



RESEARCH CENTER

FIELD

**Applied Mathematics, Computation
and Simulation**

Activity Report 2016

Section Contracts and Grants with Industry

Edition: 2017-08-25

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ACUMES Project-Team (section vide)

CAGIRE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Collaborative research contract with EDF (UPPA): “Nouveau modèle de turbulence Haut-Bas Reynolds avec prise en compte de la thermique active ou passive. (New high-low Reynolds number turbulence model accounting for active or passive heat transfer)” associated with the PhD thesis of J.-F. Wald.
- Collaboration contract “OpenLab Fluidics” with PSA (CNRS-UPPA): “Simulation numérique d’écoulements de convection naturelle typique des situations rencontrées dans l’espace sous-capot des véhicules automobiles”.

8.2. Bilateral Grants with Industry

- PhD grant (CIFRE) of J.-F. Wald, EDF, defended in May 2016.
- Internship grant of S. Jameel, PSA, defended in September 2016.

CARDAMOM Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Several contracts have been realized:

- SAFRAN-HERAKLES, 20Keuros for the development of a code for computing low-probability.
- CNES, 10 KEuros, for the technological transfer of Sparse-PDD code.
- CEA 2015 10237, 60 Keuro for the supervision of the post-doc of Maxence Claves by P.M. Congedo
- CEA 16-CIFRE PELUCHON, 20 Keuro for the supervision by L. Mieussens of the PhD of Simon Peluchon at the CEA-CESTA (1/1/15 - 31/12/17)
- BGS IT&E (2016-2018), 20 Keuro for a consulting by M. Ricchiuto on the implantation of some of the technology in the code SLOWS in their in-house model.

DEFI Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Grant with ART-FI (June 2016- June 2017) on quantification of electromagnetic radiations inside the brain from partial measurements
- A CIFRE PhD thesis started in January 2015 with Dassault Aviations. The student is M. Aloïs Bissuel who is working on "linearized Navier-Stokes equations for optimization, fluttering and aeroacoustic".
- A CIFRE PhD thesis started in December 2015 with Safran Tech. The student is Mrs Perle Geoffroy who is working on "topology optimization by the homogenization method in the context of additive manufacturing".

8.2. Bilateral Grants with Industry

- The SOFIA project (Solutions pour la Fabrication Industrielle Additive métallique) started in the summer of 2016. Its purpose is to make research in the field of metallic additive manufacturing. The industrial partners include Michelin, FMAS, ESI, Safran and others. The academic partners are different laboratories of CNRS, including CMAP at Ecole Polytechnique. The project is funded for 6 years by BPI (Banque Publique d'Investissement).
- FUI project Tandem. This three years project started in December 2012 and has been extended to September 2017 involves Bull-Amesys (coordinator), BOWEN (ERTE+SART), Ecole Polytechnique (CMAP), Inria, LEAT et VSM. It aims at constructing a radar system on a flying device capable of real-time imaging mines embedded in dry soils (up to 40 cm deep). We are in charge of numerical validation of the inverse simulator.
- FUI project Saxsize. This three years project started in October 2015 and involves Xenocs (coordinator), Inria (DEFI), Pyxalis, LNE, Cordouan and CEA. It is a followup of Nanolytix where a focus is put on SAXS quantifications of dense nanoparticle solutions.

ECUADOR Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Ecuador and Lemma share the results of Gautier Brèthes' thesis, which is partly supported by Lemma, the other part being supported by a PACA region fellowship.
- Ecuador and Lemma have a bilateral contract to share the results of Stephen Wornom, Lemma engineer provided to Inria and hosted by Inria under a Inria-Lemma contract.

GAMMA3 Project-Team

5. Bilateral Contracts and Grants with Industry

5.1. Bilateral Contracts with Industry

- The Boeing Company,
- Safran-Tech,
- Projet Rapid (DGA) avec Lemma.

IPSO Project-Team (section vide)

MATERIALS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts and grants with Industry

Many research activities of the project-team are conducted in close collaboration with private or public companies: CEA, SANOFI, IRDEP, EDF, IFPEN. The project-team is also supported by the Office of Naval Research and the European Office of Aerospace Research and Development, for multiscale simulations of random materials. All these contracts are operated at and administrated by the École des Ponts.

MEMPHIS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

We intend to pursue our partnership with Valeol, a wind turbine contractor in Aquitaine. Valeol poses simulation problems that cannot be addressed with standard tools. We have developed for them simplified PDE models for design in the frame of an industry funded PhD (CIFRE). We are currently adapting octree and Chimera approaches to the design of aerodynamic appendices to improve performance of existing installations. This is done in the frame of yet another CIFRE PhD thesis and the corresponding research contract. Moreover, thanks to this technology readiness, Valeol could join for the first time an H2020 research project, AEROGUST, that we are promoting with several academic and industrial institutions across Europe.

This year, we have also developed a new collaboration with the CorWave (<http://www.corwave.fr>). CorWave develops blood pumps based on a unique and patented wave membrane pumping technology. This collaboration has begun with an industry funded PhD (CIFRE), officially for the early 2017. Antoine Fondaneche, the PhD candidate, is now employed by CorWave on a basis of a two-month CDD contract.

We continue to deploy our effort in flow control and drag reduction for ground vehicles. After a fruitful collaboration with Renault, we are in the phase of negotiating a new collaboration. A new collaboration is starting with Valeo to optimize car cooling devices. DNS simulations are performed and compared to the industrial results obtained with URANS and LES methods and an EU network about this subject is going to be proposed.

MEPHYSTO Project-Team (section vide)

MOKAPLAN Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Optimal Transport applied to altimetric CTH dynamic interpolation

(S. Legrand V. Duval L. Chizat J-D. Benamou).

This collaboration between CLS and and funded by CNES intends to test on Column of Tropospheric Humidity data Optimal transportation interpolation techniques for balanced and unbalanced data.

NACHOS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Nuclétudes

Participants: Patrick Breuilh [Nuclétudes, Les Ulis, France], Alexis Gobé, Stéphane Lanteri.

The objective of this collaboration with the Nuclétudes company that has been initiated this year is to design a high order HDG formulation able to deal with non-conforming hybrid cubic/tetrahedral meshes, for the simulation of time-domain electromagnetic wave propagation problems with applications to radiation hardening. This first part of this study has been concerned with the specification and development of a preprocessing tool for the construction of such hybrid structured/unstructured meshes.

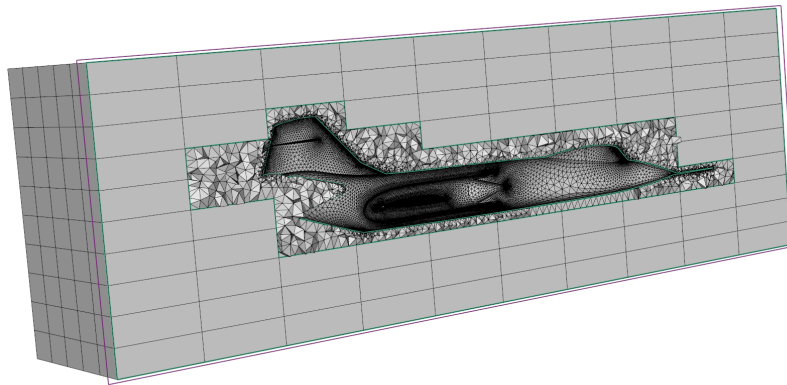


Figure 12. Non-conforming hybrid cubic/tetrahedral mesh around a jet fighter for Radar Cross Section evaluation using a frequency-domain Maxwell solver based on a HDG method.

NANO-D Project-Team (section vide)

POEMS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Contract POEMS-DGA

Participants: Eric Lunéville, Marc Lenoir, Séphanie Chaillat, Nicolas Kielbasiewicz, Nicolas Salles.

Start : 2015, End : 2018. Administrator : ENSTA.

This contract is in partnership with François Alouges and Matthieu Aussal (CMAP, Ecole Polytechnique) and concerns the improvement of Boundary Element Methods for wave propagation problems.

Contract POEMS-CEA-LIST

Participants: Marc Bonnet, Laure Pesudo.

Start : 12/01/2014, End : 11/31/2017. Administrator : CNRS.

This contract is about the coupling between high frequency methods and integral equations.

Contract POEMS-SHELL

Participants: Stéphanie Chaillat, Patrick Ciarlet, Luca Desiderio.

Start : 10/01/2013, End : 09/31/2016. Administrator : CNRS.

This contract is about fast direct solvers to simulate seismic wave propagation in complex media.

Contract POEMS-EDF

Participants: Stéphanie Chaillat, Marc Bonnet, Zouhair Adnani.

Start : 12/01/2014, End : 11/31/2017. Administrator : CNRS.

This contract is about fast solvers to simulate soil-structure interactions.

RAPSODI Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

C. Cancès supervises the PhD Thesis of Nicolas Peton at IFPEN since October 15, 2015. The bilateral contract enters the framework agreement between Inria and IFPEN.

APICS Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Contract CNES-Inria-XLIM

This contract (reference Inria: 7066, CNES: 127 197/00) involving CNES, XLIM and Inria, focuses on the development of synthesis algorithms for N -ports microwave devices. The objective is to derive analytical procedures for the design of multiplexers and routers, as opposed to "black box optimization" which is usually employed in this field (for $N \geq 3$). Emphasis at the moment bears on so-called "star-topologies".

6.2. Contract CNES-Inria-UPV/EHU

This contract (reference CNES: RS14/TG-0001-019) involving CNES, University of Bilbao (UPV/EHU) and Inria aims at setting up a methodology for testing the stability of amplifying devices. The work at Inria is concerned with the design of frequency optimization techniques to identify the unstable part of the linearized response and analyze the linear periodic components.

6.3. Contract BESA GmbH-Inria

This is a research agreement between Inria (Apics and Athena teams) and the German company BESA⁰, which deals with head conductivity estimation and co-advising of the doctoral work of C. Papageorgakis, see Section 5.1.5. BESA is funding half of the corresponding research grant, the other half is supported by Region PACA (BDO), see Section 1.

6.4. Flextronics

Flextronics, active in the manufacturing of communication devices all over the world, bought two sets of licenses for Presto-HF and Dedale-HF. Deployment of our tools in their production facilities for wireless communication units is being studied.

⁰<http://www.besa.de/>

BIPOP Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- CIFRE PhD thesis (N. Akhadkar) with Schneider Electric.

COMMANDS Project-Team**8. Bilateral Contracts and Grants with Industry****8.1. Bilateral Contracts with Industry****8.1.1. Ifpen**

In the framework of the PhD thesis of Arthur Le Rhun, we study the energy management of hybrid (parallel) vehicles, and more specifically the optimal use of the thermal engine. Before the PhD, a 4-month internship was focused on the eco-routing problem for hybrid vehicles, ie computing the optimal path. We proposed a method based on graphs: the road network is defined by a graph, and to take into account the hybrid aspect of the vehicle, we discretized the State of Charge on each node. Then a simple shortest path algorithm (A*) applied to this extended graph is able to solve the routing problem. Numerical simulations indicate that the solution of our discrete eco-routing problem converges to the correct solution when a sufficiently fine discretization of SoC is used. We illustrate the method on the Ille-et-Vilaine department, see Fig. 1 and Table 1. The main disadvantage of the method is the increasingly large computation time when the size of the extended graph grows.

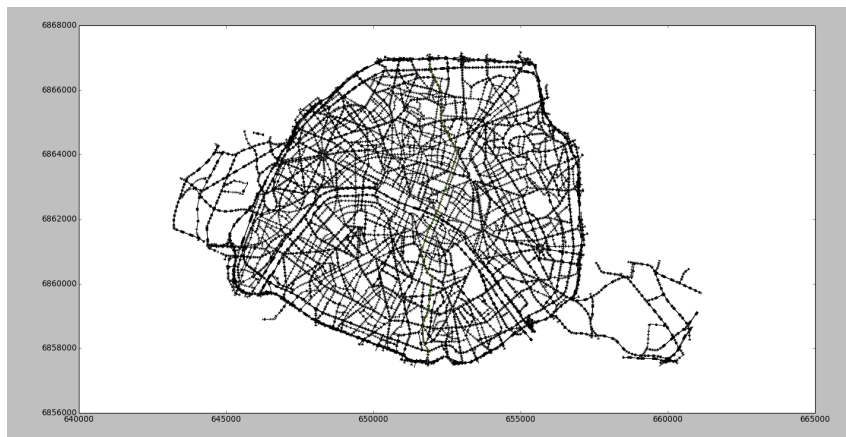
*Figure 1.*

Table 1. Results on the Ille-et-Vilaine department over 100 simulations

SoC disc.	improved cases	Fuel savings	CPU time (s)
3	19%	0.9753	6.03
5	65%	0.8531	14.64
10	88%	0.5831	52.80
20	88%	0.4222	283.43

8.1.2. Safety Line

In the framework of an Ilab with Safety Line (a startup in aeronautics), we design tools for the optimization of fuel consumption for civil planes. A first part is devoted to the identification of the aerodynamic and thrust characteristics of the plane, using recorded data from hundreds of flights. Fig. 2 shows the drag and lift coefficients for a Boeing 737, as functions of Mach and angle of attack. A second part is optimizing the fuel consumption during the climb and cruise phases. Fig. 3 shows a simulated climb phase, along with recorded data from the actual flight. This collaboration relies significantly on the toolboxes BOCOP and BOCOPHJB developed by Commands since 2010.

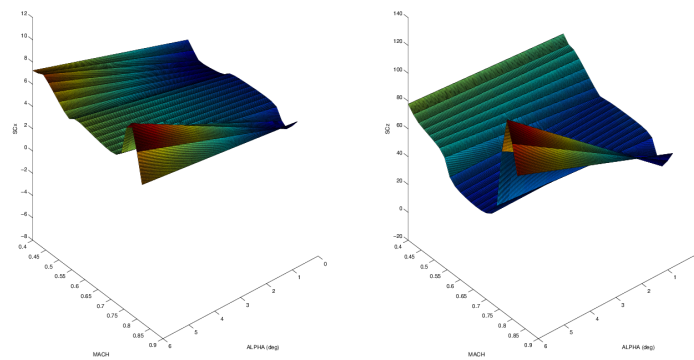


Figure 2.

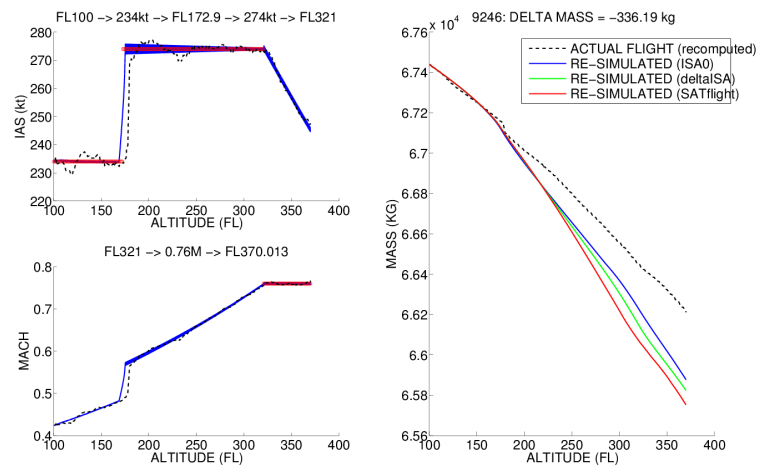


Figure 3.

DISCO Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

A collaboration with SAGEM Défense Sécurité on the stabilization of the lines of sight for pointing systems from optronic criterion using Bayesian optimization ended in December 2016 (CIFRE).

A collaboration with Renault on the observability study of AC machines ended in May 2016 (CIFRE).

A collaboration with SNCF on the supervision and rescheduling of a mixed CBTC traffic on a suburban railway line is currently undergoing (CIFRE).

A collaboration with EDF on the control of renewable energy parks is undergoing (financial support of a PhD student).

A collaboration with CEA and ADEME on the modelling and control of district heating networks is undergoing (financial support of a PhD student).

GECO Project-Team (section vide)

I4S Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. PhD project with EDF – Electrical device ageing monitoring

Participants: Nassif Berrabah, Qinghua Zhang.

A joint PhD project between Inria and EDF (Electricité de France) has been started since December 2014. The purpose of this study is to develop methods for the monitoring of electrical instruments in power stations, in order to prevent failures caused by ageing or accidental events. This project is funded by EDF and by the ANRT agency for three years.

8.1.2. Contracts with SVS

Participants: Laurent Mevel, Michael Doehler.

I4S is doing technology transfer towards SVS to implement I4S technologies into ARTEMIS Extractor Pro. This is done under a royalty agreement between Inria and SVS .

In 2014, the damage detection toolbox has been launched http://www.svibs.com/products/ARTEMIS_Modal_Features/Damage_Detection.aspx.

In 2015, SVS and Inria have earned an Innobooster grant to help transfer algorithms in 2016 Artemis Extractor Pro.

In 2016, uncertainty quantification for modal analysis has been launched http://www.svibs.com/newsletter/newsletter_2016_09.aspx.

8.1.3. Contracts with A3IP

Participant: Vincent Le Cam.

Since 2008, IFSTTAR has licensed the company A3IP to sell licenses of the PEGASE 1 platform (previous version of PEGASE 2 as mentioned above). A3IP sells them to companies, laboratories or any third-party partner interested in in-situ monitoring (SHM) with smart and wireless sensors. Since 2008, about 1000 of PEGASE 1 units have been sold, plus hundreds of the following items:

- daughter boards: 3G / Ethernet communications, Analog to Digital data acquisition...
- sensors: accelerometer, strain gauges, temperature...
- specific packaging to make the PEGASE 1 solution ready to use in waterproof conditioning

For example, in 2016, A3IP has provided a complete panoply of PEGASE-1 Vibration Monitoring system with more than 30 PEGASE1 units to ensure the monitoring of the new High Speed Train line in west of France (Bretagne Pays de la Loire high speed railway).

This non exclusive license is clearly a success in terms of dissemination.

8.1.4. Contract with SNCF: DEMETER

Participant: Vincent Le Cam.

DEMETER is one of the major projects for I4S in terms of strategy, scientific and technological impact.

DEMETER is a meta project whose global objective is the validation of the contribution of the Internet of Things (IOT) applied to the Health Monitoring of Railways Items. SNCF and IFSTTAR have signed a roadmap for safety relevant items, where wireless monitoring and smart algorithms could bring strong improvements to SNCF in terms of real-time maintenance or predictive maintenance. Those items are, amongst others:

- Crossing engine motor monitoring
- Needle motor monitoring
- Axle counter monitoring
- Train detection pedal monitoring

In each case, a prototype of a specific PEGASE 2 sensor is designed, installed along in-situ railways lines under exploitation and data are transmitted wireless to the cloud supervisor at IFSTTAR for evaluation in SHM algorithms. IFSTTAR's engineers Arthur Bouche, Laurent Lemarchand and David Pallier are contributing to this project.

In particular, SNCF and IFSTTAR are able to perform the entire validation process quickly in few months: from the algorithm to the electronic design and installation. In 2016, the consortium reached 2 milestones: the PEDAL-LORA monitoring sensor has been awarded the European Railway Cluster Price in railway innovation; this system is now becoming an industrial product, directly designed by a third-party company for SNCF. In 2017, the roadmap will be extended with a specific focus on SHM algorithms implementation to help SNCF moving from big data to smart data.

8.1.5. Contracts with SDEL-CC (VINCI Group)

Participant: Vincent Le Cam.

In 2016, a contract has been signed with the company SDEL-CC, 100% daughter of the VINCI Group, Energy department. The project exploits the unique time stamp capacity of PEGASE 2 up to 50 nanosecond, independently of distances in the network of PEGASE2 nodes. The synchronization capacity is employed to design a sensor prototype based on PEGASE2 to time-stamp the current wave after a lightning impact on a high-voltage line. By knowing the exact time, the wave can be seen at each extremity of the electrical line to localize accurately the lightning impact point. IFSTTAR's engineers Arthur Bouche and Laurent Lemarchand have contributed to this project.

During 2016, we have improved its embedded algorithms on PEGASE 2 platform to:

- take into account some specific GPS frames that output from its GPS receiver and give practical information on time drift
- take into account the temperature effect
- auto compute the real quartz period on each specific PEGASE 2 board

Two PEGASE 2 platforms are now able to time stamp an event with an accuracy of less than 10 nanoseconds. This leads to a precision of around 3 m for Lightning localization.

In 2017 in situ validation will be achieved on a real operated electric line.

8.1.6. Collaboration with SIEMENS : CityVal Rennes

Participant: Jean Dumoulin.

A first Winter season measurements campaign on the 100m metro structure mock-up built at IFSTTAR test track facilities in Nantes was carried out in 2016. It was completed by in situ instrumentation including coupling of infrared thermography with other measurements techniques for long term monitoring during several months. A new campaign is under preparation and will be launched in 2017. This collaboration is also connected with the new automated metro line B under construction in Rennes.

MCTAO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. CNES - Inria - UB Contract

Contract number: 130777/00. Call Number: R-S13/BS-005-012

"Perturbations and averaging for low thrust" (Poussée faible et moyennation).

Research contract between CNES and MCTAO (both the Inria and the Université de Bourgogne parts). It runs for the period 2014-2017. It concerns averaging techniques in orbit transfers around the earth while taking into account many perturbations of the main force (gravity for the earth considered as circular). The objective is to validate numerically and theoretically the approximations made by using averaging, and to propose methods that refine the approximation. It has co-funded the PhD thesis of Jeremy Rouot [2] (also co-funded by Région PACA) and fully funded the postdoc of Florentina Nicolau [32], [31].

NECS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. ALSTOM

Contract with ALSTOM in the framework of Inria/ALSTOM joint laboratory, and CIFRE PhD grant of Simon Gerwig. This thesis explores collaborative and reconfigurable resilient control design of hydroelectric power plants; current work is on improving performance of a hydro-electric power-plant outside its design operation conditions, by cancellation of oscillations that occur in such operation range.

NON-A Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Contract with Neotrope (Tourcoing, France), Technologies & Augmented Human UX. Subject: De-correlation of GSR measurements with acceleration, from March 2016 to September 2016, D. Efimov, R. Ushirobira.

8.2. Bilateral Grants with Industry

Project of Autonomous control of clinic table with La Maison Attentive, 2016.

8.3. Bilateral Grants with Industry

Collaboration with Safran Electronics & Defense (Massy-Palaiseau) in the framework of the CIFRE PhD thesis of Guillaume Rance on robust stabilization of gyrostabilized platforms (2014-2018).

QUANTIC Project-Team (section vide)

SPHINX Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

The Ph.D thesis of Boris Caudron is funded through a CIFRE contract with Thalès and a contract with the IECL. The goal of the Ph.D. thesis is to design new coupling techniques between integral equation methods and the finite element method for solving electromagnetic scattering problems. The advisors are Xavier Antoine (Sphinx) and Christophe Geuzaine (University of Liège).

TROPICAL Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Yield management methods applied to the pricing of data traffic in mobile networks. CRE (research contract) with Orange Labs (Orange Labs partner: Mustapha Bouhtou).
- Decentralized mechanisms of operation of power systems: equilibria and efficiency. A collaboration started on this topic at the fall, Nadia Oujdane, Olivier Beaudé, and Riadh Zorgati from EDF-labs. This leads to the PhD work of Paulin Jacquot, supervised by Stéphane Gaubert (starting CIFRE PhD).

ANJA Team (section vide)

DOLPHIN Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Beckman (2015-2018): the goal of this contract concerns the strategic and operational planning for medical laboratories (Phd of Sohrab Faramarzi).
- Strat&Logic (2012-2016): the objective of this CIFRE contract is the optimization of economic decisions in a competitive business management simulator (Phd of S. Dufourny).
- PIXEO (2014-2018): the objective of this bilateral project is the predictive models and knowledge extraction for insurance web comparator (Phd of A-L. Bedenel).
- Alicante (2014-2017): the objective of this CIFRE contract is the design of new optimization methods to extract knowledge from hospital data (Phd of M. Vandromme)
- Intel (2015-2016) Bilateral academic and research partnership between Université Lille 1 and Intel. In this context, Intel provides Lille 1 with training and technical support for the dissemination of its activities related to High Performance Computing.
- Nvidia (2016) Nvidia GPU Research Center, (see: <https://developer.nvidia.com/academia/centers/universit%C3%A9-lille-1>).

8.2. Bilateral Grants with Industry

- Intel 2015-2016 Intel has supported with a budget equivalent to 22Keuros the acquisition of a cluster of 2 multi-core servers and 8 Intel Xeon Phi coprocessors. The objective is to develop research and teaching on multi and many-core computing on coprocessors. The hybrid cluster has been deployed in 2016.

GEOSTAT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Carnot-Inria

GeoStat has been granted in 2015 a Carnot-Inria project to fund a 1 year engineer to develop a prototype of a speech emotion detection system. This contact, led by K. Daoudi, is in collaboration with the start-up BatVoice which targets the commercialization of affect-interactive digital systems. The prototype was developed and transferred to BatVoice for 48000 euros. The phase 2 of the collaboration is under discussion. Engineer: N. Brodu.

7.2. Bilateral Grants with Industry

- With Batvoice company: *Détection des émotions à partir de la voix*. Startup Batvoice: M. Sendrek & G. Maluréanu.
- With CARDIOLOGS company, headed by Y. Fleureau. Contacts and first collaborations started in 2016.

Patent in the process of being first deposited in January 2017 *Dispositif analyseur de rythme cardiaque*, Inria-185.

INOCS Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Fluxys (2016-2018). Study of optimization problems arising in the management of gas networks.
- Colisweb (2015-2016). Study of optimization problems arising in courier scheduling. This bilateral contract leads to the creation of an Inria Innovation Lab at the end of 2016.

7.2. Bilateral Grants with Industry

- PARROT (Planning Adapter performing ReRouting and Optimization of Timing), part of BEWARE Fellowships Academia funded by the COFUND program of the European Union (FP7 - Marie Curie Actions). INFRABEL is the industrial partner of this project.(2014-2018)
- Design and Pricing of Electricity Services in a Competitive Environment within the Gaspard Monge Research Program (PGMO) funded by the Fondation Mathématiques Jacques Hadamard. EDF is the industrial partner (2015-2018).
- BENMIP: A generic bender decomposition-based (mixed) integer programming solver within the Gaspard Monge Research Program (PGMO) funded by the Fondation Mathématiques Jacques Hadamard.(2015-2017)

MISTIS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

CIFRE PhD with SCHNEIDER (2015-2018). F. Forbes and S. Girard are the advisors of a CIFRE PhD (T. Rahier) with Schneider Electric. The other advisor is S. Marié from Schneider Electric. The goal is to develop specific data mining techniques able to merge and to take advantage of both structured and unstructured (meta)data collected by a wide variety of Schneider Electric sensors to improve the quality of insights that can be produced. The total financial support for MISTIS is of 165 keuros.

PhD contract with EDF (2016-2018). S. Girard is the advisor of a PhD (A. Clément) with EDF. The goal is to investigate sensitivity analysis and extrapolation limits in Extreme value theory with application to river flows analysis.

MODAL Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Arcelor-Mittal

Participant: Christophe Biernacki.

Arcelor-Mittal is a leader company in steel industry. This 11 months contract aims at optimizing predictive maintenance from mixed data (continuous, categorical, functional) provided by multiple sensors disseminated in steel production lines.

It is a joint work with Martin Bue and Vincent Kubicki (InriaTech engineers).

8.2. Banque Accord

Participants: Christophe Biernacki, Vincent Vandewalle.

Banque Accord is a credit scoring company. This 3 months contract aims at improving credit scoring performance by using the clustering principle inside the predictive process. In addition, directly managing mixed data (continuous, categorical, missing) has to be taken into account.

It is a joint work with Quentin Grimonprez (InriaTech engineer).

8.3. Vallourec

Participant: Christophe Biernacki.

Vallourec is a world leader in premium tubular solutions for the energy markets and for other demanding industrial applications. This 9 months contract aims at predicting quality of tubular connections from mixed data (continuous, categorical, functional).

It is a joint work with Vincent Kubicki (InriaTech engineer).

8.4. Cylande

Participants: Christophe Biernacki, Vincent Vandewalle.

Cylande is a software editor for retail. This 12 months contract aims at predicting future sales from past sales, including also many other available information.

It is a joint work with Etienne Goffinet and Vincent Kubicki (InriaTech engineers).

8.5. NFID

Participants: Benjamin Guedj, Quentin Grimonprez.

NFID is the agency dedicated to innovation policies of the Hauts-de-France region.

This 3 months contract aims at clustering companies from Hauts-de-France based on their economic, social, environmental, innovation, activities data. The proposed methodology relies on the MixtComp software developed within Modal, and allows for the creation of a predictive analysis tool for NFID. This predictive tool aims at identifying regional companies with the highest innovative abilities, and has a great economic and politic impact.

REALOPT Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Contract with EDF on robust maintenance planning

Our project with EDF concerns the optimization of the long term energy production planning, allowing for nuclear power plants maintenance. The challenges are to handle the large-scale instance of a five year planning and to handle the stochastic aspects of the problem: the stochastic variation of the electricity demand, the production capacity and the duration of maintenance period. The key decisions to be optimized are the dates of outages (for maintenance) and the level refuelling that determines the production of the year to come. We previously developed a column generation approach based on extended formulation which enables to solve within a few minutes a deterministic instance of the problem, which is within the time frame of the operational tools currently used by EDF. We now investigate stochastic and robust versions of the problem, where the duration of maintenance operations and the power demand are uncertain. Our approaches shall be evaluated on real life instances within a rolling horizon framework.

8.2. Collaboration with ERTUS on phytosanitary treatment planning

In planning winery operations (most importantly phytosanitary treatments on the wine tree) under weather forecast uncertainty, one searches for solutions that remain feasible and “cheap” in case of perturbation in the data. We consider the planning and scheduling of the operations that arise over a one-year horizon. More precisely, the operations to be scheduled include tasks related to soil care, or grape tree care: cutting, line building, thinning out leaves, ..., and chemical treatments. The latter are a main focus of our study since one of the principal goals of better planning is to reduce the amount of chemical treatments by selecting the appropriate products and schemes, but also by spacing out treatments while guarantying a disease free vineyard with some confidence. Each of the scheduled tasks requires its own resource, so the planning also triggers equipment and raw products selection decisions. The objective is to minimize both equipment and product costs augmented by an evaluation of the hazard of chemical product use. The planning should be “robust” to seasonal variations on the proper time frame for scheduling tasks.

8.3. Collaboration with St-Gobain Recherche on glass cutting

Through the PhD of Quentin Viaud, we study a hard glass-cutting problem. The objective is to minimize the quantity of trim loss when rectangular pieces are cut from large rectangles. This first study has shown that our methodologies are able to cope with this problem for medium-size instances. Solving the problem with large instances is a scientific challenge that we will address in the a follow-up contract.

8.4. Collaboration with Greycon Ltd. on industrial cutting

Through a research internship, we have studied a hard one-dimensional industrial cutting problem with many practical constraints. We have designed a non-standard diving heuristic, where some complicating constraints are handled through branching. Our heuristic was able to improve the solutions found by the industrial partner for several hard instances.

8.5. Collaboration with SNCF on timetable and rolling stock rotation planning

Our project with SNCF concerns the optimisation of timetable and rolling stock rotation planning. The railway production planning process combines heterogeneous resources and is usually decomposed into different sequential sub-problems, beginning by line planning, timetabling, rolling stock rotations and crew scheduling. Our goal is to solve the timetable and rolling stock problems in an integrated manner. Given a line planning and service requirement constraints, the problem is to produce a timetable for a set of trains and the objective is to minimize the cost of the railcars used. An originality of our approach is to deal with railcars composed of multiple units, which can be coupled or decoupled at some stations. The PhD thesis of Mohamed Benkirane is funded by this project.

SELECT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contract with SNECMA

Participants: Gilles Celeux, Florence Ducros, Patrick Pamphile.

SELECT has a contract with Nexter regarding modeling the reliability of vehicles.

SEQUEL Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- contract with “500px”; PI: Romaric Gaudel.

Title: Recommender System for Photos

Duration: May 2016 – Oct. 2016 (6 months)

Abstract: Recommender Systems aim at recommending items to users. Advances in that field are targeting more and more personalized recommendation. From a recommendation based on market segment to a recommendation based on individual user taste. From a recommendation based on user’s information to a recommendation based on any feedback from any user. From a recommendation based on logged data to a recommendation including latest trends... 500px is a Canadian company which is part of this trend. 500px offers solutions to store pictures online, to share pictures, and to browse among pictures exhibited by other users. Given the huge amount of pictures stored by 500px, users need help to find pictures which corresponds to their tastes. 500px offers several tools to filter the content presented to users. But the tools allowing exploration of the pictures landscape are not personalized, the selection is mostly based on the popularity of pictures/galleries. The most personalized recommendations are obtained by following other users: you see recent pictures of that users. But such recommendations requires you (i) to discover by yourself relevant users, (ii) to explicitly tag these users. The aim of the project is to scan state of the art in Collaborative Filtering and to design a tool which recommends pictures to users based on their implicit actions: given the list of followed users, faved pictures, commented pictures, browsed pictures, ..., infer user’s tastes and recommend to that user pictures and/or other user to look at. The system would also make use of informations on the pictures and of user profiles.

- contract with “Orange Labs”; PI: Philippe Preux

Title: Sequential Learning and Decision Making under Partial Monitoring

Duration: Oct. 2014 – Sep. 2017

Abstract: In applications such as recommendation systems, or computational advertising, the return collected from the user is partial: (s)he clicks on one item, or no item at all. We study this setting in which only a “partial” information is gathered in particular how to learn to behave optimally in such a setting.

- contract with “55”; PI: Jérémie Mary

Title: Novel Learning and Exploration-Exploitation Methods for Effective Recommender Systems

Duration: Oct. 2015 – Sep. 2018

Abstract: In this Ph.D. thesis we intend to deal with this problem by developing novel and more sophisticated recommendation strategies in which the collection of data and the improvement of the performance are considered as a unique process, where the trade-off between the quality of the data and the performance of the recommendation strategy is optimized over time. This work also consider tensor methods (one layer of the tensor can be the time) with the goal to scale them at RS level.

- contract with “What a nice place” ; PI: Jérémie Mary

Title: Deduplication of pictures

Duration: Mar. 2016 – Jan. 2017

Abstract: “What is nice place” is a start up which aggregates products from different sources in order to provide some home staging advises. Uniqueness of presence for the items in their database can be

hard to achieve because of the differences over names and variations of a product. Here we build a classification and deduplication system based on deep neural networks. In this contract we received support from Inria Tech and transferred them some knowledge about deep neural networks.

- contract with “What a nice place” and “Leroy Merlin”; PI: Jérémie Mary

Title: New Shopping Experience - Virtual Coach

Duration: Jun. 2016 – Fev. 2017

Abstract: The goal of this project is to use pictures of house interiors in order to propose automatically some products which would fit in nicely. The relations are learnt automatically using deep neural networks and recommendation systems techniques. We made a first version which focuses on lamps which is available for demonstration at <https://whataniceplace.leroymerlin.fr/>

SIERRA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Microsoft Research: “Structured Large-Scale Machine Learning”. Machine learning is now ubiquitous in industry, science, engineering, and personal life. While early successes were obtained by applying off-the-shelf techniques, there are two main challenges faced by machine learning in the “big data” era: structure and scale. The project proposes to explore three axes, from theoretical, algorithmic and practical perspectives: (1) large-scale convex optimization, (2) large-scale combinatorial optimization and (3) sequential decision making for structured data. The project involves two Inria sites (Paris and Grenoble) and four MSR sites (Cambridge, New England, Redmond, New York). Project website: <http://www.msr-inria.fr/projects/structured-large-scale-machine-learning/>.

7.2. Bilateral Grants with Industry

- A. d’Aspremont: AXA, "mécénat scientifique, chaire Havas-Dauphine", machine learning.
- A. d’Aspremont: Société Générale - fondation ENS, "mécénat scientifique".
- A. d’Aspremont: Projet EMMA at Institut Louis Bachelier. Collaboration with Euroclear on REPO markets.
- S. Lacoste-Julien (with J. Sivic and I. Laptev in Willow project-team): Google Research Award “Structured Learning from Video and Natural Language”.
- F. Bach: Gift from Facebook AI Research.

TAO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- **Thales Research & Technology** 2014-2017 (30 kEuros), related to Nacim Belkhir's CIFRE PhD
Coordinator: Marc Schoenauer
Participants: Johann Dréo, Pierre Savéant, Nacim Belkhir
- **Orange** 2013-2016 (30 kEuros), related to Robin Allesiardo's CIFRE PhD
Coordinator: Michèle Sebag
Participants: Raphael Feraud, Robin Allesiardo
- **Réseau Transport d'Electricité** 2015-2018 (30 kEuros), related to Benjamin Donnot's CIFRE PhD
Coordinator: Olivier Teytaud (until May 2016), now Isabelle Guyon and Marc Schoenauer
Participants: Benjamin Donnot, Antoine Marot

ASPI Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral grants with industry

See 4.1 .

7.1.1. Hybrid indoor navigation — PhD project at CEA LETI

Participants: François Le Gland, Kersane Zoubert–Ousseni.

This is a collaboration with Christophe Villien (CEA LETI, Grenoble).

The issue here is user localization, and more generally localization–based services (LBS). This problem is addressed by GPS for outdoor applications, but no such general solution has been provided so far for indoor applications. The desired solution should rely on sensors that are already available on smartphones and other tablet computers. Inertial solutions that use MEMS (microelectromechanical system, such as accelerometer, magnetometer, gyroscope and barometer) are already studied at CEA. An increase in performance should be possible, provided these data are combined with other available data: map of the building, WiFi signal, modeling of perturbations of the magnetic field, etc. To be successful, advanced data fusion techniques should be used, such as particle filtering and the like, to take into account displacement constraints due to walls in the building, to manage several possible trajectories, and to deal with rather heterogeneous information (map, radio signals, sensor signals).

The main objective of this thesis is to design and tune localization algorithms that will be tested on platforms already available at CEA. Special attention is paid to particle smoothing and particle MCMC algorithms, to exploit some very precise information available at special time instants, e.g. when the user is clearly localized near a landmark point.

In some applications, real time estimation of the trajectory is not needed, and a post processing framework may provide a better estimation of this trajectory. In [23], we present and compare three different algorithms to improve a real time trajectory estimation. Actually, two different smoothing algorithms and the Viterbi algorithm are implemented and evaluated. These methods improve the regularity of the estimated trajectory by reducing switches between hypotheses.

7.1.2. Bayesian tracking from raw data — CIFRE grant with DCNS Nantes

Participants: François Le Gland, Audrey Cuillery.

This is a collaboration with Dann Laneuville (DCNS Nantes).

After the introduction of MHT (multi–hypothesis tracking) techniques in the nineties, multitarget tracking has recently seen promising developments with the introduction of new algorithms such as the PHD (probability hypothesis density) filter [55], [62] or the HISP (hypothesised filter for independent stochastic populations) filter [47]. These techniques provide a unified multitarget model in a Bayesian framework [59], which makes it possible to design recursive estimators of a *multitarget probability density*. Two main approaches can be used here: sequential Monte Carlo (SMC, also known as particle filtering), and Gaussian mixture (GM). A third approach, based on discretizing the state–space in a possibly adaptive way, could also be considered despite its larger computational load. These methods are well studied and provide quite good results for *contact output* data, which correspond to regularly spaced measurements of targets with a large SNR (signal–to–noise ratio). Here, the data is processed (compared with a detection threshold) in each resolution cell of the sensor, so as to provide a list of detections at a given time instant. Among these methods, the HISP filter has the best performance/computational cost ratio.

However, these classical methods are inefficient for targets with a low SNR, e.g. targets in far range or small targets with a small detection probability. For such targets, preprocessing (thresholding) the data is not a good idea, and a much better idea is to feed a tracking algorithm with the raw *sensor output* data directly. These new methods [30] require a precise modeling of the sensor physics and a direct access to the radar (or the sonar) raw data, i.e. to the signal intensity level in each azimuth/range cell. Note that these new methods seem well suited to new types of sensors such as lidar, since manufacturers do not integrate a detection module and do provide raw images of the signal intensity level in each azimuth/range cell.

The objective of the thesis is to study and design a tracking algorithm using raw data, and to implement it on radar (or sonar, or lidar) real data.

CQFD Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Airbus

Participants: Benoîte de Saporta, François Dufour, Christophe Nivot.

We are interested in the optimization of a launcher integration process. It comprises several steps from the production of the subassemblies to the final launch. The four subassemblies go through various types of operations such as preparation, integration, control and storage. These operations are split up into three workshops. Due to possible breakdowns or staff issues, the time spent in each workshop is supposed random. So is the time needed to deliver the subassemblies, for similar reasons including e.g. shipping delays. We also have to deal with constraints related to the architecture of the assembly process itself. Indeed, we have to take into account waiting policies between workshops. The workshops may work in parallel but can be blocked if their output is not transferred to the next workshop in line. Storage capacity of output products is limited.

Our goal is finding the best rates of delivery of the subassemblies, the best choice of architecture (regarding stock capacities) and the best times when to stop and restart the workshops to be able to carry out twelve launches a year according to a predetermined schedule at minimal cost. To solve this problem, we choose a mathematical model particularly suitable for optimization with randomness: Markov decision processes (MDPs).

We have implemented a numerical simulator of the process based on the MDP model. It provides the fullest information possible on the process at any time. The simulator has first been validated with deterministic histories. Random histories have then been run with exponentially distributed delivery times for the subassemblies and several families of random laws for the time spent in each workshop. Using Monte Carlo simulations, we obtain the distribution of the launch times. Preliminary optimization results allow choosing stock capacities and delivery rates that satisfy the launch schedule.

In this context, the PhD Thesis of Christophe Nivot (2013-2016) is funded by Chaire Inria-Astrium-EADS IW-Conseil régional d'Aquitaine.

8.1.2. Thales Optronique

Participants: Benoîte de Saporta, François Dufour, Alizée Geeraert.

Integrated maintenance, failure intensity, optimisation.

As part of optimizing the reliability, Thales Optronics includes systems that examine the state of their equipment. This function is performed by HUMS (Health Unit Monitoring Systems). The collaboration is the subject of the PhD of Alize Geeraert (CIFRE). The aim of this thesis is to implement in the HUMS a program based on observations that can determine the state of the system, optimize maintenance operations and evaluate the failure risk of a mission.

8.1.3. DCNS

Participants: Huilong Zhang, Jonatha Anselmi, François Dufour, Dann Laneuville.

This contract is with DCNS, a French industrial group specialized in naval defense and energy. In particular, DCNS designs and builds submarines and surface combatants, develops associated systems and infrastructure, and offers a full range of services to naval bases and shipyards, together with a focus into marine renewable energy. The main objective is to have robust algorithms able to build an accurate picture of the objects that are around a submarine by only using “passive sonar” information. This means that no information is transmitted by the submarine, which just listens to acoustic waves coming in, to the target. We estimate the position and the velocity of moving targets through noisy observations and a Kalman-type filter. Estimates become accurate depending on the type and the number of maneuvers done by the submarine. Our goal is to combine the filter that is currently used in DCNS with a Markov decision process. This provides a systematic framework to compute the best sequence of submarine maneuvers that allows the system to determine, as soon as possible, accurate target position and velocity. The current technological transfer to DCNS stands in a stochastic optimization framework developed in Matlab that operates under the hypothesis that the target follows a uniform linear motion with constant velocity or zero acceleration. The case where targets move in a more complex manner gives concrete perspectives for further transfers to DCNS.

MATHRISK Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Consortium PREMIA, Natixis - Inria
- Consortium PREMIA, Crédit Agricole CIB - Inria

8.2. Bilateral Grants with Industry

Chair Ecole Polytechnique-ENPC-UPMC-Société Générale "Financial Risks" of the Risk foundation : A. Alfonsi, B. Jourdain, B. Lapeyre

TOSCA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- TOSCA Sophia is involved in a Cifre convention with Koris International. M. Bossy supervises M. Bonelli's Ph.D. thesis.
- M. Deaconu is involved in a bilateral contract with Venathec. She is supervising, with E. Vincent (EPI MULTISPEECH), the Ph.D. thesis of B. Dumortier on the acoustic control of wind farms noise.

7.2. Bilateral Grants with Industry

- Mireille Bossy is the Coordinator of the PEPS from AMIES granted with the SME Seatopic, on the wind downscaling, using finer local topography, for coastal activities.
- Mireille Bossy is the Coordinator of the TER project from the PGMO (FMJH) granted with the SME METIGATE, on the statistical description of coupled regional temperatures.