



RESEARCH CENTER  
Grenoble - Rhône-Alpes

FIELD

Activity Report 2016

**Section Software**

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## AIRSEA Project-Team

# 6. New Software and Platforms

## 6.1. AGRIF

Adaptive Grid Refinement In Fortran

FUNCTIONAL DESCRIPTION AGRIF is a Fortran 90 package for the integration of full adaptive mesh refinement (AMR) features within a multidimensional finite difference model written in Fortran. Its main objective is to simplify the integration of AMR potentialities within an existing model with minimal changes. Capabilities of this package include the management of an arbitrary number of grids, horizontal and/or vertical refinements, dynamic regridding, parallelization of the grids interactions on distributed memory computers. AGRIF requires the model to be discretized on a structured grid, like it is typically done in ocean or atmosphere modelling.

- Participants: Laurent Debreu, Marc Honnorat and Cyril Mazauric
- Contact: Laurent Debreu
- URL: <http://www-ljk.imag.fr/MOISE/AGRIF>

## 6.2. BALAISE

Bibliothèque d'Assimilation Lagrangienne Adaptée aux Images Séquencées en Environnement

KEYWORDS: Multi-scale analysis - Data assimilation - Optimal control

FUNCTIONAL DESCRIPTION

BALAISE (Bibliothèque d'Assimilation Lagrangienne Adaptée aux Images Séquencées en Environnement) is a test bed for image data assimilation. It includes a shallow water model, a multi-scale decomposition library and an assimilation suite.

- Contact: Arthur Vidard

## 6.3. DiceDesign

Designs of Computer Experiments

FUNCTIONAL DESCRIPTION

This package is useful for conducting design and analysis of computer experiments.

- Contact: Céline Hartweg
- URL: <https://cran.r-project.org/web/packages/DiceDesign/index.html>

## 6.4. DiceEval

Construction and Evaluation of Metamodels

FUNCTIONAL DESCRIPTION

This package is useful for conducting design and analysis of computer experiments. Estimation, validation and prediction of models of different types : linear models, additive models, MARS, PolyMARS and Kriging.

- Contact: Céline Hartweg
- URL: <https://cran.r-project.org/web/packages/DiceEval/index.html>

## 6.5. NEMOVAR

Variational data assimilation for NEMO

KEYWORDS: Oceanography - Data assimilation - Adjoint method - Optimal control

**FUNCTIONAL DESCRIPTION**

NEMOVAR is a state-of-the-art multi-incremental variational data assimilation system with both 3D and 4D capabilities, and which is designed to work with NEMO on the native ORCA grids. The background error covariance matrix is modelled using balance operators for the multivariate component and a diffusion operator for the univariate component. It can also be formulated as a linear combination of covariance models to take into account multiple correlation length scales associated with ocean variability on different scales. NEMOVAR has recently been enhanced with the addition of ensemble data assimilation and multi-grid assimilation capabilities. It is used operationnaly in both ECMWF and the Met Office (UK)

- Partners: CERFACS - ECMWF - Met Office
- Contact: Arthur Vidard

## 6.6. Sensitivity

**FUNCTIONAL DESCRIPTION**

This package is useful for conducting sensitivity analysis of complex computer codes.

- Contact: Laurent Gilquin
- URL: <https://cran.r-project.org/web/packages/sensitivity/index.html>

## ARIC Project-Team

# 5. New Software and Platforms

## 5.1. FPLLL

### SCIENTIFIC DESCRIPTION

The `fpLLL` library is used or has been adapted to be integrated within several mathematical computation systems such as Magma, Sage, and PariGP. It is also used for cryptanalytic purposes, to test the resistance of cryptographic primitives.

### FUNCTIONAL DESCRIPTION

`fpLLL` contains implementations of several lattice algorithms. The implementation relies on floating-point orthogonalization, and the LLL algorithm is central to the code, hence the name. It includes implementations of floating-point LLL reduction algorithms, offering different speed/guarantees ratios. It further includes an implementation of the BKZ reduction algorithm and variants thereof. It includes an implementation of the Kannan-Fincke-Pohst algorithm that finds a shortest non-zero lattice vector. For the same task, the GaussSieve algorithm is also available. Finally, it contains a variant of the enumeration algorithm that computes a lattice vector closest to a given vector belonging to the real span of the lattice.

- Participants: Martin Albrecht, Shi Bai, Guillaume Bonnoron, Léo Ducas, Damien Stehlé and Marc Stevens
- Contact: Damien Stehlé
- URL: <https://github.com/fplll/fplll>

## 5.2. HPLLL

`hpLLL` is an experimental C++ library companion to `fpLLL`.

### FUNCTIONAL DESCRIPTION

`hpLLL` provides a specific LLL reduction algorithm using Householder orthogonalization, and HPC preliminary solutions especially for integer relation finding.

- Contact: Gilles Villard
- URL: <http://perso.ens-lyon.fr/gilles.villard/hpLLL>

## 5.3. GNU-MPFR

KEYWORDS: Multiple-Precision - Floating-point - Correct Rounding

### FUNCTIONAL DESCRIPTION

GNU MPFR is an efficient multiple-precision floating-point library with well-defined semantics (copying the good ideas from the IEEE-754 standard), in particular correct rounding in 5 rounding modes. GNU MPFR provides about 80 mathematical functions, in addition to utility functions (assignments, conversions...). Special data (Not a Number, infinities, signed zeros) are handled like in the IEEE-754 standard.

There have been two new releases in 2016: 3.1.4 and 3.1.5. An MPFR-MPC developers meeting took place on 23 and 24 May 2016.

- Participants: Vincent Lefèvre and Paul Zimmermann
- Contact: Vincent Lefèvre
- URL: <http://www.mpfr.org/>

## 5.4. Gfun

A Maple package for solutions of linear differential or recurrence equations

FUNCTIONAL DESCRIPTION

Gfun is a Maple package for the manipulation of linear recurrence or differential equations. It provides tools for guessing a sequence or a series from its first terms, for manipulating rigorously solutions of linear differential or recurrence equations, using the equation as a data-structure.

- Contact: Bruno Salvy
- URL: <http://perso.ens-lyon.fr/bruno.salvy/software/the-gfun-package/>

## 5.5. Sipe

KEYWORDS: Floating-point - Correct Rounding

FUNCTIONAL DESCRIPTION

Sipe is a mini-library in the form of a C header file, to perform radix-2 floating-point computations in very low precisions with correct rounding, either to nearest or toward zero. The goal of such a tool is to do proofs of algorithms/properties or computations of tight error bounds in these precisions by exhaustive tests, in order to try to generalize them to higher precisions. The currently supported operations are addition, subtraction, multiplication (possibly with the error term), fused multiply-add/subtract (FMA/FMS), and miscellaneous comparisons and conversions. Sipe provides two implementations of these operations, with the same API and the same behavior: one based on integer arithmetic, and a new one based on floating-point arithmetic.

- Participant: Vincent Lefèvre
- Contact: Vincent Lefèvre
- URL: <https://www.vinc17.net/research/sipe/>

## 5.6. LinBox: a C++ library for exact, high-performance linear algebra computation

LinBox is a C++ template library for exact, high-performance linear algebra computation with dense, sparse, and structured matrices over the integers and over finite fields. LinBox is distributed under the LGPL license. The library is developed by a consortium of researchers in Canada, USA, and France. Clément Pernet is a main contributor, especially with a focus on parallel aspects during the period covered by this report.

- Participants: Clément Pernet, Gilles Villard
- Contact: Clément Pernet
- URL: <http://www.linalg.org>

## AVALON Project-Team

# 5. New Software and Platforms

## 5.1. Active Data

**Participants:** Gilles Fedak [correspondant], Valentin Lorentz, Laurent Lefevre.

### FUNCTIONAL DESCRIPTION

Active Data is a free software system that tracks the life cycle of data distributed across heterogeneous software and infrastructures.

As the volume of data grows exponentially, the management of these data becomes more complex in proportion. A key point is to handle the complexity of the Data Life Cycle, *i.e.*, the various operations performed on data: transfer, archiving, replication, deletion, etc. Indeed, data-intensive applications span over a large variety of devices and e-infrastructures which implies that many systems are involved in data management and processing. Active Data is a new approach to automate and improve the expressiveness of data management applications. Active Data consists of a formal model that captures the essential data life cycle stages and properties: creation, deletion, replication, derivation, transient unavailability, uniform naming, and many more. Active Data provides a programming model that simplify the development of data life cycle management applications. Active Data allows code execution at each stage of the data life cycle: routines provided by programmers are executed when a set of events (creation, replication, transfer, deletion) happen to any data.

- URL: <http://active-data.gforge.inria.fr>

## 5.2. DIET

**Participants:** Daniel Balouek-Thomert, Yves Caniou, Eddy Caron, Arnaud Lefray.

### FUNCTIONAL DESCRIPTION

DIET (Distributed Interactive Engineering Toolbox) is a middleware designed for high-performance computing in a heterogeneous and distributed environment (workstations, clusters, grids, clouds). Three main developments are done in 2016:

**Proxmox support:** DIET has a new Cloud extension that can be used to interact with this PVE (Proxmox Virtual Environment) solution. Proxmox is a complete open source server virtualization management software, based on KVM virtualization and container-based virtualization. It manages KVM virtual machines, Linux containers (LXC), storage, virtualized networks, and HA clusters. This extension is a contribution provided by the NewGeneration-SR company.

**DaaS support:** The goal of this development was to add Data-as-a-Service (DaaS) functionality to the DIET middleware via an optional module. We have added the GDConnect plug-in to the DIET Data manager that provides the capability to deal with Google's Cloud Storage.

**Energy Support:** We designed, implementation and evaluation of an energy-efficient resource management system that builds upon DIET and NSDE-divisible tasks with precedence constraints.

- Partners: CNRS - ENS Lyon - UCBL Lyon 1
- Contact: Eddy Caron
- URL: <http://graal.ens-lyon.fr/diet/>

## 5.3. Execo

**Participant:** Matthieu Imbert.



#### FUNCTIONAL DESCRIPTION

Execo offers a Python API for asynchronous control of local or remote, standalone or parallel, unix processes. It is especially well suited for quickly and easily scripting workflows of parallel/distributed operations on local or remote hosts: automate a scientific workflow, conduct computer science experiments, perform automated tests, etc. The core python package is execo. The execo\_g5k package provides a set of tools and extensions for the Grid'5000 testbed. The execo\_engine package provides tools to ease the development of computer sciences experiments. Execo is used directly by 15 to 30 users, in and out of the Avalon team, and is also used by a few Grid'5000 tools such as kwapi, funk, topo5k, g5k\_bench\_flops.

- Contact: Matthieu Imbert
- URL: <http://execo.gforge.inria.fr>

### 5.4. Kaapi

**Participant:** Thierry Gautier.

Kaapi is a library for high performance applications running on multi-cores/multi- processors with support for multi-GPUs. Kaapi provides ABI compliant implementations of libGOMP (GCC runtime for OpenMP) and libomp.so (CLANG and Intel compiler). It was one of the target runtime of the K'Star compiler (<http://kstar.gforge.inria.fr>).

Web site:

- Partners: EPI Corse (Philippe Virouleau, François Broquedis)
- Contact: Thierry Gautier
- URL: <http://kaapi.gforge.inria.fr>

### 5.5. Kwapi

**Participants:** Jean-Patrick Gelas, Laurent Lefevre.

#### FUNCTIONAL DESCRIPTION

Kwapi is a software framework dealing with energy monitoring of large scale infrastructures through heterogeneous energy sensors. Kwapi has been designed inside the FSN XLCloud project for OpenStack infrastructures. Through the support of Hemera Inria project, kwapi has been extended and deployed in production mode to support easy and large scale energy profiling of the Grid'5000 resources.

- Contact: Laurent Lefevre
- URL: <https://launchpad.net/kwapi>

### 5.6. L2C and DirectL2C

**Participants:** H el ene Coullon, Vincent Lanore, Christian Perez, J er ome Richard.

#### FUNCTIONAL DESCRIPTION

L2C (<http://hlcm.gforge.inria.fr>) is a Low Level Component model implementation targeting at use-cases where overhead matters such as High-Performance Computing. L2C does not offer network transparency neither language transparency. Instead, L2C lets the user choose between various kinds of interactions between components, some with ultra low overhead and others that support network transport. L2C is extensible as additional interaction kinds can be added quite easily. L2C currently supports C++, FORTRAN 2013, MPI and CORBA interactions.

DirectL2C is an extension to L2C that enables efficient and consistent reconfiguration of large scale L2C based assemblies. It provides an assembly model enhanced with domains, transformations, and transformation adapters.

- Partners: CEA/Maison de la Simulation (Julien Bigot)
- Contact: Christian Perez
- URL: <http://hlcm.gforge.inria.fr/l2c:start>

## 5.7. Sam4C

**Participants:** Eddy Caron, Arnaud Lefray, Marc Pinhede, Mathieu Veyrand.

### SCIENTIFIC DESCRIPTION

This editor is generated in Java from an EMF -Eclipse Modeling Framework- metamodel to simplify any modifications or extensions. The application model and the associated security policy are compiled in a single XML file which serves as input for an external Cloud security-aware scheduler. Alongside with this editor, Cloud architecture models and provisioning algorithms are provided for simulation (in the current version) or real deployments (in future versions).

### FUNCTIONAL DESCRIPTION

Sam4C (<https://gforge.inria.fr/projects/sam4c/>) -Security-Aware Models for Clouds- is a graphical and textual editor to model Cloud applications (as virtual machines, processes, files and communications) and describe its security policy. Sam4C is suitable to represent any static application without deadline or execution time such as n-tiers or parallel applications.

- Contact: Eddy Caron
- URL: <https://gforge.inria.fr/projects/sam4c/>

## 5.8. SimGrid

**Participant:** Frédéric Suter.

### FUNCTIONAL DESCRIPTION

SimGrid is a toolkit that provides core functionalities for the simulation of distributed applications in heterogeneous distributed environments. The simulation engine uses algorithmic and implementation techniques toward the fast simulation of large systems on a single machine. The models are theoretically grounded and experimentally validated. The results are reproducible, enabling better scientific practices.

Its models of networks, cpus and disks are adapted to (Data)Grids, P2P, Clouds, Clusters and HPC, allowing multi-domain studies. It can be used either to simulate algorithms and prototypes of applications, or to emulate real MPI applications through the virtualization of their communication, or to formally assess algorithms and applications that can run in the framework.

The formal verification module explores all possible message interleavings in the application, searching for states violating the provided properties. We recently added the ability to assess liveness properties over arbitrary and legacy codes, thanks to a system-level introspection tool that provides a finely detailed view of the running application to the model checker. This can for example be leveraged to verify both safety or liveness properties, on arbitrary MPI code written in C/C++/Fortran.

- Partners: CNRS - ENS Rennes
- Contact: Martin Quinson (EPC Myriads)
- URL: <http://simgrid.gforge.inria.fr/>

## 5.9. Grid'5000

**Participants:** Laurent Lefevre, Simon Delamare, David Loup, Christian Perez.

### FUNCTIONAL DESCRIPTION

The Grid'5000 experimental platform is a scientific instrument to support computer science research related to distributed systems, including parallel processing, high performance computing, cloud computing, operating systems, peer-to-peer systems and networks. It is distributed on 10 sites in France and Luxembourg, including Lyon. Grid'5000 is a unique platform as it offers to researchers many and varied hardware resources and a complete software stack to conduct complex experiments, ensure reproducibility and ease understanding of results. In 2016, a new cluster financially supported by Inria has been deployed on the Grid5000 Lyon site.

- Contact: Laurent Lefevre
- URL: <https://www.grid5000.fr/>

## BEAGLE Project-Team

### 5. New Software and Platforms

#### 5.1. DeCoSTAR

KEYWORDS: Bioinformatics - Evolution

FUNCTIONAL DESCRIPTION Given a set of gene trees, a species tree and adjacency relations between extant genes, DeCoSTAR reconstructs adjacencies between ancestral genes

- Contact: Eric Tannier
- URL: <http://pbil.univ-lyon1.fr/software/DeCoSTAR/>

#### 5.2. EvoEvo

Evolution of Evolution

KEYWORDS: Bioinformatics - Biology - Evolution

FUNCTIONAL DESCRIPTION In the context of the EvoEvo european project we are developing an integrated model of microorganisms evolution. This model will extend the current evolutionary models developed in the team (Aevol and R-Aevol) by adding a metabolic level and an ecosystem level. In 2014, a first version has been developed and released that includes the genomic, genetic and metabolic levels.

- Participants: Guillaume Beslon, Charles Rocabert and Carole Knibbe
- Contact: Guillaume Beslon
- URL: <http://www.evoevo.eu/>

#### 5.3. FluoBacTracker

KEYWORDS: Bioinformatics - Biology - Biomedical imaging

FUNCTIONAL DESCRIPTION FluoBacTracker is an ImageJ plugin designed to segment and track growing E. Coli cells from microscopy images and movies. FluoBacTracker is a software tool to : 1) Select regions of interest in each image (detect the colony) 2) Denoise and renormalize the images 3) Identify each cells in each image (segmentation) 4) Follow cells through the whole movie (tracking) 5) Detect divisions and construct cell lineage in the population FluoBacTracker is an open-source software (under a tailored license agreement), downloadable free of charge for academics.

- Participants: Magali Vangkeosay, David Parsons and Hugues Berry
- Partner: Université Descartes
- Contact: Hugues Berry
- URL: <http://fluobacktracker.inrialpes.fr>

#### 5.4. Tewep

Simulator of the dynamics of Transposable Elements Within Expanding Populations

KEYWORDS: Simulator - Transposable elements - Population genetics - Geographic expansion

**FUNCTIONAL DESCRIPTION** Transposable elements, found in the genomes of most living organisms (including humans), are pieces of DNA able to replicate themselves and to proliferate. Their presence is a source of mutations which are, most of the time, detrimental to their host. As a consequence, natural selection usually limits their spread. There are, however, some conditions where natural selection cannot be efficient enough to remove them, for example when the population size is small. It is also hypothesized that when a population geographically expands, the efficiency of natural selection could be reduced at the expansion front. TEWEP is an individual-based simulator designed to test whether transposable elements could proliferate in large expanding populations. It combines several population genetics models to simulate the evolution of the number of transposable elements in each individual of an expanding population.

- Partner: Laboratoire de Biométrie et Biologie Evolutive (LBBE) - UMR CNRS 5558
- Contact: Carole Knibbe
- URL: <https://gforge.inria.fr/projects/tewep/>

## 5.5. aevol

Artificial Evolution

**FUNCTIONAL DESCRIPTION** Aevol is a digital genetics model: populations of digital organisms are subjected to a process of selection and variation, which creates a Darwinian dynamics. By modifying the characteristics of selection (e.g. population size, type of environment, environmental variations) or variation (e.g. mutation rates, chromosomal rearrangement rates, types of rearrangements, horizontal transfer), one can study experimentally the impact of these parameters on the structure of the evolved organisms. In particular, since Aevol integrates a precise and realistic model of the genome, it allows for the study of structural variations of the genome (e.g. number of genes, synteny, proportion of coding sequences). The simulation platform comes along with a set of tools for analysing phylogenies and measuring many characteristics of the organisms and populations along evolution. An extension of the model (R-Aevol), integrates an explicit model of the regulation of gene expression, thus allowing for the study of the evolution of gene regulation networks.

- Participants: Carole Knibbe, Guillaume Beslon, Jonathan Rouzaud-Cornabas, Bérénice Batut, David Parsons, Vincent Liard, Dusan Misevic and Antoine Frénoy
- Partners: Insa de Lyon - INSERM - UCBL Lyon 1 - Université Paris-Descartes
- Contact: Carole Knibbe
- URL: <http://www.aevol.fr/>

## 5.6. evowave

**KEYWORDS:** Data stream - Clustering - Evolution - Wireless network

**FUNCTIONAL DESCRIPTION** This package is a toolbox to analyse signal strength in wifi activity logfiles. It includes three main modules. The first is a preprocessing module to aggregate logfile contents. The second one is a subspace clustering module, based on an evolutionary algorithm, to identify similar wifi activity contexts. This similarity is defined on signal strength of wifi devices and the clusters can change over time. The third module is a visualisation tool to display the cluster modifications over time.

- Participants: Jonas Abernot, Guillaume Beslon, Leo Lefebvre, Sergio Peignier, Anthony Rossi and Christophe Rigotti
- Contact: Christophe Rigotti
- URL: [http://evoevo.liris.cnrs.fr/download/4\\_-\\_deliverables/wp5/Deliverable\\_D5.1\\_software\\_archive.zip](http://evoevo.liris.cnrs.fr/download/4_-_deliverables/wp5/Deliverable_D5.1_software_archive.zip)

## BIPOP Project-Team

### 5. New Software and Platforms

#### 5.1. ACEF

- Participants: Vincent Acary and Olivier Bonnefon (previous Expert Engineer now at INRA).
- Contact: Vincent Acary.

#### 5.2. Approche

KEYWORD: Geometric computing

- Participants: Alexandre Derouet-Jourdan, Florence Descoubes and Joelle Thollot
- Contact: Florence Descoubes
- URL: <http://bipop.inrialpes.fr/~bertails/Papiers/floatingTangents3d.html>

#### 5.3. CloC

Super Space Clothoids in C

KEYWORD: Physical simulation

FUNCTIONAL DESCRIPTION

Reference software implementing the paper "Super Space Clothoids", R. Casati and F. Bertails-Descoubes, ACM Transactions on Graphics, 2013

- Participants: Florence Descoubes and Romain Casati
- Partner: UJF
- Contact: Florence Descoubes
- URL: <http://bipop.inrialpes.fr/people/casati/publications/codes/ssc.html>

#### 5.4. MECHE-COSM

Modeling Entangled fiber with frictional Contact in Hair

KEYWORDS: Physical simulation - Frictional contact - Thin elastic rod

FUNCTIONAL DESCRIPTION

Implements super-helices [Bertails et al. 2006] coupled together by a hybrid algorithm for frictional contact [Daviet et al. 2011].

- Participants: Gilles Daviet, Florence Bertails Descoubes and Florent Cadoux
- Contact: Florence Descoubes

#### 5.5. SALADYN MULTIBODY

- Participants: Vincent Acary and Olivier Bonnefon
- Contact: Vincent Acary

#### 5.6. SICONOS

KEYWORDS: NSDS - MEMS - DCDC - SD - Collision - Friction - Mechanical multi-body systems

FUNCTIONAL DESCRIPTION

Siconos is an open-source scientific software primarily targeted at modeling and simulating nonsmooth dynamical systems in C++ and in Python: - Mechanical systems (rigid or solid) with unilateral contact and Coulomb friction and impact (nonsmooth mechanics, contact dynamics, multibody systems dynamics or granular materials). - Switched Electrical Circuit such as electrical circuits with ideal and piecewise linear components: power converter, rectifier, Phase-Locked Loop (PLL) or Analog-to-Digital converter. - Sliding mode control systems. - Biology (Gene regulatory network). Other applications are found in Systems and Control (hybrid systems, differential inclusions, optimal control with state constraints), Optimization (Complementarity systems and Variational inequalities), Fluid Mechanics, and Computer Graphics.

- Participants: Vincent Acary, Olivier Bonnefon, Maurice Bremond and Franck Perignon
- Contact: Bernard Brogliato
- URL: <http://siconos.gforge.inria.fr>

## 5.7. Platforms: SICONOS

### 5.7.1. Platform A : SICONOS

**Participants:** Vincent Acary, Maurice Brémond, Olivier Huber, Franck Pérignon.

In the framework of the FP5 European project Siconos (2002-2006), Bipop was the leader of the Work Package 2 (WP2), dedicated to the numerical methods and the software design for nonsmooth dynamical systems. This has given rise to the platform SICONOS which is the main software development task in the team. The aim of this work is to provide a common platform for the simulation, modeling, analysis and control of abstract nonsmooth dynamical systems. Besides usual quality attributes for scientific computing software, we want to provide a common framework for various scientific fields, to be able to rely on the existing developments (numerical algorithms, description and modeling software), to support exchanges and comparisons of methods, to disseminate the know-how to other fields of research and industry, and to take into account the diversity of users (end-users, algorithm developers, framework builders) in building expert interfaces in Python and end-user front-end through Scilab.

After the requirement elicitation phase, the Siconos Software project has been divided into 5 work packages which are identified to software products:

1. SICONOS/NUMERICS This library contains a set of numerical algorithms, already well identified, to solve non smooth dynamical systems. This library is written in low-level languages (C,F77) in order to ensure numerical efficiency and the use of standard libraries (Blas, Lapack, ...)
2. SICONOS/KERNEL This module is an object-oriented structure (C++) for the modeling and the simulation of abstract dynamical systems. It provides the users with a set of classes to describe their nonsmooth dynamical system (dynamical systems, interconnections, nonsmooth laws, ...) and to perform a numerical time integration and solving.
3. SICONOS/FRONT-END. This module is mainly an auto-generated wrapper in Python which provides a user-friendly interface to the Siconos libraries. A scilab interface is also provided in the Front-End module.
4. SICONOS/CONTROL This part is devoted to the implementation of control strategies of non smooth dynamical systems.
5. SICONOS/MECHANICS. This part is dedicated to the modeling and the simulation of multi-body systems with 3D contacts, impacts and Coulomb's friction. It uses the Siconos/Kernel as simulation engine but relies on a industrial CAD library (OpenCascade and pythonOCC) to deal with complex body geometries and to compute the contact locations and distances between B-Rep description and on Bullet for contact detection between meshes.

Further informations may be found at <http://siconos.gforge.inria.fr/>

## CHROMA Team

# 6. New Software and Platforms

## 6.1. CUDA-HSBOF

### FUNCTIONAL DESCRIPTION

This software implements the HSBOF (Hybrid Sampling Bayesian Occupancy Filter) on GPU. It facilitates the integration of the model in an embedded chip.

- Participants: Lukas Rummelhard, Christian Laugier and Amaury Nègre
- Contact: Christian Laugier

## 6.2. DATMO (Detection and Tracking of Moving Objects)

### FUNCTIONAL DESCRIPTION

This software is developed in the context of the autonomous driving assistance. It allows to detect, to track, and to classify mobile objects from LIDAR and mono-camera data. It can be linked or not with our previous implementation of the HSBOF software. The software is divided in 4 modules : Fusion, Detection, Tracking and Classification.

- Authors: Trong Tuan Vu and Christian Laugier
- Contact: Christian Laugier

## 6.3. E.R.C.I.

Estimation of collision risks at road intersections

- Participants: Stéphanie Lefevre, Christian Laugier and Javier Ibanez-Guzman
- Contact: Christian Laugier

## 6.4. Embedded Perception

### FUNCTIONAL DESCRIPTION

The method for computing occupancy grids from a stereoscopic sensor, developed in the e-motion team, has been implemented on GPU, using NVIDIA CUDA. This allows a real time implementation and an online processing within the Lexus experimental platform.

- Participants: Amaury Nègre, Christian Laugier and Mathias Perrollaz
- Contact: Christian Laugier

## 6.5. GPU BOF

Bayesian Occupancy Filter on GPU

### FUNCTIONAL DESCRIPTION

This software is an implementation of the Occupancy Bayesian Filter (BOF) on GPU.

- Participants: Yong Mao, Christian Laugier, Amaury Nègre and Mathias Perrollaz
- Contact: Christian Laugier

## **6.6. GPU Stro Occupancy Grid**

GPU Stereo Occupancy Grid

- Participants: Amaury Nègre and Mathias Perrollaz
- Contact: Christian Laugier

## **6.7. VI-SFM**

FUNCTIONAL DESCRIPTION

Software in C++ for estimation based on the closed form solution

- Authors: Guillaume Fortier and Agostino Martinelli
- Contact: Agostino Martinelli

## **6.8. kinetics**

FUNCTIONAL DESCRIPTION

Software computing decision support strategies and decision-making

- Contact: Jilles Dibangoye



## COMPSYS Team

# 6. New Software and Platforms

## 6.1. Lattifold

Lattice-based Memory Folding

KEYWORDS: Polyhedral compilation - Euclidean Lattices

FUNCTIONAL DESCRIPTION

Implements advanced lattice-based memory folding techniques. The idea is to reduce memory footprint of multidimensional arrays by reducing the size of each dimension. Given a relation denoting conflicting array cells, it produces a new mapping based on affine functions bounded by moduli. The moduli induces memory reuse and bound memory accesses to a tighter area, allowing to reduce the array size without loss of correctness. Status: proof of concept, see related paper [2].

- Partner: ENS Lyon
- Contact: Alexandre Isoard

## 6.2. PolyOrdo

Polynomial Scheduler

FUNCTIONAL DESCRIPTION

Computes a polynomial schedule for a sequential polyhedral program having no affine schedule, in lieu of multidimensional schedules. Uses algorithms for finding positive polynomials in semi-algebraic sets. Status: proof of concept software, see related paper [14].

- Contact: Paul Feautrier

## 6.3. OpenOrdo

OpenStream scheduler

FUNCTIONAL DESCRIPTION

Finds polynomial schedules for the streaming language OpenStream. Main use: detecting deadlocks. The scheduler has been extended to bound the size of stream buffers, either directly or as a side-effect of constructing bounded delay schedules. An effort for bounding the number of in-flight tasks is under way.

Status: proof of concept, see related paper [1].

- Contact: Paul Feautrier

## 6.4. ppcg-paramtiling

Parametric Tiling Extension for PPCG

KEYWORDS: Source-to-source compiler - Polyhedral compilation

FUNCTIONAL DESCRIPTION

PPCG is a source-to-source compiler, based on polyhedral techniques, targeting GPU architectures. It involves automatic parallelization and tiling using polyhedral techniques. This version replaces the static tiling of PPCG by a fully parametric tiling and code generator. It allows to choose tile sizes at run time when the memory size is known. It also provides a symbolic expression of memory usage depending on the problem size and the tile sizes.

Status: proof of concept, unfinished, see Alexandre Isoard's thesis [17].

- Partner: ENS Lyon
- Contact: Alexandre Isoard

## CONVECS Project-Team

# 5. New Software and Platforms

## 5.1. The CADP Toolbox

**Participants:** Hubert Garavel [correspondent], Frédéric Lang, Radu Mateescu, Wendelin Serwe.

We maintain and enhance CADP (*Construction and Analysis of Distributed Processes* – formerly known as *CAESAR/ALDEBARAN Development Package*) [1], a toolbox for protocols and distributed systems engineering<sup>0</sup>. In this toolbox, we develop and maintain the following tools:

- CAESAR.ADT [34] is a compiler that translates LOTOS abstract data types into C types and C functions. The translation involves pattern-matching compiling techniques and automatic recognition of usual types (integers, enumerations, tuples, etc.), which are implemented optimally.
- CAESAR [40], [39] is a compiler that translates LOTOS processes into either C code (for rapid prototyping and testing purposes) or finite graphs (for verification purposes). The translation is done using several intermediate steps, among which the construction of a Petri net extended with typed variables, data handling features, and atomic transitions.
- OPEN/CAESAR [35] is a generic software environment for developing tools that explore graphs on the fly (for instance, simulation, verification, and test generation tools). Such tools can be developed independently of any particular high level language. In this respect, OPEN/CAESAR plays a central role in CADP by connecting language-oriented tools with model-oriented tools. OPEN/CAESAR consists of a set of 16 code libraries with their programming interfaces, such as:
  - CAESAR\_GRAPH, which provides the programming interface for graph exploration,
  - CAESAR\_HASH, which contains several hash functions,
  - CAESAR\_SOLVE, which resolves Boolean equation systems on the fly,
  - CAESAR\_STACK, which implements stacks for depth-first search exploration, and
  - CAESAR\_TABLE, which handles tables of states, transitions, labels, etc.

A number of on-the-fly analysis tools have been developed within the OPEN/CAESAR environment, among which:

- BISIMULATOR, which checks bisimulation equivalences and preorders,
- CUNCTATOR, which performs steady-state simulation of continuous-time Markov chains,
- DETERMINATOR, which eliminates stochastic nondeterminism in normal, probabilistic, or stochastic systems,
- DISTRIBUTOR, which generates the graph of reachable states using several machines,
- EVALUATOR, which evaluates MCL formulas,
- EXECUTOR, which performs random execution,
- EXHIBITOR, which searches for execution sequences matching a given regular expression,
- GENERATOR, which constructs the graph of reachable states,
- PROJECTOR, which computes abstractions of communicating systems,
- REDUCTOR, which constructs and minimizes the graph of reachable states modulo various equivalence relations,

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<sup>0</sup><http://cadp.inria.fr>

- SIMULATOR, XSIMULATOR, and OCIS, which enable interactive simulation, and
- TERMINATOR, which searches for deadlock states.
- BCG (*Binary Coded Graphs*) is both a file format for storing very large graphs on disk (using efficient compression techniques) and a software environment for handling this format. BCG also plays a key role in CADP as many tools rely on this format for their inputs/outputs. The BCG environment consists of various libraries with their programming interfaces, and of several tools, such as:
  - BCG\_CMP, which compares two graphs,
  - BCG\_DRAW, which builds a two-dimensional view of a graph,
  - BCG\_EDIT, which allows the graph layout produced by BCG\_DRAW to be modified interactively,
  - BCG\_GRAPH, which generates various forms of practically useful graphs,
  - BCG\_INFO, which displays various statistical information about a graph,
  - BCG\_IO, which performs conversions between BCG and many other graph formats,
  - BCG\_LABELS, which hides and/or renames (using regular expressions) the transition labels of a graph,
  - BCG\_MIN, which minimizes a graph modulo strong or branching equivalences (and can also deal with probabilistic and stochastic systems),
  - BCG\_STEADY, which performs steady-state numerical analysis of (extended) continuous-time Markov chains,
  - BCG\_TRANSIENT, which performs transient numerical analysis of (extended) continuous-time Markov chains, and
  - XTL (*eXecutable Temporal Language*), which is a high level, functional language for programming exploration algorithms on BCG graphs. XTL provides primitives to handle states, transitions, labels, *successor* and *predecessor* functions, etc.

For instance, one can define recursive functions on sets of states, which allow evaluation and diagnostic generation fixed point algorithms for usual temporal logics (such as HML [42], CTL [30], ACTL [32], etc.) to be defined in XTL.
- PBG (*Partitioned BCG Graph*) is a file format implementing the theoretical concept of *Partitioned LTS* [38] and providing a unified access to a graph partitioned in fragments distributed over a set of remote machines, possibly located in different countries. The PBG format is supported by several tools, such as:
  - PBG\_CP, PBG\_MV, and PBG\_RM, which facilitate standard operations (copying, moving, and removing) on PBG files, maintaining consistency during these operations,
  - PBG\_MERGE (formerly known as BCG\_MERGE), which transforms a distributed graph into a monolithic one represented in BCG format,
  - PBG\_INFO, which displays various statistical information about a distributed graph.
- The connection between explicit models (such as BCG graphs) and implicit models (explored on the fly) is ensured by OPEN/CAESAR-compliant compilers, e.g.:
  - BCG\_OPEN, for models represented as BCG graphs,
  - CAESAR.OPEN, for models expressed as LOTOS descriptions,
  - EXP.OPEN, for models expressed as communicating automata,
  - FSP.OPEN, for models expressed as FSP [50] descriptions,
  - LNT.OPEN, for models expressed as LNT descriptions, and
  - SEQ.OPEN, for models represented as sets of execution traces.

The CADP toolbox also includes TGV (*Test Generation based on Verification*), which has been developed by the VERIMAG laboratory (Grenoble) and the VERTECS project-team at Inria Rennes – Bretagne-Atlantique.

The CADP tools are well-integrated and can be accessed easily using either the EUCALYPTUS graphical interface or the SVL [36] scripting language. Both EUCALYPTUS and SVL provide users with an easy and uniform access to the CADP tools by performing file format conversions automatically whenever needed and by supplying appropriate command-line options as the tools are invoked.

## 5.2. The TRAIAN Compiler

**Participants:** Hubert Garavel [correspondent], Frédéric Lang, Wendelin Serwe.

We develop a compiler named TRAIAN, see § 5.2 ), for translating LOTOS NT descriptions into C programs, which will be used for simulation, rapid prototyping, verification, and testing.

The current version of TRAIAN, which handles LOTOS NT types and functions only, has useful applications in compiler construction [37], being used in all recent compilers developed by CONVECS.

The TRAIAN compiler can be freely downloaded from the CONVECS Web site <sup>0</sup>.

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<sup>0</sup><http://convecs.inria.fr/software/traian>

## CORSE Project-Team

# 5. New Software and Platforms

## 5.1. Tirez

TIREX is an extensible, textual intermediate code representation that is intended to be used as an exchange format for compilers and other tools working on low level code. In the scope of the TIREX project we have developed tools for generating TIREX code from higher level languages such as C, as well as a number of static analyses and transformations.

Work on the TIREX project consisted of two main parts, firstly creation of a machine description library for all parts of the TIREX project, secondly, the development of tools for parsing assembly code.

We developed `archinfo`, a LLVM based library that allows programatic access to descriptors for a target CPUs instructions and registers. The focus was to expose information that was not already available from LLVM, such as machine operand types (float or integer, bitwidth, ...) and flags describing the high level behaviour of the instructions.

The, also LLVM based, assembly parser is intended to be used for translating assembly files generated by common compilers to TIREX, but it can also handle a number of idioms usually found in hand written assembly code. It reconstructs some high level information required for the TIREX format, such as the control flow and call graph, from the assembly code. We also started investigating how our existing tools can be extended to directly parse binary code and reconstruct information from them.

## 5.2. QEMU plugins

We have collaborated with STMicroelectronics on extending the QEMU CPU emulator with a plugin system. These plugins allow users to observe and modify the machine code emitted by QEMUs binary translator.

We have leveraged this to start development on a number of tools for profiling and performance debugging.

- `cachesim`: A QEMU plugin that feeds memory accesses observed during program execution into the DineroIV cache simulator. This allows estimating the number of a cache misses caused by each instruction of a program. Using this information we can also estimate the amount of memory bandwidth required by a program. This in turn can be used to diagnose if the applications performance is constrained by memory or CPU resources.
- `dep-rate`: A QEMU plugin that uses a shadow memory to detects data dependencies between instructions and correlates them with cache misses reported by DineroIV to estimate the performance impact of these dependencies.
- `cpath`: A QEMU plugin that estimates the optimal execution time of a program on an infinitely parallel CPU and compares it to that for a more realistic model of a CPU. This comparison is used to judge the amount of instruction level parallelism existing in a program.

## 5.3. Givy

Givy is a runtime developed as part of the PhD thesis of François Gindraud. It is designed for architectures with distributed memories, with the Kalray MPPA as the main target. It executes dynamic data-flow task graphs, annotated with memory dependencies. It automatically handles scheduling and placement of tasks (using the memory dependency hints), and generate memory transfers between distributed memory nodes when needed by using a software cache coherence protocol. An important part of the work corresponds on implementing and testing a memory allocator with specific properties that is a building block of the whole run time. This memory allocator is also tuned to work on the MPPA and its constraints, turning with very little memory and being efficient in the context of multith readed calls.

## 5.4. Dynamic Dependence Graph (DDG)

By instrumenting the memory accesses, at the LLVM IR level, of a hand selected region of a program, the DDG tool builds a graph with all dynamic instructions. Each instruction, i.e. a node in the graph, is identified by a statement identifier, mapping the dynamic instruction to a static statement, and an induction vector, containing the trip counters of loops surrounding the related statement. Edges connecting these nodes represent either data dependence, reuse or anti-dependence among the instructions, obtained by using the shadow memory technique, that labels ownership to a given written memory position to a dynamic instruction, and creating relationship to it to instructions that read the exact same memory position. Instructions that have a statically known formula (SCEVs) are not tracked, allowing our technique to remove, for example, obvious dependencies from a loop iteration to the next, and still track integer instructions. As the number of dynamic instructions, even in very simple applications, grows extremely fast, the generated graph does not fit in main memory just after a few hundred loop iterations, our tool allows limiting the number of loop iterations that are tracked. Dependencies between iterations outside the observed iteration space can either be ignored or clamped as being generated by a single instruction. The generated graph can be used to guide loop optimizers, that could not extract precise dependencies. It can also be used by performance debugging tools, in order to determine if it is possible to obtain a new instruction schedule that would improve locality.

## 5.5. Integer polynomial Fourier-Motzkin elimination

Quantifier elimination is the process of removing existential variables of a given formula, obtaining one that is simpler in the number of variables, and that is implied by the original formula. A very well known algorithm is the Fourier-Motzkin elimination process, that given a system (or formula) of inequalities removes variables by combining all upper and lower bounds of such variables. At each step a variable is selected and eliminated. The very first limitation of this algorithm is the fact that it is designed for linear systems, where all coefficients of the variable being eliminated are numeric values, and the inequality can be classified as either a upper or lower bound. When dealing with polynomials, all possible values, positive, negative, or zero, for an coefficient, that is, a symbolic expression, must be explored. To avoid this requirement we use the positiveness algorithm, proposed by Mark Schweighofer, to retrieve symbolic coefficient signs. In fact, this algorithm is of major importance when resolving system over integer variables, instead of reals, as it is used in many other techniques required to preserve the precision of the simplified formula, such as symbolic normalization, convex hull detection, redundancy removing. Our C++ implementation uses GiNaC for symbolic expressions manipulation.

## 5.6. BOAST: Metaprogramming of Computing Kernels

BOAST aims at providing a framework to metaprogram, benchmark and validate computing kernels. BOAST is a programming framework dedicated to code generation and autotuning. This software allows the transformation from code written in the BOAST DSL to classical HPC targets like FORTRAN, C, OpenMP, OpenCL or CUDA. It also enables the meta-programming of optimization that can be (de)activated when needed. BOAST can also benchmark and do non regression tests on the generated kernels. This approach gives, both, performance gains and improved performance portability.

BOAST can be downloaded at this address <https://forge.imag.fr/projects/boast/>.

BOAST was already used to generate and optimize the computing kernels of three scientific applications:

- **BigDFT**: A massively parallel electronic structure code using wavelet basis set.
- **SPECFEM**: Computational Infrastructure for Geodynamics.
- **Gysela**: Fusion plasma simulations.

BOAST is currently used in the context of the European H2020/HPC4E project. The computing kernels of two scientific applications are currently studied with BOAST:

- **Alya**: Large Scale Computational Mechanics.
- **Hou10ni**: Solutions to accoustics wave propagation problems. This code is developed by the Magique3D Inria team (Pau, Julien Diaz).

Frédéric Desprez presented BOAST at the CSCD workshop <http://www.netlib.org/utk/people/JackDongarra/CCDSC-2016/> in October 2016. After this workshop, a paper was submitted at the International Journal on High Performance Computing Applications (IJHPCA).

BOAST was also used in the Bulldog project during the last CERMACS summer school <http://smai.emath.fr/cemracs/cemracs16/> in July 2016. A joint paper with CEA researchers from Cadarache and Maison de la Simulation was also submitted to present the results of the Bulldog project.

## 5.7. mcGDB: Interactive debugging of OpenMP programs

mcGDB introduced the concept of *programming-model centric* source-level interactive debugging as an extension of the traditional language-level interactive debugging. The idea was to integrate into debuggers the notion of *programming models*, as abstract machines running over the physical ones. These abstract machines, implemented by runtime libraries and programming frameworks, provide the high-level primitives required for the implementation of today's parallel applications.

We developed a proof-of-concept, mcGDB, as a Python extension of GDB, the debugger of the GNU project. mcGDB was initially developed by Kevin Pouget during his thesis with STMicroelectronics. mcGDB is currently extended with the Nano2017/DEMA project.

We proposed the new support of mcGDB for OpenMP task-based programming. This support consists of task-based execution representation and control improvements, in cooperation with Temanejo graphical debugger. We also studied import implementation details of mcGDB, related to the support of multiple OpenMP environments and CPU architectures; the separation of cross-cutting concerns (user interaction and execution representing) through aspect-oriented programming, and the first steps of mcGDB micro-benchmarking.

mcGDB [30] was presented at the second OpenMPCon developers conference in Nara.

## CTRL-A Team

# 6. New Software and Platforms

## 6.1. Heptagon BZR

### FUNCTIONAL DESCRIPTION

Heptagon is an experimental language for the implementation of embedded real-time reactive systems. It is developed inside the Synchronics large-scale initiative, in collaboration with Inria Rhones-Alpes. It is essentially a subset of Lucid Synchrone, without type inference, type polymorphism and higher-order. It is thus a Lustre-like language extended with hierchical automata in a form very close to SCADE 6. The intention for making this new language and compiler is to develop new aggressive optimization techniques for sequential C code and compilation methods for generating parallel code for different platforms. This explains much of the simplifications we have made in order to ease the development of compilation techniques.

Heptagon BZR is an extension of Heptagon, equipped with a behavioral contract mechanisms, where assumptions can be described, as well as an "enforce" property part. Its main feature is to include discrete controller synthesis within its compilation. The semantics of contracts is that the property should be enforced by controlling the behaviour of the node equipped with the contract. This property will be enforced by an automatically built controller, which will act on free controllable variables given by the programmer.

- Participants: Adrien Guatto, Marc Pouzet, Cédric Pasteur, Léonard Gerard, Brice Gelineau, Gwenael Delaval and Eric Rutten
- Contact: Gwenaël Delaval
- <http://bzs.inria.fr>



## DANTE Project-Team

# 6. New Software and Platforms

## 6.1. GraSP

Graph Signal Processing

KEYWORDS: Matlab - LaTeX - Graph - Graph visualization - Signal processing - GNU Octave

FUNCTIONAL DESCRIPTION

Matlab / GNU Octave toolbox to manipulate and visualize signals on graphs. LaTeX package to draw signals.

- Contact: Benjamin Girault
- URL: <https://gforge.inria.fr/projects/grasp/>

## 6.2. IoT-LAB aggregation-tools

KEYWORD: Internet of things

FUNCTIONAL DESCRIPTION

IoT-LAB aggregation-tools allow aggregating data results from many nodes at a time. It connects to several tcp connections and handle the received data.

- Participant: Gaetan Harter
- Contact: Eric Fleury
- URL: <https://github.com/iot-lab/aggregation-tools>

## 6.3. IoT-LAB cli-tools

KEYWORD: Internet of things

FUNCTIONAL DESCRIPTION

IoT-LAB cli-tools provide a basic set of operations for managing IoT-LAB experiments from the command-line.

- Participants: Gaetan Harter and Frédéric Saint-Marcel
- Contact: Eric Fleury
- URL: <https://github.com/iot-lab/cli-tools>

## 6.4. IoT-LAB gateway

KEYWORD: Internet of things

FUNCTIONAL DESCRIPTION

IoT-LAB software embedded on a IoT-LAB gateway node new generation provides the local management of the experiment on that node. It is a software bridge between the IoT-LAB server, the user open node and the control node.

- Contact: Frédéric Saint-Marcel
- URL: <https://github.com/iot-lab/iot-lab-gateway>

## 6.5. Queueing Systems

FUNCTIONAL DESCRIPTION

This tool aims at providing a simple web interface to promote the use of our proposed solutions to numerically solve classical queueing systems.

- Participants: Thomas Begin and Alexandre Brandwajn
- Contact: Thomas Begin
- URL: <http://queueing-systems.ens-lyon.fr/>

## 6.6. Data analysis tools

### 6.6.1. Twitter link predictions

#### FUNCTIONAL DESCRIPTION

Inference, study and prediction of the dynamics of the Twitter mention network

- Participants: Hadrien Hours, Eric Fleury and Márton Karsai
- Contact: Márton Karsai
- URL: <https://github.com/HadrienHours/TwitterMentionNetworkLinkPrediction>

## 6.7. Platforms

### 6.7.1. FIT IoT-LAB

#### FUNCTIONAL DESCRIPTION

IoT-LAB provides full control of network IoT nodes and direct access to the gateways to which nodes are connected, allowing researchers to monitor nodes energy consumption and network-related metrics, e.g. end-to-end delay, throughput or overhead. The facility offers quick experiments deployment, along with easy evaluation, results collection and analysis. Defining complementary testbeds with different node types, topologies and environments allows for coverage of a wide range of real-life use-cases.

- Partner: FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's Équipements d'Excellence (Equipex) research grant programme. The eFIT consortium is composed of: Université Pierre et Marie Curie (UPMC), Inria, Université de Strasbourg, Institut Mines Télécom and CNRS
- Contact: Éric Fleury
- URL: <https://www.iot-lab.info/>

## DATAMOVE Team

# 5. New Software and Platforms

## 5.1. OAR

KEYWORDS: HPC - Cloud - Clusters - Resource manager - Light grid

SCIENTIFIC DESCRIPTION This batch system is based on a database (PostgreSQL (preferred) or MySQL), a script language (Perl) and an optional scalable administrative tool (e.g. Taktuk). It is composed of modules which interact mainly via the database and are executed as independent programs. Therefore, formally, there is no API, the system interaction is completely defined by the database schema. This approach eases the development of specific modules. Indeed, each module (such as schedulers) may be developed in any language having a database access library.

FUNCTIONAL DESCRIPTION OAR is a versatile resource and task manager (also called a batch scheduler) for HPC clusters, and other computing infrastructures (like distributed computing experimental testbeds where versatility is a key).

The OAR ecosystem also include several associated software tools that proved to be useful independently from OAR. Among theses, two softwares play a major role in the support our research studies. The first one is Kameleon (<http://kameleon.imag.fr>), a tool to help enhancing reproducibility of experiments by guarantee the ability to reproduce the complete used software stacks. The second one is Batsim (<https://gforge.inria.fr/projects/batsim>) a RJMS simulator based on SimGrid. Batsim simulates job execution taking into account the target platform hardware capabilities through SimGrid, while scheduling is performed by an actual job management system. A comprehensive API enables to easily plug into BatSim various job management systems like OAR.

- Participants: Olivier Richard, Pierre Neyron, Salem Harrache and Bruno Bzeznik
- Partners: CIMENT - CNRS - Grid'5000 - LIG
- Contact: Olivier Richard
- URL: <http://oar.imag.fr>

## 5.2. FlowVR

KEYWORDS: HPC - In Situ Processing - Computational Steering

SCIENTIFIC DESCRIPTION FlowVR is an open source middleware to augment parallel simulations running on thousands of cores with in situ processing capabilities and live steering. FlowVR offers a very flexible environment while enabling high performance asynchronous in situ and in transit processing.

FUNCTIONAL DESCRIPTION FlowVR adopts the "data-flow" paradigm, where your application is divided as a set of components exchanging messages (think of it as a directed graph). FlowVR enables to encapsulate existing codes in components, interconnect them through data channels, and deploy them on distributed computing resources. FlowVR takes care of all the heavy lifting such as application deployment and message exchange.

- Participants: Bruno Raffin, Matthieu Dreher, Jérémy Jaussaud
- Contact: Bruno Raffin
- URL: <http://flowvr.sf.net>

## **5.3. Platforms**

### **5.3.1. *Grid'5000 (<https://www.grid5000.fr/>) and meso center Ciment (<https://ciment.ujf-grenoble.fr>)***

We have been very active in promoting the factorization of compute resources at a regional and national level. We have a three level implication, locally to maintain a pool of very flexible experimental machines (hundreds of cores), regionally through the CIMENT meso center (Equipex Grant), and nationally by contributing to the Grid'5000 platform, our local resources being included in this platform. Olivier Richard is member of Grid'5000 scientific committee and Pierre Neyron is member of the technical committee. The OAR scheduler in particular is deployed on both infrastructures. We are currently preparing proposals for the next generation machines within the context of the new university association (Univ. Grenoble-Alpes).

## DICE Team

# 5. New Software and Platforms

## 5.1. BitBallot

### FUNCTIONAL DESCRIPTION

The BitBallot voting protocol is designed to target large scale communities. The protocol allows users to share only restricted amounts of their data and computation with central platforms as well as other peers. Convinced by the need of new election mechanisms, to support emerging forms of more continuous democracy, we are developing BitBallot, to allow elections to be organized independently of any central authority. The protocol guarantees the following properties, anonymity of the data sources, non interruptible run-time, global access to results, and non predictability of results through partial communication spying.

- Contact: Stéphane Grumbach, Stéphane Frénot, Damien Reimert, Robert Riemann

## 5.2. C3PO

### FUNCTIONAL DESCRIPTION

Social networks put together individuals with common interests and/or existing real-life relationships so that they can produce and share information. There is a strong interest of individuals towards those networks. They rely on a stable, centralized network infrastructure and a user will always be provided with the same services no matter what their current context is. By contrast, the C3PO project aims at promoting “spontaneous and ephemeral social networks” (SESN), built on top of a peer-to-peer distributed architecture leveraging ad-hoc mobile networks and the resources and services offered by mobile devices. As with traditional social networks, SESN can put together nomad individuals based on their affinities and common interests so that they can collaboratively work on tasks as part of a SESN.

- Contact: Stéphane Frénot, Damien Reimert

## 5.3. Jumplyn

Jumplyn is a student project delivery platform. It offers a service based on three features: the ongoing management of the project, resources recommendation, and enhancement of the activity. Like any intermediation platform, it speaks directly to its users, students, and puts them in relation to relevant information.

### FUNCTIONAL DESCRIPTION

Jumplyn is a student project delivery platform. It offers a service based on three features: the ongoing management of the project, resources recommendation, and enhancement of the activity. Like any intermediation platform, it speaks directly to its users, students, and puts them in relation to relevant information.

- Contact: Stéphane Frénot, Stéphane Grumbach
- URL: <http://www.jumplyn.com>

## **DRACULA Project-Team**

# **5. New Software and Platforms**

## **5.1. CelDyn**

KEYWORDS: Modeling - Bioinformatics - Biology

FUNCTIONAL DESCRIPTION

Software "Celdyn" is developed in order to model cell population dynamics for biological applications. Cells are represented either as soft spheres or they can have more complex structure. Cells can divide, move, interact with each other or with the surrounding medium. Different cell types can be introduced. When cells divide, the types of daughter cells are specified. A user interface is developed.

- Participants: Nikolai Bessonov, Vitaly Volpert, Alen Tosenberger and Laurent Pujo-Menjouet
- Contact: Vitaly Volpert

## ERABLE Project-Team

# 5. New Software and Platforms

## 5.1. AcypiCyc

### FUNCTIONAL DESCRIPTION

Database of the metabolic network of *Acyrtosiphon pisum*.

- Participants: Patrice Baa Puyoule, Hubert Charles, Stefano Colella, Ludovic Cottret, Marie-France Sagot, Augusto Vellozo and Amélie Veron
- Contact: Hubert Charles
- URL: <http://acypicyc.cycadsys.org/>

## 5.2. AIViE

### FUNCTIONAL DESCRIPTION

ALViE is a post-mortem algorithm visualisation Java environment, which is based on the interesting event paradigm. The current distribution of ALViE includes more than forty visualisations. Almost all visualisations include the representation of the corresponding algorithm C-like pseudo-code. The ALViE distribution allows a programmer to develop new algorithms with their corresponding visualisation: the included Java class library, indeed, makes the creation of a visualisation quite an easy task (once the interesting events have been identified).

- Participants: Pierluigi Crescenzi, Giorgio Gambosi, Roberto Grossi, Carlo Nocentini, Tommaso Papini, Walter Verdese
- Contact: Pierluigi Crescenzi
- URL: <http://javamm.sourceforge.net/piluc/software/alvie.html>

## 5.3. Cassis

### FUNCTIONAL DESCRIPTION

Algorithm for precisely detecting genomic rearrangement breakpoints.

- Participants: Christian Baudet, Christian Gautier, Claire Lemaitre, Marie-France Sagot, Eric Tanner
- Contact: Christian Baudet (not Inria), Claire Lemaitre (Inria GenScale), Marie-France Sagot (Inria ERABLE)
- URL: <http://pbil.univ-lyon1.fr/software/Cassis/>

## 5.4. Cidane

### FUNCTIONAL DESCRIPTION

CIDANE is a novel framework for genome-based transcript reconstruction and quantification from RNA-seq reads.

- Participants: Stefan Canzar, Sandra Andreotti, David Weese, Kurt Reinert, Gunnar Klau
- Contact: Stefan Canzar (not Inria)
- URL: <http://ccb.jhu.edu/software/cidane/>

## 5.5. Coala

### FUNCTIONAL DESCRIPTION

COALA stands for “CO-evolution Assessment by a Likelihood-free Approach”. It is thus a likelihood-free method for the co-phylogeny reconstruction problem which is based on an Approximative Bayesian Computation (ABC).

- Participants: Christian Baudet, Pierluigi Crescenzi, Beatrice Donati, Christian Gautier, Catherine Matias, Marie-France Sagot, Blerina Sinimeri
- Contact: Christian Baudet (not Inria), Marie-France Sagot and Blerina Sinimeri
- URL: <http://coala.gforge.inria.fr/>

## 5.6. CophyTrees

### FUNCTIONAL DESCRIPTION

COPHYTREES is a visualiser for host-parasite and gene-species trees evolution.

- Participants: Laurent Bulteau
- Contact: Laurent Bulteau (not Inria), Blerina Sinimeri (for Inria ERABLE)
- URL: <http://eucalypt.gforge.inria.fr/viewer.html>

## 5.7. C3Part & Isofun

### FUNCTIONAL DESCRIPTION

The C3PART / ISOFUN package implements a generic approach to the local alignment of two or more graphs representing biological data, such as genomes, metabolic pathways or protein-protein interactions, in order to infer a functional coupling between them. It is based on the notion of “common connected components” between graphs.

- Participants: Frédéric Boyer, Yves-Pol Deniérou, Anne Morgat, Marie-France Sagot and Alain Viari
- Contact: Alain Viari
- URL: <http://www.inrialpes.fr/helix/people/viari/lxgraph/index.html>

## 5.8. CycADS

### FUNCTIONAL DESCRIPTION

Cyc annotation database system.

- Participants: Patrice Baa Puyoule, Hubert Charles, Stefano Colella, Ludovic Cottret, Marie-France Sagot and Augusto Vellozo
- Contact: Hubert Charles
- URL: <http://www.cycadsys.org/>

## 5.9. Dinghy

### FUNCTIONAL DESCRIPTION

DINGHY is a visualisation program for network pathways of up to 150 reactions.

- Participants: Laurent Bulteau, Alice Julien-Laferrière, Delphine Parrot
- Contact: Laurent Bulteau (not Inria), Alice Julien-Laferrière, Delphine Parrot (not Inria), Marie-France Sagot (for Inria ERABLE)
- URL: <http://dinghy.gforge.inria.fr/>



## 5.10. Eucalypt

### FUNCTIONAL DESCRIPTION

EUCALYPT stands for “EnUmerator of Co-evolutionary Associations in PoLYnomial-Time delay”. It is an algorithm for enumerating all optimal (possibly time-unfeasible) mappings of a parasite tree unto a host tree.

- Participants: Christian Baudet, Pierluigi Crescenzi, Beatrice Donati, Marie-France Sagot, Blerina Sinimeri
- Contact: Christian Baudet (not Inria), Beatrice Donati (not Inria), and Marie-France Sagot (Inria ERABLE)
- URL: <http://eucalypt.gforge.inria.fr/index.html>

## 5.11. Gobbolino & Touché

### FUNCTIONAL DESCRIPTION

GOBBOLINO and TOUCHÉ were designed to solve the metabolic stories problem, which consists in finding all maximal directed acyclic subgraphs of a directed graph  $G$  whose sources and targets belong to a subset of the nodes of  $G$ , called the black nodes. Biologically, stories correspond to alternative metabolic pathways that may explain some stress that affected the metabolites corresponding to the black nodes by changing their concentration (measured by metabolomics experiments).

- Participants: Vicente Acuña, Etienne Birmelé, Ludovic Cottret, Pierluigi Crescenzi, Fabien Jourdan, Vincent Lacroix, Alberto Marchetti-Spaccamela, Andrea Marino, Paulo Vieira Milreu, Marie-France Sagot, Leen Stougie
- Contact: Paulo Vieira Milreu (not Inria), Marie-France Sagot (Inria ERABLE)
- URL: <http://gforge.inria.fr/projects/gobbolino>

## 5.12. HapCol

### FUNCTIONAL DESCRIPTION

A fast and memory-efficient DP approach for haplotype assembly from long reads that works until 25x coverage, solves a constrained minimum error correction problem exactly.

- Participants: Paola Bonizzoni, Riccardo Dondi, Gunnar Klau, Yuri Pirola, Nadia Pisanti, Simone Zaccaria
- Contact: Gunnar Klau, Nadia Pisanti, Paola Bonizzoni (not Inria)
- URL: <http://hapcol.algolab.eu/>

## 5.13. KisSNP & DiscoSNP

### FUNCTIONAL DESCRIPTION

Algorithm for identifying SNPs without a reference genome by comparing raw reads. KISSNP has now given birth to DISCOSNP in a work involving V. Lacroix from ERABLE and the GenScale Inria Team at Rennes (contact: pierre.peterlongo@inria.fr).

- Participants: Vincent Lacroix, Pierre Peterlongo
- Contact: Pierre Peterlongo (EPI GenScale)
- URL: <http://colibread.inria.fr/software/discosnp/>

## 5.14. KisSplice

### FUNCTIONAL DESCRIPTION

Enables to analyse RNA-seq data with or without a reference genome. It is an exact local transcriptome assembler, which can identify SNPs, indels and alternative splicing events. It can deal with an arbitrary number of biological conditions, and will quantify each variant in each condition.

- Participants: Lilia Brinza, Alice Julien-Laferrière, Janice Kielbassa, Vincent Lacroix, Leandro Ishi Soares de Lima, Camille Marchet, Vincent Miele, Gustavo Sacomoto
- Contact: Vincent Lacroix
- URL: <http://kissplice.prabi.fr/>

## 5.15. kissDE

### FUNCTIONAL DESCRIPTION

KISSDE is an R Package enabling to test if a variant (genomic variant or splice variant) is enriched in a condition. It takes as input a table of read counts obtained from NGS data pre-processing and gives as output a list of condition specific variants.

- Participants: Clara Benoit-Pilven, Lilia Brinza, Janice Kielbassa, Vincent Lacroix, Camille Marchet and Vincent Miele
- Contact: Vincent Lacroix
- URL: <http://kissplice.prabi.fr/tools/kissDE/>

## 5.16. KisSplice2RefTranscriptome

### FUNCTIONAL DESCRIPTION

KISSPLICE2REFTRANSCRIPTOME enables to combine the output of KISSPLICE with the output of a full-length transcriptome assembler, thus allowing to predict a functional impact for the positioned SNPs, and to intersect these results with condition-specific SNPs. Overall, starting from RNAseq data only, we obtain a list of condition-specific SNPs stratified by functional impact.

- Participants: Mathilde Boutigny, Vincent Lacroix, H el ene Lopez-Maestre
- Contact: Vincent Lacroix
- URL: <http://kissplice.prabi.fr/tools/kiss2rt/>

## 5.17. KisSplice2RefGenome

### FUNCTIONAL DESCRIPTION

KISSPLICE (see above) identifies variations in RNAseq data, without a reference genome. In many applications however, a reference genome is available. KISSPLICE2REFGENOME enables to facilitate the interpretation of KISSPLICE's results after mapping them to a reference genome.

- Participants: Alice Julien-Laferr iere, Vincent Lacroix, Camille Marchet, Camille Sessegolo
- Contact: Vincent Lacroix
- URL: <http://kissplice.prabi.fr/tools/kiss2refgenome/>

## 5.18. Lasagne

### FUNCTIONAL DESCRIPTION

LASAGNE is a Java application which allows the user to compute distance measures on graphs by making a clever use either of the breadth-first search or of the Dijkstra algorithm. In particular, the current version of LASAGNE can compute the exact value of the diameter of a graph: the graph can be directed or undirected and it can be weighted or unweighted. Moreover, LASAGNE can compute an approximation of the distance distribution of an undirected unweighted graph. These two features are integrated within a graphical user interface along with other features, such as computing the maximum (strongly) connected component of a graph.

- Participants: Pierluigi Crescenzi, Roberto Grossi, Michel Habib, Claudio Imbrenda, Leonardo Lanzi, Andrea Marino
- Contact: Pierluigi Crescenzi
- URL: <http://lasagne-unifi.sourceforge.net/>

## 5.19. MeDuSa

### FUNCTIONAL DESCRIPTION

MEDUSA (Multi-Draft based Scaffold) is an algorithm for genome scaffolding. It exploits information obtained from a set of (draft or closed) genomes from related organisms to determine the correct order and orientation of the contigs.

- Participants: Emmanuelle Bosi, Sara Brunetti, Pierluigi Crescenzi, Beatrice Donati, Renato Fani, Marco Fondi, Marco Galardini, Pietro Lió, Marie-France Sagot,
- Contact: Pierluigi Crescenzi, Marco Fondi (not Inria)
- URL: <http://combo.dbe.unifi.it/medusa>

## 5.20. MetExplore

### FUNCTIONAL DESCRIPTION

Web server to link metabolomic experiments and genome-scale metabolic networks.

- Participants: Michael Barrett, Hubert Charles, Ludovic Cottret, Fabien Jourdan, Marie-France Sagot, Florence Vinson, David Wildridge
- Contact: Fabien Jourdan (not Inria), Marie-France Sagot
- URL: <http://metexplore.toulouse.inra.fr/metexplore/>

## 5.21. Migal

### FUNCTIONAL DESCRIPTION

Algorithm for comparing RNA structures.

- Participants: Julien Allali and Marie-France Sagot
- Contact: Marie-France Sagot
- URL: <http://www-igm.univ-mlv.fr/~allali/logiciels/index.en.php>

## 5.22. Mirinho

### FUNCTIONAL DESCRIPTION

Predicts, at a genome-wide scale, microRNA candidates.

- Participants: Christian Gautier, Cyril Fournier, Christine Gaspin, Susan Higashi, Marie-France Sagot
- Contact: Susan Higashi (not Inria), Marie-France Sagot
- URL: <http://mirinho.gforge.inria.fr/>

## 5.23. Motus & MotusWEB

### FUNCTIONAL DESCRIPTION

Algorithm for searching and inferring coloured motifs in metabolic networks (web-based version - offers different functionalities from the downloadable version).

- Participants: Ludovic Cottret, Fabien Jourdan, Vincent Lacroix, Odile Rogier and Marie-France Sagot
- Contact: Vincent Lacroix
- URL: <http://doua.prabi.fr/software/motus> and [http://pbil.univ-lyon1.fr/software/motus\\_web/](http://pbil.univ-lyon1.fr/software/motus_web/)

## 5.24. MultiPus

### FUNCTIONAL DESCRIPTION

MULTIPUS (for MULTIPLE species for the synthetic PRODUCTION of Useful biochemical SUBSTANCES) is an algorithm that, given a microbial consortium given as input, identifies all optimal sub-consortia to synthetically produce compounds that are either exogenous to it, or are endogenous but where interaction among the species in the sub-consortia could improve the production line.

- Participants: Laurent Bulteau, Alice Julien-Laferrière, Arnaud Mary, Alberto Marchetti-Spaccamela, Delphine Parrot, Marie-France Sagot, Leen Stougie and Susana Vinga
- Contact: Alice Julien-Laferrière, Arnaud Mary, Marie-France Sagot
- URL: <http://multipus.gforge.inria.fr/>

## 5.25. PepLine

### FUNCTIONAL DESCRIPTION

Pipeline for the high-throughput analysis of proteomic data.

- Participants: Jérôme Garin, Alain Viari
- Contact: Alain Viari
- URL: Available upon request to the contact person

## 5.26. Pitufu and family

### FUNCTIONAL DESCRIPTION

Algorithms to enumerate all minimal sets of precursors of target compounds in a metabolic network.

- Participants: Vicente Acuña Aguayo, Ludovic Cottret, Alberto Marchetti-Spaccamela, Fabio Henrique Viduani Martinez, Paulo Vieira Milreu, Marie-France Sagot, Leen Stougie
- Contact: Paulo Vieira Milreu (not Inria), Marie-France Sagot
- URL: <https://sites.google.com/site/pitufosoftware/home>

## 5.27. RepSeek

### FUNCTIONAL DESCRIPTION

Finding approximate repeats in large DNA sequences.

- Participants: Guillaume Achaz, Eric Coissac, Alain Viari
- Contact: Guillaume Achaz (not Inria), Alain Viari
- URL: <http://wwwabi.snv.jussieu.fr/public/RepSeek/>

## 5.28. Rime

### FUNCTIONAL DESCRIPTION

RIME detects long similar fragments occurring at least twice in a set of biological sequences.

- Participants: Maria Federico, Pierre Peterlongo, Nadia Pisanti, Marie-France Sagot
- Contact: Maria Federico (not Inria), Nadia Pisanti, Marie-France Sagot
- URL: <https://code.google.com/p/repeat-identification-rime/>

## 5.29. Sasita

### FUNCTIONAL DESCRIPTION

SASITA is a software for the exhaustive enumeration of minimal stoichiometrically valid precursor sets in metabolic networks.

- Participants: Vicente Acuña, Ricardo Andrade, Alberto Marchetti-Spaccamela, Marie-France Sagot, Leen Stougie, Martin Wannagat
- Contact: Marie-France Sagot, Ricardo Andrade, Martin Wannagat
- URL: <http://sasita.gforge.inria.fr/>

## 5.30. Smile

### FUNCTIONAL DESCRIPTION

Motif inference algorithm taking as input a set of biological sequences. A visualiser is currently being developed.

- Participants: Ricardo Andrade (visualiser), Mariana Ferrarini (visualiser), Laurent Marsan, Marie-France Sagot
- Contact: Ricardo Andrade, Marie-France Sagot
- URL: Soon available

## 5.31. Totoro & Kotoura

### FUNCTIONAL DESCRIPTION

We proposed two methods to decipher the reaction changes during a metabolic transient state using measurements of metabolic concentrations. We called these *metabolic hyperstories*.

TOTORO (for TOPological analysis of Transient metabOlic RespOnse) is based on a qualitative measurement of the concentrations in two steady-states to infer the reaction changes that lead to the observed differences in metabolite pools in both conditions. In the currently available release, a pre-processing and a post-processing steps are included. After the post-processing step, the solutions can be visualised using DINGHY.

KOTOURA (for Kantitative analysis Of Transient metabOlic and regUlatory Response And control) infers quantitative changes of the reactions using information on measurement of the metabolite concentrations in two steady-states.

- Participants: Ricardo Andrade, Laurent Bulteau, Louis Duchemin, Alice Julien-Laferrrière, Alberto Marchetti-Spaccamela, Arnaud Mary, Vincent Lacroix, Marie-France Sagot, Leen Stougie, Philippe Veber, Susana Vinga
- Contact: Alice Julien-Laferrrière, Arnaud Mary, Ricardo Andrade, Marie-France Sagot
- URL: <http://hyperstories.gforge.inria.fr/>

## 5.32. WhatsHap and pWhatsHap

### FUNCTIONAL DESCRIPTION

WHATSHAP is a DP approach for haplotype assembly from long reads that works until 20x coverage, solves the minimum error correction problem exactly. PWHATSHAP is a parallelisation of the core dynamic programming algorithm of WHATSHAP done by M. Aldinucci, A. Bracciali, T. Marschall, M. Patterson, N. Pisanti, and M. Torquati.

- Participants: Gunnar Klau, Tobias Marschall, Murray Patterson, Nadia Pisanti, Alexander Schönhuth, Leen Stougie, Leo van Iersel
- Contact: Alexander Schönhuth (not Inria), Gunnar Klau, Nadia Pisanti
- URL: <https://bitbucket.org/whatshap/whatshap> and <https://bitbucket.org/whatshap/whatshap/branch/parallel>

## EXMO Project-Team

# 5. New Software and Platforms

## 5.1. Alignment API

### SCIENTIFIC DESCRIPTION

Using ontologies is the privileged way to achieve interoperability among heterogeneous systems within the semantic web. However, as the ontologies underlying two systems are not necessarily compatible, they may in turn need to be reconciled. Ontology reconciliation requires most of the time to find the correspondences between entities (e.g., classes, objects, properties) occurring in ontologies. We call a set of such correspondences an alignment.

We have designed a format for expressing alignments in a uniform way. The goal of this format is to share available alignments on the web. It should help systems using alignments, e.g., mediators, translators, to take advantage of any matching algorithm and it will help matching algorithms to be used in many different tasks. This format is expressed in RDF, so it is freely extensible. We have proposed and implemented an expressive extension called EDOAL [13].

The Alignment API [2] is an API and implementation for expressing and sharing ontology alignments.

### FUNCTIONAL DESCRIPTION

The API itself is a Java description of tools for accessing the common format. It defines five main interfaces (OntologyNetwork, Alignment, Cell, Relation and Evaluator).

We provide an implementation for this API which can be used for producing transformations, rules or bridge axioms independently from the algorithm which produced the alignment. The proposed implementation features:

- a base implementation of the interfaces with all useful facilities,
- a library of sample matchers,
- a library of renderers (XSLT, RDF, SKOS, SWRL, OWL, C-OWL, SPARQL, etc.),
- a library of evaluators (various generalisation of precision/recall, precision/recall graphs),
- a flexible test generation framework which allows for generating evaluation datasets,
- a library of wrappers for several ontology APIs,
- parsers for different formats.

To instantiate the API, it is sufficient to refine the base implementation by implementing the align() method. Doing so, the new implementation will benefit from all the services already implemented in the base implementation.

We have developed, on top of the Alignment API, an Alignment server that can be used by remote clients for matching ontologies and for storing and sharing alignments. It is developed as an extensible platform which allows to plug-in new interfaces. The Alignment server can be accessed through HTML, web service (SOAP and REST) and agent communication interfaces.

The Alignment API is used in the Ontology Alignment Evaluation Initiative data and result processing (§6.1.1). It is also used by more than 50 other teams worldwide.

The Alignment API is freely available since december 2003, under the LGPL licence, at <http://alignapi.gforge.inria.fr>.

- Participants: Jérôme Euzenat, Jérôme David, Armen Inants
- Contact: Jérôme Euzenat
- URL: <http://alignapi.gforge.inria.fr/>

## 5.2. OntoSim

### SCIENTIFIC DESCRIPTION

There are many reasons for measuring a distance between ontologies. For example, in semantic social networks, when a peer looks for particular information, it could be more appropriate to send queries to peers having closer ontologies because it will be easier to translate them and it is more likely that such a peer has the information of interest.

OntoSim is a library offering similarity and distance measures between ontology entities as well as between ontologies themselves. It materialises our work towards better ontology proximity measures.

### FUNCTIONAL DESCRIPTION

OntoSim is a Java API allowing to compute similarities between ontologies. It relies on the Alignment API for ontology loading so it is quite independent of the ontology API used (JENA or OWL API).

OntoSim provides a framework for designing various kinds of similarities. In particular, we differentiated similarities in the ontology space from those in the alignment space. The latter ones make use of available alignments in a network of ontologies while the former only rely on ontology data. OntoSim is provided with 4 entity measures which can be combined using various aggregation schemes (average linkage, Hausdorff, maximum weight coupling, etc.), 2 kinds of vector space measures (boolean and TFIDF), and 4 alignment space measures. It also features original comparison methods such as agreement/disagreement measures. In addition, the framework embeds external similarity libraries which can be combined to our own.

OntoSim is based on an ontology interface allowing for using ontology parsed with different APIs. It is written in JAVA and is available, under the LGPL licence, at <http://ontosim.gforge.inria.fr>.

- Participants: Jérôme David, Jérôme Euzenat
- Contact: Jérôme David
- URL: <http://ontosim.gforge.inria.fr/>



## IBIS Project-Team

# 5. New Software and Platforms

## 5.1. Genetic Network Analyzer (GNA)

KEYWORDS: Bioinformatics - Gene regulatory networks - Qualitative simulation - Model checking

GENETIC NETWORK ANALYZER (GNA) is a tool for the qualitative modeling and simulation of gene regulatory networks developed in the IBIS project. The input of GNA consists of a model of the regulatory network in the form of a system of piecewise-linear differential equations (PLDEs), supplemented by inequality constraints on the parameters and initial conditions. From this information, GNA generates a state transition graph summarizing the qualitative dynamics of the system. In order to analyze large graphs, GNA allows the user to specify properties of the qualitative dynamics of a network in temporal logic, using high-level query templates, and to verify these properties on the state transition graph by means of standard model-checking tools, either locally installed or accessible through a remote web server. GNA is currently distributed by the company Genostar, but remains freely available for academic research purposes. The current version is GNA 8.7.2. In comparison with the previously distributed versions, GNA 8.7.2 has the following additional functionalities: (1) it supports the editing and visualization of regulatory networks, in an SBGN-compatible format, (2) it semi-automatically generates a prototype model from the network structure, thus accelerating the modeling process, and (3) it allows models to be exported in the SBML Qual standard.

- Participants: Hidde de Jong, Michel Page, François Rechenmann
- Partners: Genostar, Université Grenoble Alpes
- Contact: Hidde de Jong
- URL: <http://www-helix.inrialpes.fr/gna>

## 5.2. WellFARE

KEYWORDS: Bioinformatics - Statistics - Data visualization - Data modeling

WELLFARE is a Python library implementing linear inversion methods for the reconstruction of gene expression profiles from fluorescent or luminescent reporter gene data. As input, WELLFARE reads the primary data file produced by a 96-well microplate reader, containing time-series measurements of the absorbance (optical density) as well as the fluorescence and luminescence intensities in each well (if available). Various functions exist to analyze the data, in particular for detecting outliers, subtracting background, estimating growth rates, promoter activities and protein concentrations, visualizing expression profiles, synchronizing replicate profiles, etc. WELLFARE is the computational core of the web application WELLINVERTER.

- Participants: Johannes Geiselmann, Hidde de Jong, Yannick Martin, Michel Page, Delphine Ropers, Valentin Zulkower
- Partners: Université Grenoble Alpes
- Contact: Hidde de Jong
- URL: <https://github.com/ibis-inria/welfare>

## 5.3. WellInverter

KEYWORDS: Bioinformatics - Statistics - Data visualization - Data modeling

WELLINVERTER is a web application that implements linear inversion methods for the reconstruction of gene expression profiles from fluorescent or luminescent reporter gene data. As input, WELLINVERTER reads the primary data file produced by a 96-well microplate reader, containing time-series measurements of the absorbance (optical density) as well as the fluorescence and luminescence intensities in each well (if available). Various modules exist to analyze the data, in particular for detecting outliers, subtracting background, estimating growth rates, promoter activities and protein concentrations, visualizing expression profiles, synchronizing replicate profiles, etc. The computational core of the web application consists of the Python library WELLFARE.

- Participants: Johannes Geiselmann, Hidde de Jong, Yannick Martin, Michel Page, Delphine Ropers, Valentin Zulkower
- Partners: Université Grenoble Alpes
- Contact: Hidde de Jong
- URL: <https://team.inria.fr/ibis/wellinverter/>

## 5.4. WellReader

WELLREADER is a program for the analysis of gene expression data obtained by means of fluorescent and luminescent reporter genes. WELLREADER reads data files in an XML format or in a format produced by microplate readers, and allows the user to detect outliers, perform background corrections and spline fits, compute promoter activities and protein concentrations, and compare expression profiles across different conditions. WELLREADER has been written in MATLAB and is available under an LGPL licence, both as source code (M files) and compiled code (platform-specific binary files).

- Participants: Johannes Geiselmann, Hidde de Jong, Michel Page, Delphine Ropers
- Partners: Université Grenoble Alpes
- Contact: Hidde de Jong
- URL: <http://ibis.inrialpes.fr/article957.html>

## IMAGINE Project-Team

## 5. New Software and Platforms

### 5.1. Expressive

Expressive is a new C++ library created in 2013 for gathering and sharing the models and algorithms developed within the ERC Expressive project. It enables us to make our latest research results on new creative tools - such as high level models with intuitive, sketching or sculpting interfaces - soon available to the rest of the group and easily usable for our collaborators, such as Evelyne Hubert (Inria, Galaad) or Loic Barthe (IRIT, Toulouse). The most advanced part is a new version of Convol, a library dedicated to implicit modeling, with a main focus on integral surfaces along skeletons. Convol incorporates all the necessary material for constructive implicit modeling, a variety of blending operators and several methods for tessellating an implicit surface into a mesh, and for refining it in highly curved regions. The creation of new solid geometry can be performed by direct manipulation of skeletal primitives or through sketch-based modeling and multi-touch deformations.

- Participants: Marie Paule Cani, Antoine Begault, Even Entem, Thomas Delame, Ulysse Vimont
- Contact: Marie Paule Cani

### 5.2. MyCF



Figure 1. Left: My Corporis Fabrica is an anatomical knowledge database developed in our team. Right: SOFA is an open source simulator for physically based modeling.

**My Corporis Fabrica (MyCF)** is an anatomical knowledge ontology developed in our group. It relies on FMA (Foundational Model of Anatomy), developed under Creative Commons license (CC-by). MyCF browser is available on line, and is already in use for education and research in anatomy. Moreover, the MyCf's generic programming framework can be used for other domains, since the link it provides between semantic and 3D models matches several other research applications at IMAGINE.

- Participants: Olivier Palombi, Armelle Bauer, François Faure, Ali Hamadi Dicko
- Contact: Olivier Palombi
- URL: <http://www.mycorporisfabrica.org>

### 5.3. SOFA

Simulation Open Framework Architecture

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.

Sofa is extensively used by Anatoscope, who add proprietary plugins and helps maintaining the public plugins.

- Participants: François Faure, Armelle Bauer, Matthieu Nesme, Romain Testylier.
- Contact: François Faure
- URL: <http://www.sofa-framework.org>

## 5.4. Natron

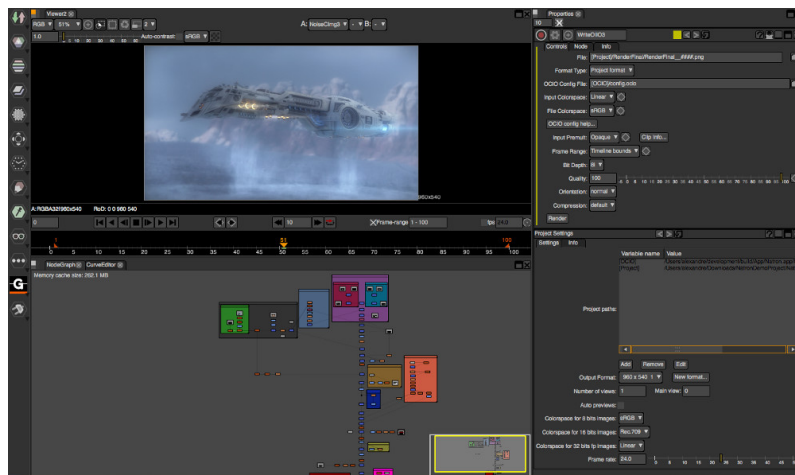


Figure 2. Video compositing using the Natron interface.

Natron (<http://natron.fr>) is a professional-quality video post-production software specialized in compositing and visual effects. Compositing is the combining of visual elements from separate sources into single images, often to create the illusion that all those elements are parts of the same scene. The math behind compositing was formalized by Porter & Duff (1984) after the preliminary work by Wallace (1981).

Typical examples of compositing are, for example:

- The superimposition of a character filmed on a green background over a scene shot in another place, at another time, or a computer-generated scene;
- The manual detouring (also called rotoscoping) of an element in a video to embed it in another video, possibly with a different motion;
- Artistic modifications of a video, after shooting a live-action scene or rendering a CGI scene, in order to modify its lighting, colors, depth of field, camera motion, or to remove noise or add film grain.

A video compositing software is not a 3D computer graphics software, like Blender or Maya, but it is perfectly suited for combining computer-generated elements produced by other software with live-action video or 2D animation. Rather than rendering a full 3D scene with the 3D software, which may cost many hours of computation, the video compositing software can assemble the elements produced separately with a much more reactive interface and an almost instantaneous visual feedback.

- Participants: Frédéric Devernay, Alexandre Gauthier-Foichat.
- Contact: Frédéric Devernay
- URL: <http://natron.fr>

## MAVERICK Project-Team

# 6. New Software and Platforms

## 6.1. Diffusion curves

KEYWORDS: Vector-based drawing - Shading

FUNCTIONAL DESCRIPTION Diffusion Curves is a vector-based design tool for creating complex shaded images. This prototype is composed of the Windows binary, along with the required shader programs (ie. in source code).

- Participants: Joelle Thollot, Pascal Barla, Adrien Bousseau and Alexandrina Orzan
- Partners: CNRS - INP Grenoble - LJK - Université Joseph-Fourier
- Contact: Joelle Thollot
- URL: <http://maverick.inria.fr/Publications/2008/OBWBTS08/index.php>

## 6.2. GRATIN

FUNCTIONAL DESCRIPTION Gratin is a node-based compositing software for creating, manipulating and animating 2D and 3D data. It uses an internal direct acyclic multi-graph and provides an intuitive user interface that allows to quickly design complex prototypes. Gratin has several properties that make it useful for researchers and students. (1) it works in real-time: everything is executed on the GPU, using OpenGL, GLSL and/or Cuda. (2) it is easily programmable: users can directly write GLSL scripts inside the interface, or create new C++ plugins that will be loaded as new nodes in the software. (3) all the parameters can be animated using keyframe curves to generate videos and demos. (4) the system allows to easily exchange nodes, group of nodes or full pipelines between people.

- Participants: Pascal Barla and Romain Vergne
- Partner: UJF
- Contact: Romain Vergne
- URL: <http://gratin.gforge.inria.fr/>

## 6.3. GigaVoxels

FUNCTIONAL DESCRIPTION Gigavoxel is a software platform which goal is the real-time quality rendering of very large and very detailed scenes which couldn't fit memory. Performances permit showing details over deep zooms and walk through very crowded scenes (which are rigid, for the moment). The principle is to represent data on the GPU as a Sparse Voxel Octree which multiscale voxels bricks are produced on demand only when necessary and only at the required resolution, and kept in a LRU cache. User defined producer lays across CPU and GPU and can load, transform, or procedurally create the data. Another user defined function is called to shade each voxel according to the user-defined voxel content, so that it is user choice to distribute the appearance-making at creation (for faster rendering) or on the fly (for storageless thin procedural details). The efficient rendering is done using a GPU differential cone-tracing using the scale corresponding to the 3D-MIPmapping LOD, allowing quality rendering with one single ray per pixel. Data is produced in case of cache miss, and thus only whenever visible (accounting for view frustum and occlusion). Soft-shadows and depth-of-field is easily obtained using larger cones, and are indeed cheaper than unblurred rendering. Beside the representation, data management and base rendering algorithm themselves, we also worked on realtime light transport, and on quality prefiltering of complex data. Ongoing researches are addressing animation. GigaVoxels is currently used for the quality real-time exploration of the detailed galaxy in ANR RTIGE. Most of the work published by Cyril Crassin (and al.) during his PhD (see <http://maverick.inria.fr/Members/Cyril.Crassin/>) is related to GigaVoxels. GigaVoxels is available for Windows and Linux under the BSD-3 licence.

- Participants: Cyril Crassin, Fabrice Neyret, Prashant Goswami, Jérémy Sinoir, Pascal Guehl and Eric Heitz
- Contact: Fabrice Neyret
- URL: <http://gigavoxels.inrialpes.fr>

## 6.4. HQR

High Quality Renderer

KEYWORDS: Lighting simulation

FUNCTIONAL DESCRIPTION

HQR is a global lighting simulation platform. HQR software is based on the photon mapping method which is capable of solving the light balance equation and of giving a high quality solution. Through a graphical user interface, it reads X3D scenes using the X3DToolkit package developed at Maverick, it allows the user to tune several parameters, computes photon maps, and reconstructs information to obtain a high quality solution. HQR also accepts plugins which considerably eases the developpement of new algorithms for global illumination, those benefiting from the existing algorithms for handling materials, geometry and light sources.

- Participant: Cyril Soler
- Contact: Cyril Soler
- URL: <http://artis.imag.fr/~Cyril.Soler/HQR>

## 6.5. MobiNet

KEYWORDS: Co-simulation - Education - Programmation

FUNCTIONAL DESCRIPTION The MobiNet software allows for the creation of simple applications such as video games, virtual physics experiments or pedagogical math illustrations. It relies on an intuitive graphical interface and language which allows the user to program a set of mobile objects (possibly through a network). It is available in public domain for Linux, Windows and MacOS.

- Participants: Fabrice Neyret, Sylvain Lefebvre, Samuel Hornus, Joelle Thollot and Franck Hetroy-Wheeler
- Partners: Cies - CNRS - GRAVIR - INP Grenoble - Inria - IREM - LJK
- Contact: Fabrice Neyret
- URL: <http://mobinet.imag.fr/index.en.html>

## 6.6. PROLAND

PROcedural LANDscape

KEYWORDS: Real time - 3D - Realistic rendering - Masses of data - Atmosphere - Ocean

FUNCTIONAL DESCRIPTION The goal of this platform is the real-time quality rendering and editing of large landscapes. All features can work with planet-sized terrains, for all viewpoints from ground to space. Most of the work published by Eric Bruneton and Fabrice Neyret (see <http://evasion.inrialpes.fr/Membres/Eric.Bruneton/>) has been done within Proland and integrated in the main branch. Proland is available under the BSD-3 licence.

- Participants: Antoine Begault, Eric Bruneton, Guillaume Piolet and Fabrice Neyret
- Contact: Fabrice Neyret
- URL: <https://proland.inrialpes.fr/>

## 6.7. ShwarpIt

KEYWORD: Warping

FUNCTIONAL DESCRIPTION ShwarpIt is a simple mobile app that allows you to manipulate the perception of shapes in images. Slide the ShwarpIt slider to the right to make shapes appear rounder. Slide it to the left to make shapes appear more flat. The Scale slider gives you control on the scale of the warping deformation.

- Contact: Georges-Pierre Bonneau
- URL: <http://bonneau.meylan.free.fr/ShwarpIt/ShwarpIt.html>

## 6.8. VRender

**FUNCTIONAL DESCRIPTION** The VRender library is a simple tool to render the content of an OpenGL window to a vectorial device such as Postscript, XFig, and soon SVG. The main usage of such a library is to make clean vectorial drawings for publications, books, etc. In practice, VRender replaces the z-buffer based hidden surface removal of OpenGL by sorting the geometric primitives so that they can be rendered in a back-to-front order, possibly cutting them into pieces to solve cycles. VRender is also responsible for the vectorial snapshot feature of the QGLViewer library.

- Participant: Cyril Soler
- Contact: Cyril Soler
- URL: <http://artis.imag.fr/Software/VRender/>

## 6.9. X3D TOOLKIT

X3D Development platform

**FUNCTIONAL DESCRIPTION** X3DToolkit is a library to parse and write X3D files, that supports plugins and extensions.

- Participants: Gilles Debunne and Yannick Le Goc
- Contact: Cyril Soler
- URL: <http://artis.imag.fr/Software/X3D/>

## 6.10. libylm

LibYLM

**KEYWORD:** Spherical harmonics

**FUNCTIONAL DESCRIPTION** This library implements spherical and zonal harmonics. It provides the means to perform decompositions, manipulate spherical harmonic distributions and provides its own viewer to visualize spherical harmonic distributions. It is available for linux on the Launchpad PPA of the author.

- Author: Cyril Soler
- Contact: Cyril Soler
- URL: <https://launchpad.net/~csoler-users/+archive/ubuntu/ylm>



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## MISTIS Project-Team

## 6. New Software and Platforms

### 6.1. BOLD model FIT

KEYWORDS: Functional imaging - fMRI - Health

FUNCTIONAL DESCRIPTION

This Matlab toolbox performs the automatic estimation of biophysical parameters using the extended Balloon model and BOLD fMRI data. It takes as input a MAT file and provides as output the parameter estimates achieved by using stochastic optimization

- Authors: Pablo Mesejo Santiago, Jan M Warnking and Florence Forbes
- Contact: Pablo Mesejo Santiago
- URL: <https://hal.archives-ouvertes.fr/hal-01221115v2/>

### 6.2. MMST

Mixtures of Multiple Scaled Student T distributions

KEYWORDS: Health - Statistics - Brain MRI - Medical imaging - Robust clustering

FUNCTIONAL DESCRIPTION

The package implements mixtures of so-called multiple scaled Student distributions, which are generalization of multivariate Student T distribution allowing different tails in each dimension. Typical applications include Robust clustering to analyse data with possible outliers. In this context, the model and package have been used on large data sets of brain MRI to segment and identify brain tumors.

- Participants: Alexis Arnaud, Florence Forbes and Darren Wraith
- Contact: Florence Forbes
- URL: <http://mistis.inrialpes.fr/realisations.html>

### 6.3. PyHRF

KEYWORDS: fMRI - Statistic analysis - Neurosciences - IRM - Brain - Health - Medical imaging

FUNCTIONAL DESCRIPTION

As part of fMRI data analysis, PyHRF provides a set of tools for addressing the two main issues involved in intra-subject fMRI data analysis : (i) the localization of cerebral regions that elicit evoked activity and (ii) the estimation of the activation dynamics also referenced to as the recovery of the Hemodynamic Response Function (HRF). To tackle these two problems, PyHRF implements the Joint Detection-Estimation framework (JDE) which recovers parcel-level HRFs and embeds an adaptive spatio-temporal regularization scheme of activation maps.

- Participants: Thomas Vincent, Solveig Badillo, Lotfi Chaari, Christine Bakhous, Florence Forbes, Philippe Ciuciu, Laurent Risser, Thomas Perret, Aina Frau Pascual and Jaime Eduardo Arias Almeida
- Partners: CEA - NeuroSpin
- Contact: Florence Forbes
- URL: <http://pyhrf.org>

### 6.4. xLLiM

High dimensional locally linear mapping

KEYWORDS: Clustering - Regression

FUNCTIONAL DESCRIPTION

This is an R package available on the [CRAN](#).

XLLiM provides a tool for non linear mapping (non linear regression) using a mixture of regression model and an inverse regression strategy. The methods include the GLLiM model (Deleforge et al (2015) ) based on Gaussian mixtures and a robust version of GLLiM, named SLLiM (see [71] ) based on a mixture of Generalized Student distributions.

- Participants: Emeline Perthame, Florence Forbes and Antoine Deleforge
- Contact: Florence Forbes
- URL: <https://cran.r-project.org/web/packages/xLLiM/index.html>

## MORPHEO Project-Team

# 6. New Software and Platforms

## 6.1. Kinovis: 4D repository

### FUNCTIONAL DESCRIPTION

This website is now part of the Kinovis platform website. It hosts dynamic mesh sequences reconstructed from images captured using a multi-camera set up. Such mesh-sequences offer a new promising vision of virtual reality, by capturing real actors and their interactions. The texture information is trivially mapped to the reconstructed geometry, by back-projecting from the images. These sequences can be seen from arbitrary viewing angles as the user navigates in 4D (3D geometry + time) . Different sequences of human / non-human interaction can be browsed and downloaded from the data section.

- Contact: Edmond Boyer
- URL: <http://kinovis.inrialpes.fr/4d-repository/>

## 6.2. Lucy Viewer

KEYWORDS: Data visualization - 4D - Multi-Cameras

### FUNCTIONAL DESCRIPTION

Lucy Viewer is an interactive viewing software for 4D models, i.e, dynamic three-dimensional scenes that evolve over time. Each 4D model is a sequence of meshes with associated texture information from the original real images.

- Participants: Mickaël Heudre, Jean-Sébastien Franco and Edmond Boyer
- Contact: Edmond Boyer
- URL: <http://kinovis.inrialpes.fr/lucyviewer/>

## 6.3. QuickCSG

KEYWORDS: 3D modeling - CAD - 3D reconstruction - Geometric algorithms

FUNCTIONAL DESCRIPTION QuickCSG is a library and command-line application that computes boolean operations between polyhedra. It is able to directly compute resulting solids from an arbitrary number of inputs and for an arbitrary boolean combination function, with state of the art execution times.

- Participants: Matthijs Douze, Jean-Sébastien Franco and Bruno Raffin
- Partner: INP Grenoble
- Contact: Matthijs Douze
- URL: <http://kinovis.inrialpes.fr/quickcsg/>

## 6.4. Shape Tracking

### FUNCTIONAL DESCRIPTION

We are developing a software suite to track shapes over temporal sequences. The motivation is to provide temporally coherent 4D Models, i.e. 3D models and their evolutions over time , as required by motion related applications such as motion analysis. This software takes as input a temporal sequence of 3D models in addition to a template and estimate the template deformations over the sequence that fit the observed 3D models.

- Contact: Edmond Boyer

## 6.5. 3DtLaplace

KEYWORDS: Laplace operator - Mesh sequence

FUNCTIONAL DESCRIPTION This software computes a discrete 3D+t Laplace operator for temporally mesh sequences.

- Participants: Victoria Fernández-Abrevaya, Franck Hétroy-Wheeler and Stefanie Wuhrer
- Partner: INP Grenoble
- Contact: Victoria Fernández-Abrevaya
- URL: <http://3dtlaplace.gforge.inria.fr/>

## 6.6. CVTGenerator

KEYWORDS: Mesh - Centroidal Voronoi tessellation - Implicit surface

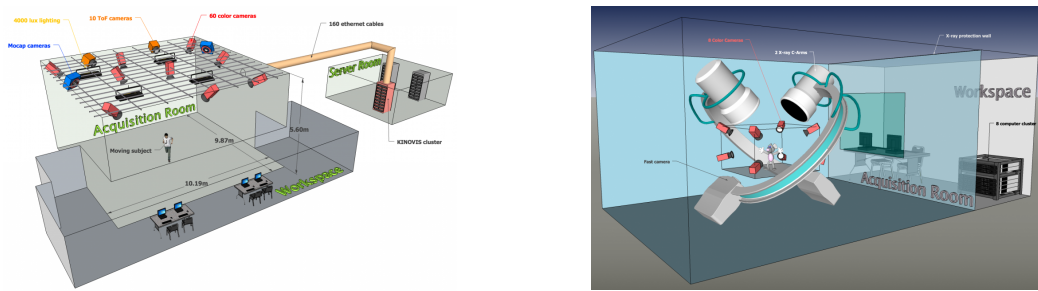
FUNCTIONAL DESCRIPTION CVTGenerator is a program that builds Centroidal Voronoi Tessellations of any 3D meshes and implicit surfaces.

- Participants: Edmond Boyer, Franck Hétroy-Wheeler and Li Wang
- Partner: INP Grenoble
- Contact: Li Wang
- URL: <http://cvt.gforge.inria.fr/>

## 6.7. Platforms

### 6.7.1. Platform Kinovis

Kinovis (<http://kinovis.inrialpes.fr/>) is a multi-camera acquisition project that was selected within the call for proposals "Equipements d'Excellence" of the program "Investissement d'Avenir" funded by the French government. The project involves 2 institutes: the Inria Grenoble Rhône-Alpes, the université Joseph Fourier and 4 laboratories: the LJK (laboratoire Jean Kuntzmann - applied mathematics), the LIG (laboratoire d'informatique de Grenoble - Computer Science), the Gipsa lab (Signal, Speech and Image processing) and the LADAF (Grenoble Hospitals - Anatomy). The Kinovis environment is composed of 2 complementary platforms. A first platform located at Inria Grenoble with a 10mx10m acquisition surface is equipped with 68 color cameras and 20 IR motion capture (mocap) cameras. It is the evolution of the Grimage platform towards the production of better models of more complex dynamic scenes. A second platform located at Grenoble Hospitals, within the LADAF anatomy laboratory, is equipped with 10 color and 2 X-ray cameras to enable combined analysis of internal and external shape structures, typically skeleton and bodies of animals. Installation works of both platforms started in 2013 and are now finished. Both platforms have already demonstrated their potential through a range of projects lead by the team and externally. Members of Morpheo are highly involved in this project. Edmond Boyer is coordinating this project and Lionel Reveret is in charge of the LADAF platform. Mickaël Heudre and Julien Pansiot were managing the technical resources of both platforms.



*Figure 1. Kinovis platforms: on the left the Inria platform; on the right Grenoble Hospital platform.*

## **NANO-D Project-Team**

# **5. New Software and Platforms**

## **5.1. SAMSON**

Software for Adaptive Modeling and Simulation Of Nanosystems

KEYWORDS: Bioinformatics - Simulation - Nanosystems - Structural Biology - Chemistry

SCIENTIFIC DESCRIPTION

Please refer to <https://www.samson-connect.net>

FUNCTIONAL DESCRIPTION

SAMSON is a software platform for real-time modelling and simulation of natural or artificial nanosystems. The objective is to make SAMSON a generic application for computer-aided design of nanosystems, similar to existing applications for macrosystem prototyping (CATIA, SolidWorks, etc.).

- Contact: Stéphane Redon
- URL: <http://www.samson-connect.net/>

## NECS Project-Team

# 6. New Software and Platforms

## 6.1. GTL

Grenoble Traffic Lab

FUNCTIONAL DESCRIPTION

The Grenoble Traffic Lab (GTL) initiative, led by the NeCS team, is a real-time traffic data Center (platform) that collects traffic road infrastructure information in real-time with minimum latency and fast sampling periods. The main elements of the GTL are: a real-time data-base, a show room, and a calibrated micro-simulator of the Grenoble South Ring. Sensed information comes from a dense wireless sensor network deployed on Grenoble South Ring, providing macroscopic traffic signals such as flows, velocities, densities, and magnetic signatures. This sensor network was set in place in collaboration with Inria spin-off Karrus-ITS, local traffic authorities (DIR-CE, CG38, La Metro), and specialized traffic research centers. In addition to real data, the project also uses simulated data, in order to validate models and to test the ramp-metering, the micro-simulator is a commercial software (developed by TSS AIMSUN ©). More details at <http://necs.inrialpes.fr/pages/grenoble-traffic-lab.php>.

- Participants: Carlos Canudas De Wit, Iker Bellicot, Pascal Bellemain, Dominik Pisarski, Alain Kibangou, Hassen Fourati, Fabio Morbidi, Federica Garin, Andres Alberto Ladino Lopez, Pietro Grandinetti, Enrico Lovisari, Rohit Singhal, Anton Andreev, Remi Piotaix, Vadim Bertrand, Maria Laura Delle Monache and Paolo Frasca
- Contact: Carlos Canudas De Wit
- URL: <http://necs.inrialpes.fr/pages/grenoble-traffic-lab.php>

## 6.2. Senslogs – Sensors recorder for Android application

**Participants:** T. Michel [contact person], H. Fourati, P. Geneves, N. Layaida.

This Android application records direct and computed measurements from internal sensors (Accelerometer, Gyroscope, Magnetometer, Calibrated Gyroscope, Calibrated Magnetic Field, Game Rotation Vector, Geomagnetic, Rotation Vector, Gravity, Linear Acceleration, Significant Motion, Step Counter, Step Detector, Ambient Temperature, Light, Pressure, Relative Humidity, Heart Rate, Proximity, GPS Location, Cell and Wifi Location, Passive Location, NMEA data, Wifi signals, Bluetooth signals (not yet), NFC (not yet), and others available...). Data are stored in files using space-separated values. This application has been designed for post-processing projects. It will be used in pedestrian navigation and augmented reality applications. This application is available online: [https://play.google.com/store/apps/details?id=fr.inria.tyrex.senslogs&hl=fr\\_BE](https://play.google.com/store/apps/details?id=fr.inria.tyrex.senslogs&hl=fr_BE)

## 6.3. Wifi Scan Interval for Android application

**Participants:** T. Michel [contact person], H. Fourati, P. Geneves, N. Layaida.

This app records the wifi scan sampling rate on your phone. This application is available online: <https://play.google.com/store/apps/details?id=fr.inria.tyrex.wifiscaninterval> To contribute to a database: <http://thibaud-michel.com/mobile/wifi-scan-interval.txt> More information: <https://github.com/ThibaudM/WifiScanInterval><http://stackoverflow.com/questions/37193175>

## NUMED Project-Team

# 5. New Software and Platforms

## 5.1. Bingham flows

### FUNCTIONAL DESCRIPTION

A 1D and 2D code with a new method for the computation of viscoplastic flows with free-surface. It essentially couples Optimization methods and Well-Balanced Finite-Volumes schemes for viscous shallow-water equations (induced by the viscoplastic nature of the fluid). Currently applied to avalanches of dense snow, it is a private code currently actively developed (in C++). One of the key feature is that its well-balanced property allows to obtained the stationary states which are linked to the stopping of the snow avalanche for this highly non-linear type of fluid.

- Contact: Paul Vigneaux

## 5.2. OptimChemo

### FUNCTIONAL DESCRIPTION

OptimChemo is a userfriendly software designed to study numerically the effect of multiple chemotherapies on simple models of tumour growth and to optimize chemotherapy schedules.

- Participants: Emmanuel Grenier, Violaine Louvet, Paul Vigneaux and Ehouarn Maguet
- Contact: Emmanuel Grenier

## 5.3. SETIS

KEYWORDS: Health - DICOM - Medical imaging - Drug development

### FUNCTIONAL DESCRIPTION

SETIS software is a GUI allowing to treat DICOM medical images to extract pathological data. These data can then be exported and used in a SAEM software (including Monolix (Inria et Lixoft)) for the parameters' estimation of models in the context of population approaches. As an example SETIS can be used to segment and compute the tumor size of a patients from MRI scans taken at different times. The software is sufficiently general to be used in various situations by clinicians (already done by colleagues in Lyon Hospital).

- Participants: Paul Vigneaux and Ehouarn Maguet
- Partner: ENS Lyon
- Contact: Paul Vigneaux

## 5.4. VAXSIMSTAB

KEYWORDS: Bioinformatics - Health - Drug development

### FUNCTIONAL DESCRIPTION

VAXSIMSTAB is a modeler stability prediction of vaccine software.

- Participants: Benjamin Ribba, Emmanuel Grenier and Vincent Calvez
- Contact: Emmanuel Grenier



## PERCEPTION Project-Team

# 5. New Software and Platforms

## 5.1. ECMPR

Expectation Conditional Maximization for the Joint Registration of Multiple Point Sets

FUNCTIONAL DESCRIPTION

Rigid registration of two or several point sets based on probabilistic matching between point pairs and a Gaussian mixture model

- Participants: Florence Forbes, Radu Horaud and Manuel Yguel
- Contact: Patrice Horaud
- URL: <https://team.inria.fr/perception/research/jrmpc/>

## 5.2. Mixcam

Reconstruction using a mixed camera system

KEYWORDS: Computer vision - 3D reconstruction

FUNCTIONAL DESCRIPTION

We developed a multiple camera platform composed of both high-definition color cameras and low-resolution depth cameras. This platform combines the advantages of the two camera types. On one side, depth (time-of-flight) cameras provide coarse low-resolution 3D scene information. On the other side, depth and color cameras can be combined such as to provide high-resolution 3D scene reconstruction and high-quality rendering of textured surfaces. The software package developed during the period 2011-2014 contains the calibration of TOF cameras, alignment between TOF and color cameras, TOF-stereo fusion, and image-based rendering. These software developments were performed in collaboration with the Samsung Advanced Institute of Technology, Seoul, Korea. The multi-camera platform and the basic software modules are products of 4D Views Solutions SAS, a start-up company issued from the PERCEPTION group.

- Participants: Patrice Horaud, Pierre Arquier, Quentin Pelorson, Michel Amat, Miles Hansard, Georgios Evangelidis, Soraya Arias, Radu Horaud, Richard Broadbridge and Clement Menier
- Contact: Patrice Horaud
- URL: <https://team.inria.fr/perception/mixcam-project/>

## 5.3. NaoLab

Distributed middleware architecture for interacting with NAO

FUNCTIONAL DESCRIPTION

This software provides a set of libraries and tools to simplify the control of NAO robot from a remote machine. The main challenge is to make easy prototyping applications for NAO using C++ and Matlab programming environments. Thus NaoLab provides a prototyping-friendly interface to retrieve sensor data (video and sound streams, odometric data...) and to control the robot actuators (head, arms, legs...) from a remote machine. This interface is available on Naoqi SDK, developed by Aldebaran company, Naoqi SDK is needed as it provides the tools to access the embedded NAO services (low-level motor command, sensor data access...)

- Authors: Quentin Pelorson, Fabien Badeig and Patrice Horaud
- Contact: Patrice Horaud
- URL: <https://team.inria.fr/perception/research/naolab/>

## 5.4. Stereo matching and recognition library

KEYWORD: Computer vision  
FUNCTIONAL DESCRIPTION

Library providing stereo matching components to rectify stereo images, to retrieve faces from left and right images, to track faces and method to recognise simple gestures

- Participants: Jordi Sanchez-Riera, Soraya Arias, Jan Cech and Radu Horaud
- Contact: Soraya Arias
- URL: <https://code.humavips.eu/projects/stereomatch>

## 5.5. Platforms

### 5.5.1. Audio-Visual Head Popeye+

In 2016 we upgraded our audio-visual platform, from Popeye to Popeye+. Popeye+ has two high-definitions cameras with a wide field of view. We also upgraded the software libraries that perform synchronized acquisition of audio signals and color images. Popeye+ has been used for several datasets.

Website:

<https://team.inria.fr/perception/projects/popeye/>

<https://team.inria.fr/perception/projects/popeye-plus/>

<https://team.inria.fr/perception/avtrack1/>.

### 5.5.2. NAO Robots

The PERCEPTION team selected the companion robot NAO for experimenting and demonstrating various audio-visual skills as well as for developing the concept of a social robot that is able to recognize human presence, to understand human gestures and voice, and to communicate by synthesizing appropriate behavior. The main challenge of our team is to enable human-robot interaction in the real world.



Figure 2. The Popeye+ audio-visual platform (left) delivers high-quality, high-resolution and wide-angle images at 30FPS. The NAO prototype used by PERCEPTION in the EARS STREP project has a twelve-channel spherical microphone array synchronized with a stereo camera pair.

The humanoid robot NAO is manufactured by Aldebaran Robotics, now SoftBank. Standing, the robot is roughly 60 cm tall, and 35cm when it is sitting. Approximately 30 cm large, NAO includes two CPUs. The first one, placed in the torso, together with the batteries, controls the motors and hence provides kinematic motions with 26 degrees of freedom. The other CPU is placed in the head and is in charge of managing the proprioceptive sensing, the communications, and the audio-visual sensors (two cameras and four microphones, in our case). NAO's on-board computing resources can be accessed either via wired or wireless communication protocols.

NAO's commercially available head is equipped with two cameras that are arranged along a vertical axis: these cameras are neither synchronized nor a significant common field of view. Hence, they cannot be used in combination with stereo vision. Within the EU project HUMAVIPS, Aldebaran Robotics developed a binocular camera system that is arranged horizontally. It is therefore possible to implement stereo vision algorithms on NAO. In particular, one can take advantage of both the robot's cameras and microphones. The cameras deliver VGA sequences of image pairs at 12 FPS, while the sound card delivers the audio signals arriving from all four microphones and sampled at 48 kHz. Subsequently, Aldebaran developed a second binocular camera system to go into the head of NAO v5.

In order to manage the information flow gathered by all these sensors, we implemented our software on top of the Robotics Services Bus (RSB). RSB is a platform-independent event-driven middleware specifically designed for the needs of distributed robotic applications. Several RSB tools are available, including real-time software execution, as well as tools to record the event/data flow and to replay it later, so that application development can be done off-line. RSB events are automatically equipped with several time stamps for introspection and synchronization purposes. RSB was chosen because it allows our software to be run on a remote PC platform, neither with performance nor deployment restrictions imposed by the robot's CPUs. Moreover, the software packages can be easily reused for other robots.

More recently (2015-2016) the PERCEPTION team started the development of NAOLab, a middleware for hosting robotic applications in C, C++, Python and Matlab, using the computing power available with NAO, augmented with a networked PC.

Websites:

<https://team.inria.fr/perception/nao/>

<https://team.inria.fr/perception/research/naolab/>

## **PERSVASIVE INTERACTION Team**

### **5. New Software and Platforms**

#### **5.1. DomiCube**

- Participant: Rémi Pincent
- Contact: Rémi Pincent

#### **5.2. EmoPRAMAD**

KEYWORDS: Health - Home care

FUNCTIONAL DESCRIPTION

Within the Pramad project, we want to offer a full affective loop between the companion robot and the elderly people at home. This affective loop is necessary within the context of everyday interaction of elderly and the companion robot. A part of this loop is to make the robot express emotions in response to the emotional state of the user. To do that, we need to test our working hypothesis about the visual representation of emotions with the 3D face of robot. EmoPRAMAD is an evaluation tool designed to conduct comparative studies between human faces and the 3D faces expressing a defined set of emotions.

The evaluation conducted through EmoPRAMAD concerns both unimodal (facial only) and bimodal conditions (facial/sound). The emotions set is composed of 4 basic emotions (joy, fear, anger, sadness) and a neutral state. While experimenting, the software collects several parameters in order to evaluate more than correctness of the answers: time to respond, length of mouse moves, etc.

- Contact: Dominique Vaufreydaz

#### **5.3. Online Movie Director**

- Participants: Patrick Reignier, Dominique Vaufreydaz and James Crowley
- Contact: Dominique Vaufreydaz

#### **5.4. SmartEnergy**

FUNCTIONAL DESCRIPTION

Inhabitants play a key role in buildings global energy consumption but it is difficult to involve them in energy management. Our objective is to make energy consumption visible by simulating inside a serious game the energy impact of inhabitants behaviours. A serious game is currently under development, coupling a 3D virtual environment and a building energy simulator. The 3D virtual environment is based on the JMonkey 3D engine. New houses can be easily imported using SweetHome 3D and Blender. The building energy simulator is EnergyPlus. The 3D engine and the energy engine are coupled using the Functional Mock-up Interface (FMI) standard. Using this standard will allow to easily switch between existing building energy simulators.

- Participant: Patrick Reignier
- Contact: Patrick Reignier

## 5.5. SmartServoFramework

- Participants: Dominique Vaufreydaz and Emeric Grange
- Contact: James Crowley

SmartServoFramework is a C++ multiplatform framework used to drive "smart servo" devices such as Dynamixel or HerkuleX actuators. The Framework, developed by members of the PRIMA team runs under Linux (and most Unix systems), Mac OS X and Windows operating systems. SmartServoFramework can run on Raspberry Pi or other similar boards. This framework can be used with any Dynamixel or HerkuleX devices. Dynamixel devices from Robotis and HerkuleX devices from Dongbu Robot are high-performance networked actuators for robots available in wide range of sizes and strengths. They have adjustable torque, speed, angle limits, and provide various feedback like position, load, voltage and temperature.

## 5.6. MobileRGBD

KEYWORDS: Benchmark corpus - Health - Home Care

- Contact: Dominique Vaufreydaz
- <http://mobilergbd.inrialpes.fr>

FUNCTIONAL DESCRIPTION MobileRGBD is corpus dedicated to low level RGB-D algorithms benchmarking on mobile platform. We reversed the usual corpus recording paradigm. Our goal is to facilitate ground truth annotation and reproducibility of records among speed, trajectory and environmental variations. As we want to get rid of unpredictable human moves, we used dummies in order to play static users in the environment (see figure). Interest of dummies resides in the fact that they do not move between two recordings. It is possible to record the same robot move in order to evaluate performance of detection algorithms varying speed. This benchmark corpus is intended for "low level" RGB-D algorithm family like 3D-SLAM, body/skeleton tracking or face tracking using a mobile robot. Using this open corpus, researchers can find a way to answer several questions: System performance under variations in operating conditions? on a mobile robot, what is the maximum linear/angular speed supported by the algorithm? which variables impact the algorithm? evaluate suitable height/angle of the mounted RGB-D sensor to reach goals: monitoring everyday live is different from searching fallen persons on the floor; finally, what is the performance on an algorithm with regards to others?

## 5.7. Unix Interface for InfraRed Sensor

- Author: Pierre Baret
- Contact: James Crowley

## 5.8. Virtual Reality rehabilitation platform for Complex Regional Pain Syndrome

Participants: Charles-Henry Dufetel, Jing Tao Chen, Sabine Coquillart Design and development of a Virtual Reality rehabilitation platform for CRPS (Complex Regional Pain Syndrome). This application is aimed at studying the impact of visual feedback on the rehabilitation process of a patient. It focuses on the hand by allowing the physical therapist to perturb (amplify or decrease) the feedback that the patient gets from his/her hand movement. First pilot tests have been conducted.

## 5.9. EquipEx AmiQual4Home - Ambient Intelligence for Quality of Life

The AmiQual4Home Innovation Factory is an open research facility for innovation and experimentation with human-centered services based on the use of large-scale deployment of interconnected digital devices capable of perception, action, interaction and communication. The Innovation Factory is composed of a collection of workshops for rapid creation of prototypes, surrounded by a collection of living labs and supported by an industrial innovation and transfer service. Creation of the Innovation Factory has been made possible by a grant from French National programme Investissement d'avenir, together with substantial contributions of resources by Grenoble INP, Univ Joseph Fourier, UPMF, CNRS, Schneider Electric and the Communaute de Communes of Montbonnot. The objective is to provide the academic and industrial communities with an open platform to enable research on design, integration and evaluation of systems and services for smart habitats.

The AmiQual4Home Innovation Factory is a unique combination of three different innovation instruments:

1. Workshops for rapid prototyping of devices that embed perception, action, interaction and communication in ordinary objects based on the MIT FabLab model,
2. Facilities for real-world test and evaluation of devices and services organized as open Living Labs,
3. Resources for assisting students, researchers, entrepreneurs and industrial partners in creating new economic activities.

The AmiQual4Home Innovation Factory works with the Inovallee TARMAC technology incubator as well as the SAT Linksium to provide innovation and transfer services to enable students, researchers and local entrepreneurs to create and grow new commercial activities based on smart objects and services.

## POLARIS Team

# 5. New Software and Platforms

## 5.1. Framesoc

### FUNCTIONAL DESCRIPTION

Framesoc is the core software infrastructure of the SoC-Trace project. It provides a graphical user environment for execution-trace analysis, featuring interactive analysis views as Gantt charts or statistics views. It provides also a software library to store generic trace data, play with them, and build other analysis tools (e.g., Ocelotl).

- Participants: Jean-Marc Vincent and Arnaud Legrand
- Contact: Guillaume Huard
- URL: <http://soctrace-inria.github.io/framesoc/>

## 5.2. GameSeer

### FUNCTIONAL DESCRIPTION

GameSeer is a tool for students and researchers in game theory that uses Mathematica to generate phase portraits for normal form games under a variety of (user-customizable) evolutionary dynamics. The aim of GameSeer is a) to provide a numerical integration kernel for phase portrait and equilibrium set generation; and b) to provide a graphical user interface that allows the user to employ said capabilities from a simple and intuitive front-end.

- Contact: Panayotis Mertikopoulos
- URL: <http://mescal.imag.fr/membres/panayotis.mertikopoulos/publications.html>

## 5.3. Moca

### Memory Organization Cartography and Analysis

MOCA is an efficient tool for the collection of complete spatiotemporal memory traces. Its objective is twofold, namely to *a*) avoid missuses of the memory hierarchy (such as false sharing of cache lines or contention); and *b*) to take advantage of the various cache levels and the memory hardware prefetcher. It is based on a Linux kernel module and provides a coarse-grained trace of a superset of all the memory accesses performed by an application over its addressing space during the time of its execution.

KEYWORDS: High-Performance Computing - Performance analysis

- Contact: Guillaume Huard
- URL: <https://github.com/dbeniamine/MOCA>

## 5.4. Ocelotl

### Multidimensional Overviews for Huge Trace Analysis

#### FUNCTIONAL DESCRIPTION

Ocelotl is an innovative visualization tool, which provides overviews for execution trace analysis by using a data aggregation technique. This technique enables to find anomalies in huge traces containing up to several billions of events, while keeping a fast computation time and providing a simple representation that does not overload the user.

- Participants: Arnaud Legrand and Jean-Marc Vincent
- Contact: Jean-Marc Vincent
- URL: <http://soctrace-inria.github.io/ocelotl/>

## 5.5. PSI

Perfect Simulator

FUNCTIONAL DESCRIPTION

Perfect simulator is a simulation software of markovian models. It is able to simulate discrete and continuous time models to provide a perfect sampling of the stationary distribution or directly a sampling of functional of this distribution by using coupling from the past. The simulation kernel is based on the CFTP algorithm, and the internal simulation of transitions on the Aliasing method.

- Contact: Jean-Marc Vincent
- URL: <http://psi.gforge.inria.fr/>

## 5.6. SimGrid

KEYWORDS: Large-scale Emulators - Grid Computing - Distributed Applications

SCIENTIFIC DESCRIPTION

SimGrid is a toolkit that provides core functionalities for the simulation of distributed applications in heterogeneous distributed environments. The simulation engine uses algorithmic and implementation techniques toward the fast simulation of large systems on a single machine. The models are theoretically grounded and experimentally validated. The results are reproducible, enabling better scientific practices.

Its models of networks, CPUs and disks are adapted to (Data)Grids, P2P, Clouds, Clusters and HPC, allowing multi-domain studies. It can be used either to simulate algorithms and prototypes of applications, or to emulate real MPI applications through the virtualization of their communication, or to formally assess algorithms and applications that can run in the framework.

The formal verification module explores all possible message interleavings in the application, searching for states violating the provided properties. We recently added the ability to assess liveness properties over arbitrary and legacy codes, thanks to a system-level introspection tool that provides a finely detailed view of the running application to the model checker. This can for example be leveraged to verify both safety or liveness properties, on arbitrary MPI code written in C/C++/Fortran.

- Participants: Frederic Suter, Martin Quinson, Arnaud Legrand, Adrien Lebre, Jonathan Pastor, Mario Sudholt, Luka Stanisic, Augustin Degomme, Jean-Marc Vincent, Florence Perronnin and Jonathan Rouzaud-Cornabas
- Partners: CNRS - ENS Rennes
- Contact: Martin Quinson
- URL: <http://simgrid.gforge.inria.fr/>

## 5.7. Tabarnac

Tool for Analyzing the Behavior of Applications Running on NUMA Architecture

KEYWORDS: High-Performance Computing - Performance analysis - NUMA

- Contact: David Beniamine
- URL: <https://dbeniamine.github.io/Tabarnac/>

## 5.8. marmoteCore

Markov Modeling Tools and Environments - the Core

KEYWORDS: Modeling - Stochastic models - Markov model

FUNCTIONAL DESCRIPTION



marmoteCore is a C++ environment for modeling with Markov chains. It consists in a reduced set of high-level abstractions for constructing state spaces, transition structures and Markov chains (discrete-time and continuous-time). It provides the ability of constructing hierarchies of Markov models, from the most general to the particular, and equip each level with specifically optimized solution methods.

This software is developed within the ANR MARMOTE project: ANR-12-MONU-00019.

- Participants: Alain Jean-Marie, Issam Rabhi, Jean-Marc Vincent, Benjamin Briot, Jean-Michel Fourneau and Franck Quessette
- Partner: UVSQ
- Contact: Alain Jean-Marie
- URL: <http://marmotecore.gforge.inria.fr/>

## PRIVATICS Project-Team

# 5. New Software and Platforms

## 5.1. FECFRAME

FEC Framework following RFC 6363 specifications (<https://datatracker.ietf.org/doc/rfc6363/>)

KEYWORDS: Error Correction Code - Content delivery protocol - Robust transmission

FUNCTIONAL DESCRIPTION

This software implements the FECFRAME IETF standard (RFC 6363) co-authored by V. ROCA, and is compliant with 3GPP specifications for mobile terminals. It enables the simultaneous transmission of multimedia flows to one or several destinations, while being robust to packet erasures that happen on wireless networks (e.g., 4G or Wifi). This software relies on the OpenFEC library (the open-source <http://openfec.org> version or the commercial version) that provides the erasure correction codes (or FEC) and thereby offer robustness in front of packet erasures.

- Author: Vincent Roca
- Contact: Vincent Roca
- URL: <http://openfec.org/>

## 5.2. Mobilities

FUNCTIONAL DESCRIPTION

Mobilities is a joint project, started in 2012 between Inria and CNIL, which targets privacy issues on smartphones. The goal is to analyze the behavior of smartphones applications and their operating system regarding users private data, that is, the time they are accessed or sent to third party companies usually neither with user's awareness nor consent.

In the presence of a wide range of different smartphones available in terms of operating systems and hardware architecture, Mobilities project focuses actually its study on the two mostly used mobile platforms, IOS (Iphone) and Android. Both versions of the Mobilities software: (1) capture any access to private data, any modification (e.g., ciphering or hashing of private data), or transmission of data to remote locations on the Internet, (2) store these events in a local database on the phone for offline analysis, and (3) provide the ability to perform an in depth database analysis in order to identify personal information leakage.

- Authors: Jagdish Achara, James-Douglass Lefruit, Claude Castelluccia, Vincent Roca, Gwendal Le Grand, Geoffrey Delcroix, Franck Baudot and Stéphane Petitcolas
- Contact: Claude Castelluccia
- URL: <https://team.inria.fr/privatics/mobilities/>

## 5.3. MyTrackingChoices

KEYWORDS: Privacy - User control

FUNCTIONAL DESCRIPTION

This extension lets you control how you are being tracked on the Internet. It allows you to choose the categories (e.g., health, adult) of the websites where you don't want to be tracked on. When you browse the web, your visited webpages will be categorized on the fly and, depending on your choices, the extension will block the trackers (webpage by webpage) or not.

Existing anti-tracking (Ghostery, Disconnect etc.) and ad-blocking (Adblock Plus etc.) tools block almost ALL trackers and as a result, ads. This has a negative impact on the Internet economy because free services/content on the Internet are fuelled by ads. As a result, websites are starting to block access to their content if they detect use of Ad-blockers or they ask users to move to a subscription-based model (where users have to pay to get access to the website).

This extension is testing another approach: It is trying to find a trade-off between privacy and economy, that would allow users to protect their privacy while still accessing to free content.

It is based on the assumption that most people are not against advertisements, but want to keep control over their data. We believe that some sites are more sensitive than others. In fact, most people don't want to be tracked on "sensitive" websites (for example related to religion, health,...), but don't see any problem to be tracked on less sensitive ones (such as news, sport,...). This extension allows you to take control and specify which on which categories of sites you don't want to be tracked on! Furthermore, the extension also gives you the option to block the trackers on specific websites.

- Contact: Claude Castelluccia
- URL: <https://addons.mozilla.org/FR/firefox/addon/mytrackingchoices/>

## 5.4. OMEN+

### FUNCTIONAL DESCRIPTION

Omen+ is a password cracker following our previous work. It is used to guess possible passwords based on specific information about the target. It can also be used to check the strength of user password by effectively looking at the similarity of that password with both usual structures and information relative to the user, such as his name, birth date...

It is based on a Markov analysis of known passwords to build guesses. The previous work Omen needs to be cleaned in order to be scaled to real problems and to be distributed or transferred to the security community (maintainability): eventually it will become an open source software. The main challenge of Omen+ is to optimize the memory consumption.

- Participants: Pierre Rouveyrol and Claude Castelluccia
- Contact: Claude Castelluccia

## 5.5. OPENFEC

### FUNCTIONAL DESCRIPTION

OpenFEC is an open-source C-language implementation of several Application-Level Forward Erasure Correction (AL-FEC) codecs, namely: 2D-parity, Reed-Solomon (RFC 5510) and LDPC-Staircase (RFC 5170) codes. The OpenFEC project also provides a complete performance evaluation tool-set, capable of automatically assessing the performance of various codecs, both in terms of erasure recovery and encoding/decoding speed or memory consumption.

- Participants: Mathieu Cunche, Jonathan Detchart, Julien Laboure, Christophe Neumann, Vincent Roca, Jérôme Lacan and Kevin Chaumont
- Contact: Vincent Roca
- URL: <http://openfec.org/>

## ROMA Project-Team

# 6. New Software and Platforms

## 6.1. MUMPS

A MULTifrontal Massively Parallel Solver

KEYWORDS: High-Performance Computing - Direct solvers - Finite element modelling

FUNCTIONAL DESCRIPTION

MUMPS is a software library to solve large sparse linear systems ( $AX=B$ ) on sequential and parallel distributed memory computers. It implements a sparse direct method called the multifrontal method. It is used worldwide in academic and industrial codes, in the context numerical modeling of physical phenomena with finite elements. Its main characteristics are its numerical stability, its large number of features, its high performance and its constant evolution through research and feedback from its community of users. Examples of application fields include structural mechanics, electromagnetism, geophysics, acoustics, computational fluid dynamics. MUMPS is developed by INPT(ENSEEIH)-IRIT, Inria, CERFACS, University of Bordeaux, CNRS and ENS Lyon. In 2014, a consortium of industrial users has been created (<http://mumps-consortium.org>).

- Participants: Patrick Amestoy, Alfredo Buttari, Jean-Yves L'Excellent, Chiara Puglisi, Mohamed Sid-Lakhdar, Bora Uçar, Marie Durand, Abdou Guermouche, Maurice Bremond, Guillaume Joslin, Stéphane Pralet, Aurélia Fevre, Clément Weisbecker, Theo Mary, Emmanuel Agullo, Jacko Koster, Tzvetomila Slavova, François-Henry Rouet, Philippe Combes and Gilles Moreau
- Partners: CERFACS - CNRS - ENS Lyon - INPT - IRIT - LIP - Université de Bordeaux - Université de Lyon - Université de Toulouse
- Latest public release: MUMPS 5.0.2 (July 2016)
- Contact: Jean-Yves L'Excellent
- URL: <http://mumps-solver.org/>
- Next MUMPS User Days: we have started organizing the next MUMPS User days, which will be hosted by Inria on June 1 and 2, 2017 near Grenoble, France (see [http://mumps.enseeiht.fr/ud\\_2017.php](http://mumps.enseeiht.fr/ud_2017.php))

In the context of the MUMPS consortium (see Section 8.1 and <http://mumps-consortium.org>), we had scientific exchanges and collaborations with industrial members and released two versions in advance for the consortium (in July 2016 and November 2016), containing major improvements for large-scale problems and many other improvements. Much effort was also put on developing features and algorithms to improve the quality and performance of MUMPS, especially in the context of problems offering potential for low-rank compression. This work is done in close collaboration with the partners who co-develop MUMPS, in particular in Toulouse.

## 6.2. DCC

DPN C Compiler

KEYWORDS: Polyhedral compilation - Automatic parallelization - High-level synthesis

FUNCTIONAL DESCRIPTION

Dcc (Data-aware process network C compiler) analyzes a sequential regular program written in C and generates an equivalent architecture of parallel computer as a communicating process network (Data-aware Process Network, DPN). Internal communications (channels) and external communications (external memory) are automatically handled while fitting optimally the characteristics of the global memory (latency and throughput). The parallelism can be tuned. Dcc has been registered at the APP ("Agence de protection des programmes") and transferred to the XtremLogic start-up under an Inria license.

- Participants: Christophe Alias and Alexandru Plesco (XtremLogic SAS)
- Contact: Christophe Alias

### 6.3. PoCo

Polyhedral Compilation Library

KEYWORDS: Polyhedral compilation - Automatic parallelization

FUNCTIONAL DESCRIPTION

PoCo (Polyhedral Compilation Library) is a compilation framework allowing to develop parallelizing compilers for regular programs. PoCo features many state-of-the-art polyhedral program analysis and a symbolic calculator on execution traces (represented as convex polyhedra). PoCo has been registered at the APP ("agence de protection des programmes") and transferred to the XtremLogic start-up under an Inria licence.

- Participant: Christophe Alias
- Contact: Christophe Alias

### 6.4. Aspic

Accelerated Symbolic Polyhedral Invariant Generation

KEYWORDS: Abstract Interpretation - Invariant Generation

FUNCTIONAL DESCRIPTION

Aspic is an invariant generator for general counter automata. Used with C2fsm (a tool developed by P. Feautrier in COMPSYS), it can be used to derivate invariants for numerical C programs, and also to prove safety. It is also part of the WTC toolsuite (see <http://compsys-tools.ens-lyon.fr/wtc/index.html>), a tool chain to compute worst-case time complexity of a given sequential program.

Aspic implements the theoretical results of Laure Gonnord's PhD thesis on acceleration techniques and has been maintained since 2007.

- Participant: Laure Gonnord
- Contact: Laure Gonnord
- URL: <http://laure.gonnord.org/pro/aspic/aspic.html>

### 6.5. Termite

Termination of C programs

KEYWORDS: Abstract Interpretation - Termination

FUNCTIONAL DESCRIPTION

TERMITE is the implementation of the algorithm "Counter-example based generation of ranking functions". Based on LLVM and Pagai (a tool that generates invariants), the tool automatically generates a ranking function for each *head of loop*.

TERMITE represents 3000 lines of OCaml and is now available via the opam installer.

- Participants: Laure Gonnord, Gabriel Radanne (PPS, Univ Paris 7), David Monniaux (CNRS/Verimag).
- Contact: Laure Gonnord
- URL: <https://termite-analyser.github.io/>

## 6.6. Vaphor

Validation of C programs with arrays with Horn Clauses

KEYWORDS: Abstract Interpretation - Safety - Array Programs

FUNCTIONAL DESCRIPTION

VAPHOR (Validation of Programs with Horn Clauses) is the implementation of the algorithm “An encoding of array verification problems into array-free Horn clauses”. The tool implements a traduction from a C-like imperative language into Horn clauses in the SMT-lib Format.

VAPHOR represents 2000 lines of OCaml and its development is under consolidation.

- Participants: Laure Gonnord, David Monniaux (CNRS/Verimag).
- Contact: Laure Gonnord
- Demo page : <http://laure.gonnord.org/pro/demopage/vaphor/index.php>

## SOCRATE Project-Team

# 5. New Software and Platforms

## 5.1. FloPoCo

Floating-Point Cores, but not only

KEYWORD: Synthesizable VHDL generator

FUNCTIONAL DESCRIPTION

The purpose of the open-source FloPoCo project is to explore the many ways in which the flexibility of the FPGA target can be exploited in the arithmetic realm.

- Participants: Florent Dupont De Dinechin, Nicolas Brunie, Matei Istoan and Antoine Martinet
- Partners: CNRS - ENS Lyon - UCBL Lyon 1 - UPVD
- Contact: Florent Dupont De Dinechin
- URL: <http://flopoco.gforge.inria.fr/>

## 5.2. WSNet

KEYWORD: Network simulator

FUNCTIONAL DESCRIPTION

WSNet is a modular event-driven simulator targeted to Wireless Sensor Networks. Its main goals are to offer scalability, extensibility and modularity for the integration of new protocols/hardware models and a precise radio medium simulation. We still hope to find the proper resource to make WSNet evolve into a wireless capillary network simulator suitable for conducting simulations at the urban scale.

- Participants: Rodrigue Domga Komguem, Quentin Lampin, Alexandre Mouradian and Fabrice Valois
- Partner: CEA-LETI
- Contact: Guillaume Chelius
- URL: <https://gforge.inria.fr/projects/wsnet-3/>

## 5.3. WiPlan

FUNCTIONAL DESCRIPTION

WiPlan is a software including an Indoor propagation engine and a wireless LAN optimization suite, which has been registered by INSA-Lyon. The heart of this software is the propagation simulation core relying on an original method, MR-FDPF (multi-resolution frequency domain ParFlow), proposed by Jean-Marie Gorce in 2001 and further extended. The discrete ParFlow equations are translated in the Fourier domain providing a large linear system, solved in two steps taking advantage of a multi-resolution approach. The first step computes a cell-based tree structure referred to as the pyramid. In the second phase, a radiating source is simulated, taking advantage of the pre-processed pyramidal structure. Using of a full-space discrete simulator instead of classical ray-tracing techniques is a challenge due to the inherent high computation requests. However, we have shown that the use of a multi-resolution approach allows the main computational load to be restricted to a pre-processing phase. Extensive works have been done to make predictions more realistic.

- Contact: Jean-Marie Gorce
- URL: <https://bil.inria.fr>

## 5.4. FFTweb

KEYWORD: Spectrum Analyser , Data visualization , SDR

FUNCTIONAL DESCRIPTION

Visualisation tool use in CorteXlab to visualize the spectrum (or any kind vector signal) occurring in the CorteXlab room. FFTweb is a fundamental debugging and demonstration component for FIT/CorteXlab user.

- Matthieu Imbert
- Partners: Inria
- Contact: Matthieu Imbert
- URL: <http://www.cortexlab.fr>

## 5.5. Minus

KEYWORD: Experiment Handler , SDR

FUNCTIONAL DESCRIPTION

Handling and deployment of experiment on the Cognitive radio platform FIT/CorteXlab. On CorteXlab, the user does not have direct access to the SDR nodes, he has access to a server from which Minus deploys the programs on the different SDR nodes.

- Matthieu Imbert, Leonardo Sampaio-Cardoso, Tanguy Risset
- Partners: Inria
- Contact: Matthieu Imbert
- URL: <http://www.cortexlab.fr>

## 5.6. Platform - FIT/CortexLab

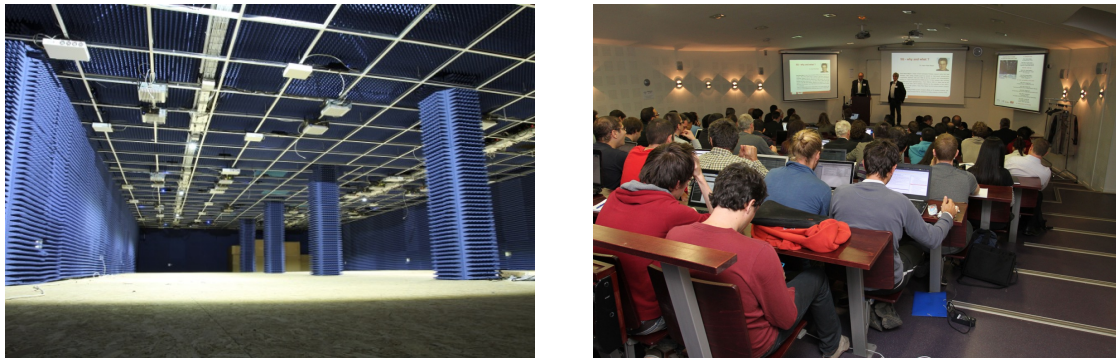
**FIT**(Future Internet of Things) is a french Equipex (Équipement d'excellence) which aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. FIT is be composed of four main parts: a Network Operations Center (NOC), a set of IoT test-beds (IoT-Lab), a set of wireless OneLab test-beds, and a cognitive radio test-bed (CorteXlab) deployed by the Socrate team in the Citi lab. In 2014 the construction of the room was finished see Figure 5 . SDR nodes have installed in the room, 42 industrial PCs (Aplus Nuvo-3000E/P), 22 NI radio boards (USRP) and 18 Nutaq boards (PicoSDR, 2x2 and 4X4) can be programmed from internet now.

A very successfully inauguration took place int 2014 <sup>0</sup>, with the noticable venue of Vincent Poor, Dean of School of Engineering and Applied Science of Princeton University. Since that date, the platform is open to public experiments.

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<sup>0</sup><http://www.inria.fr/centre/grenoble/actualites/inauguration-reussie-de-la-plateforme-cortexlab-equipex-fit>





*Figure 5. Photo of the FIT/CortexLab experimentation room installed and a snapshot of the inauguration meeting*

## SPADES Project-Team

# 5. New Software and Platforms

## 5.1. pyCPA\_TWCA: A pyCPA plugin for computing deadline miss models

### FUNCTIONAL DESCRIPTION

We are developing pyCPA\_TWCA, a pyCPA plugin for Typical Worst-Case Analysis as described in Section 6.2.5. pyCPA is an open-source Python implementation of Compositional Performance Analysis developed at TU Braunschweig, which allows in particular response-time analysis. pyCPA\_TWCA is an extension of this tool that is co-developed by Sophie Quinton, Zain Hammadeh (TU Braunschweig) and Leonie Ahrendts (TU Braunschweig). It allows in particular the computation of weakly-hard guarantees for real-time tasks, *i.e.*, the number of deadline misses out of a sequence of executions. This year, pyCPA\_TWCA has been extended to task chains but remains limited to uniprocessor systems, scheduled according to static priority scheduling. A public release is planned but has not yet taken place.

- Authors: Zain Hammadeh and Leonie Ahrendts and Sophie Quinton.
- Contact: Sophie Quinton.

## STEPP Project-Team

# 6. New Software and Platforms

## 6.1. Comptabilité Ecologique

### FUNCTIONAL DESCRIPTION

Databases, database handling tools and data visualization tools (on the website). Databases include socio-economic and environmental datasets. Visualization tools include interactive piecharts, maps and Sankey diagrams.

- Participants: Jean-Yves Courtonne and Pierre-Yves Longaretti
- Contact: Jean-Yves Courtonne
- URL: <http://www.eco-data.fr>

## 6.2. InterfacesTRANUS

### FUNCTIONAL DESCRIPTION

This software contains two interfaces dedicated to facilitating the usage of the TRANUS integrated land use and transport model+software. The first interface is dedicated to enabling the execution of the TRANUS binary programs without the need to use the console or the TRANUS GUI. The second interface provides an aid for calibrating a TRANUS model, by interactively exploring ranges of different parameters of a TRANUS model and visualising model outputs across these ranges.

- Participants: Peter Sturm, Julien Armand and Thomas Capelle
- Contact: Peter Sturm
- URL: [http://gitlab.inria.fr/tranus/TRANUS\\_Interfaces](http://gitlab.inria.fr/tranus/TRANUS_Interfaces)

## 6.3. LUM\_OSM

Land Use Mix calculation from OpenStreepMap data

### FUNCTIONAL DESCRIPTION

The software uses Mapzen Metro Extracts to retrieve the OpenStreetMap data of a given region in the PostgreSQL format. Afterwards, a continuous representation of residential and activity land uses is created. Finally, a GIS output containing the degree of land use mixture is calculated by means of using the land uses maps. The implemented approach is documented in [9].

- Participants: Martís Bosch Padros, Luciano Gervasoni, Serge Fenet and Peter Sturm
- Partners: EPFL - Ecole Polytechnique Fédérale de Lausanne - LIRIS
- Contact: Peter Sturm
- URL: <http://github.com/martibosch/landusemix>

## 6.4. QGIS\_Tranus\_Reports

### FUNCTIONAL DESCRIPTION

This software allows to graphically visualise data output by the TRANUS LUTI model (and possibly, of any other data of the same structure). In particular, this concerns any data items defined per zone of a modelled territory (productions, indicators, etc.). The software is designed as a plugin for the geographical information system platform QGIS and can be run interactively as well as by the command line or by a call from within another software. The interactive mode (within QGIS) allows the user to define graphical outputs to be generated from TRANUS output files (type of graphs to be generated – 2D or 3D – color coding to be used, choice of data to be displayed, etc.). Visualisation of data is done in the form of 2D graphs or 3D models defined using java-script.

- Participants: Patricio Inzaghi, Peter Sturm, Huu Phuoc Nguyen, Fausto Lo Feudo and Thomas Capelle
- Contact: Peter Sturm
- URL: [https://gitlab.inria.fr/tranus/QGIS\\_Tranus\\_Reports](https://gitlab.inria.fr/tranus/QGIS_Tranus_Reports)

## 6.5. REDEM

REDuction Of EMission  
FUNCTIONAL DESCRIPTION

REDEM soft is a tool designed for the benchmarking of national GHG emission reduction trajectories. The actual version of the software is implemented in Visual Basic under Microsoft Excel in order to facilitate handling and diffusion to climate/energy economists.

- Participants: Emmanuel Prados, Patrick Criqui, Constantin Ilasca, Olivier Boucher and H el ene Benveniste
- Partners: EDDEN - IPSL
- Contact: Emmanuel Prados
- URL: <http://redem.gforge.inria.fr/>

## 6.6. REDEM web

REDEM Web is a reimplementaion of the REDEM soft as a web application. The main library which contains the code corresponding to REDEM model is written in Python and the web part uses Javascript.

KEYWORDS: Benchmarking - Climate change - Global warming - Greenhouse gas emissions

- Participants: Emmanuel Prados, Patrick Criqui, Constantin Ilasca, Olivier Boucher, H el ene Benveniste and Nicolas Assouad
- Partners: EDDEN - UPMC
- Contact: Emmanuel Prados
- URL: <http://redem.inria.fr/>

## 6.7. Wassily

SCIENTIFIC DESCRIPTION

The software is structured in three different modules:

- the database module stores all the input-output data coming from Eurostat, OCDE, Insee or other sources.
- the computation module performs the input-output calculations
- the visualization module displays the results in a synthetic manner.

The database module is based on the SQLite format and makes use of SQL to manipulate the various tables involved in the process. The goal of this module is to provide a normalized data interface for the computation module, from various types of input-output data which are often stored as Excel sheet on web sites.

**FUNCTIONAL DESCRIPTION**

The purpose of this software and website is to automatize most of the work of standard input-output analysis and to visualize the results in a user-friendly way in order to efficiently address related key environmental questions.

- Participants: Julien Alapetite and Jean-Yves Courtonne
- Contact: Jean-Yves Courtonne

## THOTH Project-Team

# 6. New Software and Platforms

## 6.1. CoNFab: COnvolutional Neural FABric

**Participants:** Shreyas Saxena, Jakob Verbeek.

Despite the success of convolutional neural networks, selecting the optimal architecture for a given task remains an open problem. Instead of aiming to select a single optimal architecture, we propose Convolutional Neural Fabrics [20] that embed an exponentially large class of CNN architectures. The fabric consists of a 3D trellis that connects response maps at different layers, scales, and channels with a sparse homogeneous local connectivity pattern. The only hyper-parameters of the model (nr. of channels and layers) are not critical for performance. While individual CNN architectures can be recovered as paths in the trellis, the trellis can in addition ensemble all embedded architectures together, sharing their weights where their paths overlap. By the non-cyclic property of the trellis, its parameters can be efficiently learned using methods based on error back-propagation. The trellis parameters can be learned using standard methods based on back-propagation, at a cost that scales linearly in the fabric size. This software implements Convolutional Neural Fabrics by means of wrappers on top of the Caffe library to specify and learn such models.

## 6.2. Modl

**Participants:** Julien Mairal, Arthur Mensch [Parietal], Gael Varoquaux [Parietal], Bertrand Thirion [Parietal].

Modl is a new Python library written by Arthur Mensch for factorizing huge matrices. It implements the method presented in [25], [17], which targets matrices of several terabytes that do not fit into the main computer's memory.

## 6.3. M-CNN: Weakly-Supervised Semantic Segmentation using Motion Cues

**Participants:** Pavel Tokmakov, Cordelia Schmid, Karteek Alahari.

This is a public implementation of the method described in [23]. It includes a framework for integrating motion cues into training a deep network for weakly-supervised semantic segmentation, code for data preprocessing and trained models that correspond to the results reported in the paper. Our code is built on top of DeepLab <https://bitbucket.org/aquariusjay/deeplab-public-ver2> extension of the Caffe deep learning framework <http://caffe.berkeleyvision.org>.

## 6.4. DALY: Daily Action Localization in Youtube

**Participants:** Philippe Weinzapfel, Xavier Martin, Cordelia Schmid.

DALY is a video dataset with spatial and temporal annotation of 10 everyday human actions in 31 hours of Youtube videos, which allows to train and benchmark methods for action recognition and localization in videos. It is available at <http://thoth.inrialpes.fr/daly/>. We developed the dataset jointly with a new action localization technique. Both are described in [33].

## 6.5. GUN-71

**Participant:** Gregory Rogez.

This dataset consist of 12,000 RGB-D images of object manipulation scenes (captured from a chest-mounted camera) that were labeled with one of 71 fine-grained grasps. We considered 28 objects per grasp, resulting in a total of 1988 different hand-object configurations with 5-6 views for each. The data were captured with 8 different subjects (4 males and 4 females) in 5 different houses, see <http://www.gregrogez.net/research/egovision4health/gun-71/>.

## 6.6. Synthetic human 3D pose dataset

**Participants:** Gregory Rogez, Cordelia Schmid.

Participants: Gregory Rogez, Cordelia Schmid This large-scale dataset consists of 2,000,000 artificial RGB images of humans and associated 2D and 3D pose annotations. This dataset was generated using the image-based rendering algorithm presented in [19] and has been used to train state-of-the-art Convolutional Neural Networks (CNN) for in-the-wild 3D human pose estimation, see <http://www.gregrogez.net/research/human-pose-data-synthesis-for-cnn/>.

## TYREX Project-Team

# 5. New Software and Platforms

## 5.1. Benchmarks Attitude Smartphones

KEYWORDS: Experimentation - Motion analysis - Sensors - Performance analysis - Smartphone

SCIENTIFIC DESCRIPTION

We investigate the precision of attitude estimation algorithms in the particular context of pedestrian navigation with commodity smartphones and their inertial/magnetic sensors. We report on an extensive comparison and experimental analysis of existing algorithms. We focus on typical motions of smartphones when carried by pedestrians. We use a precise ground truth obtained from a motion capture system. We test state-of-the-art attitude estimation techniques with several smartphones, in the presence of magnetic perturbations typically found in buildings. We discuss the obtained results, analyze advantages and limits of current technologies for attitude estimation in this context. Furthermore, we propose a new technique for limiting the impact of magnetic perturbations with any attitude estimation algorithm used in this context. We show how our technique compares and improves over previous works.

- Participants: Thibaud Michel, Hassen Fourati, Pierre Geneves and Nabil Layaida
- Partner: GIPSA-Lab
- Contact: Pierre Genevès, Thibaud Michel
- URL: <http://tyrex.inria.fr/mobile/benchmarks-attitude/>

## 5.2. CSS Analyzer

FUNCTIONAL DESCRIPTION

This software now consists in two distinct prototypes: two static analyzers (with a different purpose) that share a common compiler for CSS. The first prototype is used for bug detection and verification of a cascading style sheet (CSS) file. It involves a compiler for CSS rules (and in particular selectors) into logical formulas, adapted for the semantics of CSS (see the initial WWW'12 paper). The second prototype performs automated refactoring for size reduction of CSS style sheets. It reuses the first compiler and the logical solver for detecting which rules can be refactored and how. It implements various optimisation techniques (like early pruning), for the purpose of dealing with large-size real CSS files. This prototype reduces the size of CSS files found in the most popular websites (such as CNN, facebook, Google Sites, Apple, etc.) by up to 30

- Participants: Pierre Geneves, Nabil Layaida and Marti Bosch Padros
- Contact: Pierre Geneves
- URL: <http://tyrex.inria.fr/websolver/>

## 5.3. RDFHive

KEYWORDS: Hadoop - RDF - SPARQL

SCIENTIFIC DESCRIPTION

SPARQL is the W3C standard query language for querying data expressed in RDF (Resource Description Framework). The increasing amounts of RDF data available raise a major need and research interest in building efficient and scalable distributed SPARQL query evaluators.

In this context, we propose and share RDFHive: a simple implementation of a distributed RDF datastore benefiting from Apache Hive. RDFHive is designed to leverage existing Hadoop infrastructures for evaluating SPARQL queries. RDFHive relies on a translation of SPARQL queries into SQL queries that Hive is able to evaluate.



Technically, RDFHive directly evaluates SPARQL queries i.e. there is no preprocessing step, indeed an RDF triple file is seen by Hive as a three-column table. Thus, the bash translator simply translates SPARQL queries according to this scheme. This method has two advantages: first, creating a database is very fast, second, since the upfront investment is light, RDFHive is an interesting tool to evaluate a few SPARQL queries at once.

- Participants: Damien Graux, Nabil Layaida and Pierre Geneves
- Contact: Pierre Genevès, Damien Graux
- URL: <https://github.com/tyrex-team/rdfhive>

## 5.4. Tree Reasoning Solver

### SCIENTIFIC DESCRIPTION

The tree reasoning solver is a software tool which implements research advances in tree logics, and in the analysis of query and programming languages for the web. The core algorithm is a satisfiability solver of an expressive tree logic. The underlying logic is very expressive: it is a  $\mu$ -calculus variant for finite trees, which is MSO-complete, and equipped with additional features (converse modalities, nominals, logical combinators...)

The decision procedure has an optimal worst-case complexity, and its implementation performs quite well in practice. This allows efficient reasoning with tree structures. In particular, it opens the way for solving a wide variety of problems that require reasoning with very large sets of trees.

Initially developed for the analysis of XML/XPath queries, this tool has been extended by the team to support more general query analysis, reasoning with schema constraints, with functions, and with domain specific languages such as cascading style sheets.

- Participants: Pierre Geneves, Nabil Layaida and Nils Gesbert
- Contact: Pierre Geneves
- URL: <http://tyrex.inria.fr/websolver/>

## 5.5. XQuery Type-Checker

### SCIENTIFIC DESCRIPTION

This prototype implements a sound static type-system for an XQuery core. The type language supported is a large subset of RelaxNG+Schematron, which is novel in static type checking. It also supports the static typing of backward axes, which is not supported by any other system nor the XQuery recommendation. Our type checker successfully verifies complex programs for which existing type-checkers (either known from the literature or those developed in commercial software) fail by reporting false alarms. One major benefit is to allow the cost of validation to be deferred from runtime to compile-time (once only). This prototype is implemented in Scala and interacts with the solver by issuing external calls for deciding complex subtyping relations.

- Participants: Pierre Geneves, Nabil Layaida and Nils Gesbert
- Contact: Pierre Geneves
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## 5.6. SPARQLGX

KEYWORDS: RDF - SPARQL - Distributed computing

### SCIENTIFIC DESCRIPTION

SPARQL is the W3C standard query language for querying data expressed in RDF (Resource Description Framework). The increasing amounts of RDF data available raise a major need and research interest in building efficient and scalable distributed SPARQL query evaluators.

In this context, we propose and share SPARQLGX: our implementation of a distributed RDF datastore based on Apache Spark. SPARQLGX is designed to leverage existing Hadoop infrastructures for evaluating SPARQL queries. SPARQLGX relies on a translation of SPARQL queries into executable Spark code that adopts evaluation strategies according to (1) the storage method used and (2) statistics on data. Using a simple design, SPARQLGX already represents an interesting alternative in several scenarios.

- Participants: Damien Graux, Louis Jachiet, Nabil Layaida and Pierre Geneves
- Contact: Pierre Genevès, Damien Graux
- URL: <https://github.com/tyrex-team/sparqlgx>

## URBANET Team

# 6. New Software and Platforms

## 6.1. PrivaMovApp

### FUNCTIONAL DESCRIPTION

UrbaNet is leading the development of an Android application for user data collection purposes. The application is based on the Funf framework, and is currently available on Google Play.

- Participants: Razvan Stanica and Hervé Rivano.
- Contact: Razvan Stanica
- URL: <http://liris.cnrs.fr/privamov/project/>

## 6.2. TAPASCologne

Travel and Activity PAtterns Simulation Cologne

### FUNCTIONAL DESCRIPTION

TAPASCologne is an initiative by the Institute of Transportation Systems at the German Aerospace Center (ITS-DLR), aimed at reproducing, with the highest level of realism possible, car traffic in the greater urban area of the city of Cologne, in Germany.

To that end, different state-of-art data sources and simulation tools are brought together, so to cover all of the specific aspects required for a proper characterization of vehicular traffic:

The street layout of the Cologne urban area is obtained from the OpenStreetMap (OSM) database, The microscopic mobility of vehicles is simulated with the Simulation of Urban Mobility (SUMO) software, The traffic demand information on the macroscopic traffic flows across the Cologne urban area (i.e., the O/D matrix) is derived through the Travel and Activity PAtterns Simulation (TAPAS) methodology, The traffic assignment of the vehicular flows described by the TAPASCologne O/D matrix over the road topology is performed by means of Gawron's dynamic user assignment algorithm.

- Participants: Marco Fiore and Razvan Stanica.
- Contact: Razvan Stanica
- URL: <http://kolntrace.project.citi-lab.fr/>

## 6.3. Platforms

### 6.3.1. Sense in the City

Sense in the city is a lightweight experimentation platform for wireless sensor networks in development. The main objective of this platform is to be easily transferable and deployable on the field. It allows a simplified deployment of the code running on the sensors and the collection of logs generated by the instrumentation of the code on a centralized database. In the early stage of the platform, the sensors are powered by small PCs, e.g. Raspberry Pis, but we are investigating the integration of energy harvesting capabilities such as solar panels.

- Participants: Khaled Boussetta, Hervé Rivano.
- Contact: Khaled Boussetta

### **6.3.2. Extention of the FIT IoT Lab Equipex in Tech La Doua Campus**

This testbed is located in an experimentation room which belongs to the CITI laboratory and the Telecommunications Department of INSA Lyon, Villeurbanne. The target usages of this room are quite diverse: practical works with students, robots/drones testing, wireless sensor networks experimentation, Wi-Fi security evaluation, services deployment, etc. During an experimentation, this room could be shared with others practical works. Basically, we claim that this room is useful to observe the behavior of nodes with this dense interactivity. 18 M3 open nodes, 11 A8 nodes and 12 mobile on robots are available for experimentation.

- Participants: Romain Pujol, Hervé Rivano, Fabrice Valois.
- Contact: Fabrice Valois
- URL: <https://www.iot-lab.info/deployment/lyon/>