Activity Report 2015

Section Contracts and Grants with Industry

ACUMES Team (section vide)

<div align="center" style="color:red">CAGIRE Team</div>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Collaborative research contract with EDF: "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.

8.2. Bilateral Grants with Industry

PhD grant (CIFRE) of J.-F. Wald, EDF, in progress.

CARDAMOM Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Participant: Pietro Marco Congedo [Corresponding member].

Several contracts have been realized:

- SAFRAN-HERAKLES, 20Keuros for the in-situ evaluation of the Cut-ANOVA and RobUQ codes.
- EXOES, 8 KEuros, for the analysis of the performances of the EVE engine, produced by EXOES.
- CNES, 15 KEuros, for the robust analysis of the DEBRISK code.

<p align="center" style="color:red">DEFI Project-Team</p>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Contract with EDF R&D on non destructive testing of concrete materials (in the framework of the PhD thesis of Lorenzo Audibert, defended in 2015)

- Contract with EDF R&D on data assimilation for temprature estimates in nuclear reactors (in the framework of the PhD thesis of Thibault Mercier, defended in 2015)

- 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".

7.2. Bilateral Grants with Industry

- The RODIN projet finished in September 2015. RODIN is the acronym of "Robust structural Optimization for Design in INdustry". This is a consortium of various companies and universities which has been sponsored by the FUI AAP 13 for 3 years, starting on July 2012. The industrial partners are: Renault, EADS, ESI, Eurodecision, Alneos, DPS. The academic partners are: CMAP at Ecole Polytechnique, Laboratoire J.-L. Lions at Paris 6 and 7 Universities, centre de recherches Bordeaux Sud-Ouest at Inria. The goal of the RODIN project is to perform research and develop a computer code on geometry and topology optimization of solid structures, based on the level set method. The software editor ESI is going to isse a commercial software in 2016. A sequel for RODIN is planned with a possible start in 2016.

- FUI project Nanolytix. This three years project started in October 2012 and involves Xenocs (coordinator), imXPAD, Arkema, Inria (DEFI) and CEA-Leti. It aims at building a compact and easy-to use device that images nonaparticles using X-ray diffraction at small or wide angles (SAXS and WAXS technologies). We are in charge of direct and inverse simulation of the SAXS and WAXS experiments.

- Electormagnetic simulation work package of the FUI project Tandem. This three years project started in December 2012 and 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, Cordouan and CEA. It is a followup of Saxsise where a focus is put on SAXS imaging of nanoparticles powders.

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.

- Ecuador and EDF have a bilateral contract on AD of the hydrology code "Mascaret". The correspondent on the Ecuador side is Valérie Pascual.

GAMMA3 Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

- Dassault Aviation, *Extraction de la topologie et simplification des détails géométriques*, P. Laug et H. Borouchaki, 66 k-euros, 2013-2015.

IPSO Project-Team (section vide)

<p style="color:red; text-align:center; font-weight:bold">MATHERIALS Project-Team</p>

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.

<p style="text-align:center;color:red;font-weight:bold">MEMPHIS Team</p>

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 a 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.

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 Team (section vide)

MOKAPLAN Project-Team (section vide)

NACHOS Project-Team (section vide)

NANO-D Project-Team (section vide)

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Contract POEMS-DGA
Participants: Anne-Sophie Bonnet-Ben Dhia, Sonia Fliss, Patrick Joly.

Start : 09/01/2011, End : 12/31/2015. Administrator : ENSTA.
This contract is about guided waves in photonic crystals : we want to develop new mathematical and numerical tools for the characterization, the study and the computation of the guided modes in photonic crystals.

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.

<p style="text-align:center;color:red;font-weight:bold;">RAPSODI Team</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Roberta Tittarelli was in PhD under the co-direction of Emmanuel Creusé (with S. Nicaise, LAMAV Valenciennes and F. Piriou, L2EP Lille 1) on an EDF R&D Support (CIFRE) from October 2012 to October 2015. She worked on a posteriori error estimators for problems arising in low-frequency electromagnetics. She developped residual estimators for unsteady problems, as well as equilibrated ones for harmonic formulations (see section 6.2 for new results about this last point). Its contributions have been implemented in the EDF R&D code "Carmel-3D", and allow to improve the simulations by providing an efficient tool driving the mesh refinement algorithms. She is now on an ATER support at Lille 1 University and and the PhD's defense should occur before the middle of 2016.

C. Cancès supervises the PhD Thesis of Nicolas Peton at IFPEN since October 15, 2015. The bilateral contract should be signed in the forthcoming weeks.

APICS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. 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".

7.2. 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.

7.3. Contract BESA GmbH-Inria

This is a research agreement between Inria (Apics and Athena teams) and the German company BESA [0], which deals with head conductivity estimation and co-advising of the doctoral work of C. Papageorgakis, see Section 6.1.1 . BESA is funding half of the corresponding research grant, the other half is supported by Region PACA (BDO), see Section 8.1 .

7.4. 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.

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[0]http://www.besa.de/

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Schneider Electric : CIFRE PhD thesis of Narendra Akadkhar (end of contract 31/12/2015).
- ANSYS France : CIFRE PhD thesis of Mounia Haddouni (end of contract 01/05/2015).
- ADEPT Technology : CIFRE PhD thesis of Saed AlHomsi (end of contract 31/12/2015).
- Aldebaran : CIFRE PhD thesis of Jory Lafaye (end of contract 30/06/2015).

COMMANDS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Transportation

8.1.1. IFPEN

In the framework of the PhD thesis of F.Bleuse, 'Optimal control and robustness for rechargeable hybrid vehicles'. The study is focused on the so-called parallel architecture, with both the thermal and electric engines able to move the vehicle. The main axis is to optimize the use of the thermal engine.

8.1.2. Safety Line

(a startup in aeronautics), research and transfer contract, 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 flight data. A second part is optimizing the fuel consumption during the climb phase.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

A collaboration with SAGEM Défense Sécurité on the robust stabilization of the lines of sight for pointing systems is developed through the PhD thesis of G. Rance (CIFRE).

A CIFRE PhD with Renault is currently undergoing in collaboration with Univ. d'Orleans (Nicoleta Stroe as PhD student).

GECO Project-Team (section vide)

<h1 style="text-align:center; color:red">I4S Project-Team</h1>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. PhD CIFRE with EDF

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 aging 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.

Annual agreement Inria-SVS 2381 + contract 4329

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.

8.1.3. Contracts with A3IP

Participant: Vincent Le Cam.

A licensing work has been initialized at IFSTTAR in order to sold some licenses of PEGASE 2 to companies who would like to use, modify, extend and sell the functions in the Structural Health Monitoring world. Separate and non-exclusive licenses will be regarded to:

- a) sell the PEGASE 2 devices : mother and daughter boards
- b) sell the PEGASE 2 Supervisor

8.1.4. Contract with SNCF : DEMETER

Participants: Vincent Le Cam, Mathieu Le Pen.

Deployment of a set of PEGASE platform for SNCF: SNCF has just signed a contract in view of instrumenting 2 railways sites where the needs of wireless and smart sensors has been expressed. The overall objective is to evaluate the contribution of intelligent and autonomous sensors in rail uses-boxes. I4S next contribution will mainly focus on data processing and algorithms implementation.

8.1.5. Collaboration with SNCF

Participant: Jean Dumoulin.

SNCF as contacted us to assess the thermal monitoring of some of their railways walls.

8.1.6. Contract with GDF

Participants: Vincent Le Cam, Mathieu Le Pen.

GDF (national french Gaz company) has signed a wide contract with IFSTTAR relative to many items in Wireless Sensors Networks. One of the items will be prototyped on PEGASE 2 platform and consists in finding an accurate solution for WSN synchronization without GPS source and for an autonomy of 10 years. One of the identified solution will be prototyped on PEGASE 2 as wireless and generic development platform and as it offers an accurate 100 nanoseconds absolute time reference.

8.1.7. *Collaboration with SIEMENS : NEOVAL Rennes*

Participant: Jean Dumoulin.

Since 2012, a work has been initiated for thermal studies for SIEMENS about subway infrastructures. 2013 was dedicated to the study of thermal instrumentation of subway. 2014 was focused on the instrumentation of a rail mockup in Nantes.

Maxplus Team

8. Bilateral Contracts and Grants with Industry

8.1. Contrats avec l'Industrie/Bilateral Contracts with Industry

- Modélisation et Résolution des problèmes de très grande taille dans les applications du yield management au réseau des télécommunications mobiles: CRE en cours avec Orange Labs (responsable du suivi Orange Labs: Mustapha Bouhtou).

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

7. Bilateral Contracts and Grants with Industry

7.1. Thales Alenia Space - Inria

"Transfert orbital dans le problème des deux et trois corps avec la technique de propulsion faible".

This contract started October, 2012 and ended September, 2015. It partially supported Helen Heninger's PhD.

The goal was to improve transfer strategies for guidance of a spacecraft in the gravitation field of one central body (the two-body problem) or two celestial bodies (three-body problem).

7.2. CNES - Inria - UMB

"Poussée faible et moyennation".
CNES number: 130777/00.

This three year contract started in 2014. It involves CNES and McTAO (both the Inria and the Université de Bourgogne parts). It concerns averaging techniques in orbit transfers around the earth while taking into acount many perturbation 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.

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.

8.1.2. INRIX

A collaboration with INRIX has concerned floating car data, namely data about cars velocity collected from mobile devices, that are useful to complement density and velocity measurements from road sensors.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- a PhD CIFRE with SAGEM (France), supervisors are Alban Quadrat and Hugues Mounier

QUANTIC Project-Team (section vide)

SPHINX Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

In June 2015, Boris Caudron began a CIFRE thesis with Thales under the academic supervision of Xavier Antoine. The accompanying support contract, about 45 000 euros, will be signed in January 2016.

DOLPHIN Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Intel (2015-2016) Bilateral academic and research partnarship between Université Lille 1 and Intel. In this context, Intel will provide Lille 1 with technical support help for the dissemination of its activities related to High Performance Computing.
- Strat-Logic (2012-2015): the objective of this CIFRE contract is the optimization of economic decisions in a competitive business management simulator (Phd of S. Dufourny).
- Vekia (2012-2015): the goal of the CIFRE project is to develop an efficient and generic software for employee scheduling in retail (Phd of M. Gérard).
- PIXEO (2014-2018): the objective of this bilateral project is the predictive models and knowledge extraction for insurance web comparator.
- Normand (2014-2015]: the objective of this contract is the modelling of a dynamic multi-objective scheduling problem in the medical analysis.
- Beckman (2015-2018]: the goal of this contract concerns the strategic and operational planning medical laboratories.

8.2. Bilateral Grants with Industry

- Intel 2015-2016 Bilateral grant with Intel. Intel has supported with a budget equivalent to 25K€ 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.

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Geostat has been granted in 2015 a Carnot-Inria contact 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.

- Geostat has set up an industrial contract with LECTRA Company, on the development of nonlinear signal processing tools for analysis signals acquired from turbines.

- DGT Inria has funded a Proof of Concept on heartbeat analysis with IHU LIRYC.

- Patent: Geostat is in the process of depositing a patent on hearbeat signal analysis with the help of Inria Transfer and the *Cabinet Netter*.

INOCS Team

5. Bilateral Contracts and Grants with Industry

5.1. Bilateral Contracts with Industry

- Industrial contract with EDF, Bilevel models for tariff setting problems in the energy field (2010-2011; 2012-2015)
- Industrial contract with Coliweb, Load charge assignent for freight deliveries (2015-2016)

5.2. Bilateral Grants with Industry

- Gaspard Monge Program for Optimisation and operationnal research, Design and Pricing of Electricity Services in a Competitive Environment (2015-2018)
- Gaspard Monge Program for Optimisation and Operationnal Research, BENMIP A Generic Benders Decomposition based (Mixed) Integer Programming Solver, (2015-2016)

MISTIS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

DGArapid WIFUZ (2015-2017). F. Forbes is the principal investigator for MISTIS of the 2 year project WIFUZ on *WIreless multi sensors FUSion*. The project is supported by DGA and led by the ACOEM company http://www.acoemgroup.fr/ and involves another company, the HIKOB startup, http://www.hikob.com/. The objective is to develop a prototype for surveillance and monitoring that is able to combine multi sensor data coming from acoustic sensors (microphones or antennas) and optical sensors (infrared cameras) and to distribute the processing to multiple algorithmic blocs. The financial support for MISTIS is of 122,4 keuros for a project of a total cost of 375 keuros.

CIFRE PhD with SCHNEIDER (2015-2018). F. Forbes and S. Girard are the advisors of a starting 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 will be of 165 keuros.

PhD contract with EDF (2015-2018). S. Girard is the advisor of a starting PhD (A. Clement) with EDF. The goal is to investigate sensitivity analysis and extrapolation limits in Extreme value theory with application to river flows analysis.

8.2. Bilateral Grants with Industry

UAC XEROX INDIA (2014-2017). F. Forbes is co-principal investigator with R. Horaud (PERCEPTION) of a Xerox Foundation University Affairs Committee (UAC) collaborative grant *Advanced and Scalable Graph Signal Processing Techniques*, in collaboration with Arijit Biswas and Anirban Mondal, research scientists at Xerox Research Center India (XRCI) Bangalore. This collaboration is an opportunity to launch a joint research program with a Xerox Indian team. We plan to investigate robust mixture models and techniques to deal with graphical data. Xerox Foundation funding: 80 keuros.

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

8. Bilateral Contracts and Grants with Industry

8.1. Genoscreen

Participant: Guillemette Marot.

Subject: Genoscreen is a company which offers innovative solutions in genomics and molecular biology. New technologies such as high throughput sequencing have raised statistical questions to analyse metagenomic data. Formation and expertise has been provided to this company to help them analyse this new type of data.

8.2. Bilateral Contracts with Industry

Participant: Julien Jacques.

ORANGE Labs : contrat de recherche pour l'extraction de connaissances dans de gros volumes de données hétérogènes pour la gestion automatique des réseaux radio, en lien avec le financement de la thèse CIFRE de Yosra Ben Slimen.

8.3. Arcelor-Mittal

Participants: Christophe Biernacki, Clément Thery.

Subject: Supervised and semi-supervised classification on large data bases mixing qualitative and quantitative variables. Arcelor Mittal faced some quality problems in the steel production which lead to supervised and semisupervised classification involving (1) a small number of individuals comparing to the numbers of variables, (2) heterogeneous variables, typically categorical and continous variables and (3) potentially highly correlated variables. A PhD CIFRE grant started on May 2011 on this topic and has finished on July 8th 2015. It has led also the the CorReg package, available on the CRAN (https://cran.r-project.org/web/packages/CorReg/index.html) and referenced on the Inria BIL application

8.4. Auchan

Participants: Christophe Biernacki, Serge Iovleff, Vincent Vandewalle.

Subject: Groupe Auchan SA is a French international retail group and multinational corporation headquartered in Croix. It is one of the world's principal distribution groups with a presence in 12 countries and 269,000 employees. The aim of the two months contracts (It started late 2014 and finished early in 2015) between Auchan and Modal is to identify human factors which significantly impact the economical results of the company. From a scientific point of view, it corresponds to regression studies (simple and mixture regression) with missing data and correlated data.

8.5. PIXEO

Participants: Christophe Biernacki, Anne Lise Bedenel.

Subject: PIXEO is a company allowing online comparisons of insurances. A PhD thesis for optimizing the workflow related to this activity started in June 2015, with co-supervisision of Laetitia Jourdan of the Dolphin Inria team. The title of the thesis is "Supervised and unsupervised classification with descriptors evolving in time. Application to online comparisons of insurances." Before the beginning of the thesis, a preliminary contract has been established since October 2014 until May 2015, in order to prepare precisely the research subject. It was a work in collaboration with two members of the Dolphin Inria team (Laetitia Jourdan and Marie-Eléonore Marmion).

8.6. Cylande

Participants: Christophe Biernacki, Etienne Goffinet, Vincent Kubicki, Vincent Vandewalle.

Subject: Cylande is a company which provides software solutions for retail. The aim of the contract is to provide statistical tools for optimal management delivery. The proposed solution relies on density estimation and also on model-based clustering, both for mixed data (count data, categorical data, continuous data). It should involved the MixtComp software (referenced on the Inria BIL application) developed by the team. It is a 12 months contract, started on October 1st 2015.

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 winary operations (most importantly phytosanitary treatments on the wine tree) under wheather forcast 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 sheduled 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 treatements while guarantying a desease free vineyard with some confidence. Each of the scheduled tasks requires its own resource, so the planning also triggers equipement 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 B-Travel on a yield management problem

Through the PhD thesis of Martin Bué (in collaboration with inria team Dolphin), we are now working with society B-Travel on pricing and yield management. The goal is to find the best prices and incentives in the context of professional travel. The techniques used are based on network-flow formulations and mathematical programming.

8.4. Collaboration with Asys on an employee-scheduling problem

Through the PhD thesis of Matthieu Gérard, we have investigated a very rich version of employee-scheduling problem. We have designed an efficient algorithm for computing the best shift for each employee, based on dynamic programming. This method is used in a greedy algorithm to find solutions in a faster manner, and in a branch-and-price method to prove the optimality of the solution.

8.5. Collaboration with Renault S.A. on truck loading problem

The goal of this one year industrial contrat was to analyze the algorithmic solutions used by Renault S.A. for packing items into trucks. The outcome of the contract was a report on their approach and how hints to improve it.

8.6. 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.

<p style="text-align:center;color:red;font-weight:bold;">SELECT Project-Team</p>

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.

SELECT works with the CEA on statistical modeling for battery state of charge.

Contract with AirNormand: Mixtures of experts for PM10 forecasting, and stability of kriging procedures.

Contract with EDF: Curve clustering and disaggregation of the load forecasting

SEQUEL Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Jeremie Mary got a contract with Nuukik on the use of seasonality to improve recommender systems for e-commerce. This work won the price of the "Best data analysis" at "La nuit du commerce connecté" - http://www.retail-network.fr", 1500 participants, 80 projects in 5 categories.

8.2. Bilateral Grants with Industry

- Romain Warlop obtains a CIFRE grant with the start-up Fifty-Five and started his PhD in July under the supervision of Alessandro Lazaric, Jérémie Mary and Philippe Preux. The PhD is on the use of tensor and bandits techniques for recommender systems with a special focus on the cold start problem, and the non-stationarity of the environment.

- Nicolas Carrara obtains a CIFRE grant with Orange Labs and started his PhD in October under the supervision of Olivier Pietquin. The PhD topic is on transfer learning for fast adaption of spoken dialogue systems.

SIERRA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. 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/.

8.2. Bilateral Grants with Industry

- A. d'Aspremont, IdR EMMA, Euroclear – Institut Louis Bachelier.
- A. d'Aspremont, IBM Faculty Award.
- A. d'Aspremont and F. Bach, IdR AXA "Machine Learning", chaire Havas-ILB, Economie des Nouvelles Données.
- A. d'Aspremont and F. Bach, Comité de pilotage, chaire Havas – Dauphine "Economie des nouvelles données".
- S. Lacoste-Julien (with J. Sivic and I. Laptev in Willow project-team), Google Research Award "Structured Learning from Video and Natural Language".

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

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
  Participants: Benjamin Donnot, Antoine Marot

- **Augure (SME)** 2013-2015 (150 kEuros). MoDyRum (Modélisation Dynamique d'un Réseau Médiatique), related to Marco Bressan's postdoc SME Augure)
  Coordinator: Michèle Sebag
  Participants: Philippe Caillou, Cyril Furtlehner, Marco Bressan

ASPI Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral contracts with industry

6.1.1. *Optimization of sensors location and activation (DUCATI) — contract with DGA / Techniques navales*

Participant: François Le Gland.

See 3.3 , 4.2 and 5.4

Inria contract ALLOC 7326 — April 2013 to December 2016.

This is a collaboration with Christian Musso (ONERA, Palaiseau) and with Sébastien Paris (LSIS, université du Sud Toulon Var).

The objective of this project is to optimize the position and activation times of a few sensors deployed by one or several platforms over a search zone, so as to maximize the probability of detecting a moving target. The difficulty here is that the target can detect an activated sensor before it is detected itself, and it can then modify its own trajectory to escape from the sensor. This makes the optimization problem a spatio–temporal problem. Our contribution has been to study different ways to merge two different solutions to the optimization problem : a fast, though suboptimal, solution developped by ONERA in which sensors are deployed where and when the probability of presence of a target is high enough, and the optimal population–based solution developped by LSIS and Inria in a previous contract (Inria contract ALLOC 4233) with DGA / Techniques navales.

6.2. Bilateral grants with industry

6.2.1. *Hybrid indoor navigation — PhD grant 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.

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

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 acustic 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

- Chaire X-ENPC-UPMC-Société Générale "Financial Risks" of the Risk fondation : A. Alfonsi, B. Jourdain, B. Lapeyre
- A. Sulem: Research Grant for the project "*Stochastic Control of Systemic Risk*", awarded by the scientific council and Professional Fellows of Institut Europlace de Finance (EIF) and Labex Louis Bachelier with A. Minca (Cornell University).
- R. Elie with Arthur Charpentier:

  Chaire with COVEA on digital impact in actuarial activities (2015-2018).

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- TOSCA Sophia is involved in a Cifre convention with Koris International. M. Bossy supervises M. Bonelli's Ph.D. thesis.
- TOSCA Nancy had a bilateral contract coordinated by M. Deaconu with the SME Alphability on financial risk measures with applications in portfolio management.
- 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.