



RESEARCH CENTER

FIELD

**Digital Health, Biology and Earth**

Activity Report 2016

# Section Contracts and Grants with Industry

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## ABS Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral contracts with industry

In this section, we describe the collaboration between ABS and MS Vision (<http://msvision.eu/>), and 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>).

### 7.1.1. 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 preparation (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.

### 7.1.2. 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].

**AMIB Project-Team (section vide)**

**BEAGLE Project-Team (section vide)**

## BIGS Project-Team

# 8. Bilateral Contracts and Grants with Industry

## 8.1. Bilateral Contracts with Industry

### 8.1.1. *Bilateral Contracts with Industry*

#### 8.1.1.1. *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.

#### 8.1.1.2. *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.

#### 8.1.1.3. *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 [33].



## **BONSAI Project-Team**

# **8. Bilateral Contracts and Grants with Industry**

## **8.1. Bilateral Contracts with Industry**

The PhD thesis of Léa Siegwald is funded by a CIFRE contract with the biotechnology company Gènes Diffusion.

**CAPSID Project-Team (section vide)**

**DYLISS Project-Team (section vide)**

**ERABLE Project-Team (section vide)**

## GENSCALE Project-Team

# 8. Bilateral Contracts and Grants with Industry

## 8.1. Bilateral Contracts with Industry

### 8.1.1. *Empowerd 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. *EnginesOn start-up project*

**Participant:** Jennifer Del Giudice.

EnginesOn is a start-up project based on life science digital data analysis (<http://engineson.fr/>). The origin of the project comes from a simple field observation: NGS technology is involved in numerous scientific studies. Deciphering the heterogeneous and voluminous data generated is a real challenge. People with the skills to analyze this type of data are scarce. EnginesOn focuses its first effort on health market with cancer diagnosis and personalized medicine. The start-up provides to physicians a virtual research laboratory with analysis workflows, compute infrastructure and data management that will lead to a simple, fast, reproducible diagnosis in a transparent fashion. EnginesOn also addresses the issue of big data management and storage. The project is entitled to the Fasttrack program since october 2016. Inria funds a 6-month technology transfer engineer in order to study the valorization and promote the GATB toolbox.

### 8.2.2. *Rapsodyn project*

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

RAPSODYN is a long term project funded by the IA 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.

## IBIS Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. BGene

**Participants:** Johannes Geiselmann, Hidde de Jong, 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). Johannes Geiselmann and Hidde de Jong are members of its scientific advisory board. For more information on BGene, see <http://www.bgene-genetics.com/>.

## 7.2. Genostar

**Participants:** Hidde de Jong, Michel Page, François Rechenmann.

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 (Section 5.1). Genostar offers a comprehensive service line-up that spans genome sequencing, read assembly, annotation, and comparison. Genostar thus works with trusted subcontractors, each specialized in state-of-the-art sequencing technologies. François Rechenmann is CEO of the company. For more information, see <http://www.genostar.com>.

**LIFEWARE Project-Team (section vide)**

## **MORPHEME Project-Team**

# **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. In December, we signed a collaboration contract with Bayer, Lyon, to fund a Master 2 internship with some overhead on the topic of automatic cell classification. The intern will start working on the subject in January 2017.



**PLEIADE Team (section vide)**

## SERPICO Project-Team

# 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:** Hoai Nam Nguyen, Charles Kervrann.

**Collaborators:** Vincent Paveau and Cyril Cauchois (Innopys company).

A three-year contract has been established with Innopsys in 2013 to support Hoai Nam Nguyen's PhD thesis. The objective is to investigate and develop methods and algorithms dedicated to fluorescence images acquired by the scanners and devices designed by the company. In this project, we focus on i/ localization and segmentation fluorescence tissue microarrays (TMA) cores in very large 2D images; ii/ de-arraying of digital images and correction of grid deformation adapted to devices; iii/ correction of scanning artifacts to improve image reconstruction; iv/ deconvolution, denoising and superresolution of fluorescence TMA images corrupted by Poisson noise. The algorithms will be integrated into the platforms and devices 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 on January 2015 for a CIFRE grant supporting Juan Manuel Perez Rua's PhD thesis. The purpose is to investigate new methods for extracting meaningful mid-level motion-related descriptors that may help for the semantic discovery of the scene. In 2015, we started with the occlusion detection problem. We have proposed a novel approach where occlusion in the next frame or not is formulated in terms of visual reconstruction. Our approach outperforms state-of-the-art occlusion detection methods on the challenging MPI Sintel dataset. In 2016, we have developed two hierarchical motion segmentation methods involving a compositional motion representation. The first one follows a frame-based labeling approach which amounts to the minimization of 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 three-year contract has been established with OBSYS in 2016. The objective is to investigate and develop methods and algorithms dedicated to the control of a microscope set-up and to the analysis of fluorescence images. Fast and robust algorithms will be especially developed to improve image reconstruction of 3D-TIRF microscope images. The algorithms will be integrated into the platforms and devices designed by OBSYS.

## 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).

The Fourmentin-Guilbert Foundation 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 Fourmentin-Guilbert Foundation 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 and evaluate novel methods from the field of 3D shape retrieval for identifying, localizing and counting macromolecules (e.g., 70S ribosome) within a tomogram. This project is also supported by “Region Bretagne”.

**TAPDANCE Team (section vide)**

## **VIRTUAL PLANTS Project-Team**

# **7. Bilateral Contracts and Grants with Industry**

## **7.1. Bilateral Contracts with Industry**

Guillaume Garin has been funded by itk (<http://www.itk.fr/en/>). With itk, a generic model of plant pathosystem was developed in the OpenAlea platform and illustrated on Vine and Wheat.

## ARAMIS Project-Team

# 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..

## ASCLEPIOS Project-Team

# 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. Inria - Mauna Kea Technologies I-Lab SIWA

**Participants:** Nicholas Ayache [correspondent], Xavier Pennec, Marzieh Kohandani Tafreshi, Rémi Cuingnet.

*This I-lab involves the Mauna Kea Technologies company.*

The first focus of this I-lab is to develop efficient and friendly content-based image retrieval (CBIR) tools to help users make a diagnosis. The second focus is on image registration to provide near real-time and robust image registration tools built on GPU implementations for image stabilization and super-resolution since it is a critical method for the smart atlas.

For more information, see [this link](#)<sup>0</sup>. The I-lab SIWA ended in March 2016.

#### 7.1.3. Microsoft Research

Microsoft Research is funding through the Inria-Microsoft joint lab the projects "[4D Cardiac MR Images](#)"<sup>0</sup> and "[Medilearn](#)"<sup>0</sup> 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 Loic Le Folgoc, Pawel Mlynarski as well as the post doctoral stay of Hervé Lombaert.

#### 7.1.4. Spin-off company Therapixel

[Therapixel](#)<sup>0</sup> 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.

#### 7.1.5. Siemens HealthCare

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

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<sup>0</sup><https://lisa.sophia.inria.fr/siwa-loasis-numerique-dinria-et-de-mauna-kea-706.html>

<sup>0</sup><http://www.msr-inria.fr/projects/4d-cardiac-mr-images>

<sup>0</sup><http://www.msr-inria.fr/projects/medilearn>

<sup>0</sup><http://www.therapixel.com/>

## ATHENA Project-Team

# 8. Bilateral Contracts and Grants with Industry

## 8.1. Bilateral Grants 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 transferred 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) has obtained a CIFRE PhD funding for Kai Dang, supervised by Maureen Clerc.



**BIOVISION Team (section vide)**

## **CAMIN Team**

# **8. Bilateral Contracts and Grants with Industry**

## **8.1. Bilateral Contracts with Industry**

FUI MMCD (Multifunctions Modular Cockpit Display) [2014-2017] 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 contribute 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.

## **8.2. Bilateral Grants with Industry**

CIFRE phd financial support with Axonic (PhD grant), Wafa Tigra, 2013-2016, restoration of grasping using FES and selective stimulation

**GALEN Project-Team (section vide)**

**MATHNEURO Team (section vide)**

## MIMESIS Team

# 6. Bilateral Contracts and Grants with Industry

## 6.1. Bilateral Contracts with Industry

The team is in close collaborations with:

**InSimo** is a startup we created in January 2013, after two years of thinking, maturation and incubation. Its founding members were all former team members of the SHACRA team (our previous team). The business model of the company is based on the SOFA platform and its community to transfer state-of-the-art simulation technologies into commercially-supported software components that medical simulator vendors can integrate into their products. The goal is to foster the creation of a new generation of medical simulators, highly realistic, faster to develop, allowing a broader commercial offer and novel uses. We collaborate with InSimo through the RESET ANR project.

In the context of the SOFA Consortium, the team is in close collaborations with:

**Altran** is 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. At the occasion of Altran internal scientific workshop, several members of the team (Rosalie Plantefève, Bruno Marques Jaime Guevara and Christoph Paulus) presented their work. We collaborate with Altran through the PhD thesis of Rosalie Plantefève.

**Anatoscope** is a young start-up company created in 2015 by researchers, engineers and one surgeon. It develops a software solution to automatically build 3D digital avatars based on medical images of patients. The avatars allow biomechanical simulations of the real person.

**TruPhysics** develops Industry 4.0 software solutions to support manufacturing companies in development and sales processes by using a real-time and high-resolution physics simulation. We provide software that enables developers and engineers to simulate control programs, physical properties, kinematics and behavior of industrial robots, machines and assemblies. We collaborate with TruPhysics through the RASimAs FP7 project.

## 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 Chraïbi 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 transferring our bio-inspired models to the domain of classical machine learning, as we have begun this year.

## NEUROSYS Project-Team

# 8. Bilateral Contracts and Grants with Industry

## 8.1. Bilateral Contracts with Industry

### 8.1.1. *CertiViBE*

Laurent Bougrain is a member of the steering committee of OpenViBE and CertiViBE.

CertiViBE is a medically certifiable core for OpenViBE, the software for Brain Computer Interfaces and Neuroscience research. It is an Inria innovation lab to boost technology transfers from the Inria project-team Hybrid to Mensia Technologies SA (<http://www.mensiatech.com/>).

Founded in 2012, Mensia Technologies is a medical-device spin-off of Inria owning an exclusive worldwide license of the OpenViBE software for commercial applications. So far, OpenViBE has raised a lot of interest in the research community, especially on medical applications. However, OpenViBE being a research software, it does not yet match the requirements of medical devices in terms of stability, performance, documentation, as well as engineering processes in general, slowing down the transfer of OpenViBE-based medical research to industry. Within the CertiViBE project, Inria and Mensia Technologies are putting their task forces and respective expertise together to deliver a certifiable core for the OpenViBE software. While the OpenViBE software will continue to be published as an Open Source software, the project will dramatically facilitate the transfer of the research made with OpenViBE as it will be built on ready-to-certify foundations, following the processes and normative regulation of medical devices development including risk analysis, quality assurance and medical device software development and maintenance.

## PARIETAL Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Grants with Industry

### 7.1.1. 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



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## 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 as with 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. This contract is part of the EUCLID platform (via the CIC 1401) in which Laura Richert and Rodolphe Thiébaud are involved.

## 8.2. Bilateral Grants with Industry

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

- The EBOVAC2 project, which is presented in Section 'FP7 & H2020 Projects', leads to 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. (Via the EUCLID platform and CIC 1401)
- The Prevac trial vaccine trial leads to collaboration with Merck. 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 rVSV $\Delta$ G-ZEBOV-GP (rVSV) vaccine with or without boosting, or placebo. (Via the EUCLID platform and CIC 1401)

## VISAGES Project-Team

# 8. Bilateral Contracts and Grants with Industry

## 8.1. Bilateral Contracts with Industry

### 8.1.1. Siemens

*duration: 5 years from 2011/10/26, extended until end of 2017.*

In the context of the Neurinfo imaging platform, a partnership between Siemens SAS - Healthcare and University of Rennes 1 was signed in October 2011 for 5 years. This contract defines the terms of the collaboration between Siemens and the Neurinfo platform. The Neurinfo platform 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. This is a major advance in the collaboration since it will enable the development of MRI sequences on site.

## 8.2. Bilateral Grants with Industry

### 8.2.1. MEDday

As part of its activities, MEDday led the final testing phase on patients diagnosed from Multiple Sclerosis in order to find treatment of progressive multiple sclerosis. This is done in partnership with several hospitals in France. The goal is to achieve an effective treatment for this disease. The role of the team in this industrial grant is to develop new algorithms to perform the processing and the analysis of the images from this study.

## **XPOP Team**

# **8. Bilateral Contracts and Grants with Industry**

## **8.1. Bilateral Contract with Industry**

Contract with Lixoft

## AIRSEA Project-Team

# 8. Bilateral Contracts and Grants with Industry

## 8.1. Bilateral Contracts with Industry

A 3-year contract with ARTELIA Group: funding for the PhD thesis of M.P. Daou (CIFRE)

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

A 1-year contract with NOVELTIS on the thematic "Développement de démonstrateurs avec AGRIF": see [6.1](#)

A 1-year contract with IFREMER on the thematic "Evolution de la librairie de raffinement de maillage en Fortran (AGRIF) : amélioration de la prise en compte du trait de côte et des frontières ouvertes en contexte parallèle MPI/OpenMP" : see [6.1](#)

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.

## **ANGE Project-Team**

# **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 and regular meetings with industrial (Bordeaux) and academic partners (Nantes).

## **8.2. Bilateral Grants with Industry**

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

**CASTOR Project-Team (section vide)**

## **CLIME Project-Team**

# **8. Bilateral Contracts and Grants with Industry**

## **8.1. Bilateral Grants with Industry**

A new Iilab, Rain\_Water, has been accepted in 2016. It concerns joint research with the company Weather Measures. Rain\_Water aims to define a platform of local meteorology. Users are mainly farmers that will use the platform for monitoring the agricultural practices at the parcel level.

## **COFFEE Project-Team**

# **7. Bilateral Contracts and Grants with Industry**

## **7.1. Bilateral Grants with Industry**

The project has industrial collaborations with Total, GDFSuez EP and Storengy on oil and gas recovery and gas storage.

The collaboration with Andra is concerned with the modelling and the simulation of mass and heat exchanges between porous media and ventilation channels. It leads to consider porous medium equations and hydrodynamic systems, coupled through intricate boundary conditions. Clearly one of the difficulties relies on the multiphase nature of the flows (at least water and air are present). We identify relevant physical scales, typical of the flows under consideration in nuclear waste engineering. We start by dealing with quite simple geometries, in order to discuss properly the order of magnitude of the different phenomena, and to design suitable schemes.

COFFEE has also a collaboration with BRGM, funded through the program “Carnot Institutes”, devoted to the setting of a parallel computing platform for the simulation of geothermal reservoirs. We aim at contributing to the design of a new generation of parallel tools of simulations, addressing the stiffness issues of actual reservoirs, a large variety of mesh geometries, able to handle faulted media.

A large part of these works is based on the development of the software COMPASS.



## FLUMINANCE Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Contracts with Industry

### 7.1.1. Contract CERSAT/IFREMER

**Participants:** Etienne Mémin, Valentin Resseguier.

*duration 36 months.* This partnership between Inria and Ifremer funds the PhD of Valentin Resseguier, which aims at studying 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.

### 7.1.2. Contract inter Carno IFREMER Inria

**Participants:** Etienne Mémin, Thibaut Tronchin.

*duration 36 months.* This contract aims at proposing image-based tools for the analysis of the hydraulic load of an immersed body. This project takes place within an inter Carnot cooperation between Ifremer and Inria.

### 7.1.3. 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 CIFRE 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.

### 7.1.4. 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.

### 7.1.5. 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

# 8. Bilateral Contracts and Grants with Industry

## 8.1. Bilateral Contracts with Industry

### 8.1.1. *Free surface hydraulics*

The finite volume-based, SW2D computational code (see Software section) is used by **Cereg Ingénierie** and **Enveo** (Montpellier Lavérune location) on a regular basis to carry out flood risk assessment studies. The code is constantly being developed on a work-for-hire basis depending on the company needs. The developments mostly concern pre- and post-processing functionalities, as well as specific hydraulic modules.

### 8.1.2. *Hydrodynamics of coastal lagoons with porosity models*

A two-dimensional shallow water with depth-variable porosity has been developed. The depth-variable porosity allows the subgrid-scale variations of the topography and hydraulic connectivity to be accounted for. The governing equations are written in conservation form and solved using a finite volume scheme. This allows the CPU time of the computational code to be divided by 2 to 3 orders of magnitude. The model is currently being tested against in situ measurements in the Vaccarès system in collaboration with Tour du Valat.

## 8.2. Bilateral Grants with Industry

Antoine ROUSSEAU collaborates with ARTELIA in the framework of M-P Daou's PhD thesis (CIFRE).

## **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.
- 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.
- Approximations hybrides par éléments finis discontinus pour l'élasto-acoustique  
Period: 2016 November - 2018 October, Management: Inria Bordeaux Sud-Ouest, Amount: 165000 euros.

## **SERENA Team**

# **7. Bilateral Contracts and Grants with Industry**

## **7.1. Bilateral Contracts with Industry**

- Three-parts contract Inria–EDF–Sciworks Technologies (November 2015–April 2016) on “Form-L for the formalization of constraints of complex systems”.
- Contract Inria–IFP Energies Nouvelles (December 2016–December 2017) on “A posteriori error analysis for porous media flow problems with fractures”.
- Numerous contracts accompanying Ph.D. theses and post-doc positions, see Section 1.

## **STEEP Project-Team**

# **8. Bilateral Contracts and Grants with Industry**

## **8.1. Bilateral Contracts with Industry**

The PhD thesis of Jean-Yves Courtonne has been co-sponsored by ARTELIA and Inria, via a bilateral contract.

## TONUS Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Contracts with Industry

We are involved in a common project with the company AxesSim in Strasbourg. The objective is to help for the development of a commercial software devoted to the numerical simulation of electromagnetic phenomena. The applications are directed towards antenna design and electromagnetic compatibility. This project was partly supported by DGA through "RAPID" (*régime d'appui à l'innovation duale*) funds. The CIFRE PhD of Thomas Strub is part of this project. Another CIFRE PhD has started in AxesSim on the same kind of topic in March 2015 (Bruno Weber). The new project is devoted to the use of a runtime system in order to optimize DG solvers applied to electromagnetism. The resulting software will be used for the numerical simulation of connected devices for clothes or medicine. The project is supported by the "Banque Public d'Investissement" (BPI) and coordinated by the Thales company.

## **BIOCORE Project-Team**

# **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)**

## **DRACULA Project-Team**

# **7. Bilateral Contracts and Grants with Industry**

## **7.1. 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 Cosmo Company). 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 2016. Furthermore, the ties with The Cosmo Company have been strengthened through a joint CIFRE PhD (see below).

## **7.2. 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-supervised by Larry Bodgi (from Neolys), Nicolas Foray (from Inserm) and Laurent Pujo-Menjouet.

## **7.3. Bilateral Grants with Industry**

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". The deliverable: "How accurate is my model?" Report by Celine Vial (80 pages).

**M3DISIM Project-Team (section vide)**

**MAMBA Project-Team (section vide)**

**MONC Project-Team (section vide)**

**MYCENAE Project-Team (section vide)**

## **NUMED Project-Team**

# **6. Bilateral Contracts and Grants with Industry**

## **6.1. Bilateral Contracts with Industry**

- Long standing contract with Sanofi company, on the stability of vaccines. This contract leads to the design and coding of a complete software devoted to the study of the degradation of vaccines. This software has been used in presentations of new vaccines to the FDA.
- Modeling of the quality of glass for a small French company.

## REO Project-Team

# 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 in the context of the ANRT on “Multiscale lung ventilation modeling in health and disease”, for the PhD thesis of Nicolas Pozin (March 2014 - February 2017).

### 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:** 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, Elliott Tixier.

REO partners with the software company NOTOCORD in the framework of the LabCom “cardioXcomp” (see ANR projects section). In 2016, the ANR funding came to an end, and NOTOCORD was acquired by the company Instem. Our collaboration with Instem/NOTOCORD will continue as a bilateral partnership with the purpose of developing the software cardioXcomp dedicated to the safety pharmacology industry.