Activity Report 2013

Section Contracts and Grants with Industry

CAD Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

6.1.1. Geometry

We contributed to some industrial applications, mainly:

- Aircraft industry: Design of winglets (with EADS)

  In this project, our aim was to improve the geometric preprocessing of the CAD models generation that were used for the manufacturing of the multi parted wing-fuselage configuration and the generation of the numerical grids for the corresponding numerical simulations. We try developing algorithms for automatic generation of winglets with different bending radii, angles and top views. Some of the methods for approximation, fairing, modeling and grid generation used for this task are in principle well known in literature. However, standard commercial CAD systems cannot be used for the modeling of the surfaces because they do not provide the interfaces to fulfill the special constraints, which stem from the design wishes and the manufacturing and the needs of the applied flow solver for the aerodynamics equations.

- NC Simulation (with Spring Technologies)

  The aim of this work was to rebuild a CAD file (Brep, STEP format) from the result of a machining simulation (set of triangles). Any CAM software would use this reverse engineered model for any further application (inspection / FEM / definition of further tool paths). Another expected application was to rebuild CAD files from old G -code programs for which the initial CAD files do not exist anymore (or had never been modeled in 3D). Spring NCSimul provides a set of triangles as a solid. This set is topologically closed and represents a single solid. All data could be used to help gather triangles by geometric entities and then to help compute the exact surfaces. Different types of machining operations have been considered: Machining of simple shapes: The movement of the tool generates the same kind of surfaces as the tool ones: planes, cylinders, torus, etc. and Machining of complex shapes: the tool moves on a surface (canonic surface as well as NURBS surface) along a point-to-point path. Here, the reverse engineering is far from straightforward and the surface recognition would be computed at a tolerance.

- Dam Construction (with CHIDI / Dassault System)

  Once the digital terrain modeling and the geological shapes are represented, dam design issue is one of the most important difficult applications for geological modeling. This issue considers a multiple geometric representation of geological and design features. The dam design is based on NURBS surfaces representation and parametric design is an important key point when modifying shape or geometrical parameters and properties. In the other hand, geological shapes are mesh-based (surface meshes for geometrical characteristics, and volume meshes for material and engineering properties). In the plant interaction, we have impact the dam basement on the geological modeling. That is to say, remove a solid to a mesh. Then map geological properties to the solid. At this time, there was no feasible well-designed NURBS-Mesh Boolean operation algorithm in both research and industrial field and the aim of our work was to develop a stable NURBS-Mesh Boolean operation algorithm. This long-term work was developed for the CHIDI Company (Chengdu) with the participation of Dassault System. Moreover, in order to provide simulations after the Earthquake in Sichuan, we first focused our work on the Boolean operation algorithms.

6.1.2. Computer Graphics

6.1.2.1. Image resizing (with Shanghai Film Studio)

We have developed an image resizing method that succeed in generating impressive results by using image similarity measure to guide the resizing process. An optimal operation path is found in the resizing space.

However, the slow resizing speed caused by inefficient computation strategy of the bidirectional patch matching becomes a drawback for practical use. Then, we proposed a novel method to address this problem. By combining seam carving with scaling and cropping, our method can realize content-aware image resizing very fast. We define cost functions combing image energy and dominant color descriptor for all the operators to evaluate the damage to both local image content and global visual effect. Therefore our algorithm can automatically find an optimal sequence of operations to resize the image by dynamic programming or greedy algorithm. We also extended our algorithm to indirect image resizing which can protect the aspect ratio of the dominant object in an image.

CALVI Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

CLAC is a joint project with a Strasbourg small company, AxesSim, which develops software for electromagnetic simulations. Thomas Strub, who is employed in AxesSim with a CIFRE position, is doing his PhD on the design and development of CLAC applied to electromagnetic problems.

CONCHA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.2. Bilateral Grants with Industry

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

6. Bilateral Contracts and Grants with Industry

6.1. Contracts and Grants with Industry

Many research activities of the project-team are conducted in close collaboration with private or public companies: CEA, SANOFI, Safety Line, ERAMET, IRDEP, EADS . The project-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.

6.2. National Initiatives

The project-team is involved in several ANR projects:

- the ANR MANIF focuses on the mathematical and numerical analysis of electronic structure models, such as, in particular, the Kohn-Sham model. It includes two research teams: researchers from the JL Lions Laboratory (Paris 6) and the Micmac team. It is coordinated by E. Cancès.
- E. Cancès is involved in the ANR BECASIM, which is concerned with the numerical simulation of Bose-Einstein condensates. This ANR has been accepted in June 2012, and is coordinated by I. Danaila (Université de Rouen).
- C. Le Bris participates to the ANR EMAQS. The scientist in charge is Karine Beauchard (CMLS, Ecole polytechnique).
- T. Lelièvre is member of the ANR-project "STAB" (PI: I. Gentil, Université de Lyon).

In addition, the team is participating in

- the GdR Quantum dynamics. This interdisciplinary research network is focused on physical and mathematical problems related to the time evolution of quantum systems (transport problems, nonequilibrium systems, etc),
- the GdR CoDFT,
- the GdR Maths et entreprise,
- the GdR correl (correlated methods in electronic structure computations),
- the GDR-CNRS 2434 Analyse des Equations aux Dérivées Partielles.

The MICMAC team project is involved in two Labex, namely the Labex Bezout (started in 2011) and the Labex MMCD (started in 2012).

We have invited the following National researchers to visit our team:

- A. Lozinski (University of Besançon): April 8-12 and Dec 16-20, 2013.

SCIPORT Team (section vide)

SIMPAF Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Study of the EKINOX model of corrosion (CNRS Contract with CEA, Univ Lille1, Univ B. Pascal)

Participants: Claire Chainais-Hillairet, Antoine Gloria.

In collaboration with C.Desgranges and F. Lequien (CEA), F. Bouchon (Univ. B. Pascal), A. Gloria and C. Chainais-Hillairet are considering the model EKINOX developed at CEA for the study of the corrosion of Ni-base alloys in PWR primary water. Starting from this numerical model (leading to an explicit in time scheme), they have established a macroscopic model (a system of coupled partial differential equations). Based on this model, they have proposed a new numerical method based on an implicit discretization of the diffusion terms.

7.2. Numerical methods for the DPCM model (Inria/ANDRA Contract)

Participants: Claire Chainais-Hillairet, Thomas Gallouët, Antoine Gloria.

During his post-doc, Thomas Gallouët is working on the numerical approximation of the DPCM model, see [31]. He has designed a new scheme for the direct computation of a steady-state. This scheme has been implemented in the code CALIPSO developed at ANDRA. Validation is in progress, as the numerical analysis of the scheme. Further work will also be done in order to introduce in the code CALIPSO a second order in time scheme which remain unconditionally stable. This is work in collaboration with C. Bataillon (CEA), F. Bouchon (Univ B. Pascal) and J. Fuhrmann (WIAS Berlin).

BACCHUS Team (section vide)

CAGIRE Team (section vide)

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Contract with IFPEN on multiscale finite elements for two-phase flows in porous media (in the framework of the PhD thesis of F. Ouaki, defended in 2013).

- Contract with EADS/IW on topology optimization for composite panels drapping (in the framework of the PhD thesis of G. Delgado, defended in 2013).

- Contract with Renault on geometry and topology optimization of structures (in the framework of the two PhD theses of Ch. Dapogny, with the co-advising of P. Frey, to be defended in 2013, and G. Michailidis, with the co-advising of F. Jouve, to be defended in 2014).

- 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)

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

- Houssem Haddar is coordinating the contract EDF R&D on non eddy current non destructive testing. This contract involves Zixian Jiang and a two years PostDoc, Kamel Riahi.

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.

- Houssem 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 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.

- Houssem Haddar is in charge of the 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.

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.
- Lectra, *Maillage et CAO paramétrée*, P. Laug et H. Borouchaki, 12 k-euros, 2013.

IPSO Project-Team (section vide)

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. Contracts with Industry

Thierry Colin is Scientific consulting for the CEA CESTA. The CEA is funding the thesis of M. Latige and a grand of 30 k euros has been obtained.

Angelo Iollo is consulting with OPTIMAD engineering.

7.5. Grants with Industry

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

MOKAPLAN Exploratory Action (section vide)

NACHOS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Seismic risk assessment by a discontinuous Galerkin method

Participants: Nathalie Glinsky, Stéphane Lanteri, Fabien Peyrusse.

The objective of this research grant with IFSTTAR http://www.ifsttar.fr (French institute of sciences and technology for transport, development and networks) and CETE Méditerranée is the numerical modeling of earthquake dynamics taking into account realistic physical models of geological media relevant to this context. In particular, a discontinuous Galerkin method will be designed for the solution of the elastodynamic equations coupled to an appropriate model of physical attenuation of the wave fields for the characterization of a viscoelastic material.

NANO-D Team (section vide)

OPALE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

ArcelorMittal-Inria industrial contract n. 5013 : Opale started a thorough collaboration in optimal design of high performance steel with the mentioned world leader industrial. The aim of the collaboration is to develop and study new and efficient tools dedicated to multicriteria shape optimization of structures which undergo large non-linear elasto-plastic deformations.

The present contract has three years duration and funds the Ph.D. thesis of Aalae Benki and Research financial support.

POEMS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contract POEMS-CEA-LIST-2

Participant: Anne-Sophie Bonnet-Ben Dhia.

Start : 09/01/2010, End : 07/31/2013. Administrator : ENSTA.
This contract is about the scattering of elastic waves by a stiffener in an anisotropic plate.

7.2. Contract POEMS-CEA-LIST-DIGITEO

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

Start : 10/01/2011, End : 09/30/2014. Administrator : ENSTA.
This contract is about the scattering of elastic waves by a local defects in an anisotropic plate. It consists on the funding of Antoine Tonnoir's Phd.

7.3. Contract POEMS-DGA

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

Start : 09/01/2011, End : 12/31/2013. Administrator : ENSTA.
This contract is about the waveguide 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.

7.4. 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.

7.5. 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.

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

7. Bilateral Contracts and Grants with Industry

7.1. Contract CNES-Inria-XLIM

Contract (reference Inria: 7066, CNES: 127 197/00) involving CNES, XLIM and Inria, focuses on the development of synthesis procedures for N-ports microwave devices. The objective is here to derive analytical procedures for the design of multiplexers and routers as opposed to the classical "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

Contract (reference CNES: RS10/TG-0001-019) involving CNES, University of Bilbao (UPV/EHU) and Inria whose objective is to set up a methodology for testing the stability of amplifying devices. The work at Inria concerns the design of frequency optimization techniques to identify the linearized response and analyze the linear periodic components.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Schneider Electric: thèse de Narendra Akadkhar.
- Ansys France: thèse de Mounia Haddouni.
- Aldebaran: thèse de Jory Lafaye.
- Adept Technology: thèse de Saed al Homsi.

7.1.1. L'OREAL - contrat d'étude 2012-2013

Participant: Florence Bertails-Descoubes.

Contrat d'étude with L'Oréal, from in December 2012 until April 2013. The topic was the automatic generation of the geometry of a hair wisp given some statistical properties such as density or curliness distribution.

7.1.2. AGT Digital - contrat de collaboration de recherche et de transfert 2013

Participants: Florence Bertails-Descoubes, Gilles Daviet.

Contrat de collaboration de recherche et de transfert with AGT Digital, from January 2013 until August 2013. AGT-Digital is a French start-up localized in Paris and specialized in the production of virtual hair models for the entertainment industry as well as for virtual hairstyling applications. The goal of this project was to transfer our work on the simulation of fiber assemblies suject to frictional contact [8] as well as to develop new features in line with the production pipeline under the Maya software. Gilles Daviet was hired on this project during 6 months as an Inria engineer to perform these software developments.

7.1.3. L'OREAL - contrat de collaboration de recherche et de transfert 2013-2014

Participants: Florence Bertails-Descoubes, Alexandre Derouet-Jourdan.

Contrat de collaboration de recherche et de transfert with L'Oréal, from October 2013 until April 2014. The goal was to transfer software corresponding to our recent work on the inversion of isolated fibers under gravity [54],[28] (especially the APPROCHE source code) while ensuring compatibility between different software.

COMMANDS Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Safety Line

Following the "iMatch Contrôle Optimisation" event held at Inria Saclay on October 23rd (2012), a collaboration was initiated between COMMANDS and the startup Safety Line (http ://www.safety-line.fr), with a first contract on optimizing the ascent phase for commercial planes. A crucial aspect of this work is the identification of accurate and reliable models for the aerodynamic and thrust forces acting on the plane. For this study our partners at Safety Line provide us access to data recorded during several thousands of actual commercial flights, and COMMANDS recruited Stephan Maindrault as engineer to work on this project.

6.2. CNES

This contract between CNES and ENSTA lasted from February to December 2013, and was devoted to trajectory global optimization for an Ariane 5 launcher, using HJB techniques. The optimization was on the whole launch, including ballistic phases and the parameters of the intermediate GTO orbit, while maximizing the payload mass.

CORIDA Project-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 contract made by Alban Quadrat, Silviu Iulian Niculescu and Hugues Mounier (L2S, University Paris Sud).

GECO Project-Team (section vide)

<p align="center" style="color:red">I4S Project-Team</p>

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

6.1.1. 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 .

6.2. Bilateral Grants with Industry

6.2.1. 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 will pursue the work achieved in FliTE2 and started in June 2011 funded by Dassault Aviation and the CIFRE Agency.

6.3. Bilateral Grants with Industry

6.3.1. Collaboration with Bruel and Kjaer

Participants: Laurent Mevel, Ivan Gueguen.

Collaboration has started on analysis on wind turbines data.

<div style="text-align:center">**Maxplus Project-Team**</div>

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 start in 2014, but discussion and preliminary work started in 2013.

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 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

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 comunicating vehicles in urban environment.

NON-A Project-Team (section vide)

CLASSIC Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

An industrial contract with EDF R&D (cf. CIFRE PhD of Pierre Gaillard) has come into effect as of November 8, 2012, and will last 3 years.

<div align="center">

DOLPHIN Project-Team

</div>

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

- EDF (2011-2013): Bilevel mathematical programming and pricing problems.
- EDF (2011-2014): Scheduluing outages of nuclear plants.
- Tasker (2011-2014) : Scheduling of applications in hybrid cloud computing systems.
- Alicante (2010-2013): PhD of Julie Jacques. Knowledge extraction by optimization methods for improving the process of inclusion in clinical trials.
- Genes Diffusion (2010-2013): PhD of Julie Hamon. Analysis of data from high throughput genotyping: cooperation between statistics and combinatorial optimization.
- Strat&Logic (2012-2015): PhD of Sylvain Dufourny. Optimization of economic decisions in a competitive business management simulator.
- Vekia (2012-2015). The goal of the project is to develop an efficient and generic software for employee scheduling in retail.

GEOSTAT Project-Team (section vide)

MISTIS Project-Team (section vide)

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

7. Bilateral Contracts and Grants with Industry

7.1. 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.

7.2. Banque Accord

Christophe Biernacki gave a one-day course on the Rmixmod and BlockCluster packages to statistical members of the Banque Accord company.

7.3. Hi Duty Free

Participants: Christophe Biernacki, Serge Iovleff.

HiDutyFree had to solve a combinatorial optimization problem for optimizing its costumer service. For this contract we supervise two internships, giving a mathematical treatment of the problem of HiDutyFree and furnish a beta program based on ruby and java for solving it.

7.4. 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.

7.5. Alicante

Participants: Julien Jacques, Cristian Preda, Florence Loingeville.

Alicante is member of the ANR TecSan ClinMine) we obtained for 2014-2018 to work on the path of patients at the hospital.

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

7. Bilateral Contracts and Grants with Industry

7.1. Contract with EDF on 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. In this work, we propose a novel column generation approach based on extended formulation which enables to solve within a few minutes a deterministic instance of the problem on a three years horizon, which is within the time frame of the operational tools currently used by EDF. Moreover, the approach can easily account for various demand scenarios. Our approach is tested on real life instances within a rolling horizon framework.

This project is carried in collaboration between EDF R&D (OSIRIS lab) Inria team Dolphin and Realopt.

7.2. Collaboration with ERTUS on sanitary treatment planning

In planning winary operations (most importantly sanitary 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.

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.

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

7. Bilateral Contracts and Grants with Industry

7.1. Contract with EDF

Participants: Jairo Cugliari, Jean-Michel Poggi.

SELECT has a contract with EDF regarding wavelet analysis of the electrical load consumption for the aggregation and desagggregation of curves to improve total signal prediction.

7.2. Contract with SNECMA

Participants: Gilles Celeux, Rémy Fouchereau, Patrick Pamphile.

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

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

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.

- TBS, 2012-2013
  Participants: Jérémie Mary, Philippe Preux.

  A research project has started in September 2012 in collaboration with the TBS company. The goal is to understand and predict the audience of news related websites. These websites tend to present an ergodic frequentation with respect to a context. The main goal is to separate the effect of the context (big events, elections, ...) and the impact of the policies of the news websites. This work is based on data originating from major French media websites and also involves research of tendencies on the web (as Google Trends and Google Flu do). Used algorithms mix methods from time series prediction (ARIMA and MARSS models) and machine learning methods (L1 penalization, SVM).

- 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.

- 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.

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Technicolor: "Tensor factorization algorithms for recommendation systems".
- Xerox: CIFRE PhD student "IMAGE2TXT: From images to text".
- 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 challeges 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).

7.2. Bilateral Grants with Industry

- Google Research Award: "Large scale adaptive machine learning with finite data sets"

TAO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- Thalès Air Systems (corr. Areski Hadjaz), related to Gaétan Marceau-Caron's CIFRE PhD, May 2011 - May 2014, 15kEuros per year.

- Modyrum (*Modélisation Dynamique d'un Réseau Médiatique*, related to Marco Bressan's postdoc), SME Augure, started Feb. 2013, 150kEuros.

  Participants: Marco Bressan, Cyril Furtlehner, Michèle Sebag.

- I-Lab METIS (*A general framework for decision making with uncertainty plus energy-specific applications*, related to Jérémie Decock's PhD, ARTELYS-Inria, Sept.2011 - Aug.2014, 40kEuros.

  Participants: Jérémie Decock, Jean-Joseph Christophe, Olivier Teytaud.

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Contract with Astrium/EADS. The aim of this contract, in collaboration with the EPI AYIN, is to develop automatic object tracking algorithms on a sequence of images taken from a geostationary satellite. P. Del Moral cosupervises with J. Zerubia the PhD thesis of Paula Craciun on this subject.

Contract with CNES

The goal of this contract is to predict the trajectories of space debris around the earth. It is necessary to provide a new methodology since traditional methods such as Kalman filtering do not work satisfactory.

7.2. Bilateral Grants with Industry

- EDF (phd F. Proia)

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

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 and 4.2

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 Kenne.

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.

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

7. Bilateral Contracts and Grants with Industry

7.1. Astrium

Participants: Romain Azaïs, Adrien Brandejsky, Benoîte de Saporta, François Dufour, Anne Gégout-Petit, Christophe Nivot, Huilong Zhang.

The goal of this project is to propose models for fatigue of structure and to study an approach to evaluate the probability of occurrence of events defined by the crossing of a threshold. In this context, Astrium funded the PhD Thesis of Adrien Brandejsky (2009-2012) and is a partner of ANR Fautocoes. A new contract started in 2013 about the optimization of the assembly line of the future European launcher.

7.2. DCNS

Participants: Benoîte de Saporta, François Dufour, Huilong Zhang.

In september 2010, an industrial collaboration started with DCNS on the application of Markov Decision Processes to optimal stochastic control of a submarine to maximize the acoustic signature of a target vessel. In 2012, we extended our previous results to multiple target vessels and 3D control. We also coupled our code with the output of a tracking software to take more realistically into account the uncertainty on the position and speed of the targets. In 2013, we coupled our optimization procedure with the output of the tracking algorithms to estimate the positions of the targets.

7.3. Thales Optronique

Participants: Camille Baysse, Benoîte de Saporta, François Dufour, Anne Gégout-Petit, Jérôme Saracco.

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 Camille Baysse (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. This work was presented in the conferences [33], [40] and is to appear in [18].

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

PREMIA consortium: presently composed of Crédit Agricole CIB, and Natixis.

7.2. Bilateral Grants with Industry

Chair "Financial Risks" , Risk Foundation.
Partners: Ecole des Ponts ParisTech, Ecole Polytechnique, UPMC, Société Générale.

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.

TOSCA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- TOSCA Nancy had a bilateral contract with the SME Alphability on the evaluation of the Value at Risk with applications in portfolio management. This collaboration will be continued in 2014.

7.2. Bilateral Grants with Industry

- Since September 2013, TOSCA Sophia is involved in a Cifre convention with Koris International.

7.3. Promotion of Mathematics in the industry

- D. Talay is 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 is a member of the Scientific Committee of the AMIES National Agency aimed to promote interactions between Mathematics and Industry.