RESEARCH CENTER

FIELD
Algorithmics, Programming, Software and Architecture

Activity Report 2012

Section Contracts and Grants with Industry

Edition: 2013-04-24

ARIC Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. STMicroelectronics CIFRE PhD Grant

Jingyan Jourdan-Lu was supported by a CIFRE PhD grant (from March 2009 to September 2012) from STMicroelectronics (Compilation Expertise Center, Grenoble) on the theme of floating-point arithmetic code generation and specialization for embedded processors. Advisors: Claude-Pierre Jeannerod and Jean-Michel Muller (AriC), Christophe Monat (STMicroelectronics). A contract between STMicroelectronics and Inria (duration: 36 months; amount: 36,000 euros; signature: fall 2010) aimed at supporting the developments done in the context of this PhD, defended 2012/11/15.

7.1.2. Kalray CIFRE PhD Grant

Nicolas Brunie is supported by a CIFRE PhD grant (from 15/04/2011 to 14/04/2014) from Kalray. Its purpose is the study of a tightly-coupled reconfigurable accelerator to be embedded in the Kalray multicore processor. Advisors: Florent de Dinechin (Arénaire) and B. de Dinechin (Kalray). The support contract between Kalray and Inria amounts to 76,000 euros on three years.

7.1.3. Intel Donation

Intel is making a donation of 20,000$ to AriC to support research around the automatic construction of libm functions.

CARAMEL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Training and consulting with HTCS

Participants: Pierrick Gaudry, Emmanuel Thomé [contact].

We have a one-year contract with the HTCS company, for training and consulting activities, on topics related to our research. This contract is likely to be renewed in 2013.

CASCADE Project-Team (section vide)

GALAAD Project-Team (section vide)

GEOMETRICA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Geometry Factory

The initial development phase of the CGAL library has been made by a European consortium. In order to achieve the transfer and diffusion of CGAL in the industry, a company called GEOMETRY FACTORY has been founded in January 2003 by Andreas Fabri (http://www.geometryfactory.com).

The goal of this company is to pursue the development of the library and to offer services in connection with CGAL (maintenance, support, teaching, advice). GEOMETRY FACTORY is a link between the researchers from the computational geometry community and the industrial users.

It offers licenses to interested companies, and provides support. There are contracts in various domains such as CAD/CAM, medical applications, GIS, computer vision...

GEOMETRY FACTORY is keeping close contacts with the original consortium members, and in particular with GEOMETRICA.

In 2012, GEOMETRY FACTORY had the following new customers for CGAL packages developed by GEOMETRICA: Archivideo (GIS, 2D Constrained Delaunay), Gamesim (games, 2D Constrained Delaunay), Medicm (medical imaging, 2D Constrained Delaunay, BE), Tecosim(CAD/CAM, 3D Delaunay, Germany). Midland Valley (Surface mesher, UK)

Moreover, research licenses (in-house research usage for all of CGAL) have been purchased by: ROI Bologna (medical imaging, Italy), Technicolor (France), U Southampton (medical imaging, UK), ZIB (medical imaging, Germany).

7.1.2. Astrium

Participants: Pierre Alliez, Florent Lafarge, Sven Oesau.

The main goal of this collaboration is to develop indoor models more accurate, meaningful and complete than existing methods. The conventional way for modeling indoor scenes is based on plane arrangements. This type of representation is particularly limited and must be improved by developing more complex geometric entities adapted to a detailed and semantized description of scenes.

- Starting date: April 2012

- Duration: 3 years

7.2. National Initiatives

7.2.1. ADT CGALmesh

Participants: Pierre Alliez, Mariette Yvinec, Clement Jamin, Jean-Daniel Boissonnat.

In collaboration with Jane Tournois from Geometry Factory.

CGALmesh is an Inria technological development action started in March 2009, in collaboration with Geometry Factory. Building upon components from CGAL, we are implementing a generic mesh generation framework for surfaces and 3D domains. We primarily target applications which involve data acquired from the physical world: geology, medicine, 3D cartography and reverse engineering. In 2012 we devised a new parallel 3D mesh generation and optimization algorithm for multi-core architectures with shared memory, and an algorithm for anisotropic mesh generation.

- Starting date: March 2009

- Duration: 3 years

7.2.2. ANR Présage

Participants: Olivier Devillers, Marc Glisse, Ross Hemsley, Monique Teillaud, Rémy Thomasse.

Web site: http://webloria.loria.fr/~goaoc/ANR-Presage/

We participate in the PRÉSAGE project funded by the ANR. The project involves:

- the Inria VEGAS team,
- Univeristy of Rouen, and
- the GEOMETRICA team.

This project brings together computational and probabilistic geometers to tackle new probabilistic geometry problems arising from the design and analysis of geometric algorithms and data structures. We focus on properties of discrete structures induced by or underlying random continuous geometric objects. This raises questions such as:

- What does a random geometric structure (convex hulls, tessellations, visibility regions...) look like?
- How to analyze and optimize the behavior of classical geometric algorithms on *usual* inputs?
- How can we generate randomly *interesting* discrete geometric structures?

- Starting date: 31 December 2011

- Duration: 4 years

- Year publications: [55], [50], [57].

7.2.3. ANR GIGA

Participants: Pierre Alliez, Jean-Daniel Boissonnat, Frédéric Chazal, David Cohen-Steiner, Mariette Yvinec, Steve Oudot, Marc Glisse.

GIGA stands for Geometric Inference and Geometric Approximation. GIGA aims at designing mathematical models and algorithms for analyzing, representing and manipulating discretized versions of continuous shapes without losing their topological and geometric properties. By shapes, we mean sub-manifolds or compact subsets of, possibly high dimensional, Riemannian manifolds. This research project is divided into tasks which have Geometric Inference and Geometric Approximation as a common thread. Shapes can be represented in three ways: a physical representation (known only through measurements), a mathematical representation (abstract and continuous), and a computerized representation (inherently discrete). The GIGA project aims at studying the transitions from one type to the other, as well as the associated discrete data structures.

Some tasks are motivated by problems coming from data analysis, which can be found when studying data sets in high dimensional spaces. They are dedicated to the development of mathematically well-founded models and tools for the robust estimation of topological and geometric properties of data sets sampled around an unknown compact set in Euclidean spaces or around Riemannian manifolds.

Some tasks are motivated by problems coming from data generation, which can be found when studying data sets in lower dimensional spaces (Euclidean spaces of dimension 2 or 3). The proposed research activities aim at leveraging some concepts from computational geometry and harmonic forms to provide novel algorithms for generating discrete data structures either from mathematical representations (possibly deriving from an inference process) or from raw, unprocessed discrete data. We target both isotropic and anisotropic meshes, and simplicial as well as quadrangle and hexahedron meshes.

This project coordinated by GEOMETRICA also involves researchers from the Inria team-project ABS, CNRS (Grenoble), and a representative from the industry (Dassault Systèmes).

- Starting date: October 2009.

- Duration: 4 years.

7.2.4. DIGITEO Chair C3TTA: Cell Complexes in Computational Topology: Theory and Applications

Participants: Claire Caillerie, Frédéric Chazal, David Cohen-Steiner, Marc Glisse, Steve Oudot, Amit Patel.

The primary purpose of this project is to bring about a close collaboration between the chair holder Dr Vin de Silva and Digiteo teams working on the development of topological and geometric methods in Computer Science. The research program is motivated by problems coming from the increasing need of studying and analyzing the (often huge) data sets that are now available in many scientific and economic domains. Indeed, due to the improvements of measurement devices and data storage tools, the available data about complex shapes or complex systems are growing very fast. These data being often represented as point clouds in high dimensional (or even infinite dimensional) spaces there is a considerable interest in analyzing and processing data in such spaces. Despite the high dimensionality of the ambient space, one often expects them to be located around an unknown, possibly non linear, low dimensional shape. It is then appealing to infer and analyze topological and geometric characteristics of that shape from the data. The hope is that this information will help to process more efficiently the data and to better understand the underlying complex systems from which the data are generated. In the last few years, topological and geometric approaches to obtain such information have encountered an increasing interest. The goal of this project is to bring together the complementary expertises in computational topology and geometry of the involved Digiteo teams and in applied geometry and algebraic topology of V. de Silva to develop new topological approaches to the previous mentioned domain. The project intends to develop both the theoretical and practical sides of this subject. The other partners of the project are the Ecole Polytechnique (L. Castelli-Aleardi and F. Nielsen) and the CEA (E. Goubault).

- Starting date: January 2009.

- Duration: 3 years.

7.2.5. GDR ISIS young researcher project on "scene analysis from Lidar"

Participant: Florent Lafarge.

The GDR ISIS young researcher project on "scene analysis from Lidar" consists in reconstructing in 3D large-scale city models from airborne Lidar scans. This project is in collaboration with Clément Mallet and Bruno Vallet from MATIS Laboratory, IGN [http://www.ign.fr].

- Starting date: January 2010

- Duration: 3 years

7.2.6. Grand emprunt Culture 3D Clouds

Participants: Pierre Alliez, Florent Lafarge, Thijs van Lankveld.

Culture 3D Clouds is a cloud computing platform for 3D scanning, documentation, preservation and dissemination of cultural heritage. The motivation stems from the fact that the field of 3D scanning artifacts heritage evolves slowly and only provides resources for researchers and specialists. The technology and equipment used for 3D scanning are sophisticated and require highly specialized skills. The cost is thus significant and limits the widespread practice. Culture 3D Clouds aims at providing the photographers with a value chain to commercialize 3D reproductions demand for their customers and expand the market valuation of business assets (commercial publishers, general public).

- Starting date: September 2012

- Duration: 3 years

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. CG-Learning

Title: Computational Geometric Learning

Type: COOPERATION (ICT)

Defi: FET Open

Instrument: Specific Targeted Research Project (STREP)

Duration: November 2010 - October 2013

Coordinator: Friedrich-Schiller-Universität Jena (Germany)

Others partners: National and Kapodistrian University of Athens (Greece), Technische Universität Dortmund (Germany), Tel Aviv University (Israel), Eidgenössische Technische Hochschule Zürich (Switzerland), Rijksuniversiteit Groningen (Netherlands), Freie Universität Berlin (Germany)

See also: http://cgl.uni-jena.de/

Abstract: The Computational Geometric Learning project aims at extending the success story of geometric algorithms with guarantees to high-dimensions. This is not a straightforward task. For many problems, no efficient algorithms exist that compute the exact solution in high dimensions. This behavior is commonly called the curse of dimensionality. We try to address the curse of dimensionality by focusing on inherent structure in the data like sparsity or low intrinsic dimension, and by resorting to fast approximation algorithms.

7.3.1.2. ERC IRON

Title: Robust Geometry Processing

Type: IDEAS

Instrument: ERC Starting Grant (Starting)

Duration: January 2011 - December 2015

Coordinator: Pierre Alliez, Inria Sophia Antipolis - mediterranee (France)

See also: http://www-sop.inria.fr/geometrica/collaborations/iron/

Abstract: The purpose of this project is to bring forth the full scientific and technological potential of Digital Geometry Processing by consolidating its most foundational aspects. Our methodology will draw from and bridge the two main communities (computer graphics and computational geometry) involved in discrete geometry to derive algorithmic and theoretical contributions that provide both robustness to noisy, unprocessed inputs, and strong guarantees on the outputs. The intended impact is to make the digital geometry pipeline as generic and ironclad as its Digital Signal Processing counterpart.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. COMET

Title: Computational Methods for the analysis of high-dimensional data

Inria principal investigator: Steve Y. Oudot

International Partner:

Institution: Stanford University (United States)

Laboratory: Computer Science Department

Researcher: Leonidas J. Guibas

International Partner:

Institution: Ohio State University (United States)

Laboratory: Computer Science and Engineering

Researcher: Yusu Wang

Duration: 2011 - 2013

See also: http://geometrica.saclay.inria.fr/collaborations/CoMeT/index.html

CoMeT is an associate team between the Geometrica group at Inria, the Geometric Computing group at Stanford University, and the Computational Geometry group at the Ohio State University. Its focus is on the design of computational methods for the analysis of high-dimensional data, using tools from metric geometry and algebraic topology. Our goal is to extract enough structure from the data, so we can get a higher-level informative understanding of these data and of the spaces they originate from. The main challenge is to be able to go beyond mere dimensionality reduction and topology inference, without the need for a costly explicit reconstruction. To validate our approach, we intend to set our methods against real-life data sets coming from a variety of applications, including (but not restricted to) clustering, image or shape segmentation, sensor field monitoring, shape classification and matching. The three research groups involved in this project have been active contributors in the field of Computational Topology in the recent years, and some of their members have had long-standing collaborations. We believe this associate team can help create new synergies between these groups.

7.4.2. Visits of International Scientists

7.4.2.1. Exterior research visitors

Misha Belkin (Ohio State University).

Mikhail Bessmeltsev (University of British Columbia).

Mark Blome (Zuse-Institut Berlin).

Benjamin Burton (School of Mathematics and Physics, University of Queensland, Brisbane).

Dengfeng Chai (Zhejiang University).

Mathieu Desbrun (Caltech).

Paweł Dłotko (Jagiellonian University, Krakow).

Leo Guibas (Stanford University).

Sun Jian (Tsinghua University, Beijing).

Leif Kobbelt (RWTH Aachen).

Sylvain Lazard (EPI VEGAS).

Michael Lesnick (Stanford University).

Jeff Phillips (University of Utah).

Alla Sheffer (University of British Columbia).

Vin de Silva (Pomona College).

Gert Vegter (Johan Bernoulli Institute, Groningen University).

Yusu Wang (Ohio State University).

7.4.2.2. Visiting Phd students

Ricard Campos (six months)

Topic: Reconstruction of 3D underwater scenes

Institution: University of Girona (Spain)

Andrea Tagliasacchi (three months)

Topic: surface reconstruction through optimal transportation

Institution: Simon Fraser University (Canada)

GRACE Team

6. Bilateral Contracts and Grants with Industry

6.1. Alcatel Lucent

In September, D. Augot and F. Levy-dit-Vehel submitted a proposal to fund a joint PhD thesis with Abdullatif Shikfa (Alcatel Lucent), on local codes for distributed storage and related cloud-like issues.

6.2. Cryptoexperts

A research agreement between Cryptoexperts and Grace has been made, to establish foundations for the DGA DIFMAT contract (see below). D. Augot is collaborating with M. Finiasz from Cryptoexperts.

LFANT Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Industrial ANR PACE

Participants: Andreas Enge, Jérôme Milan.

https://pace.rd.francetelecom.com/

The PACE project unites researchers of France Télécom, Gemalto, NXP, Cryptolog International, the INRIA project teams CASCADE and LFANT and University of Caen. It deals with electronic commerce and more precisely with electronic cash systems. Electronic cash refers to money exchanged electronically, with the aim of emulating paper money and its traditional properties and use cases, such as the anonymity of users during spending. The goal of PACE is to use the new and powerful tool of bilinear pairings on algebraic curves to solve remaining open problems in electronic cash, such as the strong unforgeability of money and the strong unlinkability of transactions, which would allow users to conveniently be anonymous and untraceable. It also studies some cryptographic tools that are useful in the design of e-cash systems.

7.2. DGA

Contract with *DGA maîtrise de l'information* about number theory and cryptography

- Duration: two years, 2011–2013
- Scientific coordinator: J.-M. Couveignes
- Topics covered: index calculus and discrete logarithms, fast arithmetic for polynomials, pairings and cryptography, algorithmics of the Langlands programme

7.3. Thèse cifre

Participants: Karim Belabas, Vincent Verneuil.

Vincent Verneuil, co-directed with B. Feix (Inside Contactless) and C. Clavier (Université de Limoges), works at Inside Contactless on elliptic curve cryptography, with an emphasis on embedded systems and side-channel attacks.

POLSYS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Oberthur Technologies

Oberthur Technologies is the World second largest provider of security and identification solutions and services based on smart card technologies for mobile, payment, transport, digital TV and convergence markets. Since 2007, SALSA co-supervised 3 internships of first year master student on cryptology in smart-cards, and one internship of a 2nd year master student. The goal of this last internship was to study the feasibility of implementing multivariate schemes in constrained environments (typically a smart card). A new jointly supervised PhD thesis (PolSys/Oberthur) has start in march 2012.

7.2. Gemalto

Gemalto is an international IT security company providing software applications, secure personal devices such as smart cards and token, ... Governments, wireless operators, banks, and enterprises use Gemalto's software and personal devices to deliver mobile services, payment security, authenticated cloud access, identity and privacy protection, eHealthcare, eGovernment, transport ticketing and machine to machine (M2M) communications applications.

PolSys is currently working Gemalto – thanks to PhD grabt CIFRE – on the security analysis of code-based cryptosystems (participants J.-C. Faugère, L. Perret, F. Urvoy de Portzamparc).

SECRET Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Grants with Industry

- **Gemalto** ($01/10 \rightarrow 12/12$)
  CIFRE grant for Christina Boura.

VEGAS Project-Team (section vide)

ALF Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Intel Research Grant

Participant: André Seznec.

Intel is supporting the research of the ALF project-team on "Alternative ways for improving uniprocessor performance".

CAIRN Project-Team (section vide)

CAMUS Team (section vide)

COMPSYS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Mediacom Project with STMicroelectronics

Participants: Benoit Boissinot, Florian Brandner, Quentin Colombet, Alain Darte, Fabrice Rastello.

This contract has started in September 2009 as part of the funding mechanism Nano2012. This is the continuation of the successful previous project Sceptre with STMicroelectronics, which ended in December 2009. Mediacom concerned both aggressive optimizations and the application of the previously-developed techniques to JIT compilation. The project ended this year. Quentin Colombet, whose PhD was funded by this project, defended his PhD in December 2012 [1].

7.2. Creation of the Zettice Start-Up

Participants: Christophe Alias, Alexandru Plesco [Compsys/Zettice].

Following his PhD, Alexandru Plesco initiated a start-up on high-level synthesis for FPGAs, named Zettice, and based on the use and extension of tools/techniques developed in Compsys (for high-level code transformations) and Arénaire (for the development of pipelined operators). The results described in Sections 5.7 , 5.8 , 5.9 , and 6.4 are directly linked to this effort.

The incubation of Zettice is supported by Crealys, the "Région Rhône-Alpes", and Inria: Alexandru Plesco is "ingénieur technologie and innovation" (ITI) since October 2011. Zettice should be created around April 2013. Christophe Alias is in charge of the scientific collaboration between Compsys and Zettice.

7.3. ManyCoreLabs with Kalray

Compsys is part of ManyCoreLabs, an academic/industrial project, coordinated by Kalray, a multi-core french company. The project is funded by a "Investissement d'Avenir"/BGLE ("Briques génériques du logiciel embarqué") grant. The goal of this project is to help the Kalray company, based on a collaboration with several partners, to become the European leader of the market of many-core chips for embedded systems. Industrial partners of this project include Bull, CAPS Entreprise, Digigram, Thales, Renault. Academic partners include CEA, Inria (Parkas and Compsys teams), VERIMAG.

AOSTE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Thales ARCADIA/Melody

Participants: Frédéric Mallet, Robert de Simone.

In the remote context of ARTEMIS CESAR 8.3.1.1 we conducted a specific study of the functional expressiveness of the ARCADIA/Melody environment, developed and deployed internally inside several Thales divisions. A questionnaire was designed by us, according to the various semantic variation points that we identified into this Model-Driven Engineering (MDE) environment. It was then sent to potential users for feedback, and reporting was done together with colleagues from Thales TRT (R&D division) to their management. As a result a number of non-trivial redesign decisions were taken. Our findings were presented through a number of focused meetings held at Thales in the Saclay technopark. While most work was performed at this stage on purely data-flow functional description diagrams, there is an interest inside the company to extend this type of critical survey analysis to extended description models, including event-based control and modes.

CONVECS Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

Participants: Hubert Garavel, Abderahman Kriouile, Radu Mateescu, Wendelin Serwe.

Abderahman Kriouile is supported by a CIFRE PhD grant (from March 2012 to March 2015) from STMicroelectronics (Grenoble) on the verification of cache coherency in systems on chip, under the supervision of Grégory Faux and Massimo Zendri (STMicroelectronics), Radu Mateescu and Wendelin Serwe (CONVECS).

DART Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Collaboration EADS IW, and Eurocopter

The subject deals with dynamic reconfigurable system design for avionic test applications. It is motivated by the need of methodologies and tools for the design of high-performance applications on dynamic reconfigurable computing systems. A complete methodology takes the reconfigurability of the hardware as an essential design concept and proposes the necessary mechanisms to fully exploit those capabilities at runtime. A set of tools must provide high-quality designs with improved designer productivity, which guarantees consistency with the initial requirements for adaptability and for the final implementation. This methodology allows designers to easily implement a system specification on a platform that includes general purpose processors dynamically combined with multiple accelerators running on an FPGA.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. ANR Famous

Collaboration with Inria Rhône Aples, Université de Bretagne Sud, Université de Bourgogne, SME SODIUS

FAMOUS project aims at introducing a complete methodology that takes the reconfigurability of the hardware as an essential design concept and proposes the necessary mechanisms to fully exploit those capabilities at runtime. The project covers research in system models, compile time and run time methods, and analysis and verification techniques. These tools will provide high-quality designs with improved designer productivity, while guaranteeing consistency with the initial requirements for adaptability and the final implementation. Thus FAMOUS is a research project with an immediate industrial impact. Actually, it will make reconfigurable systems design easier and faster. The obtained tool in this project is expected to be used by both companies designers and academic researchers, especially for modern applications system specific design as smart camera, image and video processing, FAMOUS tools will be based on well established standards in design community. In fact, modeling will start from very high abstraction level using an extended version of MARTE. Simulation and synthesizable models will be obtained by automatic model to model transformations, using MDE approach. These techniques will contribute to shorten drastically time-to-market. FAMOUS is a basic research project. In fact, most of partners are academic, and its main objective is to explore novel design methodologies and target modern embedded systems architectures. FAMOUS project is funded by french Agence Nationale de la Recherche (ANR). It has also been labeled by Media & Network cluster in 2009. The involved resources reach 408 person-month, from five partners: the public research labs LIFL Inria (Lille), LabSTICC (Lorient), Inria Rhône-Alpes (Grenoble), LE2I University of Bourgogne (Dijon) and the SME company Sodius SAS (Nantes). It has started on December 2009, and it will last 48 months.

7.2.1.2. The ANR Open-People project

Partners: Université de Bretagne Sud (UBS)Lab-STICC, Inria Nancy Grand Est, Inria Lille Nord Europe, Université de Rennes 1 (UR1), Université de Nice Sophia Antipolis (UNSA), THALES Communications (Colombes), InPixal (Rennes)

The Open-PEOPLE (Open Power and Energy Optimization PLatform and Estimator project is a national project funded by the ANR (Agence Nationale de la Recherche), the French National Research Agency. The objective of Open-PEOPLE is to provide a platform for estimating and optimizing the power and energy consumptions. Users will be able to estimate the consumption of an application deployed on a hardware architecture chosen in a set of parametric reference architectures. The components used in the targeted architecture will be chosen in a library of hardware and software components. Some of these components will be parametric (such as reconfigurable processors or ASIP) to further enlarge the design space for exploration. The library will be extensible; users will have the possibility to add new components, according to the evolution of both applications and technology. Open-PEOPLE is definitely an open project. The software platform for conducting estimation and optimization, will be accessible through an Internet portal. This software platform will be coupled to an automated hardware platform for physical measurements. The measurements needed to build models for new components to be added in the library will be remotely controlled through the software platform. A library of benchmarks will be proposed, to help building models for new components and architectures.

7.2.2. Competitivity Clusters

We collaborate with the L2EP (Université de Lille1) inside the research pole MEDEE, especially in the first action: industrialization of Code_CARMEL.

7.2.3. Within Inria

We collaborate with colleagues within Inria with the Triskell team at Inria Rennes-Bretagne Atlantique) on the analysis of DSMLs and on the formal definition of Kermeta.

ESPRESSO Project-Team (section vide)

MUTANT Project-Team (section vide)

PARKAS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

+ Google European Doctoral Fellowship of Tobias Grosser. $62000 per year over 3 years. Studying the interaction of affine loop transformations and vectorization, for multicore processors and hardware accelerators.

POP ART Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- With ST Microelectronics: CIFRE contract for the PhD of Vagelis Bebelis. This work is described in Section 6.4.1 .

S4 Project-Team (section vide)

TRIO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Ph.D. thesis under CIFRE collaboration with PSA

Participants: Aurélien Monot, Nicolas Navet, Françoise Simonot-Lion

The complexity of electronic embedded systems in cars is continuously growing. Hence, mastering the temporal behavior of such systems is paramount in order to ensure the safety and comfort of the passengers. As a consequence, the verification of end-to-end real-time constraints is a major challenge during the design phase of a car. The AUTOSAR software architecture drives us to address the verification of end-to-end real-time constraints as two independent scheduling problems respectively for electronic control units and communication buses.

First, we introduce an approach, which optimizes the utilization of controllers scheduling numerous software components that is compatible with the upcoming multicore architectures. We describe fast and efficient algorithms in order to balance the periodic load over time on multicore controllers by adapting and improving an existing approach used for the CAN networks. We provide theoretical result on the efficiency of the algorithms in some specific cases. Moreover, we describe how to use these algorithms in conjunction with other tasks scheduled on the controller [12], [8].

The remaining part of this research work addresses the problem of obtaining the response time distributions of the messages sent on a CAN network. First, we present a simulation approach based on the modelisation of clock drifts on the communicating nodes connected on the CAN network. We show that we obtain similar results with a single simulation using our approach in comparison with the legacy approach consisting in numerous short simulation runs without clock drifts. Then, we present an analytical approach in order to compute the response time distributions of the CAN frames. We introduce several approximation parameters to cope with the very high computational complexity of this approach while limiting the loss of accuracy. Finally, we compare experimentally the simulation and analytical approaches in order to discuss the relative advantages of each of the two approaches [20], [8].

VERTECS Project-Team (section vide)

ABSTRACTION Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Contracts with Industry

7.1.1. License agreement

7.1.1.1. Astrée

In February 2009 was signed an exploitation license agreement between CNRS, École Normale Supérieure, and AbsInt Angewandte Informatik GmbH for the industrialization of the ASTRÉE analyzer. ASTRÉE is commercially available from AbsInt since January 2010. Continuous work goes on to adapt the ASTRÉE static analyzer to industrial needs, in particular for the automotive industry. Radhia Cousot is the scientific contact.

7.2. Grants with Industry

7.2.1. FNRAE projects

7.2.1.1. Ascert

Title: Analyses Statiques CERTifiés

Type: 6th call: Verification methods for software and systems

Instrument: FNRAE grant

Duration: April 2009 - March 2012

Coordinator: Inria (France)

Others partners: Inria-Bretagne Atlantique, the Inria Rhône-Alpes, the Inria Paris-Rocquencourt, and the ENS.

See also: http://ascert.gforge.inria.fr/

Abstract: Although static analyzers have demonstrated their ability to prove the absence of large classes of errors in critical software, they are themselves large and complex software, so it is natural to question their implementation correctness and the validity of their output. The focus of the ASCERT project is the use of formal methods to ensure the correctness of an analyzer with respect to the abstraction interpretation theory. Methods to be investigated include the direct proof of the analyzer, the proof of a verifier for the analyzer result, and the validation of the inductive invariants generated by the analyzer, using the Coq proof assistant. These methods will be applied to the certification of several numerical abstract domains, of an abstract interpreter for imperative programs and its possible extensions to one of the formal semantics of the CompCert verified C compiler.

7.2.1.2. Sardanes

Title: Sémantique, Analyse et tRansformation Des Applications Numériques Embarqués Synchrones

Type: 6th call: Verification methods for software and systems

Instrument: FNRAE grant

Duration: February 2009 - September 2012

Coordinator: Université de Perpignan

Others partners: Université de Perpignan and the ENS.

See also: http://perso.univ-perp.fr/mmartel/sardanes.html

Abstract: SCADE is widely used to write critical embedded software, as a specification and verification language. The semantics of SCADE uses real arithmetics whereas it is compiled into a language that uses floating-point arithmetics. The goal of the SARDANES project is to use expression transformation so as to ensure that the numerical properties of the programs is preserved during the compilation. Patrick Cousot and Radhia Cousot are the principal investigators for this action.

ATEAMS Project-Team (section vide)

CARTE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

We are currently working with the consortium “malware.lu”.

CASSIS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Research Result Transfer

The BZ-Testing-Tools technology has been transfered to LEIRIOS Technologies, at the end of 2004. LEIRIOS changed its name into 2007 and is now called Smartesting. The partnership between the Cassis project and the R&D department of Smartesting, located at the TEMIS Scientific and Industrial area at Besançon, will be continued through (national and international) projects or with a new transfer protocol. F. Bouquet is scientific consultant of Smartesting.

CELTIQUE Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Project with FIME

Participants: Thomas Jensen, Frédéric Besson, David Pichardie, Delphine Demange, Vincent Monfort, Pierre Vittet.

Static program analysis, Javacard, Certification, AFSCM

- Partner : FIME
- Period: Starting January 2012; ending February 2013

The FIME contract consists in an industrial transfer of the Sawja platform 4.2 adapted to analyse Javacard programs according to AFSCM (Association Française du Sans Contact Mobile) security guidelines. The outcome of the project is the Jacal (JAvaCard AnaLyser) (4.3 .

6.2. The FRAE ASCERT project

Participants: Frédéric Besson, Sandrine Blazy, David Cachera, Thomas Jensen, David Pichardie, Pierre-Emmanuel Cornilleau.

Static program analysis, Certified static analysis

The ASCERT project (2009–2012) is founded by the *Fondation de Recherche pour l'Aéronautique et l'Espace*. It aims at studying the formal certification of static analysis using and comparing various approaches like certified programming of static analysers, checking of static analysis result and deductive verification of analysis results. It is a joint project with the Inria teams ABSTRACTION, GALLIUM and POP-ART.

COMETE Project-Team (section vide)

CONTRAINTES Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Dassault-Systèmes, BioIntelligence project

- The OSEO Biointelligence project coordinated by Dassault-Systèmes, with EPI Orpailleur, Sobios, Aureus pharma, Ipsen, Pierre Fabre, Sanofi-Aventis, Servier, Bayer CropScience, INSERM, Genopole Evry (2009-2014).

7.2. KLS-Optim, Rules2Optim project

- DTI ITI support for the industrialization of our Rules2CP software and technological transfer to SME KLS-Optim (2011-2013).

7.3. General Electric Transportation, Cifre contract

- Cifre PhD accompanying contract with General Electric Transportation on urban railway time tabling optimization (2011-2014).

DEDUCTEAM Team (section vide)

FORMES Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

We obtained a contract of 100 000 Chinese RMB (12 500 Euros) with Nokia Research Center in Beijing to study formal proofs of security API's in Android mobile phones.

GALLIUM Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. The Caml Consortium

Participants: Xavier Leroy [correspondant], Xavier Clerc, Damien Doligez, Didier Rémy.

The Caml Consortium is a formal structure where industrial and academic users of Caml can support the development of the language and associated tools, express their specific needs, and contribute to the long-term stability of Caml. Membership fees are used to fund specific developments targeted towards industrial users. Members of the Consortium automatically benefit from very liberal licensing conditions on the OCaml system, allowing for instance the OCaml compiler to be embedded within proprietary applications.

The Consortium currently has 12 member companies: CEA, Citrix, Dassault Aviation, Dassault Systèmes, Esterel Technologies, Jane Street, LexiFi, Microsoft, MLstate, Mylife.com, OCamlPro, and SimCorp.

For a complete description of this structure, refer to http://caml.inria.fr/consortium/. Xavier Leroy chairs the scientific committee of the Consortium.

MARELLE Project-Team (section vide)

MEXICO Project-Team (section vide)

PAREO Project-Team (section vide)

PARSIFAL Project-Team (section vide)

PI.R2 Project-Team (section vide)

PROSECCO Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Technology Transfer Grant

Inria CSATT Technology Transfer Action for Tookan. Following successful technology transfer projects around the Tookan software with Boeing and Barclays Bank, Inria have provided 12 months of funding for a software engineer (Romain Bardou) and 10 kEuros.

SECSI Project-Team (section vide)

TASC Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Ligéro

Participants: Sophie Demassey, Xavier Lorca.

Title: Ligéro.

Duration: 2009-2012.

Type: Regional research group

Budget: PhD founded by the project.

Others partners: LISA, IRCCyN (team SLP), LERIA (team MOA), LINA (team OPTI).

The goal of the project is to create an internationally visible regional research group putting together the key actors in the domain of Operations Research in the Pays de la Loire region.

7.2. CPER

Participant: Charles Prud'Homme.

Title: CPER.

Duration: 2010-2014.

Type: Regional research group.

Budget: 250000 Euros.

Others partners: EMN (team ATLANMOD), EMN (team ASCOLA), IRCCyN (team SLP).

Develop, promote and build up an eco-system around free software in the Pays de la Loire region. The TASC team is involved in the maintenance and development of the free constraint programming platform CHOCO.

7.3. UNIT

Participants: Nicolas Beldiceanu, Eliane Vacheret.

Title: UNIT.

Duration: 2011-2012.

Type: Developing teaching material.

Budget: 5000 Euros.

Others partners: EMN (CAPE).

Pedagogical material and software for learning constraints programming for non experts (integrated within the global constraint catalog).

7.4. FUI SUSTAINS

Participants: Charlotte Truchet, Bruno Belin.

Title: SUSTAINS.

Duration: 2010-2015.

Type: FUI.

Budget: 151400 Euros.

Others partners: Artefacto, Artelys, Areva TA, EPAMarne, LIMSI.

The SUSTAINS project (*Constraint-based Prototyping of Urban Environments*) aims at building decision support system for city development planning with evaluation of energy impacts. The project is focussed on spatial allocation of typical units such as industrial areas, commercial areas and leaving areas with their respective appropriate infrastructure. Its integrates sustainability, transport and energy concerns.

7.5. ANR BOOLE

Participants: Vincent Armant, Jérémie du Boisberranger, Xavier Lorca, Charlotte Truchet.

Title: BOOLE.

Duration: 2010-2015.

Type: open research program.

Budget: founding a PhD student and travels.

Others partners: Univ. de Versailles Saint-Quentin, Univ. Caen, Univ. Paris 8, Univ. Aix-Marseille, Univ. Paris Nord, Univ. Paris 11, ENS Paris.

Défi: Probabilistic method for combinatorial problems.

The work of TASC focuses on the use of probabilistic methods to avoid waking systematically global constraints for nothing. The goal is to provide probabilistic models for the consistency of global constraints such as *alldifferent* or *nvalue*. We compute the probability of a constraint to be still consistent after fixing one of its variables and provide an approximation that can be computed in constant time. The PhD of J. du Boisberranger is co-supervised with D. Gardy from Univ. de Versailles Saint-Quentin.

7.6. ANR NetWMS2

Participants: Nicolas Beldiceanu, Gilles Chabert.

Title: Networked Warehouse Management Systems 2: packing with complex shapes.

Duration: 2011-2014.

Type: cosinus research program, **new project**.

Budget: 189909 Euros.

Others partners: KLS Optim and CONTRAINTES (Inria Rocquencourt).

This project builds on the former European FP6 Net-WMS Strep project that has shown that constraint-based optimisation techniques can considerably improve industrial practice for box packing problems, while identifying hard instances that cannot be solved optimally, especially in industrial 3D packing problems with rotations, the needs for dealing with more complex shapes (e.g. wheels, silencers) involving continuous values. This project aims at generalizing the geometric kernel *geost* for handling non-overlapping constraints for complex two and three dimensional curved shapes as well as domain specific heuristics. This will be done within the continuous solver IBEX, where discrete variables will be added for handling polymorphism (i.e., the fact that an object can take one shape out of a finite set of given shapes).

7.7. ANR INFRA-JVM

Participants: Xavier Lorca, Charles Prud'Homme.

Title: Towards a Java Virtual Machine for pervasive computing.

Duration: 2011-2013.

Type: **new project**.

Budget: 78000 Euros.

Others partners: Univ. Paris 6 (REGAL team), LaBRI (LSR team), IRISA (TRISKELL).

The INFRA-JVM project will investigate how to enhance the design of Java virtual machines with new functionalities to better manage resources, namely resource reservation, scheduling policies, and resource optimization at the middleware level. TASC is concerned with this later aspect. The performance of CHOCO will be improved using the memory snapshot mechanism that will be developed.

7.8. EDF

Participants: Nicolas Beldiceanu, Helmut Simonis.

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 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 model seeker [19].

7.9. Google

Participants: Jean-Guillaume Fages, Xavier Lorca, Jean-Charles Régin, Louis Martin Rousseau.

Within the context of a Google grant involving Jean-Charles Régin from Nice University, Louis-Martin Rousseau from Polytechnique Montreal and Xavier Lorca and Jean-Guillaume Fages from TASC the following work on graph constraints has been undertaken.

In constraint programming, specific syntax for expressing unweighted circuit constraints in a graph have been proposed already since the first CP systems were developed. Most current CP systems contain a constraint to model unweighted circuits, although the associated filtering algorithm may be quite different for each system. Weighted circuit constraints are less common in CP systems, as the weights and the circuit are typically handled separately. However, several filtering algorithms have been proposed in the literature that can be applied to the weighted circuit constraint. Currently, no professional CP system offers any of these algorithms. Thus, solving problems that contain weighted circuit constraints remains a challenge for constraint programming. One of the main contributions of our work is to expand the reach of constraint programming solvers to complex routing problems. We will propose more effective filtering algorithms for the weighted circuit constraint that are guided by the resolution of real world instances and not only by benchmarking.

TOCCATA Team

7. Bilateral Contracts and Grants with Industry

7.1. Airbus contract

Participant: Sylvain Conchon [contact].

This 2 years support contract has started in Sep 10, between Inria and Airbus France at Toulouse. This is to support our efforts for the DO-178B qualification of Alt-Ergo.

7.2. CIFRE contract with Adacore

Participants: Claude Marché [contact], Andrei Paskevich, Claire Dross.

Jointly with the thesis of C. Dross, supervised in collaboration with the Adacore company, we established a bilateral collaboration contract, that started in January 2012 for 3 years.

The aim is to strengthen the usability of the *Alt-Ergo* theorem prover in the context of the GnatProve environment for the verification of safety-critical Ada programs [32]. A focus is made on programs involving Ada containers [80].

TYPICAL Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Common Research Agreements in the MSR–Inria Joint Centre

Assia Mahboubi, Enrico Tassi and Cyril Cohen are part of the *Mathematical Components* effort in the Inria and Microsoft Research joint centre. The goal is to investigate the design of large-scale, modular and reusable libraries of formalized mathematics. Developed using the Coq proof assistant. This project successfully formalized the proof of the Feit–Thompson theorem, resulting in a corpus of libraries related to various areas of algebra.

Project *Coquelicot*, funded jointly by the Fondation de Coopération Scientifique "Campus Paris-Saclay" and Digiteo.

Goal: Create a new Coq library for real numbers of mathematics.
Leader: S. Boldo (INRIA Saclay, Toccata). Participant: A. Mahboubi.
Website: http://coquelicot.saclay.inria.fr/.

VERIDIS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Tools and Methodologies for Formal Specifications and for Proofs

Participants: Stephan Merz, Hernán-Pablo Vanzetto.

We participate in the project on Tools and Methodologies for Formal Specifications and for Proofs at the MSR-Inria Joint Centre. The objective of the project is to develop a proof environment for verifying distributed algorithms in TLA$^+$ (see also sections 5.2 and 6.1). In particular, the project funds the PhD thesis of Hernán Vanzetto.