

Inria

RESEARCH CENTER

FIELD

Algorithmics, Programming, Software and Architecture

Activity Report 2019

Section Highlights of the Team

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ARIC Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Florent Bréhard, jointly with Mioara Joldes and Jean-Bernard Lasserre (CNRS LAAS) received the Distinguished paper award at ISSAC 2019 for *On Moment Problems with Holonomic Functions*.

Alice Pellet-Mary was an awardee of the L'Oréal-Unesco scholarship for Women and Science.

BEST PAPERS AWARDS :

[16]

F. BRÉHARD, M. JOLDES, J.-B. LASSERRE. *On Moment Problems with Holonomic Functions*, in "ISSAC 2019 - 44th International Symposium on Symbolic and Algebraic Computation", Pékin, China, July 2019, p. 66-73, <https://hal.archives-ouvertes.fr/hal-02006645>

AROMATH Project-Team (section vide)

CARAMBA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- On December 2nd, 2019, the factorization of RSA-240 and the computation of a 240-digit discrete logarithm were announced.
- In August 2019, Pierrick Gaudry found a vulnerability in the encryption scheme of the Internet voting system of Moscow.
- Pierrick Gaudry and Cécile Pierrot were invited speakers at the ECC 2019 conference (Bochum, Germany).

5.1.1. Awards

- Simon Abelard received the PhD prize of Université de Lorraine from the doctoral school IAEM (computer science, automatic) [25].

CASCADE Project-Team

5. Highlights of the Year

5.1. Awards

- The paper “The Gap-Problems: A New Class of Problems for the Security of Cryptographic Schemes”, by Tatsuaki Okamoto and David Pointcheval from PKC 2001, has received the Test-of-Time award at PKC 2019
- Raphaël Bost received the “2019 PhD Thesis Award” from the GDR Sécurité Informatique
- Mélissa Rossi received the L’Oréal-UNESCO For Women in Science Rising Talent Award Scholarship 2019.

DATASHAPE Project-Team (section vide)

GAMBLE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

We are happy to report that some of our past work appeared this year in highly visible journals. Our proof that deciding *shellability* of simplicial complexes, a problem that was open for 40 years, was published in the Journal of the ACM [15], and our survey on *combinatorial geometry and topology and their applications* was published in the Bulletin of the AMS [13].

GRACE Project-Team (section vide)

LFANT Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

Guilhem Castagnos defended his professorial degree (“habilitation à diriger des recherches”) on the topic of *Cryptography based on quadratic fields: cryptanalyses, primitives and protocols*[11].

4.1.1. Awards

Fredrik Johansson won the best paper award at the conference ARITH26 — 26th IEEE Symposium on Computer Arithmetic in Kyoto for his contribution on dot products and matrix multiplication in arbitrary precision .

BEST PAPERS AWARDS :

[21]

F. JOHANSSON. *Faster arbitrary-precision dot product and matrix multiplication*, in "26th IEEE Symposium on Computer Arithmetic (ARITH26)", Kyoto, Japan, June 2019, <https://arxiv.org/abs/1901.04289> , <https://hal.inria.fr/hal-01980399>

OURAGAN Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Two new projects have started this year

- the MACAO associated team in collaboration with the University of Wollongong (Australia) - see [9.3.1](#)
- a collaboration with Safran Tech - see [8.1](#)

POLSYS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

CryptoNext Security, a spinoff of the PolSys team, was founded in June 2019 and has already been selected in the Future 40 group by STATION F of the most promising young startups.

SECRET Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- **Keynote at FSE 2019:** María Naya Plasencia has been an invited keynote speaker at FSE 2019 in Paris.
- **NIST competition on post-quantum cryptography:** The members of the project-team have submitted 5 candidates to the NIST competition on post-quantum cryptography. After a first selection, three of our candidates have been moved to the second round of the competition, which includes a total of 26 candidates.
- **NIST competition on lightweight cryptography:** The members of the project-team are involved in the design of 3 authenticated encryption schemes submitted to the NIST lightweight competition. These three ciphers are among the 32 candidates which have been move to the second round of the competition.

5.1.1. Awards

- María Naya Plasencia was awarded the Inria - Académie des Sciences prize for young researchers <https://www.academie-sciences.fr/fr/Laureats/prix-inria-academie-des-sciences-2019-vincent-hayward-equipe-scikit-learn-et-maria-naya-plasencia.html>
- Anne Canteaut has been made doctor honoris causa of the University of Bergen (Norway), October 2019 <https://www.uib.no/en/news/129910/ten-new-honorary-doctorates>

BEST PAPERS AWARDS :

[31]

L. PERRIN. *Partitions in the S-Box of Streebog and Kuznyechik*, in "IACR Transactions on Symmetric Cryptology", March 2019, vol. 2019, n^o 1, p. 302-329 [DOI : 10.13154/TOSC.v2019.i1.302-329], <https://hal.inria.fr/hal-02396814>

[49]

T. DEBRIS-ALAZARD, N. SENDRIER, J.-P. TILLICH. *Wave: A New Family of Trapdoor One-Way Preimage Sampleable Functions Based on Codes*, in "ASIACRYPT 2019 - 25th International Conference on the Theory and Application of Cryptology and Information Security", Kobe, Japan, LNCS, Springer, November 2019, vol. 11921, p. 21-51 [DOI : 10.1007/978-3-030-34578-5_2], <https://hal.inria.fr/hal-02424057>

SPECFUN Project-Team (section vide)

CAIRN Project-Team (section vide)

CAMUS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

One of the main challenges of parallelization is the selection of the appropriate granularity to balance between the ideal degree of parallelism and the mitigation of the runtime system's overhead. We have worked on the granularity control for parallel applications focusing on two different paradigms. In the first one, which is the tasks with spawn/sync mechanism, we combined the use of asymptotic complexity functions provided by the programmer, with runtime measurements to predict the execution time of tasks with reasonable accuracy. This estimation can then be used to select the proper task granularity, while making sure to put enough work inside each task. In the second one, which is related to the tasks with dependencies paradigm, we have improved an existing algorithm to cluster a graph of tasks to obtain a meta-graph with larger tasks. This approach was used in an application in collaboration with the TONUS team, and we have demonstrated that it allows for a significant speedup.

CASH Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. Awards

In January 2019, the paper “Static Analysis Of Binary Code With Memory Indirections Using Polyhedra” resulting from a collaboration with colleagues from Lille University, has received a best paper award of the VMCAI 2019 conference.

The paper “Godot: All the Benefits of Implicit and Explicit Futures” received the distinguished artefact at ECOOP’19.

BEST PAPERS AWARDS :

[5]

C. BALLABRIGA, J. FORGET, L. GONNORD, G. LIPARI, J. RUIZ. *Static Analysis Of Binary Code With Memory Indirections Using Polyhedra*, in "VMCAI'19 - International Conference on Verification, Model Checking, and Abstract Interpretation", Cascais, Portugal, LNCS, Springer, January 2019, vol. 11388, p. 114-135 [DOI : 10.1007/978-3-030-11245-5_6], <https://hal.archives-ouvertes.fr/hal-01939659>

[8]

A. CHARIF, G. BUSNOT, R. MAMEESH, T. SASSOLAS, N. VENTROUX. *Fast Virtual Prototyping for Embedded Computing Systems Design and Exploration*, in "RAPIDO2019 - 11th Workshop on Rapid Simulation and Performance Evaluation: Methods and Tools", Valence, Spain, January 2019, p. 1-8 [DOI : 10.1145/3300189.3300192], <https://hal.archives-ouvertes.fr/hal-02023805>

CORSE Project-Team (section vide)

PACAP Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Benjamin Rouxel, Stefanos Skalistis, Steven Derrien and Isabelle Puaut received an Outstanding paper award for their paper entitled “Hiding Communication Delays in Contention-Free Execution for SPM-based Multi-Core Architectures” at the Euromicro conference on real time systems .

BEST PAPERS AWARDS :

[28]

B. ROUXEL, S. SKALISTIS, S. DERRIEN, I. PUAUT. *Hiding Communication Delays in Contention-Free Execution for SPM-Based Multi-Core Architectures*, in "ECRTS 2019 - 31st Euromicro Conference on Real-Time Systems", Stuttgart, Germany, July 2019, p. 1-24 [DOI : 10.4230/LIPIcs.ECRTS.2019.25], <https://hal.archives-ouvertes.fr/hal-02190271>

HYCOMES Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

The Hycomes team has reached in 2019 an important milestone in the team's research objectives: the design and implementation of an implicit structural analysis algorithm supporting multimode DAE systems. This method is based on an encoding of the varying structure of a multimode DAE as Boolean functions, represented with Binary Decision Diagrams (BDD). This enables a complete structural analysis of a multimode DAE system, without enumerating its modes.

Kairos Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- New Collaboration with Renault Software Labs - CIFRE starting in April 2019
- ANR Project on the verification of smart contracts on the use of multi-modalities transportations in the smart city - AAPG 2019 PRCE

5.1.1. Awards

Frederic Mallet is Laureate of the program 'Jeune Talent France Chine 2019' from French Embassy in China.

KOPERNIC Team

5. Highlights of the Year

5.1. Highlights of the Year

The Kopernic research results on statistical estimation of execution time bounds has been transferred to a start-up, led by Adriana Gogonel, postdoctoral student in Kopernic team. The start-up, Statinf, has been a Carnot 2019 and Wilco 2019 laureate and it has integrated the Agoranov Deeptech incubator since September 2019.

The Kopernic leader, Liliana Cucu-Grosjean has been the IEEE RTSS2019 Track co-chair as well as the DATE2020 Real-time Systems Track co-chair.

PARKAS Project-Team (section vide)

SPADES Project-Team (section vide)

TEA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Loïc Besnard was promoted to the rank of Senior Engineer Exceptional Class by CNRS, acknowledging his remarkable career of research engineer as principal developer of Signal and Polychrony, as project manager and integrator with project teams EPATR (Signal), ESPRESSO (Polychrony), TEA (ADFG) and PACAP (Heptane).

ANTIQUE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Caterina Urban joined the group as a CR in February 2019, and is opening new research directions towards static analysis for data-science software. She was invited to talk about her work in this area at SAS 2019 (Static Analysis Symposium) [13].

CAMBIUM Project-Team (section vide)

CELTIQUE Project-Team (section vide)

CONVECS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Frédéric Lang, together with Franco Mazzanti from CNR-ISTI/FMT (Pisa, Italy), won all the gold medals for the “Parallel CTL” and “Parallel LTL” tracks of the RERS’2019 (*Rigorous Evaluation of Reactive Systems*) challenge⁰. The goal of these two tracks was to verify 180 properties expressed in the branching-time temporal logic CTL and 180 properties expressed in the linear-time temporal logic LTL. These properties had to be evaluated on various complex systems, having up to 70 concurrent processes and 234 synchronization actions. To attack such difficult problems, Lang and Mazzanti decided to join forces, and managed to evaluate all the 360 properties correctly, by designing new verification algorithms and exploiting the compositional verification techniques of CADP.

⁰<http://rers-challenge.org/2019>

DEDUCTEAM Project-Team (section vide)

GALLINETTE Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. *Permanents members*

Gaëtan Gilbert, currently PhD student in the Gallinette team, will be promoted expert engineer for the Coq consortium, staying in the Gallinette team.

Matthieu Sozeau, Inria Junior Researcher and leader of the Coq development team, is joining the Gallinette team end of 2019-beginning of 2020.

Nicolas Tabareau is now director of research (DR2) at Inria since October 2019.

4.1.2. *Awards*

Marie Kerjean has been awarded a L'Oréal - Unesco Foundation grant.

L'Oréal - Unesco Grants for Women in Science are awarded to talented young female researchers.

MEXICO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

- The article *Manifestability Verification of Discrete Event Systems* by Lina Ye, Philippe Dague, and Lulu He received the *Best Paper Award* of the *30th International Workshop on Principles of Diagnosis DX'19*, Klagenfurt/Austria, November 2019.
- The article *Sequential Reprogramming of Boolean Networks Made Practical* by Hugues Mandon, Cui Su, Stefan Haar, Jun Pang, and Loïc Paulevé received the *Best Paper Award* of the conference on *Computational Models in Systems Biology (CMSB 2019)*, Trieste/Italy, September 18-20, 2019.

BEST PAPERS AWARDS :

[24]

L. YE, P. DAGUE, L. HE. *Manifestability Verification of Discrete Event Systems*, in "DX'19 - 30th International Workshop on Principles of Diagnosis", Klagenfurt, Austria, November 2019, vol. 19, p. 1-9, Best Paper Award (<https://dx-workshop.org/2019/awards/>), <https://hal.archives-ouvertes.fr/hal-02425146>

[22]

H. MANDON, C. SU, S. HAAR, J. PANG, L. PAULEVÉ. *Sequential Reprogramming of Boolean Networks Made Practical*, in "CMSB 2019 - 17th International Conference on Computational Methods in Systems Biology", Trieste, France, Lecture Notes in Computer Science, Springer, 2019, vol. 11773, p. 3–19, Best paper award [DOI : 10.1007/978-3-030-31304-3_1], <https://hal.archives-ouvertes.fr/hal-02178917>

MOCQUA Team

5. Highlights of the Year

5.1. Highlights of the Year

The ZX-calculus is a powerful diagrammatic language which can be used to reason on quantum computing. The ZX-calculus is also an essential tool for the development of the quantum computer allowing for instance optimisation of quantum programs. Indeed the ZX-calculus is equipped with an equational theory which allows one to transform and optimize quantum programs. A few years ago, we have proved the first completeness result of the ZX-calculus [41] [28], guaranteeing that two equivalent evolutions can be transformed one into the other thanks to the equational theory. Its completeness gives to the ZX-calculus a competitive advantage compared to the other models of quantum computation, like the quantum circuits, for which no complete equational theory is known.

In [31], Renaud Vilmart introduced a new, simple, and meaningful equational theory for the ZX-calculus, based on the famous Euler angle decomposition. Renaud participated to the various previous results of the team on this subject during his PhD thesis in the Mocqua team, and culminated with this sole author paper published at LICS for which he obtained the best student paper award.

5.1.1. Awards

Best student paper award at LICS'19 for Renaud Vilmart. [31].

PARSIFAL Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- The journal *Mathematical Structures in Computer Science* published “A special issue on structural proof theory, automated reasoning and computation in celebration of Dale Miller’s 60th birthday” – volume 29, Special issue 8, September 2019.
- Accattoli was invited speaker at the international conference FSCD 2019.

PL.R2 Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

A one-day scientific meeting in honour of Pierre-Louis Curien's retirement was held at Université Paris Diderot on se 6, 2019 (organisers Antonio Bucciarelli, Bérénice Delcroix-Oger and Thomas Ehrhard) (<https://www.irif.fr/plcmeeting>).

The paper [35] presents the results of a large collaborative work led by Matthieu Sozeau on the metatheory and implementation of Coq's type theory in Coq itself.

Yves Guiraud defended his habilitation thesis on the 18th of June 2019, entitled "Rewriting methods in higher algebra". Yann Régis-Gianas defended his habilitation thesis on the 22nd of November 2019 entitled "About some metamorphoses of computer programs".

Yves Guiraud was granted an Action Exploratoire, Réécriture Algébrique, to start in January 2020. Emilio Gallego Arias joined the team in November 2019 on a Starting Research Position.

STAMP Project-Team (section vide)

SUMO Project-Team

5. Highlights of the Year

5.1. Changes in 2019

SUMO was evaluated in spring 2019, and we took this opportunity to make several changes. First, we adapted the research axes of the team in our scientific foundations to reflect a slight topic drift over the last four years, which is also a consequence of modifications in the team composition. In particular, we now put emphasis on one emergent topic, namely population models. Last but not least, Éric Fabre stepped down as project-team leader and Nathalie Bertrand replaces him since April 2019.

TOCCATA Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- Martin Clochard has been awarded the GDR GPL 2018 prize (<http://gdr-gpl.cnrs.fr/node/361>) for his thesis entitled “Methods and tools for specification and proof of difficult properties of sequential programs” carried out at LRI, under the scientific supervision of Claude Marché and Andrei Paskevich. [57] [43]

Martin Clochard is currently a postdoc at ETH Zurich.

- Jean-Christophe Filliâtre receives the 2019 CAV Award, jointly with Rustan Leino (Amazon Web Services), for the design and development of reusable intermediate verification languages which significantly simplified and accelerated the building of automated deductive verifiers. Jean-Christophe is the initial designer of the Why environment for automated deductive verification, and a leading developer of its successor Why3.

The CAV award is given annually at the CAV conference for fundamental contributions to the field of Computer-Aided Verification. <http://cavconference.org/cav-award>

- Claude Marché received the FIEEC CARNOT 2019 prize for applied research for his collaboration with AdaCore. The award recognizes his collaboration with AdaCore, a computer assisted proof verification company, for applications in the development of critical software for safety and security in the aeronautics, space, air traffic control and rail transportation industries, autonomous vehicles, finance or medical devices. <https://www.instituts-carnot.eu/fr/actualite/prix-fieec-carnot-de-la-recherche-appliquee-trois-chercheurs-recompenses-pour-leurs-partenariats-retd-avec-les-pme>

VERIDIS Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Christoph Weidenbach received the Skolem test-of-time award of CADE, the international conference on automated deduction, for his paper *Towards an Automated Analysis of Security Protocols* [72].

Martin Bromberger, Mathias Fleury, Simon Schwarz and Christoph Weidenbach received the best student paper award at CADE 27 for their paper *SPASS-SATT: A CDCL(LA) Solver* .

BEST PAPERS AWARDS :

[31]

M. BROMBERGER, M. FLEURY, S. SCHWARZ, C. WEIDENBACH. *SPASS-SATT: A CDCL(LA) Solver*, in "27th International Conference on Automated Deduction (CADE-27)", Natal, Brazil, P. FONTAINE (editor), Lecture Notes in Computer Science, 2019, vol. 11716, p. 111-122 [DOI : 10.1007/978-3-030-29436-6_7], <https://hal.inria.fr/hal-02405524>

CIDRE Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

This year we highlight two key events in the team's life:

- We have organized the **SILM semester on the Security of Software/Hardware Interfaces**. The goal of this semester is to promote the scientific, teaching and industrial transfer activities on the security of software/hardware interfaces. This semester is supported by DGA.
- We have concluded the transfer of a license to use GroddDroid our Android malware analysis framework.

COMETE Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

Catuscia Palamidessi has received an European Research Council (ERC) grant for the project **HYPATIA**.

DATASPHERE Team (section vide)

PESTO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. Awards

Itsaka Rakotonirina was awarded a Google PhD fellowship in Security and Privacy.

Steve Kremer was granted an ANR Chair of research and teaching in artificial intelligence: ASAP – Tools for automated, symbolic analysis of real-world cryptographic protocols.

PRIVATICS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

PRIVATICS members have written several position documents for policy makers: a report on facial recognition, algorithmic decision-making, pseudonymisation and a white book on cybersecurity.

PROSECCO Project-Team

5. Highlights of the Year

5.1. Highlights of the Year

- We published 12 papers at top-tier conferences and journals such as S&P (1), POPL (2), Euro S&P (2), ICFP (3), CSF (1), ESOP (1)
- Our cryptographic library HAACL* was incorporated within the Linux kernel, Microsoft WinQuic, mbedTLS, and Concordium, in addition to the prior deployments in Mozilla Firefox and Tezos Blockchain
- Catalin Hritcu served as Program Chair of the 9th ACM SIGPLAN International Conference on Certified Programs and Proofs (CPP)

5.1.1. Awards

- EU Horizon Impact Award 2019 for Karthikeyan Bhargavan for his research on TLS 1.3.
- Distinguished Paper Award at CSF'19 for "Journey Beyond Full Abstraction"
- Distinguished Paper Award at POPL'19 for "Gradual Parametricity, Revisited"

BEST PAPERS AWARDS :

[17]

C. ABATE, R. BLANCO, D. GARG, C. HRIȚCU, M. PATRIGNANI, J. THIBAUT. *Journey Beyond Full Abstraction: Exploring Robust Property Preservation for Secure Compilation*, in "CSF 2019 - 32nd IEEE Computer Security Foundations Symposium", Hoboken, United States, IEEE, June 2019, p. 256-271, <https://arxiv.org/abs/1807.04603> [DOI : 10.1109/CSF.2019.00025], <https://hal.archives-ouvertes.fr/hal-02398915>

[16]

M. TORO, E. LABRADA, É. TANTER. *Gradual Parametricity, Revisited*, in "Proceedings of the ACM on Programming Languages", 2019, vol. 3, n^o POPL, <https://arxiv.org/abs/1807.04596> [DOI : 10.1145/3290330], <https://hal.archives-ouvertes.fr/hal-01960553>

TAMIS Project-Team

4. Highlights of the Year

4.1. Highlights of the Year

4.1.1. *Kick-off of the ANR JCJC AHMA project*

The ANR JCJC project lead by Annelie Heuser was kicked-off, and a PostDoc (Matthieu Mastio) and PhD (Duy Phuc Pham) have been hired. The team already created a first platform for automated hardware malware analysis. See below and in the following.

4.1.2. *New results in the TeamPlay H2020 project, coordinator*

The project is coordinated by Olivier Zendra. The TeamPlay H2020 project had a successful mid-term review in October 2019, where the reviewers stressed the quality of the overall work. We TAMIS also achieved new results on security modelling in this TeamPlay project in 2019 (see in the following).

4.1.3. *New software and platforms*

In 2019, we continued the development of several software and platforms (hardware and software), and build up four new ones:

- E-PAC, an Evolving Packer Classifier,
- The SABR (Semantic-driven Analysis of BinaRies) platform
- Orqal, an efficient scheduler for docker images.
- A Side-channel deep learning evaluation platform,
- The AHMA (IoT malware classification through side-channel information) platform and tools.