RESEARCH CENTER
Nancy - Grand Est

FIELD

Activity Report 2016

Section Software

Edition: 2017-08-25

ALICE Project-Team

6. New Software and Platforms

6.1. GEOGRAM

GEOGRAM : A functions library for geometric programming
KEYWORD: 3D modeling
GEOGRAM is a programming library with a set of basic geometric algorithms, such as search data structures (AABB tree, Kd tree), geometric predicates, triangulations (Delaunay triangulation, Regular triangulation), intersection between a simplicial mesh and a Voronoi diagram (restricted Voronoi diagram). GEOGRAM also includes a code generator for predicates (PCK: Predicate Construction Kit) and an efficient implementation of expansion arithmetics in arbitrary precision. GEOGRAM is shipped with WARPDRIVE, the first program that computes semi-discrete optimal transport in 3D.

- Participant: Bruno Lévy
- Contact: Bruno Lévy
- URL: http://alice.loria.fr/software/geogram/doc/html/index.html

6.2. GLE

GraphiteLifeExplorer
KEYWORDS: 3D modeling - Biology
GLE is a 3D modeler, developed as a plugin of Graphite, dedicated to molecular biology. Biologists need simple spatial modeling tools to help in understanding the role of the relative position of objects in the functioning of the cell. In this context, we develop a tool for easy DNA modeling. The tool generates DNA along any user-given curve, open or closed, allows for fine-tuning of atoms position and, most importantly, exports to PDB (the Protein Daba Bank file format).

- Participant: Samuel Hornus
- Partner: Fourmentin Guilbert foundation
- Contact: Samuel Hornus
- URL: https://members.loria.fr/samuel.hornus/FFG/gle.html

6.3. Graphite

Graphite: The Numerical Geometry Workbench
KEYWORDS: 3D modeling - Numerical Geometry - Texturing - Lighting - CAD - Visualization
Graphite is an experimental 3D modeler, built on top of the Geogram programming library. It has data structures and efficient OpenGL visualization for pointsets, surfacic meshes (triangles and polygons), volumetric meshes (tetrahedra and hybrid meshes). It has state-of-the-art mesh repair, remeshing, reconstruction algorithms. It also has an interface to the Tetgen tetrahedral mesh generator (by Hang Si). This year, Graphite3 was released. It is a major rewrite, based on Geogram, with increased software quality standards (zero warnings on all platforms, systematic documentation of all classes / all functions / all parameters, dramatically improved performances). It embeds Geogram (and optionally Vorpaline) with an easy-to-use Graphic User Interface.
Graphite is a dedicated software platform in numerical geometry that enables, among other things, 3D modelling and texture baking.

- Participants: Dobrina Boltcheva, Samuel Hornus, Bruno Lévy, David Lopez, Jeanne Pellerin and Nicolas Ray
- Contact: Bruno Lévy
- URL: http://alice.loria.fr/software/graphite

6.4. IceSL

The software allows us to modelize throught CSG's operations 3D's objects. These objects can be directly prepared to be send through a 3d printer without forming an intermediary mesh.

- Participants: Sylvain Lefebvre, Jérémie Dumas, Jean Hergel, Frederic Claux, Jonas Martinez Bayona and Samuel Hornus
- Contact: Sylvain Lefebvre
- URL: http://shapeforge.loria.fr/icesl

6.5. LibSL

LibSL: Simple Library For Graphics
LibSL is a toolbox for rapid prototyping of computer graphics algorithms, under both OpenGL, DirectX 9/10, Windows and Linux.

- Participant: Sylvain Lefebvre
- Contact: Sylvain Lefebvre
- URL: http://members.loria.fr/Sylvain.Lefebvre/libsl

6.6. OpenNL

OpenNL: Open Numerical Library
KEYWORDS: 3D modeling - Numerical algorithm
SCIENTIFIC DESCRIPTION

Open Numerical Library is a library for solving sparse linear systems, especially designed for the Computer Graphics community. The goal of OpenNL is to be as small as possible, while offering the subset of functionalities required by this application field. The Makefiles of OpenNL can generate a single .c + .h file, very easy to integrate in other projects. The distribution includes an implementation of the Least Squares Conformal Maps parameterization method.

- Participants: Bruno Lévy, Rhaleb Zayer and Nicolas Ray
- Contact: Bruno Lévy
- URL: http://alice.loria.fr/index.php/software/4-library/23-opennl.html

6.7. VORPALINE

VORPALINE mesh generator
KEYWORDS: 3D modeling - Unstructured heterogeneous meshes
VORPALINE is a surfacic and volumetric mesh generator, for simplicial meshes (triangles and tetrahedra), for quad-dominant and hex-dominant meshes.

- Participant: Bruno Lévy
- Contact: Bruno Lévy
- URL: http://alice.loria.fr/index.php/erc-vorpaline.html

BIGS Project-Team

6. New Software and Platforms

6.1. AGH

KEYWORDS: statistical analysis, ordered trees
SCIENTIFIC DESCRIPTION

The Matlab toolbox AGH provides methods for statistical analysis of ordered trees from their Harris paths in a user-friendly environment. More precisely it allows to easily compute estimators of the relative scale of trees which share the same shape. These estimators have been introduced for Galton-Watson trees conditioned on their number of nodes but may be computed for any ordered tree. The theoretical study of these estimators is presented in the associated paper [30] which should be consulted in parallel.

FUNCTIONAL DESCRIPTION

The Matlab toolbox AGH provides methods for statistical analysis of ordered trees from their Harris paths in a user-friendly environment.

- Participants: Romain Azaïs, Alexandre Genadot, Benoît Henry
- Contact: romain.azais@inria.fr
- URL: http://agh.gforge.inria.fr

CAMUS Team

6. New Software and Platforms

6.1. Apollo

Automatic speculative POLyhedral Loop Optimizer
KEYWORD: Automatic parallelization
FUNCTIONAL DESCRIPTION

Apollo is dedicated to automatic, dynamic and speculative parallelization of loop nests that cannot be handled efficiently at compile-time. It is composed of a static part consisting of specific passes in the LLVM compiler suite, plus a modified Clang frontend, and a dynamic part consisting of a runtime system. It can apply on-the-fly any kind of polyhedral transformations, including tiling, and can handle nonlinear loops, as while-loops referencing memory through pointers and indirections.

- Participants: Manuel Selva, Juan Manuel Martinez Caamaño, Artiom Baloian, and Philippe Clauss
- Contact: Philippe Clauss
- URL: http://apollo.gforge.inria.fr

6.2. CLooG

Code Generator in the Polyhedral Model
FUNCTIONAL DESCRIPTION

CLooG is a free software and library to generate code (or an abstract syntax tree of a code) for scanning Z-polyhedra. That is, it finds a code (*e.g.* in C, FORTRAN...) that reaches each integral point of one or more parameterized polyhedra. CLooG has been originally written to solve the code generation problem for optimizing compilers based on the polyhedral model. Nevertheless it is used now in various area *e.g.* to build control automata for high-level synthesis or to find the best polynomial approximation of a function. CLooG may help in any situation where scanning polyhedra matters. While the user has full control on generated code quality, CLooG is designed to avoid control overhead and to produce a very effective code. CLooG is widely used (including by GCC and LLVM compilers), disseminated (it is installed by default by the main Linux distributions) and considered as the state of the art in polyhedral code generation.

- Participant: Cédric Bastoul
- Contact: Cédric Bastoul
- URL: http://www.cloog.org

6.3. Clan

A Polyhedral Representation Extraction Tool for C-Based High Level Languages
FUNCTIONAL DESCRIPTION

Clan is a free software and library which translates some particular parts of high level programs written in C, C++, C# or Java into a polyhedral representation called OpenScop. This representation may be manipulated by other tools to, *e.g.*, achieve complex analyses or program restructurations (for optimization, parallelization or any other kind of manipulation). It has been created to avoid tedious and error-prone input file writing for polyhedral tools (such as CLooG, LeTSeE, Candl etc.). Using Clan, the user has to deal with source codes based on C grammar only (as C, C++, C# or Java). Clan is notably the frontend of the two major high-level compilers Pluto and PoCC.

- Participants: Cédric Bastoul
- Contact: Cédric Bastoul
- URL: http://icps.u-strasbg.fr/people/bastoul/public_html/development/clan/

6.4. Clay

Chunky Loop Alteration wizardrY
FUNCTIONAL DESCRIPTION

Clay is a free software and library devoted to semi-automatic optimization using the polyhedral model. It can input a high-level program or its polyhedral representation and transform it according to a transformation script. Classic loop transformations primitives are provided. Clay is able to check for the legality of the complete sequence of transformation and to suggest corrections to the user if the original semantics is not preserved.

- Participant: Cédric Bastoul
- Contact: Cédric Bastoul
- URL: http://icps.u-strasbg.fr/people/bastoul/public_html/development/clay/

6.5. IBB

Iterate-But-Better
FUNCTIONAL DESCRIPTION

IBB is a source-to-source xfor compiler which automatically translates any C source code containing xfor-loops into an equivalent source code where xfor-loops have been transformed into equivalent for-loops.

- Participants: Philippe Clauss and Cédric Bastoul
- Contact: Philippe Clauss
- URL: http://xfor.gforge.inria.fr

6.6. OpenScop

A Specification and a Library for Data Exchange in Polyhedral Compilation Tools
FUNCTIONAL DESCRIPTION

OpenScop is an open specification that defines a file format and a set of data structures to represent a static control part (SCoP for short), i.e., a program part that can be represented in the polyhedral model. The goal of OpenScop is to provide a common interface to the different polyhedral compilation tools in order to simplify their interaction. To help the tool developers to adopt this specification, OpenScop comes with an example library (under 3-clause BSD license) that provides an implementation of the most important functionalities necessary to work with OpenScop.

- Participant: Cédric Bastoul
- Contact: Cédric Bastoul
- URL: http://icps.u-strasbg.fr/people/bastoul/public_html/development/openscop/

6.7. PolyLib

The Polyhedral Library
FUNCTIONAL DESCRIPTION

PolyLib is a C library of polyhedral functions, that can manipulate unions of rational polyhedra of any dimension. It was the first to provide an implementation of the computation of parametric vertices of a parametric polyhedron, and the computation of an Ehrhart polynomial (expressing the number of integer points contained in a parametric polytope) based on an interpolation method. Vincent Loechner is the maintainer of this software.

- Participant: Vincent Loechner
- Contact: Vincent Loechner
- URL: http://icps.u-strasbg.fr/PolyLib/

6.8. ORWL and P99

ORWL is a reference implementation of the Ordered Read-Write Lock tools as described in [1]. The macro definitions and tools for programming in C99 that have been implemented for ORWL have been separated out into a toolbox called P99. ORWL is intended to become opensource, once it will be in a publishable state. P99 is available under a QPL at http://p99.gforge.inria.fr/.

- Participants: Jens Gustedt, Mariem Saied, Daniel Salas
- Contact: Jens Gustedt
- http://p99.gforge.inria.fr/, http://orwl.gforge.inria.fr/

6.9. Stdatomic and Musl

We implement the library side of the C11 atomic interface. It needs compiler support for the individual atomic operations and provides library support for the cases where no low-level atomic instruction is available and a lock must be taken.

- This implementation builds entirely on the ABIs of the gcc compiler for atomics.
- It provide all function interfaces that the gcc ABIs and the C standard need.
- For compilers that don't offer the direct language support for atomics it provides a syntactically reduced but fully functional approach to atomic operations.
- At the core of the library is a new and very efficient futex-based lock algorithm that is implemented for the Linux operating system.

A description of the new lock algorithm has been given in [2]. A short version of it has been presented at SAC'16.

The primary target of this library is an integration into musl to which we also contribute. It is a re-implementation of the C library as it is described by the C and POSIX standards. It is *lightweight*, *fast*, *simple*, *free*, and strives to be correct in the sense of standards-conformance and safety. Musl is production quality code that is mainly used in the area of embedded device. It gains more market share also in other area, *e.g.* there are now Linux distributions that are based on musl instead of Gnu LibC.

- Participant: Jens Gustedt
- Contact: Jens Gustedt
- http://stdatomic.gforge.inria.fr/, http://www.musl-libc.org/

CAPSID Project-Team

6. New Software and Platforms

6.1. Hex

KEYWORDS: 3D rendering - Bioinformatics - 3D interaction - Structural Biology
SCIENTIFIC DESCRIPTION The underlying algorithm uses a novel polar Fourier correlation technique to accelerate the search for close-fitting orientations of the two molecules.
FUNCTIONAL DESCRIPTION Hex is an interactive protein docking and molecular superposition program. Hex understands protein and DNA structures in PDB format, and it can also read small-molecule "SDF" files. Hex will run on most Windows-XP, Linux and Mac OS X PCs. The recent versions now include CUDA support for Nvidia GPUs. On a modern workstation, docking times range from a few minutes or less when the search is constrained to known binding sites, to about half an hour for a blind global search (or just a few seconds with CUDA). On multi-processor Linux systems, docking calculation times can be reduced in almost direct proportion to the number of CPUs and GPUs used. The calculations can be accelerated by using an optional disc cache (strongly recommended) of about 1 GB of disc space.

- Participant: David Ritchie
- Contact: David Ritchie
- URL: http://hex.loria.fr

6.2. Kbdock

FUNCTIONAL DESCRIPTION Database 3D protein domain-domain interactions with a web interface

- Authors: Anisah Ghoorah, Anisah Ghoorah, David Ritchie and Marie Dominique Devignes
- Contact: David Ritchie
- URL: http://kbdock.loria.fr

6.3. Kpax

KEYWORDS: Bioinformatics - Structural Biology
SCIENTIFIC DESCRIPTION To align and superpose the 3D structures of protein molecules.

- Participant: David Ritchie
- Contact: David Ritchie
- URL: http://kbdock.loria.fr

6.4. Sam

Symmetry Assembler
FUNCTIONAL DESCRIPTION To predict the three-dimentional structures of symmetrical protein complexes using spherical polar Fourier representations

- Authors: David Ritchie and Sergey Grudinin
- Partner: CNRS
- Contact: David Ritchie
- URL: http://sam.loria.fr

6.5. ECDomainMiner

KEYWORDS: Protein Domain Annotation

SCIENTIFIC DESCRIPTION

EC-DomainMiner is a recommender-based approach for associating EC (Enzyme Commission) numbers with Pfam domains.

FUNCTIONAL DESCRIPTION

EC-DomainMiner uses a statistical recommender-based approach to infer EC-Pfam relationships from EC-sequence relationships that have been annotated previously in the SIFTS and Uniprot databases.

- Contact: David Ritchie
- URL: http://ecdm.loria.fr

6.6. Platforms

6.6.1. The MBI Platform

The MBI (Modeling Biomolecular Interactions) platform (http://bioinfo.loria.fr) was established to support collaborations between Inria Nancy – Grand Est and other research teams associated with the University of Lorraine. The platform is a research node of the Institut Français de Bioinformatique (IFB), which is the French national network of bioinformatics platforms (http://www.france-bioinformatique.fr).

- Contact: Marie-Dominique Devignes

CARAMBA Project-Team

6. New Software and Platforms

6.1. Belenios

Belenios - Verifiable online voting system
KEYWORD: E-voting
FUNCTIONAL DESCRIPTION

Belenios is an online voting system that provides confidentiality and verifiability. End-to-end verifiability relies on the fact that the ballot box is public (voters can check that their ballots have been taken into account) and on the fact that the tally is publicly verifiable (anyone can recount the votes). Confidentiality relies on the encryption of the votes and the distribution of the decryption key.

Belenios builds upon Helios, a voting protocol used in several elections. The main design enhancement of Belenios vs Helios is that the ballot box can no longer add (fake) ballots, due to the use of credentials.

In 2016 our online platform has been used for several elections, for instance: representatives at the "comité de centre" in several Inria research centers, at the "conseil de laboratoire" at IRISA, and for the head of the "GT Calcul Formel" of the GDR-IM.

- Participants: Pierrick Gaudry, Stéphane Glondu and Véronique Cortier
- Partners: CNRS - Inria
- Contact: Stéphane Glondu
- URL: http://belenios.gforge.inria.fr/

6.2. Kalray-ECM

KEYWORDS: Factorization - Kalray
FUNCTIONAL DESCRIPTION

Implementation of the factorization algorithm based on elliptic curves (ECM) for the MPPA-256 Kalray processor.

- Authors: Jérémie Detrey, Pierrick Gaudry and Masahiro Ishii
- Partner: Nara Institute of Science and Technology, Japan
- Contact: Jérémie Detrey
- URL: https://gforge.inria.fr/projects/kalray-ecm

6.3. TinyGB

- Author: Pierre-Jean Spaenlehauer
- Contact: Pierre-Jean Spaenlehauer
- URL: https://gforge.inria.fr/projects/tinygb/
- Licence: LGPL-3.0+

`TinyGB` is a software implementing tools for computing Gröbner bases of ideals in polynomial rings over finite fields. It has been released in April 2016.

It is not competitive with state-of-art software for computations over small prime fields. However, for polynomial systems over $\mathbb{Z}/p\mathbb{Z}$, with $p > 2^{31}$, its timings are competitive with the computer algebra system `Magma-2.22-2` (although the `Magma` is much better in terms of memory requirements). This is due to the fact that `TinyGB` relies on the library `MPFQ` (developed in the Caramba team) for the efficient arithmetic over large prime fields. For instance, computing the grevlex Gröbner basis of a system of 13 dense homogeneous quadratic equations in 13 variables over the field $\mathbb{Z}/(2^{31}+11)\mathbb{Z}$ can be achieved within 907 seconds with `TinyGB`, whereas `Magma-2.22-2` requires 4459 seconds (on an Intel Core i5-4590@3.30GHz).

The distribution of `TinyGB` contains the libraries `OpenBLAS`, `FFLAS-FFPACK` and `MPFQ`.

CARTE Team (section vide)

COAST Project-Team

4. New Software and Platforms

4.1. MUTE

Multi-User Text Editor
FUNCTIONAL DESCRIPTION

MUTE (Multi-User Text Editor) is a web-based text editing tool that allows users to edit documents collaboratively in real-time. It implements our recent work on collaborative editing algorithms and more specifically the LogootSplit+ approach. Compared to existing web-based collaborative text editing tool this editor does not require a powerful central server since the server is not performing any computation and acts as a simple broadcast server. Our editor offers support for working offline while still being able to reconnect at a later time.

- Participants: Gérald Oster, François Charoy, Claudia-Lavinia Ignat, Phillippe Kalitine, Matthieu Nicolas and Victorien Elvinger
- Contact: Gérald Oster
- URL: https://github.com/coast-team/mute/

4.2. NetFlux

Peer-to-Peer Network Library over WebRTC
FUNCTIONAL DESCRIPTION

NetFlux is a Nodejs library that allows users to deploy a peer-to-peer network between web browsers using the WebRTC technology.

- Participants: Gérald Oster, Phillippe Kalitine, Matthieu Nicolas.
- Contact: Gérald Oster
- URL: https://github.com/coast-team/netflux

4.3. MUTE-structs

Peer-to-Peer Network Library over WebRTC
FUNCTIONAL DESCRIPTION

MUTE-structs is a Nodejs module that provides an implementation of the LogootSplit CRDT algorithm. It is an optimistic replication algorithm that ensures eventual consistency on replicated text sequences. It is used in the MUTE real-time collaborative text editor.

- Participants: Gérald Oster, Claudia-Lavinia Ignat, Phillippe Kalitine, Matthieu Nicolas and Victorien Elvinger
- Contact: Gérald Oster
- URL: https://github.com/coast-team/mute-structs

4.4. Replication Benchmarker

FUNCTIONAL DESCRIPTION

The Replication Benchmarker is a performance evaluation framework for optimistic replication mechanisms used in collaborative applications. It contains a library of implementation of several CRDT (Commutative Replicated Data Type) and OT (Operational Transformation) algorithms for different data types: text, set, trees. The framework is able to evaluate the performance of comparable algorithms on different corpus of event traces. These event traces can be produced randomly according to different parameters, can be extracted from actual real-time editing session that have been recorded, or can be automatically extracted from distributed version control repositories such as the one produced with Git. Performances of the algorithms are measured in terms of execution time, memory footprint and quality of merge result (compared to manual merge history stored in git repositories).

- Participants: Pascal Urso and Gérald Oster
- Contact: Pascal Urso
- URL: https://github.com/score-team/replication-benchmarker/

4.5. Rivage

Real-tIme Vector grAphic Group Editor
FUNCTIONAL DESCRIPTION

Rivage is a real-time collaborative graphical editor. Several users can edit at the same time and in real-time a graphical document, user changes being immediately seen by the other users. The editor relies on a peer-to-peer architecture where users can join and leave the group at any time. Each user has a copy of the shared document and user changes on the document copies are merged in real-time by using a CRDT (Commutative Replicated Data Type) algorithm.

- Participant: Claudia-Lavinia Ignat
- Contact: Claudia-Lavinia Ignat
- URL: https://github.com/stephanemartin/rivage/

LARSEN Team

6. New Software and Platforms

6.1. Limbo

LIbrary for Model-based Bayesian Optimization
KEYWORDS: Black-box optimization - C++ - Global optimization - Machine learning - Policy Learning - Bayesian optimization
FUNCTIONAL DESCRIPTION

Limbo is an open-source C++11 library for Bayesian optimization which is designed to be both highly flexible and very fast. It can be used to optimize functions for which the gradient is unknown, evaluations are expensive, and where runtime cost matters (e.g., on embedded systems or robots). Benchmarks on standard functions show that Limbo is about 2 times faster than BayesOpt (another C++ library) for a similar accuracy.

- Partners: Imperial College London - UPMC
- Contact: Jean-Baptiste Mouret
- URL: http://www.resibots.eu/limbo

6.2. sferes2

A lightweight generic C++ framework for evolutionary computation
FUNCTIONAL DESCRIPTION

Sferes2 is a high-performance, multi-core, lightweight, generic C++98 framework for evolutionary computation. It is intently kept small to stay reliable and understandable.

Sferes2 relies heavily on template-based meta-programming in C++ to get both abstraction and execution speed.

- Partner: UPMC
- Contact: Jean-Baptiste Mouret
- URL: http://github.com/sferes2/sferes2/

6.3. xsensdriver

`xsens_driver`
FUNCTIONAL DESCRIPTION

This is a driver for the third and fourth generation of Xsens IMU devices. The driver is in two parts, a small implementation of most of the MT protocol in Python and a ROS node. It works both on serial and USB interfaces.

These MT* devices can store their configuration and will retrieve it at each boot and then stream data according to this configuration. The node only forwards the data streamed onto ROS topics. In order to configure a device, one can use the mtdevice.py script (or the vendor tool on Windows).

- Contact: Francis Colas
- URL: https://github.com/ethz-asl/ethzasl_xsens_driver

6.4. Platforms

6.4.1. iCub

iCub is a humanoid robot with the size of a 4 years old child. It is developed by the Italian Institute of Technology (Genoa, Italy), which is the coordinator of the EU project CoDyCo. The iCub robot was acquired thanks to the funding of this project.

Our version of iCub has a v2 head, v1 torso, v2.5 legs. It has 6 force/torque sensors, a distributed tactile skin, and inertial sensor in the head.

The robot is used in the context of the projects CoDyCo and Resibots. The software developed for the iCub is mostly published on the github page of our team:

https://github.com/inria-larsen

6.4.2. Pepper

Pepper is a humanoid mobile robot, produced by SoftBank Robotics (formerly Aldebaran). It is designed to engage humans in social interactions, entertain or communicate through gestures and visual animations on its front laptop.

The robot was acquired in the context of the CPER SCIARAT to study human-robot interaction for personal assistance.

MADYNES Project-Team

5. New Software and Platforms

5.1. Distem

KEYWORDS: Large scale - Experimentation - Virtualization - Emulation
FUNCTIONAL DESCRIPTION

Distem is a distributed systems emulator. When doing research on Cloud, P2P, High Performance Computing or Grid systems, it can be used to transform an homogenenous cluster (composed of identical nodes) into an experimental platform where nodes have different performance, and are linked together through a complex network topology, making it the ideal tool to benchmark applications targetting such environments, or aiming at tolerating performance degradations or variations which are frequent in the Cloud or in other applications distributed at large scale (P2P for example).

- Participants: Luc Sarzyniec, Lucas Nussbaum and Tomasz Buchert
- Partners: CNRS - Grid'5000 - Inria - Loria - Université de Lorraine
- Contact: Lucas Nussbaum
- URL: http://distem.gforge.inria.fr

5.2. Grid'5000 testbed

FUNCTIONAL DESCRIPTION Grid'5000 is a scientific instrument designed to support experiment-driven research in all areas of computer science related to parallel, large-scale or distributed computing and networking. It gathers 10 sites, 25 clusters, 1200 nodes, for a total of 8000 cores. It provides its users with a fully reconfigurable environment (bare metal OS deployment with Kadeploy, network isolation with KaVLAN) and a strong focus on enabling high-quality, reproducible experiments.

- Participants: Luc Sarzyniec, Jérémie Gaidamour, Arthur Garnier, Clement Parisot, Emmanuel Jeanvoine, Lucas Nussbaum and Emile Morel
- Contact: Lucas Nussbaum
- URL: https://www.grid5000.fr/

5.3. Kadeploy

KEYWORD: Operating system provisioning
FUNCTIONAL DESCRIPTION

Kadeploy is a scalable, efficient and reliable deployment (provisioning) system for clusters and grids. It provides a set of tools for cloning, configuring (post installation) and managing cluster nodes. It can deploy a 300-nodes cluster in a few minutes, without intervention from the system administrator. It plays a key role on the Grid'5000 testbed, where it allows users to reconfigure the software environment on the nodes, and is also used on a dozen of production clusters both inside and outside Inria.

- Participants: Emmanuel Jeanvoine, Lucas Nussbaum and Luc Sarzyniec
- Partners: CNRS - Grid'5000 - Inria - Loria - Université de Lorraine
- Contact: Lucas Nussbaum
- URL: http://kadeploy3.gforge.inria.fr

5.4. MECSYCO-RE-C++

Multi-agent Environment for Complex SYstems COsimulation. Cœur C++

KEYWORDS: Modeling - Simulation - Simulator - Multi-model - Multi-agent - Agent - Artefact
FUNCTIONAL DESCRIPTION

MECSYCO is a project aiming at the modeling and simulation of complex systems. It provides concepts and tools to describe and then simulate a system as a set of heterogeneous models (namely a multi-model). MECSYCO-RE-C++ is the C++ implementation of the central part (core) of MECSYCO. It can be complimente by mecsyco-com (a communication package for distributed exécution) and mecsyco-visu (a set of tools for vizualizing simulations).

- Participants: Vincent Chevrier, Laurent Ciarletta, Benjamin Camus, Julien Vaubourg, Yannick Presse, Victorien Elvinger, Benjamin Segault and Nicolas Kirchner
- Partners: Inria - Université de Lorraine
- Contact: Vincent Chevrier

5.5. MECSYCO-RE-java

Multi-agent Environment for Complex SYstems COsimulation. Coeur java
KEYWORDS: Modeling - Simulation - Simulator - Multi-model - Co-simulation - Multi-agent - Agent - Artefact
FUNCTIONAL DESCRIPTION

MECSYCO is a project aiming at the modeling and simulation of complex systems. It provides concepts and tools to describe and then simulate a system as a set of heterogeneous models (namely a multi-model). MECSYCO-RE-java is the Java implementation of the central part (core) of MECSYCO. It can be complimente by mecsyco-com (a communication package for distributed exécution) and mecsyco-visu (a set of tools for vizualizing simulations).

- Participants: Christine Bourjot, Vincent Chevrier, Laurent Ciarletta, Benjamin Camus, Julien Vaubourg, Yannick Presse, Victorien Elvinger and Julien Siebert
- Partners: Inria - Université de Lorraine
- Contact: Vincent Chevrier
- URL: http://www.mecsyco.com

5.6. NDNperf

KEYWORDS: Performance measure - Named-Data Networking
FUNCTIONAL DESCRIPTION

We designed NDNperf, an open source tool for NDN server-side performance evaluation and sizing purposes, in order to have an idea of the throughput a server can achieve when it has to generate and transmit NDN Data packets. It is very similar to iPerf and also needs a client and a server to perform the measurements while minimizing the number of instructions between Interest reception and Data emission. It has the following features: - Periodic report of performances: end-to-end throughput, latency, processing time, - Fresh NDN Data generation or NDN Data delivery from caches, - Multi-threaded (one main thread for event lookup and N threads for NDN Data generation), - Able to use all available signatures implemented in the NDN library, choose the size of the key, and the transmission size of Data packets.

- Contact: Thibault Cholez
- URL: http://madynes.loria.fr/software/

5.7. Ruby-cute

KEYWORDS: Experimentation - HPC - Cloud
FUNCTIONAL DESCRIPTION

Ruby-Cute is a set of Commonly Used Tools for Experiments, or Critically Useful Tools for Experiments, depending on who you ask. It is a library aggregating various Ruby snippets useful in the context of (but not limited to) development of experiment software on distributed systems testbeds such as Grid'5000.

- Contact: Lucas Nussbaum
- URL: http://ruby-cute.github.io/

MAGRIT Project-Team

5. New Software and Platforms

5.1. Ltrack

The Inria development action (ADT) LTrack aims at developing an Android platform in order to facilitate the transfer of some of our algorithms onto mobile devices. For the moment, the tracking-by-synthesis algorithm has been implemented (up to our knowledge, for the first time on a mobile device) in order to rigidly track a real object in real time assuming that a CAD model of this object is available. The design and implementation of the platform have been guided by the need to enable easy integration of any tracking algorithm based on combining video data and other sensor information.

- Contact: Marie-Odile Berger, Gilles Simon.

5.2. PoLAR

PoLAR (Portable Library for Augmented Reality) is a software library that offers powerful and state of the art visualization solutions under an API that is adapted and easy to use for a computer vision scientist. An ADT, also named PoLAR, started in October, 1st 2014 to sustain its development: a software engineer, Pierre-Jean Petitprez, was hired for two years. His contract ended at the end of September, 2016.

This year, the library was ported on Android, and Qt 5.7. Various diffusion media were also built: demos, e.g. linked with OpenCV; web site http://polar.inria.fr; detailed documentation with tutorials; and a paper was published at ISMAR'2016 conference [23].

PoLAR was made available to the public in October 2015, and can be used under Linux, Windows, MacOS and Android.

- Contact: Erwan Kerrien, Pierre-Frédéric Villard.
- URL: http://polar.inria.fr

5.3. Fast>VP

Fast>VP is a fast and effective tool to detect vanishing points in uncalibrated images of man-made environments and automatically orthorectify the involved planes. It is a Matlab implementation of the algorithm described in our Eurographics'2016 paper [25].

- Contact: Gilles Simon
- URL: https://members.loria.fr/GSimon/fastvp/

5.4. The GridMethod Toolbox

This Matlab toolbox implements several efficient and state-of-the art algorithms to estimate displacement and strain fields from grid images deposited on the surface of a specimen submitted to a loading or tensile test.

- Contact: Frédéric Sur
- URL:http://www.thegridmethod.net

MIMESIS Team

4. New Software and Platforms

4.1. Simulation Open Framework Architecture

Keywords: Real time - Multi-physics simulation - Medical applications

Description: SOFA is an Open Source framework primarily targeted at real-time simulation, with an emphasis on medical simulation. It is mostly intended for the research community to help develop new algorithms, but can also be used as an efficient prototyping tool. Based on an advanced software architecture, it allows : the creation of complex and evolving simulations by combining new algorithms with algorithms already included in SOFA, the modification of most parameters of the simulation (deformable behavior, surface representation, solver, constraints, collision algorithm, etc.) by simply editing an XML file, the building of complex models from simpler ones using a scene-graph description, the efficient simulation of the dynamics of interacting objects using abstract equation solvers, the reuse and easy comparison of a variety of available methods.

URL: http://www.sofa-framework.org

MULTISPEECH Project-Team

6. New Software and Platforms

6.1. ASTALI

Automatic Speech-Text Alignment Software
KEYWORD: Speech-text alignment
FUNCTIONAL DESCRIPTION

ASTALI is a software for aligning a speech signal with its corresponding orthographic transcription (given in simple text file for short audio signals or in .trs files as generated by transcriber for longer speech signals). Using a phonetic lexicon and automatic grapheme-to-phoneme converters, all the possible sequences of phones corresponding to the text are generated. Then, using acoustic models, the tool finds the best phone sequence and provides the boundaries at the phone and at the word levels. ASTALI is available through a web application, which makes the service easy to use, without requiring any software downloading. This year, the integration of the web application on the ORTOLANG platform has been finalized.

- Participants: Dominique Fohr, Odile Mella, Antoine Chemardin, Valérian Girard and Denis Jouvet
- Contact: Dominique Fohr
- URLs: https://www.ortolang.fr/market/tools/astali; http://astali.loria.fr/; and http://ortolang108.inist.fr/astali/

6.2. dnnsep

Multichannel audio source separation with deep neural networks
KEYWORDS: Audio - Source Separation - Deep learning
SCIENTIFIC DESCRIPTION

dnnsep is the only source separation software relying on multichannel Wiener filtering based on deep learning. Deep neural networks are used to initialize and reestimate the power spectrum of the sources at every iteration of an expectation-maximization (EM) algorithm. This results in state-of-the-art separation quality for both speech and music.
FUNCTIONAL DESCRIPTION

dnnsep is a new software that combines deep neural networks and multichannel signal processing for speech enhancement and separation of musical recordings.

- Participants: Aditya Nugraha, Antoine Liutkus and Emmanuel Vincent
- Contact: Emmanuel Vincent

6.3. JSnoori

FUNCTIONAL DESCRIPTION

JSnoori is written in Java and uses signal processing algorithms developed within the WinSnoori software with the double objective of being a platform independent signal visualization and manipulation tool, and also for designing exercises for learning the prosody of a foreign language. JSnoori can be used directly or via scripts written in Jython. This year, several approaches for computing the fundamental frequency have been added; and, JSnoori is now available through the ORTOLANG platform.

- Participants: Yves Laprie, Slim Ouni, Aghilas Sini and Ilef Ben Farhat
- Contact: Yves Laprie

6.4. KATS

Kaldi-based Automatic Transcription System
KEYWORD: Speech recognition
FUNCTIONAL DESCRIPTION

KATS is a multipass system for transcribing audio data, and in particular radio or TV shows. The audio stream is first split into homogeneous segments that are decoded using the most adequate acoustic model with a large vocabulary continuous speech recognition engine. In this new software, the recognition engine is based on the Kaldi toolkit, and uses Deep Neural Network - DNN - based acoustic models. An extra processing pass is run in order to rescore the n-best hypotheses with a higher order language model.

- Participants: Odile Mella, Dominique Fohr and Denis Jouvet
- Contact: Dominique Fohr
- URL: Available online on the Allgo platform: https://allgo.inria.fr/app/loriasts_kaldi

6.5. PLAVIS

Sofware for audio-visual and multimodal data acquisition and processing
FUNCTIONAL DESCRIPTION

Within the ADT PLAVIS (cf. 9.2.12), we have developed a software for 3D audiovisual data acquisition and synthesis. The system incorporates an animation module of the talking head to reconstruct the animated face along with audio. The acquisition software handles one or several acquisition systems: motion-capture (Kinect-like), Vicon or EMA systems. The various acquisition channels are synchronized. The animation technique can exploit multimodal data to define blendshapes that controls the face; the advantage of using blendshapes is to be able to transfer the animation from one 3D human model to another. A semi-automatic acoustic boundary correction process is integrated in the corpus building process. The text-to-speech processing is driven by the Soja software.

- Participants: Vincent Colotte, Slim Ouni, Sara Dahmani
- Contact: Vincent Colotte

6.6. SOJA

Speech Synthesis platform in JAva
FUNCTIONAL DESCRIPTION

SOJA is a software for Text-To-Speech synthesis (TTS) which relies on a non uniform unit selection algorithm. It performs all steps from text input to speech signal output. A set of associated tools is available for elaborating a corpus for a TTS system (transcription, alignment. . .). Currently, the corpus contains about 3 hours of speech recorded by a female speaker. Most of the modules are in Java, some are in C. The SOJA software runs under Windows and Linux. It can be launched with a graphical user interface or directly integrated in a Java code or by following the client-server paradigm. During 2016, the part of code in C was reduced to go to a full-Java software in the future. The natural language processing can now be restarted from any step. This functionality is useful for instance during corpus processing when using semi-automatic boundaries correction.

- Participants: Vincent Colotte and Alexandre Lafosse
- Contact: Vincent Colotte

6.7. VisArtico

Visualization of EMA Articulatory data
FUNCTIONAL DESCRIPTION

VisArtico is a user-friendly software which allows visualizing EMA data acquired by an articulograph (AG500, AG501 or NDI Wave). This visualization software has been designed so that it can directly use the data provided by the articulograph to display the articulatory coil trajectories, synchronized with the corresponding acoustic recordings. Moreover, VisArtico not only allows viewing the coil trajectories but also enriches the visual information by indicating clearly and graphically the data for the tongue, lips and jaw. In addition, it is possible to insert images (MRI or X-Ray, for instance) to compare the EMA data with data obtained through other acquisition techniques. It is possible to generate a movie for any articulatory-acoustic sequence. During 2016, we have made a new version of VisArtico where the 3D view is now based on OpenGL. This allows a better quality rendering. It is possible to make measurement between sensors to compute the distance. Finally, we added the possibility to display the fundamental frequency on the spectrogram.

- Participants: Slim Ouni, Loic Mangeonjean, Ilef Ben Farhat and Bertrand Muller
- Contact: Slim Ouni
- URL: http://visartico.loria.fr

6.8. Xarticulators

KEYWORD: Medical imaging
FUNCTIONAL DESCRIPTION

The Xarticulators software is intended to delineate contours of speech articulators in X-ray images, construct articulatory models and synthesize speech from X-ray films. This software provides tools to track contours automatically, semi-automatically or by hand, to make the visibility of contours easier, to add anatomical landmarks to speech articulators and to synchronize images with the sound. In addition we also added the possibility of processing digitized manual delineation results made on sheets of papers when no software is available. Xarticulators also enables the construction of adaptable linear articulatory models from the X-ray images and incorporates acoustic simulation tools to synthesize speech signals from the vocal tract shape. Recent work was on the possibility of synthesizing speech from X-ray or 2D-MRI films.
During 2016, we developed a new version of the articulatory model which incorporates a more realistic model of the epiglottis and lips.

- Contact: Yves Laprie

6.9. Platforms

6.9.1. Platform MultiMod : Multimodal Acquisition Data Platform

FUNCTIONAL DESCRIPTION

Within a LORIA exploratory project (cf. 9.2.13), we have set up an acquisition hardware platform to acquire multimodal data in speech communication context. The system is composed of the articulograph Carstens AG501 (which was acquired as part of the EQUIPEX ORTOLANG - cf. 9.2.1), 4 Vicon cameras (a motion capture system), an Intel RealSense which is a depth camera (acquired as part of the project COREXp - cf. 9.1.1), a video camera and a microphone. With such heterogeneous hardware the synchronization is essential; this is achieved through a trigger device. All the data processing is performed with the PLAVIS software. This year, the system has been used to acquire multimodal data for the MCC project (cf. 9.4.2.1) and a first exploratory expressive multimodal corpus [40].

- Participants: Slim Ouni, Vincent Colotte, Valerian Girard, Sara Dahmani
- Contact: Slim Ouni

NEUROSYS Project-Team

6. New Software and Platforms

6.1. AnaesthesiaSimulator

KEYWORDS: General anaesthesia - Spiking neural networks - Health
FUNCTIONAL DESCRIPTION

AnaesthesiaSimulator simulates the activity of networks of spiking neurons subject to specific receptor dynamics. The tool is a platform to test effects of anaesthetics on neural activity and is still in its first stage of development. The neural activity is planned to be visualized in a 2D and 3D-plot evolving in time. It is written in Python, open-source and involves heavily the simulation package BRIAN.

- Participants: Axel Hutt and Laure Buhry
- Partner: University of Auckland
- Contact: Axel Hutt
- URL: https://gforge.inria.fr/projects/anasim/

6.2. BrianModel

Library of Brian Neuron Models
KEYWORDS: Spiking neural networks - Neurosciences - Numerical simulations
FUNCTIONAL DESCRIPTION

BrianModel is a library of neuron models and ionic currents for the BRIAN simulator. The purpose of BrianModel is to speed up simulation set-up and reduce code duplication across simulation scripts. Template neurons are defined by the ionic currents that flow through their membrane. Implemented templates include: Hodgkin-Huxley pyramidal neuron, Hodgkin-Huxley pyramidal neuron with CAN receptors, Hodgkin-Huxley fast-spiking inhibitory hippocampal. The current library is easily extensible by third-party users due to its hierarchical design. The template neurons and their currents are defined as YAML files, which are conveniently parsed by a Python library which acts as an interface to the BRIAN simulator API's.

- Contact: Francesco Giovannini
- URL: https://github.com/JoErNanO/brianmodel

6.3. MATCWT

continuous wavelet transform
KEYWORDS: Matlab - Visualization - Signal processing
FUNCTIONAL DESCRIPTION

This MATLAB script builds continuous wavelet transform (CWT) allowing to choose scales/frequencies and how to compute cone of influence (COI). It uses built-in MATLAB functions to calculate the transform (cwt.m and cwtft.m). This function returns scalogram, percentage energy for each coefficient of CWT. It also plots CWT (if such option is specified), all the values on the plot are linear ones. Plot function displays COI as hatched regions, to do so an additional function is required. Hatchfill function was used for that. I modifies this function slightly in order to control color of hatch lines and added to the repo for convenience. Otherwise, instead of using hatched regions, COI can be indicated by using MATLAB patch function with alpha set to a value less than 1.

- Contact: Mariia Fedotenkova
- URL: https://github.com/mfedoten/wavelets

6.4. MATSPECTRO

Spectrogram reassignment
KEYWORDS: Matlab - Visualization - Signal processing
FUNCTIONAL DESCRIPTION

This matlab function computes reassigned version of the conventional and multitaper spectrograms. The algorithm is based on Auger and Flandrin method, some parts are adopted from Fulop and Fitz. The idea is to first compute conventional spectrogram, then find optimal (in a sense of energy) time and frequency positions and reassigns values in the spectrogram to this new positions. The difference between conventional and multitaper spectrograms is that multitaper method computes additional spectrogram with each taper. Taper is a generic term for a window function but in this method tapers refer to Slepian sequences. As a result, generally multitaper spectrogram reveals less variance than conventional one.

- Contact: Mariia Fedotenkova
- URL: https://github.com/mfedoten/reasspectro

6.5. NFSimulator

NeuralFieldSimulator
KEYWORDS: Neurosciences - Simulation - Health
FUNCTIONAL DESCRIPTION

The NeuralFieldSimulator computes numerically activity in two-dimensional neural fields by solving integral-differential equations involving transmission delays and visualizes the spatio-temporal activity. The tool includes a GUI that allows the user to choose field parameters. It is written in Python, open-source and is aimed to be promoted to become a major graphical visualization tool in the domain of neural field theory. We aim to establish this simulation software as the first open-source standard simulator for the neural field research community.

- Contact: Axel Hutt
- URL: https://gforge.inria.fr/projects/nfsimulator/

6.6. OpenVIBE

KEYWORDS: Neurosciences - Interaction - Virtual reality - Health - Real time - Neurofeedback - Brain-Computer Interface - EEG - 3D interaction
FUNCTIONAL DESCRIPTION

OpenViBE is a software platform for real-time neurosciences (that is, for real-time processing of brain signals). It can be used to acquire, filter, process, classify and visualize brain signals in real time from various signal sources. OpenViBE is free and open source software. It works on Windows and Linux operating systems.

- Participants: Yann Renard, Anatole Lécuyer, Fabien Lotte, Bruno Renier, Vincent Delannoy, Laurent Bonnet, Baptiste Payan, Jozef Legény, Jussi Tapio Lindgren, Alison Cellard, Loïc Mahé, Guillaume Serriere, Marsel Mano, Maureen Clerc Gallagher, Théodore Papadopoulo, Laurent Bougrain, Jérémy Frey and Nathanaël Foy
- Partners: CEA-List - GIPSA-Lab - INSERM
- Contact: Anatole Lécuyer, Hybrid/Inria Rennes-Bretagne Atlantique
- URL: http://openvibe.inria.fr

6.7. Platforms

6.7.1. EEG experimental room

A room at Inria Nancy - Grand Est is now dedicated to electroencephalographic recordings. An umbrella agreement and several additional experiment descriptions have been approved by the Inria Operational Legal and Ethical Risk Assessment Committee (COERLE).

Figure 1. Electroencephalographic Experimental room at Inria Nancy-Grand Est

ORPAILLEUR Project-Team

6. New Software and Platforms

6.1. Symbolic KDD Systems

6.1.1. LatViz

- Contact: Thi Nhu Nguyen Le
- URL: http://latviz.loria.fr/latviz/
- KEYWORDS: Formal Concept Analysis, Pattern Mining, Concept Lattice, Implications, Visualization

FUNCTIONAL DESCRIPTION.

LatViz is a new tool which allows the construction, the display and the exploration of concept lattices. LatViz proposes some remarkable improvements over existing tools and introduces various new functionalities focusing on interaction with experts, such as visualization of pattern structures (for dealing with complex non-binary data), AOC-posets (the core elements of the lattice), concept annotations, filtering based on various criteria and a visualization of implications [28], [27]. This way the user can effectively perform interactive exploratory knowledge discovery as often needed in knowledge engineering.

The Latviz platform can be associated with the Coron platform and extends its visualization capabilities (see http://coron.loria.fr). Recall that the Coron platform includes a complete collection of data mining algorithms for extracting itemsets and association rules.

6.1.2. OrphaMine – Data mining platform for orphan diseases

- Partners: INSERM – MoDYCo CNRS – Greyc Université de Caen Basse Normandie
- Contact: Chedy Raïssi
- URL: http://orphamine.inria.fr/
- KEYWORDS: Bioinformatics, data mining, biology, health, data visualization, drug development.

FUNCTIONAL DESCRIPTION.

The OrphaMine platform, developed as part of the ANR Hybrid project, enables visualization, data integration and in-depth analytics. The data at the heart of the platform is about orphan diseases and is extracted from the OrphaData ontology (http://www.orpha.net).

We aim at building a true collaborative portal that will serve the different actors of the Hybrid project: (i) A general visualization of OrphaData data for physicians working, maintaining and developing this knowledge database about orphan diseases. (ii) The integration of analytics (data mining) algorithms developed by the different academic actors. (iii) The use of these algorithms to improve our general knowledge of rare diseases.

6.1.3. POQEMON Analytics: Platform for Quality Evaluation of Mobile Networks

- Partners: Altran, DataPublica, GenyMobile, HEC, Inria Nancy-Grand Est, IP-Label, Next Interactive Media, Orange, Université Paris-Est Créteil
- Contact: Chedy Raïssi
- URL: https://members.loria.fr/poqemon/
- KEYWORDS: Data mining, data visualization.

FUNCTIONAL DESCRIPTION.

POQEMON is a quality evaluation platform for mobile phone networks developed in the Orpailleur team in the frameowrok of an FUI project (see 8.2.2). The quality measures which are studied include the coverage, availability and network performances. Multiple methods are implemented in this platform, either in visualization or in data anonymization to make on-line analytics as simple as possible.

6.1.4. Siren - Interactive and visual redescription mining

- Contact: Esther Galbrun
- URL: http://siren.gforge.inria.fr/main/
- KEYWORDS: Redescription mining, Interactivity, Visualization.

FUNCTIONAL DESCRIPTION.

Siren is a tool for interactive mining and visualization of redescriptions. Redescription mining aims to find distinct common characterizations of the same objects and, vice versa, to identify sets of objects that admit multiple shared descriptions. The goal is to provide domain experts with a tool allowing them to tackle their research questions using redescription mining. Merely being able to find redescriptions is not enough. The expert must also be able to understand the redescriptions found, adjust them to better match his domain knowledge and test alternative hypotheses with them, for instance. Thus, Siren allows mining redescriptions in an anytime fashion through efficient, distributed mining, to examine the results in various linked visualizations, to interact with the results either directly or via the visualizations, and to guide the mining algorithm toward specific redescriptions.

6.2. Stochastic systems for knowledge discovery and simulation

6.2.1. The CarottAge and ARPEnTAge Systems

- Contact: Jean-François Mari
- URL:http://carottage.loria.fr
- KEYWORDS: Stochastic process, Hidden Markov Models.

FUNCTIONAL DESCRIPTION.

The system CarottAge is based on Hidden Markov Models of second order and provides a non supervised temporal clustering algorithm for data mining [84]. CarottAge is currently used by INRA researchers interested in mining the changes in territory and landscape related to the loss of biodiversity (projects ANR BiodivAgrim and ACI Ecoger) and/or water contamination. CarottAge was also used for mining hydromorphological data and gave interesting results for that purpose.

ARPEnTAge, for "*Analyse de Régularités dans les Paysages : Environnement, Territoires, Agronomie*" is built on top of the CarottAge system to fully take into account the spatial dimension of input sequences. It can be used for analyzing spatio-temporal databases [85] and for space-time clustering of a landscape based on temporal land uses. Displaying tools and the generation of time-dominant shape files have also been defined. With agronomists, we are now focusing on the simulation of unknown spatial time sequences in order to explore various crop management scenarios.

CarottAge and ARPEnTAge are freely available under GPL license. A special effort is currently aimed at designing interactive visualization tools to provide the expert a user-friendly interface.

PESTO Project-Team

6. New Software and Platforms

6.1. Akiss

Akiss (Active Knowledge in Security Protocols) is a tool for verifying indistinguishability properties in cryptographic protocols, modelled as trace equivalence in a process calculus. Indistinguishability is used to model a variety of properties including anonymity properties, strong versions of confidentiality and resistance against offline guessing attacks, etc. *Akiss* implements a procedure to verify equivalence properties for a bounded number of sessions based on a fully abstract modelling of the traces of a bounded number of sessions of the protocols into first-order Horn clauses and a dedicated resolution procedure. The procedure can handle a large set of cryptographic primitives, namely those that can be modeled by an optimally reducing convergent rewrite system. The tool also includes the possibility for checking everlasting indistinguishability properties [32].

The tool is still under active development, including optimisations to improve efficiency, but also the addition of new features, such as the possibility to model protocols using weak secrets, and the addition of support for exclusive or.

The *Akiss* tool is freely available at https://github.com/akiss/akiss.

6.2. ATSE

We develop *CL-AtSe*, a Constraint Logic based Attack Searcher for cryptographic protocols, initiated and continued by the European projects *AVISPA*, AVANTSSAR (for web-services) and Nessos respectively. The *CL-AtSe* approach to verification consists in a symbolic state exploration of the protocol execution for a bounded number of sessions, thus is both correct and complete. *CL-AtSe* includes a proper handling of sets, lists, choice points, specification of any attack states through a language for expressing e.g., secrecy, authentication, fairness, or non-abuse freeness, advanced protocol simplifications and optimizations to reduce the problem complexity, and protocol analysis modulo the algebraic properties of cryptographic operators such as XOR (exclusive or) and Exp (modular exponentiation).

CL-AtSe has been successfully used to analyse protocols from e.g., France Telecom R&D, Siemens AG, IETF, Gemalto, Electrum in funded projects. It is also employed by external users, e.g., from the AVISPA's community. Moreover, *CL-AtSe* achieves good analysis times, comparable and sometimes better than other state-of-the art tools.

CL-AtSe has been enhanced in various ways. It fully supports the Aslan semantics designed in the context of the AVANTSSAR project, including Horn clauses (for intruder-independent deductions, e.g., for credential management), and a large fragment of LTL-based security properties. A Bugzilla server collects bug reports, and online analysis and orchestration are available on our team server (https://cassis.loria.fr). Large models can be analysed on the TALC Cluster in Nancy with parallel processing. *CL-AtSe* also supports negative constraints on the intruder's knowledge, which reduces drastically the orchestrator's processing times and allows separation of duties and non-disclosure policies, as well as conditional security properties, like: i) an authentication to be verified iff some session key is safe; ii) relying on a leaking condition on some private data instead of an honesty predicate to trigger or block some agent's property. This was crucial for e.g., the Electrum's wallet where all clients can be dishonest but security guarantees must be preserved anyway.

6.3. Belenios

In collaboration with the Caramba project-team, we develop an open-source private and verifiable electronic voting protocol, named *Belenios*. Our system is an evolution and a new implementation of an existing system, Helios, developed by Ben Adida, and used e.g., by UCL and the IACR association in real elections. The main differences with Helios are a cryptographic protection against ballot stuffing and a practical threshold decryption system that allows us to split the decryption key among several authorities, k out of n authorities being sufficient to decrypt. We will continue to add new cryptographic and protocol improvements to offer a secure, proved, and practical electronic voting system.

Belenios has been implemented (cf. http://belenios.gforge.inria.fr) by Stéphane Glondu (SED Team). Since 2015, it is used by CNRS for remote election among its councils and since 2016, it used by Inria to elect representatives in the "comités de centre" of each Inria center. It has also been used to elect the leader of the GdR-IM working groups C2 and Calcul Formel. It has also been used in smaller elections (e.g., to choose an invited speaker).

6.4. Tamarin

The *TAMARIN* prover is a security protocol verification tool that supports both falsification and unbounded verification of security protocols specified as multiset rewriting systems with respect to (temporal) first-order properties and a message theory that models Diffie-Hellman exponentiation combined with a user-defined subterm-convergent rewriting theory.

Its main advantages are its ability to handle stateful protocols and its interactive proof mode. Moreover, it has recently been extended to verify equivalence properties.

The tool is developed jointly by the PESTO team, the Institute of Information Security at ETH Zurich, and the University of Oxford.

TAMARIN is freely available at http://tamarin-prover.github.io/. In a joint effort, the partners wrote and published a user manual in 2016, available from the same website.

6.5. Sapic

SAPIC is a tool that translates protocols from a high-level protocol description language akin to the applied pi-calculus into multiset rewrite rules, that can then be be analysed using the *TAMARIN* prover. *TAMARIN* has also bee extended with dedicated heuristics that exploit the form of translated rules and favour termination.

SAPIC offers support for the analysis of protocols that include states, for example Hardware Security Tokens communicating with a possibly malicious user, or protocols that rely on databases. It also allows us to verify liveness properties and a recent extension adds a notion of location and reporting used for modelling trusted execution environments. It has been successfully applied on several case studies including the Yubikey authentication protocol, extensions of the PKCS#11 standard and fair exchange protocols.

SAPIC is freely available at http://sapic.gforge.inria.fr/.

SEMAGRAMME Project-Team

5. New Software and Platforms

5.1. ACGtk

Abstract Categorial Grammar Development Toolkit
KEYWORDS: Natural language processing - NLP - Syntactic analysis - Semantics
FUNCTIONAL DESCRIPTION

ACGtk provides softwares for developing and using Abstract Categorial Grammars (ACG).

- Contact: Sylvain Pogodalla
- URL: http://www.loria.fr/equipes/calligramme/acg/

5.2. Grew

Graph Rewriting
FUNCTIONAL DESCRIPTION

Grew is a Graph Rewriting tool dedicated to applications in NLP. Grew takes into account confluent and non-confluent graph rewriting and it includes several mechanisms that help to use graph rewriting in the context of NLP applications (built-in notion of feature structures, parametrization of rules with lexical information).

In 2016, Grew was used in different applications. The Graph Rewriting System presented in [1] was improved and is used in the preprocessing of data in the ZombiLingo project (see 6.3.1). It was also extensively used in the Universal Dependencies project for improving the French sub-corpus.

- Contact: Bruno Guillaume
- URL: http://grew.loria.fr

5.3. ZombiLingo

FUNCTIONAL DESCRIPTION

ZombiLingo is a GWAP (Game With A Purpose) where gamers have to give linguistic information about the syntax of natural language sentence.

During 2016, the main evolutions of the application were:

- New game modes: for instance the duel mode where two players can compare their results on a set on sentence.
- Integration of data preprocessing, data postprocessing to the back-office.
- Integration of evaluation methods [15] in the back-office.

The current version is used for the French language and it is planned to use it with other languages (English and low-resourced languages).

- Authors: Nicolas Lefebvre, Karën Fort, Bruno Guillaume and Valentin Stern
- Contact: Bruno Guillaume
- Application URL: http://zombilingo.org/
- Code URL: https://github.com/zombilingo

5.4. SLAMtk

A management chain of the transcriptions of interviews for the SLAM project which products of a full anonymized randomized version of the resources. Some extensions have been implemented based on Distagger (disfluences) and MElt (POS and lemma). The tool was reimplemented in order to propose generic treatments for the different corpora.

- Contact: Maxime Amblard
- URL: http://slam.loria.fr

SPHINX Project-Team

6. New Software and Platforms

6.1. GPELab

Gross-Pitaevskii equations Matlab toolbox
KEYWORDS: 3D - Quantum chemistry - 2D
FUNCTIONAL DESCRIPTION

GPELab is a Matlab toolbox developed to help physicists compute ground states or dynamics of quantum systems modeled by Gross-Pitaevskii equations. This toolbox allows the user to define a large range of physical problems (1d-2d-3d equations, general nonlinearities, rotation term, multi-components problems...) and proposes numerical methods that are robust and efficient.

- Contact: Xavier Antoine
- URL: http://gpelab.math.cnrs.fr/

6.2. GetDDM

KEYWORDS: Large scale - 3D - Domain decomposition - Numerical solver
FUNCTIONAL DESCRIPTION

GetDDM combines GetDP and Gmsh to solve large scale finite element problems using optimized Schwarz domain decomposition methods.

- Contact: Xavier Antoine
- URL: http://onelab.info/wiki/GetDDM

6.3. μ-diff

μ-diff is a Matlab toolbox developed with B. Thierry (UPMC, France) for solving 2D multiple scattering problems by a random collection of circular cylinders.

- Contact: Xavier Antoine
- URL: http://mu-diff.math.cnrs.fr/mu-diff/

6.4. Platforms

6.4.1. A software for the efficient assignment of L-INP students

Each year, the 1500 students of the L-INP Collégium (gathering most of the engineering students in Lorraine) have to choose one or several among the 70+ courses. J-F. Scheid, a member of our team, is a faculty member of TELECOM Nancy and developed a solver giving a fair, fast and reliable assignment of the students to the courses. The solver works with integer linear optimization and is written in Python and CBC/COIN-OR.

TONUS Team

5. New Software and Platforms

5.1. SCHNAPS - KIRSCH

Participants: Emmanuel Franck, Pierre Gerhard, Philippe Helluy, Michel Massaro, Malcolm Roberts, David Coulette, Laura Mendoza, Bruno Weber.

SCHNAPS: Solveur pour les lois de Conservation Hyperboliques Non-linéaires Appliqué aux PlasmaS

SCIENTIFIC DESCRIPTION

The future computers will be made of a collection of thousands of interconnected multicore processors. Globally, it appears as a classical distributed memory MIMD machine. But at a lower level, each of the multicore processors is itself made of a shared memory MIMD unit (a few classical CPU cores) and a SIMD unit (a GPU or Xeon Phi). When designing new algorithms, it is important to adapt them to this kind of architecture. Practically, we use the MPI library for managing the coarse grain parallelism, while the OpenCL library efficiently operate the fine grain parallelism.

We have invested for several years until now into scientific computing on GPUs, using the open standard OpenCL (Open Computing Language). We were recently awarded a prize in the international AMD OpenCL innovation challenge thanks to an OpenCL two-dimensional Vlasov-Maxwell solver that fully runs on a GPU. OpenCL is a very interesting tool because it is an open standard now available on almost all brands of multicore processors and GPUs. The same parallel program can run on a GPU or a multicore processor without modification. OpenCL programs are quite complicated to construct. For instance it is difficult to distribute efficiently the computation or memory operations on the different available accelerators. StarPU http://starpu.gforge.inria.fr/ is a runtime system developed at Inria Bordeaux that simplifies the distribution of tasks on heterogeneous compute units. We have started to use this software tool in SCHNAPS.

Because of the envisaged applications, which may be either academic or commercial, it is necessary to conceive a modular framework. The kernel of the library is made of generic parallel algorithms for solving conservation laws. The parallelism can be both fine-grained (oriented towards GPUs and multicore processors) and coarse-grained (oriented towards GPU clusters). The separate modules allow managing the meshes and some specific applications. With our partner AxesSim, we also develop a C++ specific version of SCHNAPS for electromagnetic applications.
Since the middle of the year a specific version of SCHNAPS (called KIRSCH for Kinetic Representation of SChnaps) has been developed to handle Lattice Boltzmann schemes for MHD and fluid simulations.

FUNCTIONAL DESCRIPTION

SCHNAPS and KIRSCH are a generic Discontinuous Galerkin solver and an implicit Lattice Boltzmann solver, written in C, based on the OpenCL, MPI and StarPU frameworks.

- Partner: AxesSim
- Contact: Philippe Helluy
- URL: http://schnaps.gforge.inria.fr/

5.2. Selalib

Participants: Sever Adrian Hirstoaga, Michel Mehrenberger, Pierre Navaro, Laurent Navoret, Thi Trang Nhung Pham, Christophe Steiner.

KEYWORDS: Plasma physics - Semi-Lagrangian method - PIC - Parallel computing - Plasma turbulence

SCIENTIFIC DESCRIPTION

The objective of the Selalib project (SEmi-LAgrangian LIBrary) is to develop a well-designed, organized and documented library implementing several numerical methods for kinetic models of plasma physics. Its ultimate goal is to produce gyrokinetic simulations.

Another objective of the library is to provide to physicists easy-to-use gyrokinetic solvers, based on the semi-Lagrangian techniques developed by Eric Sonnendrücker and his collaborators in the past CALVI project. The new models and schemes from TONUS are also intended to be incorporated into Selalib.

FUNCTIONAL DESCRIPTION

Selalib is a collection of modules conceived to aid in the development of plasma physics simulations, particularly in the study of turbulence in fusion plasmas. Selalib offers basic capabilities from general and mathematical utilities and modules to aid in parallelization, up to pre-packaged simulations.

- Partners: Max Planck Institute - Garching - IRMA, Université de Strasbourg - IRMAR, Université Rennes 1 - LJLL, Université Paris 6
- Contact: Michel Mehrenberger
- URL: http://selalib.gforge.inria.fr/

5.3. Django

Participants: Emmanuel Franck [correspondent], Boniface Nkonga, Ahmed Ratnani.

- Scientific description:
  The JOREK code is one of the most important MHD codes in Europe. This code written 15 years ago allows to simulate the MHD instabilities which appear in the Tokamak. Using this code the physicists have obtained some important results. However to run larger and more complex test cases it is necessary to extend the numerical methods used.
  In 2014, the DJANGO code has been created, the aim of this code is twofold: have a numerical library to implement, test and validate new numerical methods for MHD, fluid mechanics and Electromagnetic equations in the finite element context and prepare the future new JOREK code. This code is a 2D-3D code based on implicit time schemes and IsoGeometric (B-Splines, Bezier curves) for the spatial discretization.
- Functional description:
  DJANGO is a finite element implicit solver written in Fortran 2008 with a Basic MPI framework.
- Authors:
  Ahmed Ratnani (Max Planck Institut of Plasma Physic, Garching, Germany), Boniface Nkonga (University of Nice and Inria Sophia-Antipolis, France), Emmanuel Franck (Inria Nancy Grand Est, TONUS Team)
- Contributors:
  Mustafa Gaja, Jalal Lakhlili, Matthias Hoelzl and Eric Sonnendrücker (Max Planck Institut of Plasma Physic, Garching, Germany), Ayoub Iaagoubi (ADT Inria Nice), Hervé Guillard (University of Nice and Inria Sophia-Antipolis, France), Virginie Grandgirard, Guillaume Latu (CEA Cadarache, France)
- Year 2016:
  Between the years 2015 and 2016 the code has been partially rewritten using Fortran 2008 to prepare the implementation of new methods (compatible finite element spaces, 3D B-Splines meshes). The different models, hyperbolic, parabolic and elliptic introduced in the previous version of the code have been rewritten and validated. Actually, we will begin to introduce the Maxwell equations for the coupling with kinetic equations and the nonlinear fluid models (first step for the MHD simulations). A large effort of optimization and parallelization in the matrices assembly has been made and new preconditioning for elliptic models has been introduced.
  - Partners: Max Planck Institute - Garching - IRMA, Université de Strasbourg - Inria Nice Sofia- Antipolis
  - Contact: Emmanuel Franck

TOSCA Project-Team

5. New Software and Platforms

5.1. AGH

FUNCTIONAL DESCRIPTION

AGH (for Analysis of Galton-Watson Harris paths) is a Matlab toolbox providing methods for statistical analysis of ordered trees from their Harris paths in a user-friendly environment. More precisely it allows to easily compute estimators of the relative scale of trees which share the same shape. These estimators have been introduced for Galton-Watson trees conditioned on their number of nodes but may be computed for any ordered tree.

- Participants: Romain Azaïs, Alexandre Genadot, Benoît Henry
- Contact: Benoît Henry
- URL: http://agh.gforge.inria.fr/

5.2. ExitBM

FUNCTIONAL DESCRIPTION

The exitbm library provides methods to simulate random variables related to the first exit time and position of the Brownian motion from simple domains, namely intervals, squares and rectangles.

- Participants: Madalina Deaconu and Antoine Lejay
- Contact: Antoine Lejay
- URL: http://exitbm.gforge.inria.fr/

5.3. SDM-WindPoS

Stochastic Downscaling Method and Wind Power Simulation
FUNCTIONAL DESCRIPTION

The computation of the wind at small scale and the estimation of its uncertainties is of particular importance for applications such as wind energy resource estimation. To this aim, we have developed a computer code belonging to the family of codes of atmospheric flow calculation, in the atmospheric boundary layer. SDM-windpos especially concerns the simulation of wind at small space scales (meaning that the horizontal resolution is one kilometer or less), based on the combination of an existing Numerical Weather Prediction model providing a coarse prediction, and a Lagrangian Stochastic Model for turbulent flows.

The ability of SDM-WindPoS to regamma the wind computation in the horizontal scale but also in the vertical scale is of particular interest for wind farm power production assessment. WindPoS couples direct actuator disk approach and SDM Atmospheric Boundary Layer (ABL) model for wind farm simulation.

This year we start to introduce more accurate ABL convection models in SDM. Moreover, we start to add the possibility to introduce more accurate topography when SDM is running with some coarse scale atmospheric input data. Our dedicated GUI was also improved (better rendering for the 2D and 3D views).

- Participants: Mireille Bossy
- Contact: Mireille Bossy
- URL: http://windpos.inria.fr

VEGAS Project-Team

5. New Software and Platforms

5.1. ISOTOP

Topology and geometry of planar algebraic curves
KEYWORDS: Topology - Curve plotting - Geometric computing
Isotop is a Maple software for computing the topology of an algebraic plane curve, that is, for computing an arrangement of polylines isotopic to the input curve. This problem is a necessary key step for computing arrangements of algebraic curves and has also applications for curve plotting.

This software, registered at the APP in June 2011, has been developed since 2007 in collaboration with F. Rouillier from Inria Paris. The distributed version is based on the method described in [3], which presents several improvements over previous methods. In particular, our approach does not require generic position. This version is competitive with other implementations (such as ALCIX and INSULATE developed at MPII Saarbrücken, Germany and TOP developed at Santander Univ., Spain). It performs similarly for small-degree curves and performs significantly better for higher degrees, in particular when the curves are not in generic position.

We are currently working on an improved version integrating a new bivariate polynomial solver based on several of our recent results published in [11]. This version is not yet distributed.

Via the Inria ADT FastTrack funding, Eric Biagioli has joined the project in November 2016 for 6 months. He is porting the maple code to C code and enhancing the visualization. This work will prepare for a better diffusion of the software via a webserver and a transfert to Maplesoft with which Inria has signed a contract in April 2016.

- Contact: Sylvain Lazard & Marc Pouget
- URL: http://vegas.loria.fr/isotop/

5.2. SubdivisionSolver

KEYWORDS: Numerical solver - Polynomial or analytical systems
The software SubdivisionSolver solves square systems of analytic equations on a compact subset of a real space of any finite dimension. SubdivisionSolver is a numerical solver and as such it requires that the solutions in the subset are isolated and regular for the input system (i.e. the Jacobian must not vanish). SubdivisionSolver is a subdivision solver using interval arithmetic and multiprecision arithmetic to achieve certified results. If the arithmetic precision required to isolate solutions is known, it can be given as an input parameter of the process, otherwise the precision is increased on the fly. In particular, SubdivisionSolver can be interfaced with the Fast_Polynomial library (https://bil.inria.fr/en/software/view/2423/tab) to solve polynomial systems that are large in terms of degree, number of monomials and bit-size of coefficients.

The software is based on a classic branch and bound algorithm using interval arithmetic: an initial box is subdivided until its sub-boxes are certified to contain either no solution or a unique solution of the input system. Evaluation is performed with a centered evaluation at order two, and existence and uniqueness of solutions is verified thanks to the Krawczyk operator.

SubdivisionSolver uses two implementations of interval arithmetic: the C++ boost library that provides a fast arithmetic when double precision is enough, and otherwise the C mpfi library that allows to work in arbitrary precision. Considering the subdivision process as a breadth first search in a tree, the boost interval arithmetic is used as deeply as possible before a new subdivision process using higher precision arithmetic is performed on the remaining forest.

The software has been improved and a technical report published [28].

- Contact: Rémi Imbach
- URL: https://bil.inria.fr/fr/software/view/2605/tab

VERIDIS Project-Team

6. New Software and Platforms

6.1. The Nunchaku Higher-Order Model Finder

FUNCTIONAL DESCRIPTION

Nunchaku is a model finder for higher-order logic, with dedicated support for various definitional principles. It is designed to work as a backend for various proof assistants and to use state-of-the-art model finders and other solvers as backends.

In 2016, the first three versions of the tools were released (0.1 through 0.3). The Isabelle2016-1 release includes Nunchaku as well as the frontend that bridges the gap between the proof assistant and the model finder. Work has commenced on a Coq frontend [28] and a TLA$^+$ frontend. Currently, the backends CVC4, Kodkod, and Paradox are supported.

- Participants: Jasmin Blanchette and Simon Cruanes
- Contact: Jasmin Blanchette
- URL: https://github.com/nunchaku-inria

6.2. The Redlog Computer Logic System

FUNCTIONAL DESCRIPTION

Redlog is an integral part of the interactive computer algebra system Reduce. It supplements Reduce's comprehensive collection of powerful methods from symbolic computation by supplying more than 100 functions on first-order formulas.

Redlog generally works with interpreted first-order logic in contrast to free first-order logic. Each first-order formula in Redlog must exclusively contain atoms from one particular Redlog-supported theory, which corresponds to a choice of admissible functions and relations with fixed semantics. Redlog-supported theories include Nonlinear Real Arithmetic (Real Closed Fields), Presburger Arithmetic, Parametric QSAT, and many more.

In 2016 there was significant progress with the generation of models for real satisfiability problems [15]. When obtained via quantifier elimination by virtual substitutions, such models contain in general non-standard numbers like positive infinitesimal and infinite values. In an efficient post-processing step Redlog now generates standard models.

- Participants: Thomas Sturm and Marek Kosta
- Contact: Thomas Sturm
- URL: http://www.redlog.eu/

6.3. The SPASS automated theorem prover

FUNCTIONAL DESCRIPTION

The classic SPASS is an automated theorem prover based on superposition that handles first-order logic with equality and several extensions for particular classes of theories. With version SPASS 3.9 we have stopped the development of the classic prover and have started the bottom-up development of SPASS 4.0 that will actually be a workbench of automated reasoning tools.

In 2016 we have made available for the first time our LIA solver SPASS-IQ. Furthermore, we have developed a state-of-the-art SAT solver SPASS-SATT that will be available in 2017.

- Contact: Christoph Weidenbach
- URL: http://www.spass-prover.org/

6.4. TLAPS, the TLA+ Proof System

FUNCTIONAL DESCRIPTION

TLAPS, the TLA$^+$ proof system developed at the Joint MSR-Inria Centre, is a platform for developing and mechanically verifying proofs about TLA$^+$ specifications. The TLA$^+$ proof language is hierarchical and explicit, allowing a user to decompose the overall proof into independent proof steps. TLAPS consists of a *proof manager* that interprets the proof language and generates a collection of proof obligations that are sent to *backend verifiers*. The current backends include the tableau-based prover Zenon for first-order logic, Isabelle/TLA$^+$, an encoding of TLA$^+$ as an object logic in the logical framework Isabelle, an SMT backend designed for use with any SMT-lib compatible solver, and an interface to a decision procedure for propositional temporal logic.

The current version 1.4.3 of TLAPS was released in June 2015, it is distributed under a BSD-like license. The prover fully handles the non-temporal part of TLA$^+$. Basic temporal logic reasoning is supported through an interface with a decision procedure for propositional temporal logic that performs on-the-fly abstraction of first-order subformulas. Symmetrically, subformulas whose main operator is a connective of temporal logic are abstracted before being sent to backends for first-order logic.

A complete rewrite of the proof manager is ongoing. Its objectives are a cleaner interaction with the standard TLA$^+$ front-ends, in particular SANY, the standard parser and semantic analyzer. This is necessary for extending the scope of the fragment of TLA$^+$ that is handled by TLAPS, such as full temporal logic and module instantiation.

TLAPS has been used in several case studies, including the proof of determinacy of PharOS [21] and the verification of the Pastry routing protocol [22]. These case studies feed back into the development of the proof system and of its standard library.

- Contact: Stephan Merz
- URL: https://tla.msr-inria.inria.fr/tlaps/content/Home.html

6.5. The veriT Solver

SCIENTIFIC DESCRIPTION

veriT comprises a SAT solver, a congruence closure based decision procedure for uninterpreted symbols, a simplex-based decision procedure for linear arithmetic, and instantiation-based quantifier handling.

FUNCTIONAL DESCRIPTION

VeriT is an open, trustable and efficient SMT (Satisfiability Modulo Theories) solver, featuring efficient decision procedure for uninterpreted symbols and linear arithmetic, and quantifier reasoning.

Efforts in 2016 have been focused on non-linear arithmetic reasoning and quantifier handling. The reasoning capabilities of veriT have been significantly improved along those two axes, but non-linear arithmetic reasoning is not yet stable.

The veriT solver participated in the SMT competition SMT-COMP 2016 with good results.

We target applications where validation of formulas is crucial, such as the validation of TLA$^+$ and B specifications, and work together with the developers of the respective verification platforms to make veriT even more useful in practice. The solver is available as a plugin for the Rodin platform, it is integrated within the Atelier B.

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- Partners: Université de Lorraine - Federal University of Rio Grande do Norte
- Contact: Pascal Fontaine
- URL: http://www.veriT-solver.org