informatics *mathematics*

Inria

RESEARCH CENTER
Rennes - Bretagne-Atlantique

FIELD

Activity Report 2014

Section Highlights of the Team

ALF Project-Team

6.1. Highlights of the Year

André Seznec and Pierre Michaud won the 4th Championship Branch Prediction in all the 3 categories, 4KB, 32 KB and unlimited storage predictors [23], [33], thus confirming the past championships in 2011, 2006 and 2004.

CAIRN Project-Team

6.1. Highlights of the Year

Our work on accuracy evaluation and optimisation for fixed point arithmetic was presented during a tutorial "Automatic Fixed-Point Conversion: a Gateway to High-Level Power Optimization" at IEEE/ACM Design Automation and Test in Europe [77].

As a proof of concept of our research on improving efficiency of dynamic reconfiguration in FPGAs [47] [48], the *eFPGA* (Figure 5) chip was designed and fabricated in 65nm CMOS technology. In the proposed and patented architecture [73] (EU patent), the configuration of the FPGA becomes independent from its placement and is moreover significantly compressed (up to $\times 10$). This notion of *Virtual Bit Stream* allows for seamless partial and dynamic reconfiguration and for task migration.
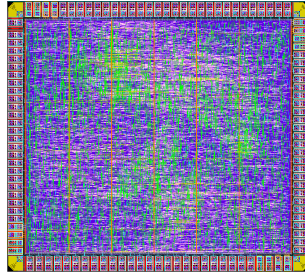
Figure 5. CAIRN*'s eFPGA chip*

CELTIQUE Project-Team (section vide)

ESTASYS Exploratory Action

6.1. Highlights of the Year

The Plasma statistical model checker has been made available to other scientists. ESTASYS has open a new branch on verifying the security of complex systems.

HYCOMES Team

6.1. Highlights of the Year

The main advances in 2014 of the Hycomes team have been as follows:

Causality analysis of hybrid systems with ordinary differential equations (ODE)   We have proposed a causality analysis, in the form of a simple type system, rejecting hybrid programs with algebraic circuits — see section 6.2 .

An index theory of DAE hybrid systems with differential algebraic equations (DAE)   We have proposed a conservative extension of the notion of differentiation index to hybrid systems with differential algebraic equations — see section 6.3 .

SUMO Project-Team

6.1. Highlights of the Year

We started our first industrial collaboration "Project P22" with Alstom Transport, in the context of a common laboratory between Inria and Alstom. The project started in March 2014 and tackles robustness issues and regulation in urban train systems. The second phase of the project will start in march 2015, for a duration of three years. Most of the researchers of Sumo are involved in this project.

TASC Project-Team

6.1. Highlights of the Year

In the context of the MiniZinc Challenge and in concurrency with 16 other solvers, CHOCO has won three bronze medals in three out of four categories: free search, parallel search and Open class.

TEA Project-Team

6.1. Highlights of the Year

This year's effort has been mainly devoted to the successful creation of project-team TEA and the definition of its new research perspective on Time, Events and Architectures in CPS design.

The SAE committee on the AADL adopted our recommendations to implement a timed and synchronous behavioural annex [13], [11] for standardisation [20]. The specification and reference implementation of this revised behavioral annex will be the focus of most our attention next year.

Adnan Bouakaz published and implemented more of the original results from his PhD. work on abstract affine scheduling [14], [15].

ASPI Project-Team (section vide)

I4S Project-Team

6.1. Highlights of the Year

The team organized the 7th European Workshop on SHM in Nantes in July 2014 (http://ewshm2014.com) .

IPSO Project-Team

5.1. Highlights of the Year

- E. Faou was plenary speaker at the CANUM, Congrès d'analyse numérique, France, June 2014
- E. Faou was invited to give two presentations in the Analysis and applied mathematics seminars, Cambridge, UK, February 2014.

DYLISS Project-Team

6.1. Highlights of the Year

Four PhD theses were defended this year. They evidenced that ASP-technologies are now mature enough to perform data integration of large-scale bio-molecular datasets: classification of families of proteins [10], reconstruction of regulatory networks [13], reconstruction of metabolic network [11], and modelling of the discrete dynamics of a signalling or a regulatory network [12]. Importantly, symbolic classification technics have been adapted to exhibit relevant biological features: we used both formal concept analysis and semantic-based analysis for sequence and network analysis.

FLUMINANCE Project-Team

6.1. Highlights of the Year

6.1.1. *Stochastic fluid flow dynamics under uncertainty*

We have proposed the basis of a formalism allowing to built large scale stochastic representation of fluid flows dynamics [17]. This formalism relies on a location uncertainty principle which separates the flow in terms of a resolved large scale component and a highly oscillating random component. The dynamics is built in a similar way as in the deterministic case through a stochastic representation of the Reynolds transport theorem. This principle paves a new way for the construction of subgrid models from the uncertainties we have on the flow. The associated subgrid tensor provides a clear interaction between small scale data and large scale resolved quantities. This characteristic opens new directions for the devising of methods for the nulmerical simulation of large scale components of the flow. It allows also deriving large-scale models that takes into account explicitly the inherent errors to a particular geophysical dynamics representation.

GENSCALE Project-Team

6.1. Highlights of the Year

discoSnp published in NAR. The publication presents a wide range of discoSnp applications that highlight the advantages and the drawbacks of predicting SNPs when no reference genomes are available. The publication witnesses the enthusiasm of users regarding both reference-free methods and the quality of the method. [20]

SAGE Project-Team

6.1. Highlights of the Year

Lionel Lenôtre and his co-authors revisited in a very efficient way the Hastings-Metropolis Algorithm on Markov Chains for Small-Probability Estimation.

SERPICO Project-Team (section vide)

VISAGES Project-Team

6.1. Highlights of the Year

Dr Camille Maumet was awarded by the French Society of Magnetic Resonance in Biology and Medicine (SFRMBM) for her PhD Thesis on analysis of neuroimaging data including images from functional Magnetic Resonance Imaging (fMRI) and Arterial Spin Labeling http://www2.warwick.ac.uk/fac/sci/wmg/idh/idhnews/?tag=Neural+Engineering.

Dr Americ Stamm was awarded by the Univ. of Rennes I foundation as the best PhD thesis in Math, Computer Sciences and Electrical Engineering. This award is dedicated for the PhDs having the highest potential for innovation and technological transfer
;ses-de-la-fondationhttps://fondation.univ-rennes1.fr/les-prix-de-thèses-de-la-fondation.

ASAP Project-Team

6.1. Highlights of the Year

- Anne-Marie Kermarrec is the recipient of the **ACM/IFIP/USENIX/Middleware 10-Years Best Paper Award**, for her paper *The peer sampling service: Experimental evaluation of unstructured gossip-based implementations* (Middleware 2004), co-authored with Márk Jelasity, Rachid Guer-raoui, and Maarten van Steen.

- Anne-Marie Kermarrec is the recipient of the **WISE 2014 Best Paper Award**, for her paper [18], co-authored with Alexandra Olteanu and Karl Aberer.

- Michel Raynal is the recipient of the **PODC 2014 Best Paper Award**, for his paper [34], co-authored with Achour Mostefaoui and Moumen Hamouna.

- The MEDIEGO recommendation engine was demonstrated at **Le Web 14** in partnership with FranceTV.

BEST PAPERS AWARDS :

[18] **15th International Conference on Web Information System Engineering (WISE 2014)**. O. ALEXAN-DRA, A.-M. KERMARREC, K. ABERER.

[34] **ACM PODC**. A. MOSTEFAOUI, M. HAMOUNA, M. RAYNAL.

ASCOLA Project-Team

6.1. Highlights of the Year

Nicolas Tabareau was awarded a starting grant from the European Research Council (ERC), the most prestigious type of research projects of the European Union for young researchers. From 2015–2020 he will pursue research on "CoqHoTT: Coq for Homotopy Type Theory."

Jonathan Pastor has won the joint 1st prize at the Grid5000 Scale challenge, an international challenge for large-scale experiments on geographically-distributed cluster environments. Jonathan has shown with a colleague how to deploy and manage thousands of VMs in such an environment using his approach to fully distributed virtual machine management.

This year we have provided major research results in two domains. First, we have developed several new approaches for the formal reasoning over software in the domains of theorem proving [31], as well as reasoning over distributed interaction protocols [32] and software compositions [24]. Second, we have developed new methods supporting dynamic computations over the cloud, both by means of more elastic cloud applications [27] and better locality management for the dynamic placement of virtual machines in Cloud infrastructures [29].

ATLANMOD Project-Team (section vide)

<h1 style="color:red; text-align:center">CIDRE Project-Team</h1>

6.1. Highlights of the Year

The supervision of distributed system relies heavily on correlation mechanisms that are responsible for collecting alerts coming from sensors and detecting complex scenarios in the flow of alerts. The problem is that it requires to write complex correlation rules. The work we have performed proposes a technique to generate semi-automatically such correlation rules. It describes a process that uses an attack tree and a representation of the system as inputs, and generate a correlation tree that can be translated in an alert correlation description language. This work received the best paper award of SAR-SSI 2014 [50].

One approach to protect the privacy of users in personalized recommendation systems is to publish a sanitized version of the profile of the user by relying a non-interactive mechanism compliant with the concept of differential privacy. In a joint work with Raghavendran Balu and Teddy Furon (LinkMedia Inria team), we have consider two existing schemes offering a differentially private representation of profiles: BLIP (BLoom-and-flIP) and JLT (Johnson-Lindenstrauss Transform). For assessing their security levels, we play the role of an adversary aiming at reconstructing a user profile. To realize this, we design two inference attacks named single and joint decoding. The first inference attack tests the presence of a single item in the profile, and is iterated independently for each possible item of the item set. In contrast, the second inference attack aims at deciding whether a particular subset of items is likely to be in the user profile. This attack is tested on all the possible subsets of items. Our contributions are a theoretical analysis and practical implementations of both attacks tested on datasets composed of real user profiles revealing that joint decoding is the most powerful attack. This also gives useful insights on the setting the differential privacy parameter ϵ. This work has received the best student paper award at the conference ESORICS 2014.

BEST PAPERS AWARDS :

[27] **European Symposium on Research in Computer Security**. R. BALU, T. FURON, S. GAMBS.

DIONYSOS Project-Team

5.1. Highlights of the Year

Pierre L'Ecuyer received the Award of Merit from the Canadian Operational Research Society, 2014.

We had one best paper award in 2014 on a novel architecture for resilient networks (see 5.8).

BEST PAPER AWARD :

[50]   **IEEE International Conference on Innovations for Community Services**. D. LEQUÉRÉ, C. BE-
TOULE, G. THOUENON, Y. HADJADJ-AOUL, A. KSENTINI, R. CLAVIER.

DIVERSE Project-Team

6.1. Highlights of the Year

"Globalizing Modeling Languages" appears in IEEE Computer Magazine. This paper synthesizes our vision of how domain-specific languages form the foundations of global software development. Its appearance in a highly visible venue is major milestone for the dissemination and impact of our work about the diversity of languages.

DiverSE extremely present at the SPLC conference. SPLC is the main international conference for software product line engineering. In 2014, the DiverSE team had a very strong presence at this conference, presenting novel scientific contributions, results of industrial collaborations, and demonstrations of latest software tools.

KerData Project-Team

6.1. Highlights of the Year

IEEE Cluster 2014.   The KerData Team had a leading role the organization of the IEEE Cluster 2014 conference, held in Madrid (22–26 September 2014): Gabriel Antoniu as PC Chair, Luc Bougé as Student Mentoring Program Chair, Alexandru Costan as Submissions Chair.

MYRIADS Project-Team

5.1. Highlights of the Year

- The Contrail project coordinated by Christine Morin received the "Excellent" grade at its final review held on March 14th, 2014 in Brussels.
- Anne-Cécile Orgerie has been awarded the Young Researcher prize of the Lyon city in November 2014.
- Christine Morin has been awarded one of the 12 "Etoile de l'Europe 2014" prizes in December 2014 for the coordination of the Contrail European project.

BEST PAPERS AWARDS :

[18] **4th International Conference on Cloud Computing and Services Science**. H. FERNANDEZ, C. STRATAN, G. PIERRE.

TACOMA Team (section vide)

DREAM Project-Team (section vide)

HYBRID Project-Team

6.1. Highlights of the Year

- Paper [22] from Merwan Achibet, Maud Marchal, Ferran Argelaguet and Anatole Lécuyer received the "Best Paper Award" at IEEE Symposium on 3D User Interfaces 2014 (IEEE 3DUI'14).
- Paper [26] from Jean-Baptiste Barreau, Valérie Gouranton received the "Third Best Poster Award" at International Conference on Cultural Heritage 2014.

BEST PAPERS AWARDS :

[22] **IEEE Symposium on 3D User Interfaces**. M. ACHIBET, M. MARCHAL, F. ARGELAGUET SANZ, A. LÉCUYER.

LAGADIC Project-Team (section vide)

LINKMEDIA Project-Team

6.1. Highlights of the Year

BEST PAPER AWARD :

[21] **European Symposium on Research in Computer Security**. R. BALU, T. FURON, S. GAMBS.

MIMETIC Project-Team

6.1. Highlights of the Year

6.1.1. *Link between performance and risk of injury*

Participants: Richard Kulpa [contact], Benoit Bideau, Michaël Ropars.

In our previous biomechanical analysis of the tennis serve, we have demonstrated that the energy flow is a pathomechanical factor, that means that it can increase joint constraints (and thus risk of injury) while not increasing performance. Nevertheless, the definition and evaluation of energy flow is still a complex scientific challenge. We have proposed to compare the energy flow during the serve between injured and non-injured tennis players by investigating the relationships between the quality and magnitude of energy flow, the ball velocity and the peaks of upper limb joint kinetics [11]. The results showed that ball velocity increased and upper limb joint kinetics decreased with the quality of energy flow from the trunk to the 'hand+racket'. Injured players showed a lower quality of energy flow through the upper limb kinetic chain, a lower ball velocity and higher rates of energy absorbed by the shoulder, the elbow than non-injured players. These findings imply that an effective energy flow through the kinetic chain by using a proper serve technique is necessary for reducing overuse joint injury risks.

6.1.2. *ACM SIGGRAPH Course on crowd simulation*

Participant: Julien Pettré [contact].

Crowds for entertainment or safety applications purposes are most of the time simulated using microscopic algorithms. In contrast with other types of approaches, microscopic simulators are able to generate continuous and smooth trajectories for individual agents. They are based on models of local interactions between agents. The crowd motion result form the combination of all local motion and interactions. The fact that the resulting crowd motion is emergent makes difficult anticipating the simulation results. Many motion and interaction models have been proposed to design a plethora of simulation algorithms: force-based models, rule-based models, coupled or not with flow-based models, etc. Each type of interaction models will actually result into specific crowd motions as well as agents trajectories. Unfortunately, not all have the desired properties: oscillations, jerky trajectories, residual collisions or deadlocks are often observed in simulations. From this point of view, the course [28] presents the many recent progresses in crowd simulation algorithms since the introduction of velocity-based algorithms , as well as the impact on the level of realism and the visual quality of simulated crowd motions. It also presents the impact on various kind of applications.

6.1.3. *Immersive basketball playing*

Participants: Franck Multon [contact], Alexandra Covaci, Anne-Hélène Olivier.

The paper has received the best paper award of the ACM VRST 2014 Conference in November 2014. This paper addressed the problem of perception of distances in immersive environments when dealing with precision distant tasks, such as basketball free throw. The work has been done in collaboration with University of Brasov in Romania, thanks to the FP7 VISIONAIR infrastructure project. The main results of this work tend to show that third person perspectives enabled subjects to perform the task with similar movements than in real world, compared to first person perspective. Third person perspective consists in placing the camera at a different place from the eye point of view, as in many videogames. On the opposite first person perspective consists in place the camera at the place of the user's eyes in scale 1:1, as if the user was colocalized in the virtual environment. We also demonsrated an adaptation to the task in immersive environments, which is a key information for future development of training methods using VR. We have been invited to submit an extended version of the paper to the IEEE Computer and Graphics journal for 2015.

BEST PAPERS AWARDS :

[21] **ACM Symposium on Virtual Reality Software and Technology VRST**. A. COVACI, A.-H. OLIVIER, F. MULTON.

PANAMA Project-Team

6.1. Highlights of the Year

The EUSIPCO 2014 Best Student Paper Award was awarded to our joint paper [32] on dynamic screening for sparse regularization. .

A review paper on audio source separation, rooted in METISS/PANAMA know-how and contributions to this topic over the years, was published in the IEEE Signal Processing Magazine [25].

A new version of the Flexible Audio Source Separation Toolbox (FASST) was released in January 2014 and downloaded 300 times.

BEST PAPERS AWARDS :

[32] **European Signal Processing Conference EUSIPCO 2014**. A. BONNEFOY, V. EMIYA, L. RALAIVOLA, R. GRIBONVAL.

SIROCCO Project-Team (section vide)