Activity Report 2017

Section Contracts and Grants with Industry

MODELING AND CONTROL FOR LIFE SCIENCES

ABS Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

In this section, we describe the collaboration between ABS and MS Vision (http://msvision.eu/), a company based in the Netherlands. MSVision was created in 2004 and currently involves 20 employees; it is a worldwide leader in delivering tailored hardware solutions to the mass spectrometry community. As detailed below, the collaboration aims at strengthening the offer of the company on the algorithmic and software sides.

This collaboration is funded by the Instituts Carnots (http://www.instituts-carnot.eu/en).

6.1.1. Context

Protein complexes underlie most biological functions, so that studying such complexes in native conditions (intact molecular species taken in solution) is of paramount importance in biology and medicine. Unfortunately, the two leading experimental techniques to date, X ray crystallography and cryo electron microscopy, involve aggressive sample reparation (sample crystallization and sample freezing in amorphous ice, respectively) which may damage the structures and/or create artifacts. These experimental constraints legitimate the use of mass spectrometry (MS) to study biomolecules and their complexes under native conditions, using electrospray ionization (ESI), a soft ionization technique developed by John Fenn (Nobel prize in chemistry, 2002). MS actually delivers information on the masses of the molecular species studied, from which further information on the stoichiometry, topology and contacts between subunits can be inferred. Thanks to ESI, MS is expected to play a pivotal role in biology to unravel the structure of macromolecular complexes underlying all major biological processes, in medicine and biotechnology to understand the complex patterns of molecules involved in pathways, and also in biotechnologies for quality checks.

6.1.2. Specific goals

A mass spectrometer delivers a mass spectrum, i.e. an histogram representing the relative abundance of the ions (ionized proteins or protein complexes in our case), as a function of their mass-to-charge (m/z) ratio. Deconvoluting a mass spectrum means transforming it into a human readable mass histogram. Due to the nature of the ESI process (i.e. the inclusion of solvent and various other molecules) and the intrinsic variability of the studied biomolecules in native conditions, the interpretation of such spectra is delicate. Methods currently used are of heuristic nature, failing to satisfactorily handle the aforementioned difficulties. The goal of this collaboration is to develop optimal algorithms and the associated software to fill the critical gap of mass spectra deconvolution. The benefits for the analyst will be twofold, namely time savings, and the identification of previously undetected components. Upon making progress on the deconvolution problem, the collaboration will be expanded on the geometric and topological modeling of large macro-molecular assemblies, a topic to which ABS recently made significant contributions [2], [3].

AMIBIO Team (section vide)

BEAGLE Project-Team (section vide)

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Bilateral Contracts with Industry

7.1.1.1. Transgene 1. (2016-2017)

Participants: A. Gégout-Petit, A. Muller-Gueudin, Y. Shi

Transgene (Euronext: TNG), part of Institut Mérieux, is a publicly traded French biopharmaceutical company focused on discovering and developing targeted immunotherapies for the treatment of cancer and infectious diseases. B. Bastien, head of the biostatistics team appeals to BIGS to select covariates among genomics, proteomics expressions linked to the success of a treatment of the lung cancer. This subject was the purpose of the master thesis of Y. Shi and a paper on the subject is in preparation.

7.1.1.2. Transgene 2. (2016-2017)

Participants: T. Bastogne, L. Batista, P. Vallois

Transgene (Euronext: TNG), part of Institut Mérieux, is a publicly traded French biopharmaceutical company focused on discovering and developing targeted immunotherapies for the treatment of cancer and infectious diseases. B. Bastien, head of the biostatistics team appeals to BIGS to model data collected in vivo for growth tumor and to measure the effect of the treatment on the dynamics of the tumor.

7.1.1.3. SAFRAN Aircraft Engines (2016-2019)

Participants: R. Azaïs, A. Gégout-Petit, F. Greciet

SAFRAN Aircraft Engines designs and products Aircraft Engines. For the design of pieces, they have to understand mechanism of crack propagation under different conditions. It appeals to BIGS for modeling crack propagation with Piecewise Deterministic Markov Processes (PDMP). It is the subject of F. Greciet PhD, granted by ANRT. F. Greciet presented her work during a Fédération Charles Hermite Journey on November the 23th. She was laureat of "Mathématiques, oxygene du monde numérique" poster challenge [52].

7.1.1.4. CYBERNANO (2014-2017)

Participants: T. Bastogne, L. Batista, P. Guyot

Cybernano is a start-up founded in 2013 by one BIGS member: T. Bastogne. Cybernano develops computational services to analyze high-content data in cell biology for applications in oncology, cardiotoxicity and virology. After the end of his PhD (2017), L. Batista became chief technical officer of Cybernano. A EuroStars project proposal was submitted in Sep. 2017 in which Cybernano will be the leader and BIGS a scientific partner (Eurostars is a H2020 programme that supports research-performing small and medium enterprises).

BONSAI Project-Team (section vide)

CAPSID Project-Team (section vide)

<div align="center">

DYLISS Project-Team

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8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Participants: Olivier Dameron, Anne Siegel, Méline Wery.

Our software *AskOmics* was considered as relevant by the SANOFI bio-medical company in order to facilitate the integration and the query of the data produced by their scientists. A former Ph.D. of Dyliss who designed the first prototypes of *AskOmics* was recruited by SANOFI. Since then, SANOFI is included in the developer's team of *AskOmics* and a joint Dyliss–SANOFI CIFRE Ph.D. thesis started about the integration of complementary reasoning features to SPARQL queries in Oct. 2017.

ERABLE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

ERABLE was awarded a PhD grant by the ANRt together with the Maat Pharma company. The PhD scholarship was granted to Marianne Borderes, who will be co-supervised starting from January 2018 by Marie-France Sagot and Susana Vinga (IST, Lisbon, Portugal) together with Lilia Boucinha from Maat Pharma.

GENSCALE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Processing in memory

Participants: Charles Deltel, Dominique Lavenier.

The UPMEM company is currently developing new memory devices with embedded computing power (http://www.upmem.com/). GenScale investigates how bioinformatics algorithms can benefit from these new types of memory (see section New Results).

8.2. Bilateral Grants with Industry

8.2.1. Enancio Start-Up

Participants: Jennifer Del Giudice, Stephane Picq, Guillaume Rizk.

After 2 years of development the EnginesOn project has led to the creation of Enancio in August 2017 (http://www.enancio.fr). Enancio main focus is to give the biologist all the resources needed to decipher the information held on a biological molecule such as DNA, without worrying about the informatics behind it. The start-up provides a software platform available through the net with analysis workflows that have been conceived and validated by the field experts, solutions to handle massive data, and health data certified computational infrastructure. Simplification, optimization and faster execution of analyses workflows are the main focuses of the company. Enancio workflows uses the GATB-core library developed by GenScale.

8.2.2. Rapsodyn project

Participants: Dominique Lavenier, Claire Lemaitre, Sebastien Letort, Pierre Peterlongo.

RAPSODYN is a long term project funded by the IA ANR French program (Investissement d'Avenir) and several field seed companies, such as Biogemma, Limagrain and Euralis (http://www.rapsodyn.fr/). The objective is the optimization of the rapeseed oil content and yield under low nitrogen input. GenScale is involved in the bioinformatics work package, in collaboration with Biogemma's bioinformatics team, to elaborate advanced tools dedicated to polymorphism detection and analysis.

7. Bilateral Contracts and Grants with Industry

7.1. BGene

Participants: Johannes Geiselmann, Corinne Pinel.

BGene is a start-up company of Université Grenoble Alpes in the field of DNA engineering. BGene proposes efficient and custom-made modifications of bacterial genomes, leaving no scars or antibiotics resistance genes. The company has know-how and expertise at all stages of the development process, including the *in-silico* design of a desired construction, the choice of the appropriate genetic tools, and the delivery of the finished product. Former IBIS-member Caroline Ranquet and Johannes Geiselmann are co-founders of BGene, together with Marie-Gabrielle Jouan (Floralis, Université Grenoble Alpes). For more information on BGene, see http://www.bgene-genetics.com/.

7.2. Genostar

Participants: Hidde de Jong, Michel Page.

Genostar, an Inria start-up created in 2004, provides bioinformatics solutions for the comparative analysis of bacterial genomes, proteomes and metabolomes. Genostar's software suite performs the annotation of sets of genomic sequences, *i.e.*, the identification of the coding sequences and other features, followed by the prediction of the functions of the gene products. The modules which make up the software suite were originally developed within the Genostar consortium and the HELIX project team at Inria Grenoble - Rhône-Alpes. The software suite also includes the modeling and simulation tool GNA developed by members of IBIS. Unfortunately after the retirement of its CEO, former IBIS member François Rechenmann, Genostar ceased its activity.

LIFEWARE Project-Team (section vide)

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

General Electric Healthcare: a 36 months (from feb. 2016 to jan. 2019) companion contract for the Cifre thesis of E. Poulain.

Bayer, Lyon: a 6 months (from jan. 2017 to jun. 2017) companion contract for the Master intership of S. Laroui.

PLEIADE Team (section vide)

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Contract with Innopsys: Tissue microarrays (TMA) image analysis

Participants: Charles Kervrann.

Collaborators: Vincent Paveau and Cyril Cauchois (Innopys company).
A three-year contract has been established with Innopsys in 2013 to support the PhD thesis of Hoai-Nam Nguyen. The objective was to investigate and develop methods and algorithms dedicated to fluorescence images acquired by scanners and devices designed by the company. In this project, we focused on localization and segmentation of fluorescence tissue microarrays (TMA) cores in very large 2D images, de-arraying of digital images and correction of grid deformation adapted to devices, correction of scanning artifacts to improve image reconstruction and deconvolution of fluorescence TMA images. The algorithms are currently embedded into software and hardware products designed by Innopsys.

8.1.2. Contract (CIFRE) with Technicolor: Semantically meaningful motion descriptors for video understanding

Participants: Juan Manuel Perez Rua, Patrick Bouthemy.

Collaborators: Tomas Crivelli and Patrick Pérez (Technicolor).

A three-year contract has been established with Technicolor in January 2015 for a CIFRE grant supporting the PhD thesis of Juan Manuel Pérez Rúa. The purpose was to investigate new methods for extracting meaningful mid-level motion-related descriptors that may help for the semantic discovery of the content. First, we addressed the occlusion detection problem and proposed a novel approach where occlusion is formulated in terms of visual reconstruction. Contrary to the usual approaches, the proposed alternative does not critically depend on a pre-computed, dense displacement field, while being shown to be more effective. Second, we developed two hierarchical motion segmentation methods involving a compositional motion representation. The first one follows a frame-based labeling approach which amounts to minimizing a global energy function. The second one is trajectory-based and relies on tree-structured learning and sparse coding.

8.1.3. Contract with OBSYS: microscope set-up control and inverse problems in microscopy

Participants: Giovanni Petrazzuoli, Charles Kervrann.

Collaborators: Charles Gudeudry (OBSYS).

A two-year contract was established with OBSYS in 2016 for hiring an expert-engineer (12 months). The objective is to investigate and develop software for the control of a microscope set-up and the analysis of fluorescence images. Fast and robust algorithms have been especially developed to improve image reconstruction of 3D-TIRF microscope images. The algorithms will be embedded into platforms and devices designed by OBSYS. Giovanni Petrazzuoli has been hired in August 2017 on a full-time R&D engineer position in OBSYS (CDI). The collaboration with Inria will be pursued in 2018.

8.2. Bilateral grants with industry

8.2.1. Fourmentin-Guilbert Foundation: Macromolecule detection in cryo-electron tomograms

Participants: Emmanuel Moebel, Charles Kervrann.

Collaborator: Damien Larivière (Fourmentin-Guilbert Foundation).

A three-year contract was established with Fondation Fourmentin-Guilbert to partly support the PhD thesis of Emmanuel Moebel. The Fondation Fourmentin-Guilbert strives for building a virtual E. coli bacteria. Information about the position of macromolecules within the cell is necessary to achieve such a 3D molecularly-detailed model. The Fondation Fourmentin-Guilbert supports cutting-edge *in-situ* cryo-electron tomography combined with image processing at the Max-Planck Institute of Biochemistry to map the spatial distribution of the ribosomes, and obtain structural information on the complexes they form *in-situ* with cofactors and other ribosomes. The objective of the project is to explore novel methods from the field of 3D shape retrieval for identifying and counting macromolecules within a tomogram. This project is also supported by Région Bretagne.

TAPDANCE Team (section vide)

VIRTUAL PLANTS Project-Team (section vide)

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Air-Liquide Medical Systems*

Participants: Mario Chavez [Correspondant], Xavier Navarro.

Project title: Real-time characterisation of respiratory states from EEG

Funded in 2014

Amount: 370 K€

Coordinator: Thomas Similowski

Other partners: UPMC, Inserm UMR 1158

Abstract: The project aims at developing a real-time brain computer interface (BCI) for the monitoring of respiratory states from scalp EEG data of healthy volunteers and patients, recorded at the laboratory, hospital ward, operating room or intensive care units.

8.2. Bilateral Grants with Industry

8.2.1. *Carthera*

Participants: Stéphane Epelbaum [Correspondant], Alexandre Carpentier, Anne Bertrand, Marie Odile Habert.

Project title: Open label phase 1/2 study evaluating the safety and usefulness of transient opening of the blood-brain barrier using low intensity pulsed ultrasounds generated by the implantable device SONOCLOUD in patients with mild Alzheimer's disease

Funded in 2016

Amount: 400 K€

Coordinator: Stéphane Epelbaum

Other partners: UPMC, AP-HP

Abstract: This project aims at opening the blood brain barrier (BBB) in 10 mild Alzheimer's disease patients in order to improve the clearance of beta-amyloid and tau deposits in their brain as suggested in mice models of the disease. This first in man study will evaluate the safety and efficacy of an implanted device, SONOCLOUD, to open the BBB 7 times in each participant. Efficacy will be evaluated on the ability of the method to decrease the amyloid load evidenced by AV45 Positron Emission Tomography (PET), increase the brain metabolism analyzed by Fluorodeoxyglucose PET and improve cognition. If successful, this study will pave the way for future trials in which drugs can be used in addition to BBB opening to maximize their effect.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. CIFRE PhD Fellowships

7.1.1.1. Neurelec/Oticon Medical

Participants: Thomas Demarcy [correspondent], Hervé Delingette, Nicholas Ayache, Dan Gnansia [Oticon Medical].

The work of Thomas Demarcy, *Segmentation and anatomic variability of the cochlea and other temporal bone structures from medical images*, is supported by a PhD fellowship from the Neurelec/Oticon Medical company.

7.1.2. Microsoft Research

Microsoft Research is funding through the Inria-Microsoft joint lab the projects "4D Cardiac MR Images"[0] and "Medilearn"[0] which aim at analyzing large databases of cardiac images to help the diagnosis of cardiac diseases and planning of therapy. This project involves A. Crimisi from MSR and partially funds the PhDs of Pawel Mlynarski.

7.1.3. Spin-off company Therapixel

Therapixel[0] is a spin-off of the Asclepios (Inria Sophia Antipolis) and Parietal (Inria Saclay) project teams founded in 2013. Therapixel makes surgical information systems. It relies on depth sensing, advanced software processing and innovative user interfaces to provide touchless control of the computer. This technology allows for a direct control of the computer, which sterility constraints made impractical in the past. In 2015, Therapixel obtained the CE marking of its product on touchless visualization of medical images.

7.1.4. Spin-off company inHEART

inHEART[0] is a spin-off of the Asclepios team and IHU Liryc founded in 2017. inHEART provides a service to generate detailed anatomical and structural meshes from medical images, that can be used during ablation interventions. inHEART received 2 awards, one from Aquitaine region and one i-LAB form the BPI.

7.1.5. Siemens HealthCare

Siemens Healthcare, Medical Imaging Technologies, Princeton, NJ (U.S.A). is funding the Phd work of Julian Krebs which aims at developping robust medical image registration methods

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[0]http://www.msr-inria.fr/projects/4d-cardiac-mr-images
[0]http://www.msr-inria.fr/projects/medilearn
[0]http://www.therapixel.com/
[0]http://www.inheart.fr/

ATHENA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- The Olea Medical company from La Ciotat (FR) funds 50% of the PhD of Marco Pizzolato, supervised by Rachid Deriche, which is funded by the PACA Region for the remaining 50%.

- The dMRI Library has been transfered to the Olea Medical company.

- The BESA company (Brain Electrical Source Analysis) from Germany funds 50% of the PhD of Christos Papageorgakis, co-supervised by Maureen Clerc (ATHENA) and Juliette Leblond (APICS), which is funded by the PACA Region for the remaining 50%.

- The Neurelec company (Cochlear Implants) supports a CIFRE PhD funding for Kai Dang, supervised by Maureen Clerc.

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. ARVIP: Augmented reality for visually impaired people

Participants: Josselin Gautier, Pierre Kornprobst, Frédéric Dosière [Bosch Visiontec], David Coupé [Bosch Visiontec]

Duration: August 2017 to March 2018

In Biovision, we want to develop new augmented reality systems for low-vision people, to facilitate scene interpretation by enhancing important scene characteristics. Research and investigations are conducted using automotive industry HW solutions, thanks to a partnership with Bosch Visiontec. Our goal is to investigate how such hardware could be used to design efficient vision aid systems. The case-study that we are considering is the one of improving the social interaction which is amongst the first reported needs. We are studying methods to selectively enhance faces in real time, thus allowing low-vision people to better capture faces and emotions of their interlocutors. This work is also conducted in collaboration with Centre hospitalier Pasteur 2 (service d'ophtalmologie, Nice, France) and "27Delvalle" (Centre d'Innovation Santé de la ville de Nice, France) in order to have feedback on our prototype as we develop it.

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- FUI MMCD (Multifunctions Modular Cockpit Display) [2014-2018] Labels : Pegase, ASTech

  The MMCD project (Multi Functions Modular Cockpit Display) aims at designing a mechatronic architecture that is modular, certifiable and evolutive in terms of embedded GPU. This project will contribue to Avionics 2020 by developing a mock-up of new cockpit display system, allowing easy to manage GPU evolution.

  Our contribution concerns formal design and prototyping of embedded supervisory functions, using the HILECOP methodology and tool.

- collaboration contract with FEETME [0] company.

- collaboration contract with Innopsys [0] company.

- collaboration contract with NEURORESP [0] company (CIFRE PhD thesis).

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[0]http://www.feetme.fr
[0]https://www.innopsys.com/en
[0]http://neuroresp.com/

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Contract with General Electric Healthcare
Project title: Optimization methods for breast tomosynthesis
Duration: 2017-2020
Responsible: J.-C. Pesquet

MATHNEURO Team (section vide)

MIMESIS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

MIMESIS has active bilateral collaborations with following industrial partners:

InSimo: A startup providing biomedical simulation software which are able to reproduce the behavior of organs, tissues and surgical procedures in a realistic and interactive way. Created in January 2013 as a spin-off forces by former members of team SHACRA (the predecessor of MIMESIS). Currently, we collaborate on simulations of eye surgery as well as on preparation of projects aiming at validation of algorithms and codes of simulation framework SOFA.

Altran: A global leader in innovation and high-tech engineering consulting, Altran accompanies supports its clients in the creation and development of their new products and services. We have a common history of successful collaboration via CIFRE Ph.D. thesis of Rosalie Plantefève. A new CIFRE Ph.D. will start on 01/01/2018 focusing on fusion of multisensor data in the context of intra-operative navigation of catheters.

Siemens: A global leader in healthcare industry. Via IHU, we collaborate with Siemens in the context of the IHU project *CIOS Alpha Fusion* dealing with augmentation of the intra-operative image provided by a fluoroscopic imaging modality with pre-operative data.

Renumics: A German startup focusing on automation of computer aided engineering (CAE) using artificial intelligence in general and machine learning techniques in particular. In close collaboration with SOFA Consortium, MIMESIS is involved in preparation of projects aiming at validation of SOFA.

Naviworks: A South Korean company specialized in ICT convergence simulation/IoT smart controlling. We collaborate on simulation and visualization in the context of interventional radiology.

MNEMOSYNE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Contract with Algotech

Participants: Frédéric Alexandre, Ikram Chraibi Kaadoud, Nicolas Rougier, Thierry Viéville.

Algotech is a SME working in the domain of CADD software edition for electrical circuit diagram interpretation and design. Its activity is interesting for our team because they are also interested in the design, by learning, of perception (for diagram identification) and action aspects of loops (for diagram genesis) with the specificity of working at a small scale, considering the variety of items to be manipulated. This is consequently a very interesting benchmark for transfering our bio-inspired models to the domain of classical machine learning.

NEUROSYS Project-Team (section vide)

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

8.1.1. *The Wendelin FUI project*

The Wendelin project has been granted on December 3rd, 2014. It has been selected at the *Programme d'Investissements d'Avenir (PIA)* that supports "cloud computing et Big Data". It gives visibility and fosters the French technological big data sector, and in particular the scikit-learn library, the NoSQL "NEO" et the decentralized "SlapOS" cloud, three open-source software supported by the Systematic *pôle de compétitivité*.

Scikit-learn is a worldwide reference library for machine learning. Gaël Varoquaux, Olivier Grisel and Alexandre Gramfort have been major players in the design of the library and Scikit-learn has then been supported by the growing scientific Python community. It is currently used by major internet companies as well as dynamic start-ups, including Google, Airbnb, Spotify, Evernote, AWeber, TinyClues; it wins more than half of the data science "Kaggle" competitions. Scikit-learn makes it possible to predict future outcomes given a training data, and thus to optimize company decisions. Almost 1 million euros will be invested to improve the algorithmic core of scikit-learn through the Wendelin project thanks to the Inria, ENS and Institut Mines Télécom teams. In particular, scikit-learn will be extended in order to ease online prediction and to include recent stochastic gradient algorithms.

NEO is the native NoSQL base of the Python language. It was initially designed by Nexedi and is currently used and embedded in the main software of company information systems. More than one million euros will be invested into NEO, so that scikit-learn can process within 10 years (out-of-core) data of 1 exabyte size.

Paris13 university and the Mines Télécom institute will extend the SlapOS distributed mesh cloud to deploy Wendelin in *Big Data as a Service* (BDaaS) mode, to achieve the interoperability between the Grid5000 and Teralab infrastructures and to extend the cloud toward smart sensor systems.

The combination of scikit-learn, NEO and SlapOS will improve the predictive maintenance of industrial plants with two major use cases: connected windmills (GDF SUEZ, Woelfel) and customer satisfaction in car sale systems (MMC Rus). In both cases it is about non-personal, yet profitable big data. The Wendelin project actually demonstrates that Big data can improve infrastructure and everyday-life equipment without intrusive data collection. For more information, please see http://www.wendelin.io.

The project partners are:

- Nexedi (leader)
- GDF SUEZ
- Abilian
- 2ndQuadrant
- Institut Mines Télécom
- Inria
- Université Paris 13

VISAGES Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Siemens

In the context of the Neurinfo imaging platform, a master research agreement between Siemens SAS - Healthcare and University of Rennes 1 was signed in October 2011 for 5 years and renewed in 2016. This contract defines the terms of the collaboration between Siemens, Visages and the Neurinfo platform. From this research agreement contract, Neurinfo has received work in progress (WIP) sequences from Siemens in the form of object code for evaluation in the context of clinical research. The Neurinfo platform has also received source code of selected MRI sequences. As an example, the diffusion sequence code was modified to load arbitrary diffusion gradient waveforms for the FastMicroDiff project led by E. Caruyer. This is crucial in the collaboration since it enables the development of MRI sequences on site. Siemens currently provides research resources through the funding of a PhD student (Cédric Meurée: CIFRE Inria / Siemens grant).

8.2. Bilateral Grants with Industry

The PhD of Cédric Meurée is funded by Siemens Healthineers under a CIFRE grant.

AIRSEA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Contract with IFPEN (Institut Français du pétrole et des énergies nouvelles), for the supervision of Adrien Hirvoas. Research subject: Sensitivity of a floating offshore wind turbine to uncertain parameters and identification of observable variables for data assimilation.

The Chair OQUAIDO – for "Optimisation et QUAntification d'Incertitudes pour les Données Onéreuses" in French – is the chair in applied mathematics held at Mines Saint-Étienne (France). It aims at gathering academical and technological partners to work on problems involving costly-to-evaluate numerical simulators for uncertainty quantification, optimization and inverse problems. This Chair, created in January 2016, is the continuation of the projects DICE and ReDICE which respectively covered the periods 2006-2009 and 2011-2015. Reda El Amri's PhD thesis is funded by OQUAIDO.

A 1-year contract with NOVELTIS on the thematic "Développement de démonstrateurs avec AGRIF": see 6.1

A 3-year contract named ALBATROS with Mercator-Ocean on the topic « Interaction océan, vagues, atmosphère à haute résolution ».

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

A contract has been made (120.000 euros) with SAUR, IAV (Institut d'Aménagement de la Vilaine) and Agence de l'eau Loire-Bretagne in collaboration with SciWorks Technologies. It deals with the modelling and the simulation of chlorides entry in the Vilaine reservoir.

The ANR project Hyflo-Eflu relies on a collaboration with the company "HydroTube Energie". It comprises the recruitment of a young engineer (J. Ledoux) and regular meetings with industrial (Bordeaux) and academic partners (Nantes).

The ANR project ESTIMAIR includes the SME NUMTECH for a commercial deployment of the project results.

The EIT Digital project Env&You involves the SME NUMTECH and the startup Ambiciti, whose products rely on the results of this European project.

8.2. Bilateral Grants with Industry

P. Quémar's PhD thesis is funded by EDF (CIFRE). His PhD is entitled "3D numerical simulations of environmental hydrolics: application to Telemac".

J. Thorey's PhD thesis was funded by EDF R&D (CIFRE). The title of PhD thesis was: "Ensemble forecasting using sequential aggregation for photovoltaic power applications".

CASTOR Project-Team (section vide)

COFFEE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Contract with Andra financing the two years postdoctoral position of Nabil Birgle (april 2016- march 2018) and dealing with domain decomposition algorithms to couple the non-isothermal liquid gas Darcy flow and the free gas flow occurring at the interface between the nuclear waste repository and the ventilation galleries. Supervision Roland Masson from LJAD-Inria and Laurent Trenty from Andra.

- Contract with Andra financing the two year postdoctoral position of Joubine Aghili (october 2017 - september 2019) and dealing with the simulation of compositional liquid gas Darcy flows in highly heterogeneous porous medium with network of fractures using Discrete Fracture Matrix models (DFM). It is applied to the simulation of the desaturation of the nuclear waste storage in the neighbourhood of the galleries. Supervision Roland Masson and Konstantin Brenner from LJAD-Inria, Jean-Raynald de Dreuzy from Geosciences Rennes and Laurent Trenty from Andra.

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Contract CERSAT/IFREMER

Participants: Etienne Mémin, Valentin Resseguier.

duration 39 months. This partnership between Inria and Ifremer funded the PhD of Valentin Resseguier, which aimed to study image based data assimilation strategies for oceanic models incorporating random uncertainty terms. The goal targeted will consist in deriving appropriate stochastic version of oceanic model and on top of them to devise estimation procedures from noisy data to calibrate the associated subgrid models.

8.1.2. Contract inter Carno IFREMER Inria

Participants: Etienne Mémin, Thibaut Tronchin.

duration 36 months. This contract was centred on the elaboration of an image-based tools for the analysis of the hydraulic load of an immersed body. This project tooke place within an inter Carnot cooperation between Ifremer and Inria.

8.1.3. Contract ITGA

Participants: Dominique Heitz, Etienne Mémin.

duration 36 months. This partnership between Inria, Irstea and ITGA funds the PhD of Romain Schuster. The goal of this PhD is to design new image-based flow measurement methods for the study of industrial fluid flows. Those techniques will be used in particular to calibrate industrial fume hood.

8.1.4. Contract CSTB

Participants: Mohamed Yacine Ben Ali, Dominique Heitz, Etienne Mémin.

duration 36 months. This partnership between Inria, Irstea and CSTB funds the PhD of Yacine Ben Ali. This PhD aims to design new data assimilation scheme for Reynolds Average Simulation (RANS) of flows involved in wind engineering and buildings construction. The goal pursued here consists to couple RANS models and surface pressure data in order to define data driven models with accurate turbulent parameterization.

8.1.5. ANDRA project

Participants: Yvan Crenner, Benjamin Delfino, Jean-Raynald de Dreuzy, Jocelyne Erhel.

Contract with ANDRA (National Agency for Nuclear Waste)
Duration: three years from November 2015.
Title: reactive transport in fractured porous media
Coordination: Jocelyne Erhel.
Partners: Geosciences Rennes.
Abstract: Even in small numbers, fractures must be carefully considered for the geological disposal of radioactive waste. They critically enhance diffusivity, speed up solute transport, extend mixing fronts and, in turn, modify the physicochemical conditions of reactivity around possible storage sites. Numerous studies in various fields have shown that fractures cannot be simply integrated within an equivalent porous medium with a simple enhancement of its petro-physical properties (porosity and permeability). We propose a combined numerical and experimental approach to determine the influence on reactivity of typical fracture patterns found in some radioactive waste applications.

8.1.6. IFPEN project

Participants: Bastien Hamlat, Jocelyne Erhel.

Contract with IFPEN (Institut Français du Pétrole et Energies Nouvelles)
Duration: three years from October 2016.
Title: Fully implicit Formulations for the Simulation of Multiphase Flow and Reactive Transport
Coordination: Jocelyne Erhel.
Abstract: Modeling multiphase flow in porous media coupled with fluid-rock chemical reactions is essential in order to understand the origin of sub-surface natural resources and optimize their extraction. This project aims to determine optimal strategies to solve the coupled transport and chemical reaction equations describing the physical processes at work in reactive multiphase flow in porous media. Three different formulations show great potential to accurately solve these equations. Two are fully implicit ("Reactive Coats" and "Semi-smooth Newton)" and one is an operator splitting approach. These formulations are still incomplete at the moment. The work will focus on extending the existing formulations to more complex physical phenomena, study their stability, convergence and theoretical equivalence. Another objective is to provide practical solutions to efficiently solve the resulting non-linear systems.

LEMON Team (section vide)

MAGIQUE-3D Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with TOTAL

- Depth Imaging Partnership (DIP)

  Period: 2014 May - 2019 April , Management: Inria Bordeaux Sud-Ouest, Amount: 120000 euros/year.

- Approximations hybrides par éléments finis discontinus pour l'élasto-acoustique

  Period: 2016 November - 2018 October, Management: Inria Bordeaux Sud-Ouest, Amount: 165000 euros.

- Méthodes d'inversion sismique dans le domaine fréquentiel

  Period: 2014 October - 2017 December , Management: Inria Bordeaux Sud-Ouest, Amount: 180000 euros.

- Portage de méthodes numériques de simulation de phénomènes complexes sur des architectures exascales

  Period: 2016 January - 2017 December , Management: Inria Bordeaux Sud-Ouest, Amount: 150000 euros.

- Utilisation d'images 3D DRP à différentes échelles et résolutions pour vérifier l'applicabilité des problèmes acoustiques Period: 2017 November - 2019 October, Management: Inria Bordeaux Sud-Ouest, Amount: 170000 euros.

- Petrophysics in pre-salt carbonate rocks

  Period: 2017 December - 2019 November, Management: Inria Bordeaux Sud-Ouest, Amount: 190000 euros.

SERENA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Three contracts with EDF accompanying the PhD theses of Amina Benaceur, Nicolas Pignet, and Riccardo Milani.

One contract with CEA accompanying the PhD thesis of Frédéric Marazzato.

One contract with ANDRA accompanying the PhD thesis of Sarah Ali Hassan (ended, Ph.D. defended in June 2017).

One contract with IFP Energies Nouvelles, in the framework of the Inria–IFP Energies Nouvelles "contrat cadre".

Three-parts contract Inria–EDF–Sciworks Technologies (from April 2017) on "Form-L for the formalization of constraints of complex systems".

STEEP Project-Team (section vide)

TONUS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

We are involved in the PhD direction of Lucie Quibel in collaboration with EDF Chatou (CIFRE support). The objective is to design new Equations Of States (EOS) for the simulation of multiphase flows. The EOS cannot be chosen arbitrarily if one wants to ensure the stability of the fluid model. We are also interested to apply our palindromic method for computing low-Mach liquid-vapor flows.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

BioEnTech: the collaboration with the BioEnTech start-up is aiming at developing new functionalities for ODIN in order to improve the advanced monitoring and control of industrial anaerobic digesters.

Inalve: with the Inalve start-up we develop a breakthrough process that we patented, in which microalgae grow within a moving biofilm. The objective of the collaboration is to optimize the process by enhancing productivity, while reducing environmental footprint.

CARMEN Project-Team (section vide)

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

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

The industrial connections of the Dracula team have been made through the "Modeling of the immune response" project. Contacts have been established with both large pharmaceutical companies (Sanofi-Pasteur and Merial) and SMEs (AltraBio and the CosmoTech). The now finished ANR PrediVac project included the two aforementioned SMEs and therefore strengthened the ties between Dracula and its industrial local ecosystem. The same consortium applied to ANR grants on close research topics in 2017. Furthermore, the ties with CosmoTech have been strenghened through a joint CIFRE PhD (A. Bonnaffoux).

6.2. Bilateral Grants with Industry

- A recent cooperation has been initiated with the start up "Neolys Diagnostics" about radiotherapy effects on healthy cells and tumor cells. A PhD student, Aurélien Canet, has started his doctorate studies in January 2016 paid for one half by the start up and for the other half by the labex Milyon. Aurélien Canet is co-supervized by Larry Bodgi (from Neolys), Nicolas Foray (from Inserm) and Laurent Pujo-Menjouet.

- Celine Vial is scientific responsible of a contract with the European Consortium Eurokin and in collaboration with IFP "Energies nouvelles" on the topic: "Design experiments, sensibility and uncertainty analysis and kriging".

M3DISIM Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Technical contract with CEA-LIST on coupling strategies between subdomains for transient elasto-dynamics (8keuros)

Contract with the Sensome startup. Aims: feasibility of the measurement of blood clots mechanical properties. (1.6keuros)

MAMBA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Industrial contract with SANOFI on the modelling of employees population dynamics and turnover.

MONC Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Research contract between Roche and Monc team.

MYCENAE Project-Team (section vide)

NUMED Project-Team (section vide)

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Air Liquide Santé International*

Participants: Céline Grandmont, Nicolas Pozin, Irene Vignon Clementel.

CIFRE convention and contract with Air Liquide Santé International (March 2014 - December 2017) in the context of the ANRT on "Multiscale lung ventilation modeling in health and disease", for the PhD thesis of Nicolas Pozin.

8.1.2. *Philips Research*

Participants: Miguel Ángel Fernández Varela, Jean-Frédéric Gerbeau, Alexandre This.

CIFRE convention and contract with Philips Research for the PhD thesis of Alexandre This (January 2016 - December 2018) on fusion data/simulation for the assessment of mitral regurgitation.

8.1.3. *Kephalios & Epygon*

Participants: Gautier Bureau, Miguel Ángel Fernández Varela, Jean-Frédéric Gerbeau, Ludovic Boilevin-Kayl, Marina Vidrascu.

REO is an academic partner of the industrial project MIVANA, dedicated to the development of new technologies for mitral valve treatment. It is led by the start-up company Kephalios, with the participation of the start-up company Epygon, by the company MDB Texinov and the research institute IFTH. In this framework, REO has two bilateral contracts with Kephalios and Epygon on the modeling and simulation of two medical devices for mitral valve repair.

8.1.4. *Instem/NOTOCORD*

Participants: Muriel Boulakia, Damiano Lombardi, Jean-Frédéric Gerbeau, Fabien Raphel, Eliott Tixier.

REO partners with the software company NOTOCORD. The collaboration started in 2013 the framework of the LabCom "cardioXcomp". In 2016, the ANR funding came to an end, and NOTOCORD was acquired by the company Instem. Our collaboration with Instem/NOTOCORD continues as a bilateral partnership with the purpose of developing the software cardioXcomp dedicated to the safety pharmacology industry. This project is also supported by a grant by AMIES (Agency for Interaction in Mathematics with Business and Society).

SISTM Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Implication in research for the development of vaccine has lead to a direct contracts with industry such Iliad Biotechnologies. This contract had been signed for the BPZE-1 pertussis vaccine trial. This study evaluates the safety and immunogenicity of a higher dose formulation of a new live attenuated vaccine, BPZE1, intended to prevent Bordetella pertussis nasopharyngeal colonization and pertussis disease, and investigates whether higher doses of BPZE1 induce the live vaccine to colonize subjects' nasopharynx. The study is a Phase Ib (high dose), single centre, dose-escalating, placebo-controlled study of the live attenuated B. pertussis strain BPZE1 given as a single intranasal dose to healthy adult volunteer.

8.2. Bilateral Grants with Industry

Implication in research for the development of Ebola vaccine has lead to several indirect contracts with industry:

- The EBOVAC1, EBOVAC2 and EBOVAC3 project, collaboration with Janssen from Johnson et Johnson.

- The BPZE-1 pertussis vaccine trial , which is presented in Section 'Bilateral Contracts with Industry', leads to collaboration with Iliad Biotechnologies.

- The Prevac trial vaccine trial leads to collaboration with Merck and Janssen. The purpose of this study is to evaluate the safety and immunogenicity of three vaccine strategies that may prevent Ebola virus disease (EVD) events in children and adults. Participants will receive either the Ad26.ZEBOV (rHAd26) vaccine with a MVA-BN-Filo (MVA) boost, or the rVSVΔG-ZEBOV-GP (rVSV) vaccine with or without boosting, or placebo.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Contract with Dassault Systèmes