



RESEARCH CENTER

FIELD

**Applied Mathematics, Computation
and Simulation**

Activity Report 2014

Section Contracts and Grants with Industry

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BACCHUS Team (section vide)

CAGIRE Team

7. Bilateral Contracts and Grants with Industry

7.1. 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.

7.2. Bilateral Grants with Industry

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

DEFI Project-Team

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, to be defended in 2015)
- Houssein Haddar has a contract with EDF R&D on data assimilation for temperature estimates in nuclear reactors (in the framework of the PhD thesis of Thibault Mercier, to be defended in 2015)

7.2. Bilateral Grants with Industry

7.2.1. FUI Projects

- Gregoire Allaire is in charge of the RODIN project. 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.
- Houssein Haddar is in charge of DEFI part of the 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 nanoparticles 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.
- Houssein Haddar is in charge of the electromagnetism 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.

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.
- 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

5. Bilateral Contracts and Grants with Industry

5.1. 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)

MATHERIALS Team

6. Bilateral Contracts and Grants with Industry

6.1. Contracts and Grants with Industry

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

MC2 Team

7. Bilateral Contracts and Grants with Industry

7.1. Program PREDIT

Participants: Charles-Henri Bruneau, Iraj Mortazavi.

Program PREDIT ADEME with Renault and Peugeot. The aim of this program is the work on drag reduction in order to decrease the fuel consumption.

7.2. Renault

Participants: Charles-Henri Bruneau, Iraj Mortazavi.

CARAVAJE project with ADEME (PREDIT Véhicules propres et économes) notified october 24th 2008. Collaboration with Renault and Peugeot, two PME and 3 labs to reduce the drag coefficient of a ground vehicle. 95 k euros for 3 years.

7.3. Plastic Omnium

Participant: Iraj Mortazavi.

The MC2 team works actually with the Plastic Omnium company in order to study the flow behaviour around square back ground vehicles (like buses, camions,...) using LES and DNS techniques. The main target of this collaboration is to identify the structures of velocity fields that generate aerodynamical losses, in order to design drag reduction control strategies using pulsed or synthetic jets. In the framework of this project, we also want to compute accurately instantaneous velocity fields, with high velocities. The computations should be performed on long time for complex geometries. A part of this work is included in the PhD thesis of Yoann Eulalie.

7.4. Bilateral Contracts with Industry

Angelo Iollo is consulting with OPTIMAD engineering.

7.5. Bilateral Grants with Industry

CIFRE - Conventions Industrielles de Formation par la REcherche - with VALEOL (VALOREM Group)

MEPHYSTO Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

The team (C. Chainais and A. Gloria) has had its third bilateral contract with ANDRA (French nuclear waste storage agency) from December 2012 to June 2014. The post-doctoral position of T. Gallouët was funded by this contract.

This collaboration concerned mathematical and numerical issues on a corrosion model, and in particular the identification of steady-states and the design of asymptotic-preserving schemes for a free interface problem.

MOKAPLAN Team (section vide)

NACHOS Project-Team (section vide)

NANO-D Project-Team (section vide)

OPALE Project-Team (section vide)

POEMS Project-Team

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-CEA-LIST

Participants: Marc Bonnet, Audrey Vigneron.

Start : 01/01/2013, End : 12/31/2015. Administrator : ENSTA.

This contract is about the modelisation of eddy current by integral equations.

Contract POEMS-CEA-LIST

Participants: Marc Bonnet, Stéphanie Chaillat, 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 : 10/01/2010, 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.

7.2. Bilateral Grants with Industry

Contract POEMS-CEA-LIST-DIGITEO

Participants: Anne-Sophie Bonnet-Ben Dhia, Sonia Fliss, Antoine Tonnoir.

Start : 10/01/2011, End : 09/30/2014. Administrator : CEA-LIST.

SIDONIE : SIMulation numérique de la Diffraction d'Ondes ultrasonores par un défaut localisé dans une Plaque aNISotropE

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 8.1.1 .

⁰<http://www.besa.de/>

BIPOP Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Schneider Electric (Cifre Ph.D. thesis of N. Akhadkar)
- Ansys France (Cifre Ph.D. thesis of M. Haddouni)
- Aldebaran (Cifre Ph.D. thesis of J. Lafaye)
- Adept Technologies (Cifre Ph.D. thesis of S. al Homsi)

COMMANDS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- EDF, PhD thesis of N. Gréville, 'Numerical methods for solving stochastic equilibrium problems'.
- IFPEN, 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.
- Safety Line (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.

CORIDA Team (section vide)

DISCO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

A collaboration with SAGEM Défense Sécurité, Etablissement de Massy, has been developed on the effect of time-delay in inertially stabilized platforms for optical imaging systems. This collaboration led to research contracts made by Alban Quadrat, Silviu Niculescu and Hugues Mounier (L2S, University Paris Sud).

GECO Project-Team (section vide)

I4S Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. 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 cables 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.

7.1.2. 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.

7.1.3. 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

7.1.4. PhD CIFRE with Dassault Aviation

Participants: Laurent Mevel, Philippe Mellinger.

contract 7843.

Following the FLiTE2 project, a joint PhD thesis between Inria and Dassault Aviation has been initiated. The thesis pursue the work achieved in FLiTE2 and started in June 2011 funded by Dassault Aviation and the ANRT agency. PhD of P. Mellinger has been defended in December 2014.

7.1.5. Collaboration with Bruel and Kjaer

Participants: Laurent Mevel, Ivan Guéguen.

Collaboration has started on analysis on wind turbines data. A paper has been presented at EWSHM 2014.

7.1.6. Contract with SNCF

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. I4S contribution will mainly focus on data processing and algorithms implementation.

7.1.7. 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.

7.1.8. Collaboration with SIEMENS

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 Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. 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 avec Orange Labs (responsable du suivi Orange Labs: Mustapha Bouhtou), signé en août 2013.

MCTAO Project-Team

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 for 3 years. It partially supports Helen Heninger’s PhD.

The goal is 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

This three year contract will formally started in 2014. It involves CNES and McTAO both through Inria and through Université de Bourgogne. 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.

NECS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. *IFPEN*

Accompanying PhD contract with IFPEN (IFP Energies Nouvelles), in the framework of the PhD grant of A. Ben Khaled. The thesis explores new architectures and flexible scheduling methods to enhance the trade-off between the integration accuracy and the simulation speed of distributed real-time (hardware-in-the-loop) simulators, in particular in the framework of automotive power-trains.

Accompanying PhD contract with IFPEN (IFP Energies Nouvelles), in the framework of the PhD grant of Giovanni de Nunzio. The thesis explores eco-driving for communicating vehicles in urban environment.

7.1.2. *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 adaptive cancellation of oscillations that occur in such operation range.

NON-A Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Agreement with Sick Company for equipment support of the research in the field of the in-door mobile robot navigation.

QUANTIC Team (section vide)

CLASSIC Project-Team (section vide)

DOLPHIN Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- **EDF** (2011-2014): the goal of this bilateral contract is to formulate pricing problems of electrical energy using bilevel mathematical programs.
- **EDF** (2011-2014): this contract models and solves scheduling outages of nuclear plants under uncertainty (Phd of N. Dupin).
- **BeTravel** (2012-2014): this CIFRE project deals with the optimization of group travel plannings (Phd of M. Bue).
- **Tasker** (2011-2014): the goal of this CIFRE project is the multi-objective scheduling of applications in public cloud computing systems (Phd of F. Legillon).
- **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** (2014-2015): the objective of this bilateral project is the predictive models and knowledge extraction for insurance web comparator.

GEOSTAT Project-Team (section vide)

MISTIS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

A contract with the HEMERA company was contracted including the internships of Anne Charlier and Lisa Qianru. Hemera designs, produces and sells online liquid and gaz analyzers. It is located in Grenoble. The aim of Hemera is to measure, in any gaseous or liquid environment, with a minimalized environmental impact and in a selective way, all compounds seen nowadays as pollutants : for our health, for an industrial process, etc. Hemera's analyzers measure gaz concentrations using optical techniques. The goal of the collaboration was to investigate the use of statistical methods to improve both the determination of the present gaz and their respective concentrations from the analysis of spectra representing a mixture of the different gaz. A preliminary study based on the Lasso technique was implemented and tested with promising first conclusions.

MODAL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Arcelor-Mittal

Participants: Christophe Biernacki, Clément Théry.

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 continuous variables and (3) potentially highly correlated variables. A PhD CIFRE grant started on May 2011 on this topic and will finish on 2015.

7.2. PGXIS

Participant: Christophe Biernacki.

PGXIS is a UK pharmacogenomics company aiming to discover virtual drugs. Its business model relies on its star technology, named Taxonomy3, a ground breaking mathematical method. Applied to Big Genetic Data, it delivers novel drug targets that are biologically confirmed. These drug targets will drive its drug discovery programmes. This six months contract aims at developing mathematical tool for accelerating convergence rate of Taxonomy3. From a scientific point of view, it corresponds to define specific importance sampling methods related to the Monte Carlo process involved in Taxonomy3.

7.3. RougeGorge

Participants: Christophe Biernacki, Serge Iovleff, Vincent Vandewalle, Vincent Kubicki, Komi Nagbe.

The RougeGorge company sells lingerie item for women. This three months contract aims at defining a new marketing segmentation for customers and also for items. From a scientific point of view, it corresponds to clustering of mixed data, difficulty being provided but the data volume (millions of customers), by the heterogeneity of data (mixed data) and also by many missing data.

7.4. Auchan

Participants: Christophe Biernacki, Serge Iovleff, Vincent Vandewalle, Vincent Kubicki.

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 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.

7.5. Cap Gemini

Participants: Christophe Biernacki, Vincent Vandewalle.

Cap Gemini S.A. is a French multinational corporation headquartered in Paris, with regional activities. It provides IT services and is one of the world's largest consulting, outsourcing and professional services companies with more than 140,000 employees in over 40 countries. The company aims at developing its Big Data ability in regards to its customer needs. A PhD thesis performing specific research to this activity is planned in 2015. In this aim, a preliminary contract has been established since December 2014. It will allow to prepare precisely the research subject.

7.6. PIXEO

Participant: Christophe Biernacki.

PIXEO is a company allowing online comparisons of insurances. A PhD thesis for optimizing the workflow related to this activity is planned in 2015. In this aim, a preliminary contract has been established since October 2014. It will allow to prepare precisely the research subject. It is a work in collaboration with two members of the Dolphin Inria team (Laetitia Jourdan and Marie-Eléonore Marmion).

7.7. AGLAE

Participants: Julien Jacques, Cristian Preda, Florence Loingeville.

AGLAE aims to improve analyses, especially chemical and microbiological, of water and other matrices of the environment. In the context of the Ph.D. of Florence Loingeville, we work on ANOVA models for counting data.

7.8. Alicante

Participants: Julien Jacques, Cristian Preda, Vincent Vandewalle.

ALICANTE develops applications and tools for data coming from health domain. As a participant of the ClinMine ANR project, ALICANTE and GHICL (Groupe Hospitalier de l'Institut Catholique de Lille) provide us well-structured data for clustering hospital stays.

REALOPT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contract with EDF on robust maintenance planning

We are currently working on a project aiming to plan the energy production and the maintenance breaks for a set of nuclear power plants generating electricity. We consider the large-scale power plant maintenance scheduling and production planning problem submitted by EDF to the 2010 Euro/Roadef Challenge. Two types of power plants are used to satisfy a customer demand over a specific time horizon. Type 1 plants can operate continuously while Type 2 plants have to be shut down regularly for refuelling and maintenance, and cannot produce during outage periods. The decision to be made consists of the dates of outages, the amount of refuel for Type 2 plants, and production level for both types of plants. The objective is to minimize the average cost of refuelling and production on various demand scenarios. 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 approach is tested on real life instances within a rolling horizon framework.

7.2. 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.

7.3. Collaboration with Exeo-Solutions on dimensionning a vehicle fleet for waste collection

Through the internships of Damien Trut and Youcef Magnouche in Exeo, and the current work of Pierre Pesneau, we study the optimization of partitionning a urban area into zones that shall be assigned to vehicles for waste collection. The goal is to minimize the distance traversed by the vehicles in each zone. This can be modeled as a clustering problem with side constraints: zones assigned to a same cluster must be contiguous and satisfy capacity and time constraints.

7.4. 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.

7.5. Collaboration with Vekia on an employee-scheduling problem

Through the PhD thesis of Matthieu Gérard (in collaboration with inria team Dolphin), we are now investigating 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.

7.6. 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.

7.7. Collaboration with St-Gobain Recherche on glass cutting

Through the internships of Quentin Viaud, we have studied 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-sized instances. Solving the problem with large instances is a scientific challenge that we will address in the a follow-up contract. Quentin Viaud has begun a PhD thesis (CIFRE) in 2015 on this topic.

SELECT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contract with SNECMA

Participants: Gilles Celeux, Rémy Fouchereau, Patrick Pamphile.

SELECT has a contract with SAFRAN - SNECMA, an high-technology group (Aerospace propulsion, Aircraft equipment, Defense Security, Communications), regarding modelling reliability of Aircraft Equipment.

7.2. Contract with Thales

Participants: Erwan Le Pennec, Michel Prenat, Solenne Thivin.

SELECT has a contract with Thales Optronique on target detection on complex backgrounds.

SEQUEL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- **Deezer**, 2013-2014

Participants: Jérémie Mary, Philippe Preux, Romaric Gaudel.

A research project has started on June 2013 in collaboration with the Deezer company. The goal is to build a system which automatically recommends music to users. That goal is an extension of the bandit setting to the Collaborative Filtering problem.

- **Nuukik**, 2013-2014

Participant: Jérémie Mary.

Nuukik is a start-up from Hub Innovation in Lille. It proposes a recommender systems for e-commerce based on matrix factorization. We worked with them specifically on the cold start problem (*i.e* when you have absolutely no data on a product or a customer). This led to promising result and allowed us to close the gap between bandits and matrix factorization. This work led to a patent submission in december 2013.

- **Squoring Technologies**, 2011-2014

Participants: Boris Baldassari, Philippe Preux.

Boris Baldassari has been hired by Squoring Technologies (Toulouse) as a PhD student in May 2011. He works on the use of machine learning to improve the quality of the software development process. During his first year as a PhD student, Boris investigated the existing norms and measures of quality of software development process. He also dedicated some time to gather some relevant datasets, which are made of either the sequence of source code releases over a multi-years period, or all the versions stored on an svn repository (svn or alike). Information from mailing-lists (bugs, support, ...) may also be part of these datasets. Tools in machine learning capable of dealing with this sort of data have also been investigated. Goals that may be reached in this endeavor have also been precised.

7.2. Bilateral Grants with Industry

- **INTEL Corp.**, 2013 - 2014

Participants: Philippe Preux, Michal Valko, Rémi Munos, Adrien Hoarau.

This is a research project on Algorithmic Determination of IoT Edge Analytics Requirements. We are attempting to solve the problem of how to automatically predict the system requirements for edge node analytics in the Internet of Things (IoT). We envision that a flexible extensible system of edge analytics can be created for IoT management; however, edge nodes can be very different in terms of the systems requirements around: processing capability, wireless communication, security/cryptography, guaranteed responsiveness, guaranteed quality of service and on-board memory requirements. One of the challenges of managing a heterogeneous Internet of Things is determining the systems requirements at each edge node in the network.

We suggest exploiting opportunity of being able to automatically customize large scale IoT systems that could comprise heterogeneous edge nodes and allow a flexible and scalable component and firmware SoC systems to be matched to the individual need of enterprise/ government level IoT customers. We propose using large scale sequential decision learning algorithms, particularly contextual bandit modeling to automatically determine the systems requirements for edge analytics. These algorithms have an adaptive property that allows for the addition of new nodes and the re-evaluation of existing nodes under dynamic and potentially adversarial conditions.

SIERRA Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. 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-Rocquencourt and Grenoble) and four MSR sites (Cambridge, New England, Redmond, New York).

Technicolor, CIFRE PhD student: "User profiling from unstructured data".

6.2. 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, Scientific committee, Thales Alenia Space. Evaluation program in control, signal processing, etc.

A. d'Aspremont, Projet EMMA at Institut Louis Bachelier. Collaboration with Euroclear on REPO markets.

TAO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- **Thalès Air Systems** (corr. Areski Hadjaz)– 2011-2014 (45 kEuros)
Related to Gaétan Marceau-Caron’s CIFRE PhD
Participants: Marc Schoenauer
- **Thalès Research & Technology** (corr. Johann Dreo)– 2014-2017 (30 kEuros)
Related to Nacim Belkhir’s CIFRE PhD
Participants: Marc Schoenauer
- **Modyrum (Modélisation Dynamique d’un Réseau Médiatique, related to Marco Bressan’s postdoc SME Augure – 2013-2015 (150 kEuros)**
Participants: Philippe Caillou, Cyril Furtlehner, Michèle Sebag
- **I-Lab METIS (A general framework for decision making with uncertainty plus energy-specific applications) ARTELYS – 2011-2014 (40 kEuros)**
Related to Jérémie Decock’s PhD
Participants: Jérémie Decock, Jean-Joseph Christophe, Olivier Teytaud.

ASPI Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral contracts with industry

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

Participant: François Le Gland.

See 3.3 , 4.2 and 5.3

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), related with the supervision of the PhD thesis of Yannick Kenné.

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. The activity in the beginning of this project has been to study different ways to merge two different solutions to the optimization problem : a fast, though suboptimal, solution developed 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 developed by LSIS and Inria in a previous contract (Inria contract ALLOC 4233) with DGA / Techniques navales.

CQFD Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. 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.

7.2. 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.

MATHRISK Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

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

7.2. Bilateral Grants with Industry

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

REGULARITY Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- The Tandem Project is a consortium involving several industrial companies (e.g. Bull Amesys) and some research laboratories (e.g. CMAP). The aim is to detect landmines from 3D radar images.
- Hadopi contract on the economical feasibility of a way to reduce pirating of cultural goods on the Internet.

TOSCA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- TOSCA Nancy had a bilateral contract coordinated by M. Deaconu with the SME Alphability on financial risk measures with applications in portfolio management. This collaboration will be continued in 2015.
- M. Deaconu is involved in a bilateral contract with Venathec. She is supervising, with E. Vincent (EPI PAROLE), the Ph.D. Thesis of B. Dumortier on the acoustic control of wind farms noise.

7.2. Bilateral Grants with Industry

- TOSCA Sophia is involved in a Cifre convention with Koris International. M. Bossy supervises M. Bonelli's Ph.D. thesis.

7.2.1. Promotion of Mathematics in the industry

- M. Deaconu was invited to give a talk at the Workshop *Modélisation et Simulation Numérique - Applications, Enjeux, Besoins, Interactions Laboratoires/Entreprises*, on November 25 in Nancy.
- D. Talay continued to serve as the Vice-President of the Fondation d'Entreprise Natixis which aims to contribute to develop research in quantitative finance. He also serves as a member of the Scientific Committee of the Foundation.
- D. Talay continued to serve as a member of the Scientific Committee of the AMIES National Agency aimed to promote interactions between Mathematics and Industry.