



RESEARCH CENTER  
Rennes - Bretagne-Atlantique

FIELD

Activity Report 2014

# Section Contracts and Grants with Industry

Edition: 2015-03-24



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## **ALF Project-Team**

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

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

### **7.1.1. Intel research grant ALF-INTEL2014-8957**

**Participant:** André Seznec.

Intel is supporting the research of the ALF project-team on "Mixing branch and value prediction to enable high sequential performance".

## **CAIRN Project-Team**

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

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

Automatic Analysis, Classification and Processing of Audio Signals, Contract with Orange Labs.

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

## **ESTASYS Exploratory Action (section vide)**

**HYCOMES Team (section vide)**



## **SUMO Project-Team**

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

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

Several researchers of Sumo are involved in the joint research lab of Alstom and Inria, in a common research team called P22. On Alstom side, this joint research team involves researchers of the ATS division (Automatic Train Supervision). The objective of this joint team is to evaluate regulation policies of urban train systems, to assess their robustness to perturbations and failures, to design more efficient regulation policies and finally to provide decision support for human regulators. The project started in march 2014, and a second phase of the project will start in march 2015, for a duration of three years. This covers in particular the PhD of Karim Kecir.

## TASC Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Grants with Industry

### 7.1.1. *Gaspard Monge*

**Participants:** Nicolas Beldiceanu, Helmut Simonis.

Title: Gaspard Monge 2.

Duration: 2014.

Type: **continuation of 2012,2013 project.**

Budget: 6000 Euros.

Others partners: EDF.

Within the context of the **Gaspard Monge call program for Optimisation and Operation Research** we work with **EDF** on the research initiative on *Optimization and Energy*. The goal of the project (continuation of last year project) is first to extract constraints from daily energy production temporal series issued from the 350 production plants of **EDF**, second to see how to use these constraints in order to reduce the combinatorial aspect of the daily production planning solving process. The work is based on the CP 2012 model seeker.

## 7.2. Bilateral Contracts with Industry

### 7.2.1. *Labcom TransOp*

**Participants:** Charles Prud'Homme, Xavier Lorca.

Title: TransOp.

Duration: 2014-2016.

Type: **new project.**

Budget: 300000 Euros.

Others partners: **Eurodécision.**

The goal of the project is to handle robustness in the context of industrial timetabling problems with constraint programming using **CHOCO**. The project is managed by **Xavier Lorca**.

## **TEA Project-Team**

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

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

### **7.1.1. Toyota Info-Technology Centre (2014-2016)**

Title: Co-Modeling of Safety-Critical Multi-threaded Embedded Software for Multi-Core Embedded Platforms

Inria principal investigator: Jean-Pierre Talpin

International Partner (Institution - Laboratory - Researcher):

Virginia Tech Research Laboratories, Arlington (United States)

Embedded Systems Group, Technische Universität Kaiserslautern (Germany)

Duration: 2014 - 2016

Abstract: We started a new project in April 2014 funded by Toyota ITC, California, to work with Huafeng Yu (a former post-doctorate of team ESPRESSO) and with VTRL as US partner. The main topic of our project is the semantic-based model integration of automotive architectures, virtual integration, toward formal verification and automated code synthesis. This year, Toyota ITC is sponsoring our submission for the standardisation of a time annex in the SAE standard AADL.

In a second work-package, we aim at elaborating a standardised solution to virtually integrate and simulate a car based on heterogeneous models of its components. This year, it will be exemplified by the elaboration of a case study in collaboration with Virginia Tech. The second phase of the project will consist of delivering an open-source, reference implementation, of the proposed AADL standard and validate it with a real-scale model of the initial case-study.

## 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.

## 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](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.

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

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



## FLUMINANCE Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Contracts with Industry

### 7.1.1. Contrat CERSAT/IFREMER

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

*duration 36 months.* This partnership between Inria and Ifremer funds the PhD of Valentin Resseguier, which aims at studying image based data assimilation strategies for oceanic models incorporating random uncertainty terms. The goal targeted will consist in deriving appropriate stochastic version of oceanic model and on top of them to devise estimation procedures from noisy data to calibrate the associated subgrid models.

## **GENSCALE Project-Team**

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

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

### **7.1.1. Kalray Company : Parallelization of bioinformatics algorithm on the MPPA Platform**

**Participants:** Charles Deltel, Dominique Lavenier.

The purpose was to investigate the performances of the Kalray MPPA architecture on scientific life science software. The collaboration started in 2013, and was aiming at implementing the PLAST software on the Kalray MPPA chip (256 cores). PLAST is a BLAST-like parallel implementation designed by GenScale. Experimentations have shown that for these kinds of applications that manage very huge volume of data, the MPPA chip memory capacity was a serious bottleneck.

### **7.1.2. Sofiproteol Company : Detection of SNPs in the Pea genome**

**Participants:** Susete Alves Carvalho, Pierre Peterlongo.

The Peapol project is funded by Sofiproteol Company. Its mission is to develop the French vegetable oil and protein industry, open up new markets, and ensure an equal distribution of value among its members. The Peapol project counts two collaborators, Biogemma, and INRA, the latter working in collaboration with the GenScale team in charge of algorithmic research to detect SNPs in the pea genome.

## **7.2. Bilateral Grants with Industry**

### **7.2.1. Korilog: I-Lab KoriScale**

**Participants:** Sébastien Brillet, Erwan Drezen, Dominique Lavenier, Ivaylo Petrov.

In June 2013, GenScale and the Korilog Company created an Inria common research structure (I-LAB) called KoriScale. This is the outcome of a solid relationship, which has enabled the transfer of the PLAST software (bank to bank genomic sequence comparison) from GenScale to Korilog. The resulting commercial product (Klast) is now 5 to 10 times faster than the reference software (Blast). The main research axe of the I-LAB focuses on comparing huge genomic and metagenomic datasets.

### **7.2.2. Rapsodyn project**

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

RAPSODYN is a long term project funded by the IA French program (Investissement d'Avenir) and several field seed companies, such as Biogemma, Limagrain and Euralis. The objective is the optimization of the rapeseed oil content and yield under low nitrogen input. GenScale is involved in the bioinformatics work package, in collaboration with Biogemma's bioinformatics team, to elaborate advanced tools dedicated to polymorphism.

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

## **SERPICO Project-Team**

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

## **7.1. Innopsys: Methods and algorithms for tissue microarrays image analysis**

In collaboration with Magellium company and Institut Gustave Roussy, Innopsys plans to develop new image analysis software to be included in the INGRID platform developed by Megellium company. New statistical methods and algorithms will be investigated by SERPICO for:

- segmentation and detection of deformable cell contours and cell nuclei in 2D fluorescence tissue microarray images;
- deconvolution and superresolution of fluorescence microarray imaging.

The three-year contract supports the PhD thesis of Hoai Nam Nguyen (2013-2016).

## VISAGES Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Contracts with Industry

### 7.1.1. Siemens

*duration: 5 years from 2011/10/26*

In the context of the Neurinfo imaging platform, a partnership between Siemens SAS - Healthcare and University of Rennes 1 was signed in October 2011 for 5 years. This contract defines the terms of the collaboration between Siemens and the Neurinfo platform. The Neurinfo platform has received work in progress (WIP) sequences from Siemens in the form of object code for evaluation in the context of clinical research. The Neurinfo platform has also received source code of selected MRI sequences. This is a major advance in the collaboration since it will enable the development of MRI sequences on site.

## 7.2. Bilateral Grants with Industry

### 7.2.1. MEDday

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

## ASAP Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Technicolor

**Participants:** Fabien André, Anne-Marie Kermarrec.

We have a contract with Technicolor for collaboration on large-scale infrastructure for recommendation systems . In this context, Anne-Marie Kermarrec is the PhD advisor of Fabien André since Nov 2013. Fabien André will work on efficient algorithms for heterogeneous data on large-scale platforms.

## 7.2. Orange Labs

**Participants:** Ali Gouta, Anne-Marie Kermarrec.

We have had a contract with Orange Labs for collaboration on peer-assisted approaches for caching and recommendation in streaming applications. In this context, Anne-Marie Kermarrec has been the PhD advisor of Ali Gouta since 2012.

## 7.3. Web Alter-Egos Google Focused Award

**Participants:** George Giakkoupis, Anne-Marie Kermarrec, Nupur Mittal, Javier Olivares.

Duration: Sep. 2013 - Sep. 2015; Coordinator: Inria and EPFL.

This project addresses the problem of extracting the alter-egos of a Web user, namely profiles of like-minded users who share similar interests, across various Internet applications, in real time and in the presence of high dynamics. Beyond their intrinsic social interest, the profiles of alter-egos of a user are crucial to identify a personalized slice of the Internet that can be leveraged to personalize the Web navigation of that user. The expected outcome of the project is a generic architecture of a Web-Alter-Ego service that can run on various devices and use, as well as be used for, various Web applications.

## ASCOLA Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Cooperation with SIGMA group

**Participants:** Thomas Ledoux [correspondent], Simon Dupont.

In 2012, we have started a cooperation with Sigma Group (<http://www.sigma.fr>), a software editor and consulting enterprise. The cooperation consists in a joint (a so-called Cifre) PhD on eco-elasticity of software for the Cloud and the sponsorship of several engineering students at the MSc-level.

As a direct consequence of the increasing popularity of Cloud computing solutions, data centers are rapidly growing in number and size and have to urgently face with energy consumption issues. The aim of Simon Dupont's PhD, started in November 2012, is to explore the *software elasticity* capability in Software-as-a-Service (SaaS) development to promote the management of SaaS applications that are more flexible, more reactive to environment changes and therefore self-adaptive for a wider range of contexts. As a result, SaaS applications become more elastic and by transitivity more susceptible to energy constraints and optimization issues.

In 2014, we have performed real world evaluations within Sigma's data centers that validated the results on new techniques for the management of elasticity within Cloud applications [27]. We have also presented our current work at <sup>0</sup>.

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<sup>0</sup>GreenTouch @ Nantes Digital Week

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



## CIDRE Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Contracts with Industry

- **Thales contract (2014): “Capalid v2”**

This contract consists in validating an intrusion detection strategy in a supervised distributed system. This work relies on the results obtained by Erwan Godefroy in his PhD Thesis: considering the description of an attack and a description of the deployed system (topology, cartography, IDS deployment), we must answer the question: "Is it possible to detect this attack?". This answer consists in determining if it is possible to build a correlation rule that a correlation system can use to detect the attack.

- **CS contract (2014-2015): “SecEF”**

The COSCOM contract consists in analyzing current used standards for information security events. Such events following a standardized structure are needed to allow communications between the various security tools, in order to consolidate and correlate information, and for communications between different security response teams, to share information relative to incidents. Examples of such events are IDMEF (Intrusion Detection Message Exchange Format, RFC 4765) or IODEF (Incident Object Description Exchange Format, RFC 5070). Unfortunately, these two standards are insufficiently deployed on a market still dominated by proprietary formats. The objective of the SecEF (Security Exchange Format) project is thus to propose evolutions of these formats, based on the initial feedback form current users.

- **Technicolor contract (2011-2014): “Data Aggregation in Large Scale Systems”**

The theme of this contract focuses on the management of massively distributed data sets. In a nutshell, our goal is to provide a lightweight yet continuous flow of aggregate and relevant data from a very large number of distributed sources to a management system. Collaborative data aggregation are relevant mechanisms that could help in securely providing digests of information. However, an important aspect that we want to preserve is the privacy of the aggregated information. This is of particular interest for Telco operators or software/hardware providers in order to smoothly manage the current state of their deployed platforms, allowing accordingly to develop new applications based on quick reactions/optimizations to identify and handle services inconsistencies.

This study is conducted in cooperation with the Inria project Dionysos.

- **HP contract (2013-2014): “Embedded Systems Security”**

We have initiated a research program in collaboration with HP Labs in the domain of embedded systems security. We aim at researching and prototyping low-level intrusion detection mechanisms in embedded system software. This involves mechanisms in continuation of previous work realized by our team as well as investigating new techniques more directly tied to specific device architectures. Details about this research program cannot be provided as they are covered by a non-disclosure agreement.

## 7.2. Bilateral Grants with Industry

- **Amossys: “Evaluation of intrusion detection mechanisms”**

The PhD of Georges Bossert is done in the context of a CIFRE contract with the SME Amossys (<http://www.amossys.fr/>). His work consists in proposing new approaches for protocol reverse-engineering. He developed Netzob, a tool dedicated to this task. The goal is to use this tool to generate realistic traffic during IDS assessment. In 2013, Georges has developed two important

improvements of the protocol inference process he previously proposed. First, he improved the message format reverse engineering phase. Unlike previous work, our approach uses contextual information and its semantic definition as a key parameter in both the processes of message clustering and field partitioning. We can also detect complex linear and nonlinear relationships between value, size and offset of message fields using correlation-based filtering. Besides, our multi-step pre-clustering phase reduces the required computation time of the main clustering phase. These results have been presented in an article that is under review. The second aspect of his work consisted in enhancing the grammar inference phase. He proposed a new approach that combines passive and active algorithms to infer protocol grammars. This approach also relies on grammar decompositions. Thus, he decreased inference time by using an action-based sequential decomposition and we took into account background noise by using a parallel decomposition. The PhD defense of Georges Bossert was held in December 2014.

- **Orange Labs: “Data persistence and consistency in ISP infrastructures”**

Pierre Obame is doing his PhD thesis in the context of a CIFRE contract with Orange Labs at Rennes. Pierre Obame has proposed a distributed storage system called Mistore, dedicated to users who access Internet via a Digital Subscriber Line (DSL) technology. This system aims at guaranteeing data availability, persistence, and low access latency by leveraging millions of home gateways and the hundreds of Points of Presence (POP) of an Internet Service Provider (ISP) infrastructure. Pierre Obame has also proposed a mathematical framework for defining both strong and weak consistency criteria within the same formalism. These criteria are offered by Mistore to its clients when they manipulate their data. Pierre Obame, whose PhD thesis is planned to terminate in February 2015, is in the process of writing his PhD manuscript so as to defend it by April 2015.

- **Orange Labs: “Privacy-preserving location-based services”**

Solenn Brunet has started her PhD thesis since 2014 within the context of a CIFRE contract with Orange Labs Caen. Her PhD subject concerns the development of privacy-preserving location-based services that are able to personalize the service provided to the user according to his current position while preserving his location privacy. In particular, Solenn will adapt existing cryptographic primitives (private information retrieval, secure multiparty computation, secure set intersection, ...) or design novel ones to use them as building blocks for the construction of these privacy-preserving location-based services.

- **DGA-MI: “Security events visualization”**

The PhD of Christopher Humphries on visualization is done in the context of a cooperation with DGA-MI. The objective is to propose new visualization mechanisms dedicated to the analysis of security events, for instance for forensic purposes. The CORGI tool presented earlier in this document is the most recent contribution to this contract.

- **DGA-MI: “Alerts correlation taking the context into account”**

The PhD of Erwan Godefroy is done in the context of a cooperation with DGA-MI. This PhD started in November 2012. The current work consists in the automatic generation of alert correlation rules in the context of deployed distributed systems. The correlation rules aim at being used by our GnG correlation system.

## **DIONYSOS Project-Team**

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

## **6.1. Bilateral Contract with Industry: ALSTOM-Inria Common Lab**

**Participants:** Bruno Tuffin, Gerardo Rubino.

Bruno Tuffin is the co-director of ALSTOM-Inria common Lab.

The group currently manages a project with ALSTOM on system availability simulation taking into account logistic constraints. Current ALSTOM Transport and Power contracts, especially service-level agreements, impose stringent system availability objectives. Non-adherence to the required performance levels often leads to penalties, and it is therefore critical to assess corresponding risk already at a tender stage. The challenge is to achieve accurate results in a reasonable amount of time. Monte Carlo simulation provides estimates of the quantities it is desired to predict (e.g., availability). Since we deal with rare events, variance reduction techniques, specifically Importance Sampling (IS) here, is used. The goal of the project is to establish the feasibility of IS for solving problems relevant to ALSTOM and to develop the corresponding mathematical tools.

## **6.2. Bilateral Contract with Industry: Participation in a CRE with Orange**

**Participant:** Bruno Tuffin.

We are participating to a CRE (managed by Telecom Bretagne) with Orange on the strategies of Content Delivery Networks (CDNs) and their impact on the overall Internet economy and regulation. In this study, we focus on the CDN as an economic actor. The goals are 1) to analyze CDNs' caching strategies from an economic point of view, 2) to study the strategies of an integrated CDN actor, and 3) to study the impact of CDNs in the net neutrality debate.

## **6.3. Bilateral Contract with Industry: Data-aggregation for large-scale distributed networks**

**Participants:** Bruno Sericola, Romaric Ludinard.

This was a 3-year (2011 - 2014) bilateral project with Technicolor R & D, France, on data-aggregation for large-scale distributed networks. Along with the ubiquity of data and computing devices, comes the complexity of extracting and gathering relevant information for management purposes. The very distributed nature of sources of data (be they partially local applications at user's place, or hardware as gateways), as well as their ever increasing number prohibit a systematic and exhaustive gathering on a single (or few) central server for offline analysis. In this context, collaborative data aggregation, where some computing resources collaborate securely to provide digests, appears as an interesting application for both scalability and efficiency. Moreover, collecting information at a large scale pose the problem of privacy and data aggregation may allow preserving the privacy while collecting data.

## **6.4. Cifre contract on LOCARN: Low Opex and Capex Architecture for Resilient Networks**

**Participants:** Damien Le Quéré, Adlen Ksentini, Bruno Sericola, Yassine Hadjadj-Aoul.

This is a Cifre contract (2012-2015) including a PhD thesis supervision, done with Orange Labs, on evaluating and developing a new plug-and-play routing protocol (called Low Opex and Capex Architecture for Resilient Networks, or LOCARN), which do not require any network management or configuration.

## 6.5. Cifre contract on Small Cell Networks

**Participants:** Btissam Er-Rahmadi, Adlen Ksentini, César Viho.

This is a Cifre contract (2013-2016) including a PhD thesis supervision, done with Orange Labs, on cooperation and self-\* small cell networks. The aim is to define architectures and protocols for deploying small cell networks in AMEA (Africa, Middle East and Asia) countries.

## 6.6. Cifre contract on a dynamic adaptive service-driven SDN architecture

**Participants:** Jean-Michel Sanner, Yassine Hadjadj-Aoul, Gerardo Rubino.

This is a Cifre contract (2013-2016) including a PhD thesis supervision, done with Orange Labs, on defining a dynamic adaptive service-driven network architecture based on the SDN concept.

## 6.7. Cifre contract on defining an open, a flexible and a unified network architecture

**Participants:** Yue Li, Yassine Hadjadj-Aoul, Gerardo Rubino.

This is a Cifre contract (2013-2016) including a PhD thesis supervision, done with Orange Labs, on designing an open, flexible and unified network architecture.

## 6.8. DGA Grant

**Participant:** Adlen Ksentini.

This DGA grant, with Cifre Inria team, is for the PhD supervision of Florient Grandhomme. The aim of the PhD program is to study a new routing protocol for MANET.

## 6.9. DVD2C

**Participant:** Adlen Ksentini.

We are working in the 3-year (September 2014 to September 2017) FUI Project DVD2C, which aims to virtualize CDN through the Cloud and Network Function Virtualization concept. DVD2C is led by Orange Labs, and the partners are two SMEs (Viotech and Resonate) and two academics (our team and Télécom Paris Sud).

## 6.10. IPChronos

**Participants:** Adlen Ksentini, Yassine Hadjadj-Aoul, Bruno Sericola, Pantelis Frangoudis.

The 3-year (September 2011 – September 2014) FUI Project IPChronos, where the main focus is in the use of the IEEE 1588 synchronization protocol over IP, ended. Our contribution focused on developing analytical models to estimate, based on the IEEE 1588 protocol, the end-to-end delay. IPChronos was led by ORALIA SPECTRACOM, and the partners are IPlabel and our team.

## 6.11. Camion

**Participants:** Yassine Hadjadj-Aoul, César Viho, Raymond Marie, Pantelis Frangoudis.

We are working in the 2-year (October 2014 to October 2016) Eurostars European Project Camion, which aims at offering cost-efficient, QoE-optimized content delivery, allowing for faster content access, as well as offline operation, while improving wireless network capacity and coverage. Camion is led by JCP-Connect, and the partners are a SME (FON) and our team.

## **DIVERSE Project-Team**

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

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

### **7.1.1. Bilateral industrial partnerships**

#### *7.1.1.1. Partnership with Thales*

Dates: 2011-2014

This partnership with Thales Research and Technology explores variability management both in modeling and metamodeling (*i.e.*, design and implementation of software languages). At the model level, this collaboration is a direct follow-up of the MOVIDA and the MUTATION projects, in which we explore the challenges related to software product line and multi-view engineering for the different development phases of systems of systems construction. At the metamodeling level, we investigate how the notions of variability modeling and management can serve the rigorous definition of families of modeling languages, which address the different interpretations of UML needed to model the different viewpoints in the systems engineering.

The project enrolls 4 faculty members and 2 PhD students from the Triskell team. This year, we keep working on the CVL usage in the Thales context.

#### *7.1.1.2. CIFRE grants*

- All4Tec (2011-2014). In this project with the All4Tec company we investigate the support of variability modelling for model-based test generation with Matelo (a tool developed by All4Tec). In this context, Benoit Baudry acts as Ph.D advisor for Hamza Samih.
- Zenexity (2011-2014). In this project with the Zenexity company we investigate the new architecture model for efficient web development on top of the play framework (a web framework developed by Zenexity). In this context, Jean-Marc Jézéquel and Olivier Barais act as Ph.D advisor for Julien Richard Foy.
- Orange (2014-2017). In this project with the Orange company we investigate the support of trust in web communication using software reconfiguration techniques. In this context, Olivier Barais acts as Ph.D advisor for Kevin Corre with Gerson Sunye.

## **KerData Project-Team**

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

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

Microsoft: Z-CloudFlow (2013–2016). In the framework of the Joint Inria-Microsoft Research Center, this project is a follow-up to the A-Brain project. The goal of this new project is to propose a framework for the efficient processing of scientific workflows in clouds. This approach will leverage the cloud infrastructure capabilities for handling and processing large data volumes. In order to support data-intensive workflows, the cloud-based solution will: adapt the workflows to the cloud environment and exploit its capabilities; optimize data transfers to provide reasonable times; manage data and tasks so that they can be efficiently placed and accessed during execution. The validation will be performed using real-life applications, first on the Grid5000 platform, then on the Azure cloud environment, access being granted by Microsoft through a *Azure for Research Award* received by G. Antoniu. The project also provides funding for the PhD thesis of Luis Pineda, started in 2014. The project is being conducted in collaboration with the Zenith team from Montpellier, led by Patrick Valduriez.

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

**TACOMA Team (section vide)**



## **DREAM Project-Team**

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

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

### **7.1.1. SoCTrace**

**Participants:** Serge Vladimir Emteu Tchagou, Alexandre Termier.

SoCTrace is a FUI project led by STMicroelectronics, with the companies ProbaYes and Magilem, Université Joseph Fourier and Inria Rhône-Alpes. Its goal is to provide an integrated environment for storing and analyzing execution traces. In this project, we are working on data mining techniques for analyzing the traces, and on the use of ontologies to enable querying traces with a higher level of abstraction.

### **7.1.2. ManageYourSelf: diagnosis and monitoring of embedded platforms**

**Participants:** Marie-Odile Cordier, Sophie Robin, Laurence Rozé.

ManageYourSelf is a project that deals with the diagnosis and monitoring of embedded platforms, in the framework of a collaboration with Telelogos, a French company expert in mobile management and data synchronization. ManageYourSelf aims to perform diagnostic and repair on a fleet of mobile smartphones and PDAs. The idea is to embed on the mobile devices a rule-based expert system and its set of policies, for example "if memory full then delete (directory)". At regular intervals the recognition is performed, using the parameters of the phones as the fact base. Of course, it is impossible to foresee all the rules in advance. Upon detection of a non anticipated problem, a report containing all the system's information prior to the problem is sent to a server. The learning step is realised using rules: crash rules are learnt, they are transformed in preventive rules by an expert and embedded on the phone.

### **7.1.3. Particular contract of the strategic action EDF/Inria**

**Participants:** Thomas Guyet, René Quiniou, Véronique Masson.

At the time of digitalization of multi-channel customer relations, the analysis of customer pathways has become a strategic issue for any business unit. The interaction traces left by clients when connecting to the customer services can be combined with data from other communication channels (phone, web form, e-mail, mail, fax, SMS, shop, etc.) and allow to analyse the customer pathways in details.

Pattern mining tools are able to extract the frequent customer behaviors in very large database of client pathways, but taking into account the duration and the delay between the customer actions remains a challenging issue for pattern mining. The objective of this one year particular contract was to design and to develop a frequent mining tool taking into account the time dimension for analysis of multichannel customer pathways.

## **HYBRID Project-Team**

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

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

### **7.1.1. Mensia Technologies**

**Participants:** Jozef Legény, Jussi Lindgren, Anatole Lécuyer.

**Mensia Technologies** is an Inria start-up company created in November 2012 as a spin-off of Hybrid team. Mensia is focused on wellness and healthcare applications emerging from the BCI and Neurofeedback technologies. The Mensia startup should benefit from the team's expertise and of valuable and proprietary BCI research results. Mensia is based in Rennes and Paris. Anatole Lécuyer and Yann Renard (former Inria expert engineer who designed the OpenViBE software architecture and was involved in team projects for 5 years) are co-founders of Mensia Technologies together with CEO Jean-Yves Quentel.

The on-going contract between Hybrid and Mensia started in November 2013 and supported the transfer of several softwares designed by Hybrid team ("OpenViBE", "StateFinder") related to our BCI activity and our OpenViBE software (section 5.1 ) to Mensia Technologies for 5 years, for future multimedia or medical applications of Mensia.

### **7.1.2. MBA Multimedia**

**Participants:** Ferran Argelaguet Sanz, Maud Marchal, Anatole Lécuyer.

This on-going contract started in June 2013 and supported the transfer of several softwares designed by Hybrid team ("3D Cursors", "Elastic Images") in the frame of the W3D project to MBA Multimédia company for future applications in the field of multimedia and web design based mainly on HTML5 and Word Press software.

### **7.1.3. Polymorph Studio**

**Participants:** Ferran Argelaguet Sanz, Maud Marchal, Anatole Lécuyer.

This on-going contract started in June 2013 and supported the transfer of several softwares designed by Hybrid team ("3D Cursors", "Pseudo-haptik", "Elastic Images") in the frame of the W3D project to Polymorph Studio company for future applications in the field of multimedia and web design based mainly on Unity3D software.

## **7.2. Bilateral Grants with Industry**

### **7.2.1. Orange Labs**

**Participant:** Anatole Lécuyer.

This grant started in October 2012 and ended in 2014. It has supported Pierre Gaucher's CIFRE PhD program on "Novel 3D interaction techniques based on pseudo-haptic feedback".

### **7.2.2. Technicolor**

**Participants:** Fabien Danieau, Anatole Lécuyer.

This grant started in January 2011 and ended in 2014. It has supported Fabien Danieau's CIFRE PhD program on "Improving audiovisual experience with haptic feedback".

## LAGADIC Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Contracts with Industry

### 7.1.1. *Robocortex*

**Participants:** Souriya Trinh, Fabien Spindler, François Chaumette.

*no. Inria Rennes 8492, duration: 13 months.*

This contract with the Inria spin off company Robocortex started in March 2014. It is devoted to the visual tracking and 3D localization of some particular targets.

## 7.2. Bilateral Grants with Industry

### 7.2.1. *Astrium EADS*

**Participants:** Tawsif Gokhool, Patrick Rives.

*no. Inria Sophia 7128, duration: 36 months.*

The objective of this project that started in February 2012 is to investigate the general problem of visual mapping of complex 3D environments that evolve over time. This contract supports Tawsif Gokhool's Ph.D. (see Section 6.3.5).

### 7.2.2. *ECA Robotics*

**Participants:** Romain Drouilly, Patrick Rives.

*no. Inria Sophia 7030, duration: 36 months.*

This project started in May 2012. It aims at specifying a semantic representation well adapted to the problem of navigation in structured environment (indoors or outdoors). This contract is devoted to support the Cifre Convention between ECA Robotics and Inria Sophia Antipolis regarding Romain Drouilly's Ph.D.

## **LINKMEDIA Project-Team**

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

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

CIFRE Ph. D. contract with Institut National de l'Audiovisuel (Bingqing Qu)

CIFRE Ph. D. contract with Institut National de l'Audiovisuel (Ludivine Kuznik)

CIFRE Ph. D. contract with Orange (Mohamed-Haykel Boukadida)

CIFRE Ph. D. contract with Technicolor (Himalaya Jain)

## MIMETIC Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Contracts with Industry

### 7.1.1. Faurecia

**Participants:** Franck Multon [contact], Pierre Plantard.

This contract aims at developing new ergonomics assessments based on inaccurate Kinect measurements in manufactures on real workers. The main challenges are:

- being able to improve the Microsoft Kinect measurement in order to extract accurate poses from depth images while occlusions may occur,
- developing new inverse dynamics methods based on such inaccurate kinematic data in order to estimate the joint torques required to perform the observed task,
- and proposing a new assessment tool to translate joint torques and poses into potential musculoskeletal disorders risks.

Faurecia has developed its own assessment tool but it requires tedious and subjective tasks for the user, at specific times in the work cycle. By using Kinect information we aim at providing more objective data over the whole cycle not only for specific times. We also wish to make the user focus on the interpretation and understanding of the operator's tasks instead of taking time estimating joint angles in images.

This work is performed in close collaboration with an ergonomist in Faurecia together with the software development service of the company to design the new version of their assessment tool. This tool will be first evaluated on a selection of manufacture sites and will then be spread worldwide among the 270 Faurecia sites in 33 countries.

This contract enabled us to hire Pierre Plantard as a PhD student to carry-out this work in MIMETIC and M2S Lab. He started in January 2013 and will finish in December 2015.

In 2014, we have developed a testbench based on virtual humans in order to evaluate the expected accuracy of a Kinect sensor in work conditions: the Kinect cannot be placed at a location compatible with the provider's recommendation. This testbench enabled us to evaluate more than 500000 configurations (Kinect location and upper-limb poses) with a virtual mannequin and a simulated Kinect. It will help to design the most appropriate protocol according to the work condition and the poses used by the operators at workstation.

## PANAMA Project-Team

# 7. Bilateral Contracts and Grants with Industry

## 7.1. Bilateral Contracts with Industry

### 7.1.1. Contract with Studio MAIA

**Participants:** Nancy Bertin, Frédéric Bimbot, Jules Espiau de Lamaestre, Jérémy Paret, Nathan Souviraà-Labastie.

*Duration:* 3 years (2012–2014).

*Research axis:* 3.2.2

*Partners:* Studio MAIA (*Musiciens Artistes Interprètes Associés*), Imaging Factory

This contract aims at transferring some of the research done within PANAMA towards new services provided by MAIA Studio.

More specifically, the main objective is to adapt source separations algorithms and some other advanced signal processing techniques elaborated by PANAMA in a user-informed context.

The objective is twofold:

- partial automation of some tasks which the user previously had to accomplish manually
- improved quality of separation and processing by exploiting user inputs and controls

The resulting semi-automated separation and processing will feed an integrated software used for the professional remastering of audiovisual pieces. New PANAMA tools were integrated in the software developed by Imaging Factory and delivered to MAIA in May 2014, and the final release will be delivered in December 2014.

## 7.2. Bilateral Grants with Industry

### 7.2.1. CIFRE contract with Technicolor R&I France on Compressive Sensing for the manipulation of large multimedia databases

**Participants:** Rémi Gribonval, Anthony Bourrier.

*Duration:* 3 years (2011-2014)

*Research axis:* 3.1.2

*Partners:* Technicolor R&I France, Inria-Rennes

*Funding:* Technicolor R&I France, ANRT

The objective of this thesis was to explore, both numerically and theoretically, the potential of compressive sensing for the manipulation of large (audiovisual) databases. A particular objective was to propose learning techniques that can work on strongly compressed versions of a large corpus of data while maintaining the ability to infer essential characteristics of the distribution of the items in the corpus.

## **SIROCCO Project-Team**

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

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

### **7.1.1. Contract with Astrium on compression of satellite images**

**Participants:** Jeremy Aghaei Mazaheri, Christine Guillemot, Claude Labit.

- Title : Compression of satellite images.
- Research axis : § 6.3.2 .
- Partners : Astrium, Inria-Rennes.
- Funding : Astrium.
- Period : Oct.11-Sept.14.

This contract with Astrium addresses the problem of sparse representation and dictionary learning for efficient sparse coding of video signals captured from a geostationary satellite. The goal is to develop a compact spatio-temporal representation taking advantage of the high redundancy present in the video which is of very high resolution and characterized by low motion. Different methods for learning tree-structured dictionaries have been studied. The tree-structured dictionaries are well-tailored to the characteristics of the signals to be processed at each iteration of the greedy matching pursuit algorithms, while allowing efficient encoding of the produced sparse vectors. Adaptive tree-structures have been developed and the use of such dictionaries in HEVC-based intra coding has been investigated. First tests have also been carried out to know to which extent the learned dictionaries can allow detecting the modulation transfer function (MTF) used to characterize the quality of electro-optical imaging systems on board remote sensing satellites.

## **7.2. Bilateral Grants with Industry**

### **7.2.1. Contract with EutelSat on video traffic analysis**

**Participants:** Laurent Guillo, Aline Roumy.

- Title : Bit rate statistical analysis of HEVC encoded video in a broadcast transmission.
- Partners : EutelSat, Inria-Rennes.
- Funding : EutelSat.
- Period : Aug.12-Mar.14.

This contract with EutelSat (starting in August 2012) is a consulting contract and aims at analyzing the variation of the video traffic, when the video is encoded by HEVC. Indeed, the main characteristic of satellite broadcasting, as proposed by Eutelsat, is to provide a nearly constant video quality, which is obtained by variable video traffic (bit rate). Then, to address this variability issue, statistical multiplexing is used to share the resource among the users. However, statistical multiplexing needs a precise analysis of this variability. In this contract, we therefore analyze this variability, when the video is compressed with the upcoming video compression standard HEVC.

### **7.2.2. CIFRE contract with Orange on Generalized lifting for video compression**

**Participants:** Christine Guillemot, Bihong Huang.

- Title : Generalized lifting for video compression.
- Research axis : § 6.3.3 .
- Partners : Orange Labs, Inria-Rennes, UPC-Barcelona.
- Funding : Orange Labs.
- Period : Apr.2012-Mar.2015.

This contract with Orange labs. (started in April. 2012) concerns the PhD of Bihong Huang and aims at modelling the redundancy which remains in spatial and temporal prediction residues. The analysis carried out in the first year of the PhD has shown that this redundancy (hence the potential rate saving) is high. In 2013, different methods have been investigated to remove this redundancy, such as generalized lifting and different types of predictors. The generalized lifting is an extension of the lifting scheme of classical wavelet transforms which permits the creation of nonlinear and signal probability density function (pdf) dependent and adaptive transforms. This study is also carried out in collaboration with UPC (Prof. Philippe Salembier) in Barcelona.

### **7.2.3. CIFRE contract with Orange on 3D quality assessment**

**Participants:** Darya Khaustova, Olivier Le Meur.

- Title : Objective Evaluation of 3D Video Quality.
- Research axis : § 6.1.3 .
- Partners : Orange Labs, Inria-Rennes.
- Funding : Orange Labs.
- Period : Dec.2011-Nov.2014.

This contract with Orange labs. (starting in Dec. 2011) concerns the PhD of Darya Khaustova and aims at developing a video quality metric for 3D content. The usage of 3D video is expected to increase in the next years. In order to ensure a good QoE (Quality of Experience), the 3D video quality must be monitored and accurately measured. The goal of this thesis is to study objective measures suitable for estimating 3D video quality. A comparison with ground truth as well as with the state-of-the-art 2D metrics should be carried out. To be as effective as possible, the feature of the human visual system should be taken into account.

### **7.2.4. CIFRE contract with Technicolor on High Dynamic Range (HDR) video compression**

**Participants:** Mikael Le Pendu, Christine Guillemot.

- Title : Floating point high dynamic range (HDR) video compression
- Research axis : § 6.3.4 .
- Partners : Technicolor, Inria-Rennes.
- Funding : Technicolor, ANRT.
- Period : Dec.2012-Nov.2015.

High Dynamic Range (HDR) images contain more intensity levels than traditional image formats, leading to higher volumes of data. HDR images can represent more accurately the range of intensity levels found in real scenes, from direct sunlight to faint starlight. The goal of the thesis is to design a visually lossless compression algorithm for HDR floating-point imaging data. The first year of the thesis has been dedicated to the design of a quantization method converting the floating point data into a reduced bit depth representation, with minimal loss. The method leads to a bit rate saving of 50% compared to the existing Adaptive LogLuv transform.

### **7.2.5. CIFRE contract with Technicolor on sparse modelling of spatio-temporal scenes**

**Participants:** Martin Alain, Christine Guillemot.

- Title : Spatio-temporal analysis and characterization of video scenes
- Research axis : § 6.1.4 .
- Partners : Technicolor, Inria-Rennes.
- Funding : Technicolor, ANRT.
- Period : Oct.2012-Sept.2015.



A first CIFRE contract has concerned the Ph.D of Safa Cherigui from Nov.2009 to Oct.2012, in collaboration with Dominique Thoreau (Technicolor). The objective was to investigate texture and video scene characterization using models based on sparse and data dimensionality reduction techniques, as well as based on epitomes. The objective was then to use these models and methods in different image processing problems focusing in particular on video compression. While, the first PhD thesis has focused on spatial analysis, processing, and prediction of image texture, a second CIFRE contract (PhD thesis of Martin Alain) has started in Oct. 2012 to push further the study by addressing issues of spatio-temporal analysis and epitome construction, with applications to temporal prediction, as well as to other video processing problems such as denoising and super-resolution.

### **7.2.6. CIFRE contract with Thomson Video Networks (TVN) on Video analysis for HEVC based video coding**

**Participants:** Nicolas Dhollande, Christine Guillemot, Olivier Le Meur.

- Title : Coding optimization of HEVC by using pre-analysis approaches.
- Research axis : § 6.3.3 .
- Partners : Thomson Video Networks, Univ. Rennes 1.
- Funding : Thomson Video Networks (TVN).
- Period : Nov.2012-Sept.2015.

This contract with TVN (started in Oct. 2012) concerns the PhD of Nicolas Dhollande and aims at performing a coding mode analysis and developing a pre-analysis software. HEVC standard is a new standard of compression including new tools such as advanced prediction modes. Compared to the previous standard H.264, HEVC's complexity is three to four times higher. The goal of this thesis is to infer the best coding decisions (prediction modes...) in order to reduce the computational complexity of HEVC thanks to a pre-analysis step. The pre-analysis is expected to provide useful estimates of local video characteristics which will then help selecting the prediction and transform partitions as well as a number of other parameters such as the quantization parameters or the prediction modes.

### **7.2.7. CIFRE contract with Envivio on LDR compatible HDR video coding**

**Participants:** Christine Guillemot, David Gommelet, Aline Roumy.

- Title : LDR-compatible coding of HDR video signals.
- Research axis : § 6.3.3 .
- Partners : Envivio.
- Funding : Cifre Envivio.
- Period : Oct.2014-Sept.2017.

The goal of this Cifre contract is to design solutions for LDR-compatible coding of HDR videos. This involves the study of rate-distortion optimized tone mapping operators taking into account constraints of temporal coherency to avoid the temporal flickering which results from a direct frame-by-frame application of classical tone mapping operators. The goal is also to design a coding architecture which will build upon these operators, integrating coding tools tailored to the statistics of the HDR refinement signals.