pipeline and APIs for creating realistic embodied agents and incorporating them in interfaces for a wide range of applications in entertainment, media and advertising.

8.3.5. H2020 FET-OPEN H-Reality

Participants: Claudio Pacchierotti, Paolo Robuffo Giordano, François Chaumette.

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), CNRS (France), 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. Rainbow is involved in H-Reality in cooperation with Anatole Lécuyer and Maud Marchal from the Hybrid group.

Collaborations in European Programs, Except FP7 & H2020

8.3.6. 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.

Collaborations with Major European Organizations

8.3.7. 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.

8.3.8. 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 Ocean (Norway)

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

Abstract: This project was granted by the Norwegian Government. Its main objective was to develop novel concepts and methods for flexible and sustainable food processing in Norway. In the scope of this project, the Rainbow group was involved for visual tracking and visual servoing of generic and potentially deformable objects (see Section 6.1.1 and Section 6.1.2). This year, we published [52], [53] in the scope of this project.

8.3.9. GentleMAN

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

Project acronym: GentleMAN

Project title: Gentle and Advanced Robotic Manipulation of 3D Compliant Objects

Duration: August 2019 - December 2023

Coordinator: Sintef Ocean (Norway)

Other partners: NTNU (Norway), NMBU (Norway), MIT (USA) and QUT (Australia).

Abstract: This project is funded by the Norwegian Government. Its main objective is to develop a novel learning framework that uses visual, force and tactile sensing to develop new multi-modal learning models, interfaced with underlying robot control, for enabling robots to learn new and advanced skills for the manipulation of 3D compliant objects. In the scope of this project, the Rainbow group is involved in the elaboration of new approaches for visual tracking of deformable objects, active vision and visual servoing for deforming soft objects into desired shapes.

8.4. International Initiatives

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

8.4.1.1. ISI4NAVE

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

International Partner (Institution - Laboratory - Researcher):

University College London (United Kingdom) - Aspire CREATe - Tom Carlson

Start year: 2019

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

Using a wheelchair allows people with disability to compensate a loss of mobility. However only 5 to 15% of the 70 million people worldwide who require a wheelchair have access to this type of technical aid. In particular, visual, visuo-spatial and/or cognitive impairments can alter the ability of an individual to independently operate a wheelchair safely.

This project focuses then on two main complementary objectives:

1. to compensate both sensorimotor disabilities and cognitive impairments by designing adapted interfaces,
2. to enhance the driving experience and to bring a new tool for rehabilitation purposes by defining efficient physical Human-Robot Interaction.

In order to ensure a widespread use of robotic systems, innovative interfaces, enabling relevant feedback (medically validated), constitute a major challenge. Trajectory corrections, obtained thanks to an assistance module, will have to be perceived by the user by means of sensitive (visual, tactile...) feedback that will have to be easily adapted to the pathology. Conversely, user interaction with the robotic system can be interpreted to control the wheelchair. Designing such systems require a multidisciplinary study, including medical data collection and analysis.

In our preliminary works, we demonstrated the relevance of share control frameworks. The scope of this new ISI4NAVE Associate Team is then to provide advanced and innovative solutions for controlling wheelchair as well as providing appropriate and relevant feedback to users.

8.4.2. Participation in Other International Programs

8.4.2.1. 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, Alexander Oliva received a grant to participate to the 2019 Robotic Vision Summer School in Kioloa (New South Wales) and spent a 1-week visit at QUT in March 2019.

RITS Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. VALET

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

Instrument: ANR

Duration: January 2016 - September 2019

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.

8.1.1.2. 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.

8.1.2. FUI

8.1.2.1. PAC V2X

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

Instrument: FUI

Duration: September 2016 - May 2020

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.

8.1.3. 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).

8.2. European Initiatives

8.2.1. FP7 & H2020 Projects

8.2.1.1. 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.

8.2.2. 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/

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. 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

8.3.2. Participation in Other 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.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Plamen Petrov from Technical University of Sofia, from July to September 2019.

8.4.1.1. Internships

- Pranav Agarwal, from August 2019.
- Fares Bessam, Master student, April-September 2019.
- Manuel Gonzalez and Leonardo Ward, from Simon Bolivar University, Venezuela, from September 2019.
- Manohar KV, May-July 2019.

8.4.2. Visits to International Teams

8.4.2.1. 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

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. 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.

9.1.2. 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.

9.2. National Initiatives

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

Participants: Laurent Amsaleg, Cheikh Brahim El Vaigh, Guillaume Gravier, Cyrielle Mallart, 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 heterogeneous 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.

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

Participants: Florent Michel, 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.

9.2.3. ANR Archival: Multimodal machine comprehension of language for new intelligent interfaces of scientific and cultural mediation

Participants: Laurent Amsaleg, Guillaume Gravier, Pascale Sébillot.

Duration: 3.5 year, started in Dec. 2019

The multidisciplinary and multi-actor ARCHIVAL project aims at yielding collaborations between researchers from the fields of Information and Communication Sciences as well as Computer Sciences around archive value enhancing and knowledge sharing for arts, culture and heritage. The project is structured around the following questionings: What part can machine comprehension methods play towards the reinterpretation of thematic archive collections? How can content mediation interfaces exploit results generated by current AI approaches?

ARCHIVAL teams will explore heterogeneous document collection structuration in order to explicitly reveal implicit links, to explain the nature of these links and to promote them in an intelligible way towards ergonomic mediation interfaces that will guarantee a successful appropriation of contents. A corpus has been delimited from the FMSH "self-management" collection, recently awarded as Collex, which will be completed from the large Canal-U academic audiovisual portal. The analysis and enhancement of this collection is of particular interest for Humanities and Social Sciences in a context where it becomes a necessity to structurally reconsider new models of socioeconomic development (democratic autonomy, social and solidarity-based economy, alternative development,...).

9.3. European Initiatives

9.3.1. EIT Digital CREEP2

Program: EIT Digital

Project acronym: CREEP 2

Project title: Cyberbullying effects prevention

Duration: 01/2019 - 12/2019

Coordinator: FBK, Italy

Other partners: Expert Systems (IT), Inria (FR), Engineering (IT)

Abstract: Project CREEP (Cyberbulling Effects Prevention) aims at identifying and preventing the possible negative impacts of cyberbullying on young people. It seeks to realise 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 adolescents' needs through a virtual coaching system (chatbot).

9.3.2. JPI CH READ-IT

Program: Joint Programming Initiative on Cultural Heritage

Project acronym: READ-IT

Project title: Reading Europe Advanced Data Investigation Tool

Duration: 05/2018 - 04/2021

Coordinator: Université Le Mans (FR)

Other partners: CNRS-IRISA (FR), Open University (UK), Universiteit Utrecht (NL), Institute of Czech Litterature (CZ)

Abstract: READ-IT is a transnational, interdisciplinary R&D project that 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. READ-IT will ensure the sustainable and reusable aggregation of qualitative data allowing an in-depth analysis of the Cultural Heritage of reading. State-of-the art technology in Semantic Web and information systems will provide a versatile, end-users oriented environment enabling scholars and ordinary readers to retrieve information from a vast amount of community-generated digital data leading to new understanding about the circumstances and effects of reading in Europe.

9.3.3. CHIST-ERA ID_IOT

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 Khorasgani), 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.

9.3.4. Collaborations with Major European Organizations

Program: ConFAP-CNRS Project

Project acronym: FIGTEM

Project title: FIne-Grain TExt Mining for clinical data

Duration: 01/2016 - 05/2019

Coordinator: CNRS-IRISA

Other partners: PUCPR, Curitiba, Brasil; CNRS-STL Lille; Inserm LTSI/CHU Rennes

Abstract: FIGTEM is a research project that involves STL-CNRS, CHU Rennes, PUC Parana, Curitiba and led by LINKMEDIAThis project aimed at developing natural language processing methods, including information extraction and indexing, dedicated to the clinical trial domain. The goal was to populate a formal representation of patients (via their electronic patient records) and clinical trial data in different languages (French, English, Portuguese). The main outcomes of the project was NLP tools for these 3 languages and annotated datasets made available for research purposes. It ended in May 2019.

9.4. International Initiatives

9.4.1. Inria International Partners

9.4.1.1. Informal International Partners

- Michael Houle, NII, Japan
- Marcel Worring, UvA, Netherlands
- Martha Larson, Radboud U., Netherlands

9.4.2. Participation in Other International Programs

9.4.2.1. STIC AmSud TRANSFORM

Program: STIC AmSud

Project acronym: TRANSFORM

Project title: Transforming multimedia data for indexing and retrieval purposes

Duration: 01/2018 - 31/2019

Partners: CNRS-IRISA (FR), PUC Minas (BR), UChile (CL)

9.4.2.2. CAPES/COFECUB HIMMD

Program: CAPES/COFECUB

Project acronym: HIMMD

Project title: Hierarchical graph-based analysis of image, video, and multimedia data

Duration: 01/2019 - 31/2022

Partners: LIGM (FR), IRISA (FR), INPG (FR), PUC Minas (BR), UNICamp (BR), UFMG (BR)

9.5. International Research Visitors

9.5.1. Visits of International Scientists

- Silvio Guimaraes (PUC Minas, Brazil) visited the team in July (1 week). His visit was related to the Stic-Amsud project.
- Benjamin Bustos (Univ. Chile, Chile) visited the team in July (1 week). His visit was related to the Stic-Amsud project.

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

- Yannis Avrithis, National and Kapodistrian University of Athens, 3 visits on April (1 week), June (1 week) and September-October 2019 (3 weeks).

MAGRIT Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

The project *Imagerie et Robotique Médicale Grand Est (IRMGE)* started in 2018. Clinical and interventional imagery is a major public health issue. Teams from the Grand-Est region involved in medical imaging (Inria, ICuve, CRESTIC) have thus proposed a research project to broaden and strenghten cooperation. The three axes 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.

8.2. National Initiatives

8.2.1. ANR JCJC ICaRes

Participant: F. Sur
This 3-year project (2019-2022) headed by B. Blaysat (Université Clermont-Auvergne), is supported by the Agence Nationale de la Recherche. It addresses residual stresses, which are introduced in the bulk of materials during processing or manufacturing. Since unintended residual stresses often initiate early failure, it is of utmost importance to correctly measure them. The goal of the ICaRes project is to improve the performance of residual stress estimation through the so-called virtual digital image correlation (DIC) which will be developed. The basic idea of virtual DIC is to mark the specimen with virtual images coming from a controlled continuous image model, instead of the standard random pattern. Virtual DIC is expected to outperform standard DIC by, first, matching real images of the materials with the virtual images, then, to run DIC on the virtual images on which strain fields are estimated, giving ultimately residual stresses.

8.2.2. Projet RAPID EVORA

(2016-2010) Participants: M.-O. Berger, V. Gaudillière, G. Simon.
This 4-years 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.
This year we have built a demonstrator to locate a camera in a factory modeled by a set of registered RGB-D panoramic images. The panoramic image closest to the current image is selected using a CNN descriptor calculated inside proposed boxes. Points and edges are then detected and matched between the current image and the selected panoramic image by using our method published at ICIP 2018 [31]. The camera pose can finally be obtained with regard to the scene by transitivity (image $\longleftrightarrow$ panoramic view $\longleftrightarrow$ scene).

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 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.

8.3.2. Inria International Partners

8.3.2.1. 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.
- Gabriele Steidl (Technische Universität Kaiserslautern, Germany) invited Fabien Pierre during two days in her team to work on convolution on Riemannian manifolds for color images. The goal of this collaboration is the design of a CNN to process images which values are on a Manifolds.

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 in July 2019. 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 during one week.
- Douglas Perrin, a senior researcher at Harvard University (http://www.childrenshospital.org/researchers/douglas-perrin), visited the MAGRIT team in September 2019. He gave a talk to the Department 1 in Loria, he worked on the segmentation of the mitral valve leaflet and he provided advice to Daryna Panicheva during one week.
- Ioana Ilea, Technical University Cluj-Napoca visited the Magrit team in October. She gave a talk entitled “Robust classification on covariance matrix space: Application to texture”.

8.4.1.1. Internships

Anastasiia Onanko from Kiev Polytechnique Institute was hosted to fulfill her Master internship (Erasmus mobility program). She worked to initiate a new research line in collaboration with our partners from CHRU Nancy, who were interested in having faster, more automated, but still faithful, means of detecting

intracranial aneurysms from 3D magnetic resonance angiography (MRA) images. The deep learning approach that was followed addressed three challenges: the impossibility to use full-sized 3D MRA as input to a deep Convolutional Neural Network (CNN), the difficulty to collect annotated data, and the scarcity of aneurysms within the whole brain vasculature (about 50 voxels in a volume that counts millions of voxels). We designed two patch-based classification approaches, with roughly annotated data, and experimented with various data augmentation protocols. Results are preliminary and need to be consolidated. In particular, the current (limited) database will be expanded in the next few months.

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

- Pierre-Frédéric Villard spent one month (May 2019) 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.
- Daryna Panicheva and Pierre-Frédéric Villard stayed in Harvard University in Cambridge (USA) respectively 2 weeks and 1 month in the context of the CURATIVE team. Each of them gave a talk to the Harvard Biorobotics Lab. An acquisition of a porcine mitral valve was done with 4 different amounts of pressure with a microCT scan. Biomechanical simulations on the mitral valve were also studied in term of stability and convergence.

MORPHEO Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Data Driven 3D Vision

Edmond Boyer obtained a chair in the new Multidisciplinary Institute in Artificial Intelligence (MIAI) of Grenoble Alpes University. The chair entitled Data Driven 3D Vision is for 4 years and aims at investigating deep learning for 3D artificial vision in order to break some of the limitations in this domain. Applications are especially related to humans and to the ability to capture and analyze their shapes, appearances and motions, for upcoming new media devices, sport and medical applications.

9.2. National Initiatives

9.2.1. ANR

9.2.1.1. 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 and is currently handled by Tomas Svaton, recruited as an engineer in April 2018.

9.2.1.2. ANR JCJC SEMBA – Shape, Motion and Body composition to Anatomy

Existing medical imaging techniques, such as Computed Tomography (CT), Dual Energy X-Ray Absorption (DEXA) and Magnetic Resonance Imaging (MRI), allow to observe internal tissues (such as adipose, muscle, and bone tissues) of in-vivo patients. However, these imaging modalities involve heavy and expensive equipment as well as time consuming procedures. External dynamic measurements can be acquired with optical scanning equipment, e.g. cameras or depth sensors. These allow high spatial and temporal resolution acquisitions of the surface of living moving bodies. The main research question of SEMBA is: "can the internal observations be inferred from the dynamic external ones only?". SEMBA's first hypothesis is that the quantity and distribution of adipose, muscle and bone tissues determine the shape of the surface of a person. However, two subjects with a similar shape may have different quantities and distributions of these tissues. Quantifying adipose, bone and muscle tissue from only a static observation of the surface of the human might be ambiguous. SEMBA's second hypothesis is that the shape deformations observed while the body performs highly dynamic motions will help disambiguating the amount and distribution of the different tissues. The dynamics contain key information that is not present in the static shape. SEMBA's first objective is to learn statistical anatomic models with accurate distributions of adipose, muscle, and bone tissue. These models are going to be learned by leveraging medical dataset containing MRI and DEXA images. SEMBA's second objective will be to develop computational models to obtain a subject-specific anatomic model with an accurate distribution of adipose, muscle, and bone tissue from external dynamic measurements only.

9.2.1.3. ANR JCJC 3DMOVE - Learning to synthesize 3D dynamic human motion

It is now possible to capture time-varying 3D point clouds at high spatial and temporal resolution. This allows for high-quality acquisitions of human bodies and faces in motion. However, tools to process and analyze these data robustly and automatically are missing. Such tools are critical to learning generative models of human motion, which can be leveraged to create plausible synthetic human motion sequences. This has the potential to influence virtual reality applications such as virtual change rooms or crowd simulations. Developing such tools is challenging due to the high variability in human shape and motion and due to significant geometric and topological acquisition noise present in state-of-the-art acquisitions. The main objective of 3DMOVE is to automatically compute high-quality generative models from a database of raw dense 3D motion sequences for human bodies and faces. To achieve this objective, 3DMOVE will leverage recently developed deep learning techniques. The project also involves developing tools to assess the quality of the generated motions using perceptual studies. This project currently involves one Ph.D. student who was hired in November 2019.

9.2.2. Competitivity Clusters

9.2.2.1. 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.

9.3. International Research Visitors

The Morpheo team is hosting Professor Stephane Durocher during his sabbatical from July 2019 to June 2020. He is involved in the team research activities, in particular on the development of efficient algorithms to cluster a set of moving objects based on their trajectories, as obtained using the Kinovis platform. This will allow to perform motion analysis tasks, such as clustering objects into components that follow similar motions, which can help in analyzing the relative motion of body parts.

9.3.1. Visits to International Teams

9.3.1.1. Research Stays Abroad

1. Victoria Fernández Abrevaya did an internship with a British company in London, from July 2019 until September 2019.
2. Nitika Verma did an intership with Google at New York, from May 2019 until September 2019.

PERCEPTION Project-Team

7. Partnerships and Cooperations

7.1. European Initiatives

7.1.1. Collaborations with Major European Organizations

Universitat Politècnica de Catalunya (UPC), Spain

Physical complex Interactions and Multi-person Pose Estimation (PIMPE) is three year project financed by IDEX. The scientific challenges of PIMPE are the followings: (i) Modeling multi-person interactions in full-body pose estimation, (ii) Estimating human poses in complex multi-person physical interactions, and (iii) Generating controlled and realistic multi-person complex pose images.

7.2. International Research Visitors

7.2.1. Research Stays Abroad

Xavier Alameda-Pineda spent three months at the University of Verona, Italy.

Yihong Xu (Ph.D. student) spent three months at the Technical University Munich, Germany.

SIROCCO Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. 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 partners: L2S, CentraleSupelec, Univ. Paris Sud; EPFL, Signal Processing Laboratory (LTS4).
- Funding : Labex CominLabs.
- Period : Oct. 2016 - Dec. 2020.

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, Fatma Hawary, Xiaoran Jiang, Maja Krivokuca, Ehsan Miandji, Hoai Nam Nguyen, Mira Rizkallah, Alexander Sagel, Jinglei Shi.

- Title : Computational Light field Imaging.
- Research axis : 7.1.1 , 7.1.2 , 7.1.4 , 7.2.1 , 7.2.3 , 7.2.4 , 7.2.2 , 7.3.1 , 7.3.2 , 7.3.3 , 7.3.4
- Partners : Inria-Rennes
- Funding : European Research Council (ERC) advanced grant
- Period : Sept. 2016 - Aug. 2021.

All imaging systems, when capturing a view, record different combinations of light rays emitted by the environment. In a conventional camera, each sensor element sums all the light rays emitted by one point over the lens aperture. Light field cameras instead measure the light along each ray reaching the camera sensors and not only the sum of rays striking each point in the image. In one single exposure, they capture the geometric distribution of light passing through the lens. This process can be seen as sampling the plenoptic function that describes the intensity of the light rays interacting with the scene and received by an observer at every point in space, along any direction of gaze, for all times and every wavelength.

The recorded flow of rays (the light field) is in the form of high-dimensional data (4D or 5D for static and dynamic light fields). The 4D/5D light field yields a very rich description of the scene enabling advanced creation of novel images from a single capture, e.g. for computational photography by simulating a capture with a different focus and a different depth of field, by simulating lenses with different apertures, by creating images with different artistic intents. It also enables advanced scene analysis with depth and scene flow estimation and 3D modeling. The goal of the ERC-CLIM project is to develop algorithms for the entire static and video light fields processing chain. The planned research includes the development of:

- novel low-rank or graph-based models for dimensionality reduction and compression
- deep learning methods for scene analysis (e.g. scene depth and scene flow estimation)
- learning methods for solving a range of inverse problems: denoising, super-resolution, axial super-resolution, view synthesis.

9.3. International Initiatives

9.3.1. Inria International Labs

EPFL-Inria: Associate Team involved in the International Lab: Graph-based Omnidirectional video Processing (GOP)

- Participant: Thomas Maugey
- International Partner (Institution - Laboratory - Researcher): Ecole Polytechnique Fédérale de Lausanne (Switzerland) - LTS4 - Pascal Frossard
- period: 2017-2019

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°. 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. During this project, we study how graphs can be built for defining a suitable structure on one or several 360 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.
- Pascal Frossard, Prof. at EPFL, in the context of the Comin Lab/Intercom project and in the context of the EPFL-Inria associated team.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

9.4.1.1. Internships

- Zhaolin Xiao, Prof. Xian University, Dec. 2018-Nov. 2019.

Stars Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

See CoBTek, Nice Hospital, FRIS

8.2. National Initiatives

See Vedecom

8.2.1. ANR

8.2.1.1. ENVISION

Program: ANR JCJC

Project acronym: ENVISION

Project title: Computer Vision for Automated Holistic Analysis of Humans

Duration: October 2017-September 2020.

Coordinator: Antitza Dantcheva (STARS)

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

8.2.2. FUI

8.2.2.1. Visionum

Program: FUI

Project acronym: Visionum

Project title: Visonium.

Duration: January 2015- December 2018.

Coordinator: Groupe Genious

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

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

8.2.2.2. StoreConnect

Program: FUI

Project acronym: StoreConect.

Project title: StoreConnect.

Duration: September 2016 - June 2019.

Coordinator: Ubudu (Paris).

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

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

8.2.2.3. ReMinAry

Program: FUI

Project acronym: ReMinAry.

Project title: ReMinAry.

Duration: September 2016 - June 2020.

Coordinator: GENIOUS Systèmes,

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

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

8.3. European Initiatives

8.3.1. Collaborations in European Programs, Except FP7 & H2020

See EIT Health.

8.4. International Initiatives

8.4.1. Inria International Labs

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

8.4.1.1. Other IIL projects

- RESPECT

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

  Project acronym: RESPECT

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

  Duration: April 2019-March 2023.

  Coordinator: Antitza Dantcheva (STARS)

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

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

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

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

8.4.2.1. SafEE (Safe & Easy Environment)

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

International Partner (Institution - Laboratory - Researcher):

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

Start year: 2018

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

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

8.4.2.2. Declared Inria International Partners

See Taiwan, China

8.4.3. Participation in Other International Programs

8.4.3.1. International Initiatives

FER4HM

Title: Facial expression recognition with application in health monitoring

International Partner (Institution - Laboratory - Researcher):

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

Duration: 2017 - 2019

Start year: 2017

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

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

8.5. International Research Visitors

8.5.1. Visits of International Scientists

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

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

8.5.2. Internships

Several students from India, China, South Korea

THOTH Project-Team

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. MIAI chair - Towards more data efficiency in machine learning

Participants: Julien Mairal, Karteek Alahari, Jakob Verbeek.

Julien Mairal holds a chair of the 3IA MIAI institute. The goal is to improve the data efficiency of machine learning algorithms.

9.1.2. MIAI chair - Towards self-supervised visual learning

Participant: Cordelia Schmid.

Cordelia Schmid holds a chair of the 3IA MIAI institute. The goal is to develop new self-supervised learning methods for computer vision.

9.1.3. MIAI chair - Multiscale, multimodal and multitemporal remote sensing

Participant: Jocelyn Chanussot.

Jocelyn Chanussot holds a chair of the 3IA MIAI institute.

9.1.4. 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).

9.1.5. 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. This collaboration ended in 2019.

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, 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 and ended in March 2019. 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 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, Konstantin Shmelkov, Vladyslav Sydorov, Daan Wynen, Nikita 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) - Machine Learning Department - Katerina Fragkiadaki

Start year: 2019

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

We propose to renew the associate team GAYA, with the primary goal of interpreting videos in terms of recognizing actions, understanding the human-human and human-object interactions. In the first three years, the team has started addressing the problem of learning an efficient and robust video representation to attack this challenge. GAYA will now focus on building semantic models, wherein we learn incremental, joint audio-visual models, 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 (Thoth and WILLOW), a US university (Carnegie Mellon University [CMU]) as the main partner team, and another US university (UC Berkeley) as a secondary partner. It will allow the partners to effectively combine their respective strengths in areas such as inference and machine learning approaches for vision tasks, joint audio-visual models, large-scale learning, geometric reasoning. The main expected outcomes of this collaboration are: new machine learning algorithms for handling minimally annotated multi-modal data, large-scale public datasets for benchmarking, theoretical analysis of objects shapes and contours. This associate team originally started in 2016, and was extended in 2019 for another 3 years.

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. In 2019, the project resulted in the development of an approach for object interaction [20].

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 until Jan 2019.
- Avijit Dasgupta (PhD Student, IIIT Hyderabad, India) was an intern in the team from Feb to May 2019.
- Gunnar Sigurdsson (PhD student, CMU) was an intern in the team from Jan to Mar 2019.

WILLOW Team

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. PRAIRIE

Participants: Ivan Laptev, Jean-Paul Laumond, Jean Ponce, Josef Sivic.

The Prairie Institute (PaRis AI Research InstitutE) is one of the four French Institutes for Interdisciplinary Artificial Intelligence Research (3IA), which were created as part of the national French initiative on AI announced by President Emmanuel Macron on May 29, 2018. It brings together five academic partners (CNRS, Inria, Institut Pasteur, PSL University, and University of Paris) as well as 17 industrial partners, large corporations which are major players in AI at the French, European and international levels, as well as 45 Chair holders, including four of the members of WILLOW (Laumond, Laptev, Ponce, Sivic). Ponce is the scientific director of PRAIRIE.

9.1.2. 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. 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. International Initiatives

9.3.1. 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

- 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.
- Vladimir Petrik spent October - Janurary 2020 in Willow as a visiting post-doc within the framework of collaboration with the Intelligent Machine Perception project.
- Mircea Cimpoi spent three weeks in March 2019 in Willow as a visiting post-doc within the framework of collaboration with the Intelligent Machine Perception project.

9.4.1.1. Internships

- Anna Kukleva (Master student, University of Bonn) spent six months in the Willow team working on her Master project under supervision of M. Tapaswi and I. Laptev.

9.4.2. Visits to International Teams

9.4.2.1. Explorer programme

- J.Ponce, multiple visits to CMU's Robotics Institute within the framework of the Gaia associated team