Activity Report 2015

Section Contracts and Grants with Industry

ALF Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Intel research grant ALF-INTEL2014-8957
Participants: André Seznec, Fernando Endo.

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

8.2. Bilateral Grants with Industry

8.2.1. Nano 2017 PSAIC
Participants: Arif Ali Ana-Pparakkal, Erven Rohou, Emmanuel Riou.

Nano 2017 PSAIC is a collaborative R&D program involving Inria and STMicroelectronics. The PSAIC (Performance and Size Auto-tuning through Iterative Compilation) project concerns the automation of program optimization through the combination of several tools and techniques such as: compiler optimization, profiling, trace analysis, iterative optimization and binary analysis/rewriting. For any given application, the objective is to devise through a fully automated process a compiler profile optimized for performance and code size. For this purpose, we are developing instrumentation techniques that can be focused and specialized to a specific part of the application aimed to be monitored.

The project involves the Inria teams ALF, AriC, CAMUS and CORSE. ALF contributes program analyses at the binary level, as well as binary transformations. We will also study the synergy between static (compiler-level) and dynamic (run-time) analyses.

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 has been 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. 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.

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 2015, we have presented an autonomic approach to manage cloud elasticity that obey cross-layer constraints [23].

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

Participant: François Le Gland.

See 3.3 , 4.2 and 5.4

Inria contract ALLOC 7326 — April 2013 to December 2016.

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

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

6.2. Bilateral grants with industry

6.2.1. *Hybrid indoor navigation — PhD grant at CEA LETI*

Participants: François Le Gland, Kersane Zoubert–Ousseni.

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

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

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

ATLANMODELS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

Orange Labs (Cesson-Sévigné) is founding a PhD Thesis (CIFRE) on the topic of trust modeling on Web-RTC communications.

CAIRN Project-Team (section vide)

CELTIQUE Project-Team (section vide)

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- **CS contract (2014-2016): "SecEF"**

  The SecEF contract consists in analyzing current used standards for information security events [39]. 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 from current users. During the first years of the project, we focused our work on alert formats. We conduced a comparative study of different alert formats and propose quantitative metrics to asses format expressiveness. We also proposed some evolutions for the IDMEF format and started the development of a generic library dedicated to IDMEF. This library could be used in different programming languages to generate and parse IDMEF messages. It will also support different encodings and transport protocols.

- **HP contract (2013-2016): "Embedded Systems Security"**

  We have initiated a research program in collaboration with HP Inc 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. In 2015, the project has been extended. We initiated a knew research work involving a Master student. The main objective of this extension is to monitor low-level software (firmware, OS kernels, hypervisors) thanks to a dedicated external co-processor. HP Inc Labs will fund a PhD on that subject. Details about this research program cannot be provided as they are covered by a non-disclosure agreement.

8.2. Bilateral Grants with Industry

- **DGA-MI: "BGP-like Inter Domain routing protocol for tactical mobile ad hoc networks: feasibility, performances and quality of service."**

  Florian Grandhomme is doing his PhD thesis in the context of a cooperation with DGA-MI. The goal of this thesis is to propose new secure and efficient algorithms and protocols to provide inter-domain routing in the context of tactical mobile ad hoc network. The protocol proposed will have to handle context modification due to the mobility of MANET, that is to say split of a MANET, merge of two or more MANET, and also handle hetereogeneity of technology and infrastructure. The solution will be independant from the underlying intra-domain routing protocol and from the infrastructure: wired or wireles, fixed or mobile.

- **DGA-MI: "Visualization for security events monitoring"**

  Damien Crémilleux was hired this year as a Ph.D. student on a DGA-MI funding to work on visualization for security events monitoring. The purpose of this thesis it to define relevant representations to allow front-line security operators to monitors systems from a security perspective. A first proposal was made that led to a tool, VEGAS, that allows to monitor large quantities of alerts in real time and to dispatch these alerts in a relevant way to security analysts. VEGAS was presented during the poster session in VizSec 2015 [58] that took place in Chicago, Illinois on the 26th of October 2015.

- **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 2016, is in the process of writing his PhD manuscript so as to defend it in 2016.

- **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. A first paper on the development of a privacy-preserving e-toll service based on the partially blind signature has just been accepted for publication.

- **DGA-MI: "Security events visualization"**

  Christopher Humphries defended his Ph.D. thesis on the 8th of December 2015. This Ph.D. was funded by DGA-MI. The objective of this thesis was to propose new visualization mechanisms dedicated to the analysis of security events, for instance for forensic purposes. Two tools, ELVIS and CORGI, were produced. This research led to two publications in VizSec, which is the most famous venue on the topic of visualization for security.

- **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 and is expected to finish in 2016. 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.

DECENTRALISE Team (section vide)

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

7. Bilateral Contracts and Grants with Industry

7.1. 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.

7.2. 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.

7.3. Cifre contract on Device-Assisted Distributed Machine-Learning on Many Cores

Participants: Corentin Hardy, Bruno Sericola.

This is a Cifre contract including a PhD thesis supervision, done with Technicolor. The starting point of this thesis would be to consider the possibility to deploy machine-learning algorithms over many cores, but out of the datacenter: on the devices (home-gateways) deployed by Technicolor in users' homes. In this device-assisted view, an initial processing step in the device may significantly reduce the burden on the datacenter back-end. Problems are numerous (power consumption, CPU power, network bandwidth and latency), but costs for the operator can be lowered and scale may bring some new level in data processing.

7.4. Cifre contract on Small Cell Networks

Participants: Adlen Ksentini, César Viho.

This is a Cifre contract (2013-2016) including 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.

7.5. Cifre contract on SDN for 5G mobile networks

Participant: Adlen Ksentini.

This is a Cifre contract (2015-2018) including PhD thesis supervision, done with TDF, on cooperation the use SDN for the 5 generation of mobile network. The objective of the thesis is to study and devise appropriate solutions to introduce SDN with the current LTE architecture toward 5G.

7.6. DGA Grant

Participant: Adlen Ksentini.

This DGA grant, with Cidre Inria team, is for the PhD supervision of Florient Grandhomme.

7.7. DVD2C

Participants: Adlen Ksentini, Pantelis Frangoudis.

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

7.8. 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 the supervision and work of the PhD thesis of Jean-Michel Sanner, done with Orange Labs, on defining a dynamic adaptive service-driven network architectures based on the SDN concept.

7.9. 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 the supervision and work of the PhD thesis of, done with Orange Labs, on designing an open, flexible and unified network architecture.

7.10. Camion

Participants: Yassine Hadjadj-Aoul, César Viho, Raymond Marie, Thiago Wanderley Matos de Abreu.

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 leaded by JCP-Connect, and the partners are a SME (FON) and our team.

DIVERSE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. April

This work is performed in collaboration with APRIL Technologies. This company develops all the IT solutions for APRIL group [0] and their clients in the insurance business. They have a very large information system that they specialize for all the divisions of the group. A critical need for them is to ensure that changes in their applications (new features, bug repair, etc.) do not degrade functional correctness and performance.

Software testing techniques and tools have greatly improved over the last decade and it is now possible for software developers to write test cases that are automatically executed. Consequently, each time the program evolves, it is rebuild and re-tested automatically, which supports the detection of errors early in the process and prevents the propagation of the bug into the production code. However, the test cases are manually written and are thus usually weak when it comes at finding bugs that are deep in the code or in nested loops for example. The main challenge of this work is automatically generate new test cases that increase the effectiveness of regression testing.

In this project we aim at automatically generating new test cases from the ones that have been manually produced by the developers, in order to add value in the continuous integration process and improve the quality of software that goes in production. The process of automatically producing new test cases from existing ones is called *test amplification*. We can experiment our recent results about test transformations on APRIL Technologies's set of test cases very early in the project.

This project supports one postdoc in the DiverSE team and is funded by Inria's transfer and industrial partnership department.

8.2. Bilateral Grants with Industry

8.2.1. 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.

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[0]http://groupe.april.fr/groupe

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *SocTrace: analysis of SOC traces*

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.

8.1.2. *ITRAMI: Interactive Trace Mining*

Participants: Alexandre Termier, Thomas Guyet, René Quiniou.

ITRAMI is a Nano2017 project. Such projects are designed to support joint research efforts between STMicrolectronics and academic partners in the domain of embedded systems. Alexandre Termier is the PI of this projet, having for goal to design novel data mining methods for interactive analysis of execution traces. Such methods aim at considerably reducing the time that STMicroelectronics developers spend at understanding, debugging and profiling applications running on STMicrolectronics chips. The project work is done at University Joseph Fourier (Grenoble), in collaboration with DREAM researchers Thomas Guyet and René Quiniou. Two contractual personnel are working on the project in Grenoble: Willy Ugarte as a postdoc, and Soumay Ben Alouane as an engineer.

DYLISS Project-Team (section vide)

ESTASYS Team (section vide)

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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants 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.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Empowered memory

Participants: Charles Deltel, Dominique Lavenier.

The UPMEM company is currently developing new memory devices with embedded computing power. GenScale investigates how bioinformatics algorithms can benefit from these new types of memory (see section New Results).

8.2. Bilateral Grants with Industry

8.2.1. 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 structure research (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. In June 2015, Korilog stopped its activity.

8.2.2. Rapsodyn project

Participants: Dominique Lavenier, Claire Lemaitre, Sebastien Letort, 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.

HYBRID Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Mensia Technologies*

Participants: Anatole Lécuyer, Jussi Lindgren.

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 6.1) to Mensia Technologies for 5 years, for future multimedia or medical applications of Mensia.

8.1.2. *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 (e.g., "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.

8.1.3. *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 (e.g., "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.

8.2. Bilateral Grants with Industry

8.2.1. *Technicolor*

Participants: Antoine Costes, Anatole Lécuyer, Ferran Argelaguet.

This grant started in December 2015. It supports Antoine Costes's CIFRE PhD program with Technicolor company on "Haptic Texturing".

8.2.2. *Realyz*

Participants: Guillaume Cortes, Anatole Lécuyer.

This grant started in December 2015. It supports Guillaume Cortes's CIFRE PhD program with Realyz company on "Improving tracking in VR".

8.2.3. *VINCI*

Participants: Anne-Solène Dris-Kerdreux, Bruno Arnaldi, Valérie Gouranton.

This grant started in November 2015. It supports Anne-Solene Dris-Kerdreux's CIFRE PhD program with Vinci company on "Training in VR for construction applications".

HYCOMES Team (section vide)

<div align="center">

I4S Project-Team

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8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. PhD CIFRE with EDF

Participants: Nassif Berrabah, Qinghua Zhang.

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

8.1.2. Contracts with SVS

Participants: Laurent Mevel, Michael Doehler.

Annual agreement Inria-SVS 2381 + contract 4329

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

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

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

8.1.3. Contracts with A3IP

Participant: Vincent Le Cam.

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

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

8.1.4. Contract with SNCF : DEMETER

Participants: Vincent Le Cam, Mathieu Le Pen.

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

8.1.5. Collaboration with SNCF

Participant: Jean Dumoulin.

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

8.1.6. Contract with GDF

Participants: Vincent Le Cam, Mathieu Le Pen.

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

8.1.7. *Collaboration with SIEMENS : NEOVAL Rennes*

Participant: Jean Dumoulin.

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

IPSO Project-Team (section vide)

8. Bilateral Contracts and Grants with Industry

8.1. 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.

LAGADIC Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Robocortex
Participants: Souriya Trinh, Fabien Spindler, François Chaumette.

no. Inria Rennes 8492, duration: 22 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.

8.2. Bilateral Grants with Industry

8.2.1. Astrium EADS
Participants: Tawsif Gokhool, Patrick Rives.

no. Inria Sophia 7128, duration: 36 months.

The objective of this project that started in February 2012 was to investigate the general problem of visual mapping of complex 3D environments that evolve over time. This contract supported Tawsif Gokhool's Ph.D. (see Section 7.4.3).

8.2.2. ECA Robotics
Participants: Romain Drouilly, Patrick Rives.

no. Inria Sophia 7030, duration: 36 months.

This project started in May 2012. It aimed at specifying a semantic representation well adapted to the problem of navigation in structured environment (indoors or outdoors). This contract was devoted to support the Cifre Convention between ECA Robotics and Inria Sophia Antipolis regarding Romain Drouilly's Ph.D. (see Section 7.4.5).

8.2.3. Technicolor
Participants: Salma Jiddi, Eric Marchand.

Univ. Rennes 1, duration: 36 months.

This project funded by Technicolor started in October 2015. It supports Salma Jiddi's Ph.D. about augmented reality.

8.2.4. Pôle Saint Hélier
Participants: Louise Devigne, Marie Babel.

no. Insa Rennes 2015/0890, duration: 36 months.

This project started in November 2015. It will address the following two issues. First, the idea is to design a low-cost indoor / outdoor efficient obstacle avoidance system that respects the user intention, and does not alter user perception. This involves embedding innovative sensors to tackle the outdoor wheelchair navigation problem. The second objective is to take advantage of the proposed assistive tool to enhance the user Quality of Experience by means of biofeedback as well as the understanding of the evolution of the pathology.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Teddy Furon spent 20 % of his time during 6 months to transfer research result to IRT B-com

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

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

Ph. D. contract with Alcatel-Lucent Bell Labs (Raghavendran Balu) in the framework of the joint Inria-Alcatel Lucent lab.

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Visual Analytics for Cinematographic Data*
Participant: Marc Christie [contact].

The contract has two objectives: first developping a film annotation tool that integrates cinematographic image and editing features such as visual composition, shot type, balance, depth, shot transition, etc. While existing annotation tools such as Anvil and Elan are are largely used for film annotation, the specificities of cinematographic and editing features requires the design of dedicated tools which mix automated and manual annotation stages. The work builds on the Insight annotation tool developed in our group (see [29]).

The second objective is to provide means to visualize and interact with the data, following the general trend of Visual Analytics. Different representations are currently explored and developped inside Technicolor's internal tools.

8.2. Bilateral Grants with Industry

8.2.1. *Cifre Faurecia*
Participant: Franck Multon [contact].

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 300 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 January 2016.

MYRIADS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Thales Research and Technology

Participants: Baptiste Goupille–lescar, Christine Morin, Nikolaos Parlavantzas.

Our collaboration with Thales Research and Technology focuses on the development of distributed Cyber-Physical Systems, such as those developed by Thales to monitor and react to changing physical environments. These systems need to be highly adaptable in order to cope with the dynamism and diversity of their operating environments. Notably, they require distributed, parallel architectures that support dynamic sets of applications, not known in advance, while providing strong QoS guarantees. The objective of this collaboration is to explore adaptive resource management mechanisms for such systems that can adapt to changes in the requirements and in the availability of resources. From November 2015 to December 2015, we performed a state of the art study on resource management in virtualized computing infrastructures to cope with cyber-physical system constraints.

PANAMA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Research contract with TDF
Participants: Nancy Bertin, Ewen Camberlein, Rémi Gribonval.

> *Duration: 6 weeks*
>
> *Partners: TDF*

This contract aimed at conceiving an algorithm to estimate the time offset between to identical or similar audio streams, to implement this algorithm in a prototype and to benchmark it on test files provided by the partner.

8.2. Bilateral Grants with Industry

8.2.1. CIFRE contract with Technicolor R&I France on Very large scale visual comparison
Participants: Rémi Gribonval, Himalaya Jain.

> *Duration: 3 years (2015-2018)*
>
> *Research axis: 3.1.2*
>
> *Partners: Technicolor R&I France, Inria-Rennes*
>
> *Funding: Technicolor R&I France, ANRT*

The grand goal of this thesis is to design, analyze and test new tools to allow large-scale comparison of high-dimensional visual signatures. Leveraging state of the art visual descriptors, the objective is to obtain new compact codes for visual representations, exploiting sparsity and learning, so that they can be stored and compared in an efficient, yet meaningful, way.

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. ANDRA project

Participants: Yvan Crenner, Benjamin Delfino, Jean-Raynald de Dreuzy, Jocelyne Erhel.

Contract with ANDRA (National Agency for Nuclear Waste)
Duration: three years from November 2015.
Title: reactive transport in fractured porous media
Coordination: Jocelyne Erhel.
Partners: Geosciences Rennes.
Web page: http://www.irisa.fr/sage/

Abstract: Even in small numbers, fractures must be carefully considered for the geological disposal of radioactive wastes. They critically enhance diffusivity, speed up solute transport, extend mixing fronts and, in turn, modify the physicochemical conditions of reactivity around possible storage sites. Numerous studies in various fields have shown that fractures cannot be simply integrated within an equivalent po- rous medium with a simple enhancement of its petro-physical properties (porosity and permeability). We propose a combined numerical and experimental approach to determine the influence on reactivity of typical fracture patterns found in some radioactive waste applications.

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Contract with Innopsys: Tissue microarrays (TMA) image analysis*

Participants: Hoai Nam Nguyen, Charles Kervrann.

Collaborators: Vincent Paveau and Cyril Cauchois (Innopys).

A three-year contract has been established with Innopsis in 2013 to support Hoai Nam Nguyen's Ph-D thesis. The objective is to investigate and develop methods and algorithms dedicated to fluorescence images acquired by the scanners and devices designed by the company. In this project, we focus on i/ localization and segmentation fluorescence tissue microarrays (TMA) cores in very large 2D images; ii/ de-arraying of digital images and correction of grid deformation adapted to devices; iii/ correction of scanning artifacts to improve image reconstruction; iv/ deconvolution, denoising and superresolution of fluorescence TMA images corrupted by Poisson noise. The algorithms will be integrated into the plateforms and devices designed by Innopsis.

8.1.2. *Contract (CIFRE) with Technicolor: Semantically meaningful motion descriptors for video understanding*

Participants: Juan Manuel Perez Rua, Patrick Bouthemy.

Collaborators: Tomas Crivelli and Patrick Pérez (Technicolor).

A three-year contract has been established with Technicolor on January 2015 for a CIFRE grant supporting Juan Manuel Perez Rua's Ph-D thesis. The purpose is to investigate new methods for extracting meaningful mid-level motion-related descriptors that may help for the semantic discovery of the scene. In 2015, we started with the occlusion detection problem. We have proposed a novel approach where occlusion in the next frame or not is formulated in terms of visual reconstruction. Contrary to the ubiquitous displaced-frame-difference, the proposed alternative does not critically depend on a pre-computed, dense displacement field, while being shown to be more effective. We then leverage this local modeling within an energy-minimization framework that delivers occlusion maps. An easy-to-obtain collection of parametric motion models is exploited within the energy to provide the required level of motion information. Our approach outperforms state-of-the-art occlusion detection methods on the challenging MPI Sintel dataset.

8.2. Bilateral grants with industry

8.2.1. *Fourmentin-Guilbert Foundation: Macromolecule detection in cryo-electron tomograms*

Participants: Emmanuel Moebel, Charles Kervrann.

Collaborator: Damien Larivière (Fourmentin-Guilbert Foundation).

The Fourmentin-Guilbert Foundation strives for building a virtual E. coli bacteria. Information about the position of macromolecules within the cell is necessary to achieve such a 3D molecularly-detailed model. The Fourmentin-Guilbert Foundation supports cutting-edge *in-situ* cryo-electron tomography combined with image processing at the Max-Planck Institute of Biochemistry to map the spatial distribution of the ribosomes and obtain structural information on the complexes they form *in-situ* with cofactors and other ribosomes. The objective of the project is to explore and evaluate novel methods from the field of 3D shape retrieval for identifying, localizing and counting macromolecules (e.g. 70S ribosome) within a tomogram. This project is also supported by "Region Bretagne".

<p align="center">**SIROCCO Project-Team**</p>

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

8.1.1. CIFRE contract with Orange on Generalized lifting for video compression
Participants: Christine Guillemot, Bihong Huang.

- Title : Generalized lifting for video compression.
- Research axis : § 7.3.2 .
- 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.

8.1.2. 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 : § 7.3.4 .
- 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.

8.1.3. 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 : § 7.1.2 .
- 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.

8.1.4. 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 : § 7.3.5 .
- 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.

8.1.5. 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 : § 7.3.3 .
- 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.

8.1.6. CIFRE contract with Technicolor on light fields editing

Participants: Christine Guillemot, Matthieu Hog.

- Title : Light fields editing
- Research axis : *just started*
- Partners : Technicolor, Inria-Rennes.
- Funding : Technicolor, ANRT.
- Period : Oct.2015-Sept.2018.

Editing is quite common with classical imaging. Now, if we want light-fields cameras to be in the future as common as traditional cameras, this functionality should also be enabled with light-fields. The goal of the PhD will therefore be to develop methods for light-field editing focusing first on object removal thanks to light-fields inpainting and for constructing panoramic images based on light-fields stitching. This objective also includes the development of algorithms for dynamic light fields spatio-temporal segmentation with spatio-temporal coherence constraints across sub-aperture images.

8.1.7. CIFRE contract with Technicolor on cloud-based video compression

Participants: Jean Begaint, Christine Guillemot.

- Title : Cloud-based video compression
- Research axis : *just started*
- Partners : Technicolor, Inria-Rennes.
- Funding : Technicolor, ANRT.
- Period : Nov.2015-Oct.2018.

The goal of this Cifre contract is to develop a novel image compression scheme exploiting similarity between images in a cloud. The objective will therefore be to develop rate-distortion optimized affine or homographic estimation and compensation methods which will allow us to construct prediction schemes and learn adapted bases from most similar images retrieved by image descriptors. One issue to be addressed is the rate-distortion trade-off induced by the need for transmitting image descriptors.

SUMO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Joint Alstom-Inria research lab: 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. Alstom agreed to start a second phase of the project in 2016, for a duration of three years. This covers in particular the CIFRE PhD of Karim Kecir.

TACOMA Team (section vide)

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

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. 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.

8.2. Bilateral Grants with Industry

8.2.1. 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 years projects) is to provide a systematic reformulation of time-series constraints in term of linear constraints that can be used in a MIP solver.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Toyota Info-Technology Centre (2014+)

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):

Toyota Info-Technology Centre, Mountain View, California

Virginia Tech Research Laboratories, Arlington

Duration: renewed yearly since 2014

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.

8.2. Bilateral Grants with Industry

8.2.1. Mitsubishi Electric R&D Europe (2015-2018)

Title: Analysis and verification for correct by construction orchestration in automated factories

Inria principal investigator: Jean-Pierre Talpin, Simon Lunel

International Partner: Mitsubishi Electric R&D Europe

Duration: 2015 - 2018

Abstract: The primary goal of our project is to ensure correctness-by-design in cyber-physical systems, i.e., systems that mix software and hardware in a physical environment, e.g., Mitsubishi factory automation lines. We plan to explore a multi-sorted algebraic framework for static analysis and formal verification starting from a simple use case extracted from Mitsubishi factory automation documentations. This will serve as a basis to more ambitious research where we intend to leverage recent advance in type theory, SMT solvers for nonlinear real arithmetic (dReal and δ-decidability) and contracts theory (meta-theory of Benveniste et al., Ruchkin's contracts) to provide a general framework of reasoning about heterogeneous factory components.

VISAGES Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *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.

8.2. Bilateral Grants with Industry

8.2.1. *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.