



RESEARCH CENTER
Grenoble - Rhône-Alpes

FIELD

Activity Report 2015

Section Software

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1. AIRSEA Team	4
2. ARIC Project-Team	5
3. AVALON Project-Team	7
4. BEAGLE Project-Team	10
5. BIPOP Project-Team	12
6. Chroma Team	14
7. COMPSYS Project-Team	15
8. CONVECS Project-Team	18
9. CORSE Team	21
10. CTRL-A Team	23
11. DANTE Project-Team	24
12. DICE Team	26
13. DRACULA Project-Team	27
14. ERABLE Project-Team	28
15. EXMO Project-Team	35
16. IBIS Project-Team	37
17. IMAGINE Project-Team	39
18. LEAR Project-Team	41
19. MAVERICK Project-Team	43
20. MESCAL Project-Team	46
21. MISTIS Project-Team	51
22. MOAIS Project-Team	52
23. MORPHEO Project-Team	55
24. NANO-D Project-Team	58
25. NECS Project-Team	59
26. NUMED Project-Team	60
27. PERCEPTION Project-Team	61
28. PRIMA Project-Team	65
29. PRIVATICS Project-Team	70
30. ROMA Project-Team	72
31. SOCRATE Project-Team	75
32. SPADES Project-Team	78
33. STEEP Project-Team	80
34. TYREX Project-Team	82
35. URBANET Team	85

AIRSEA 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
- 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. 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

6.4. 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

6. New Software and Platforms

6.1. FPLLL: a lattice reduction library

fpLLL contains several algorithms on lattices that rely on floating-point computations. This includes implementations of the floating-point LLL reduction algorithm, offering different speed/guarantees ratios. It contains a “wrapper” choosing the estimated best sequence of variants in order to provide a guaranteed output as fast as possible. In the case of the wrapper, the succession of variants is oblivious to the user. It also includes a rigorous floating-point implementation of the Kannan-Fincke-Pohst algorithm that finds a shortest non-zero lattice vector, and the BKZ reduction algorithm.

The fpLLL library is distributed under the LGPL license. It has been used in or ported to several mathematical computation systems such as Magma, Sage, and PariGP. It is also used for cryptanalytic purposes, to test the resistance of cryptographic primitives.

- Participants: Shi Bai, Damien Stehlé
- Contact: Damien Stehlé
- URL: <https://github.com/dstehle/fplll>

6.2. GNU MPFR: a library for arbitrary precision floating-point arithmetic

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

GNU MPFR is an efficient multiple-precision floating-point library written in C 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. It is distributed under the LGPL license.

The development of MPFR started in Loria (Nancy). When Vincent Lefèvre moved from Nancy to Lyon, it became a joint project between the project-team Caramel (Nancy) and AriC. Many systems use MPFR, several of them being listed on its web page. MPFR 3.1.3 was released on 19 June 2015.

New developments in the trunk: Full rewrite of `mpfr_sum` completed, with new tests [38]. Generic tests improved. Bug fixes and various improvements, in particular concerning the flags.

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

6.3. Gfun: a Maple package for solutions of linear differential or recurrence equations

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

Its development moved to AriC with Bruno Salvy in 2012, while a submodule NumGfun dedicated to symbolic-numeric computations with linear ODEs has been developed by Marc Mezzarobba during his post-doc at AriC. An old version of gfun is distributed with the Maple library. Newer versions are available on the web page of gfun, which also lists a number of articles by scientists who cited it.

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

6.4. Sipe: a library for very low precision computations with correct rounding

KEYWORDS: Floating-point - Correct Rounding

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. It is distributed under the LGPL license and mostly used internally.

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

6.5. 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.

- Participant:
- Contact: Clément Pernet
- URL: <http://www.linalg.org>

6.6. Exhaustive Tests for the Correct Rounding of Mathematical Functions

Participant: Vincent Lefèvre.

The search for the worst cases for the correct rounding (hardest-to-round cases) of mathematical functions (exp, log, sin, cos, etc.) in a fixed precision (mainly double precision) using Lefèvre's algorithm is implemented by a set of utilities written in Perl, with calls to Maple/intpakX for computations on intervals and with C code generation for fast computations. It also includes a client-server system for the distribution of intervals to be tested and for tracking the status of intervals (fully tested, being tested, aborted).

The support for the tanh function has been added, and this function has been tested on the full domain (together with its inverse function). Results are available from: <https://www.vinc17.net/research/testlibm/>

- Participant: Vincent Lefèvre
- Contact: Vincent Lefèvre

6.7. Multiplication by Integer Constants

Participant: Vincent Lefèvre.

A Perl implementation of algorithms for the multiplication by integer constants has been updated to get more results based on exhaustive tests: threading has been implemented in this part of the script.

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

AVALON Project-Team

6. New Software and Platforms

6.1. Active Data

Participants: Gilles Fedak [correspondant], Anthony Simonet.

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>

6.2. BitDew

Participants: Gilles Fedak [correspondant], Anthony Simonet.

FUNCTIONAL DESCRIPTION

The BitDew framework is a programmable environment for management and distribution of data for Grid, Desktop Grid and Cloud Systems. BitDew offers programmers a simple API for creating, accessing, storing and moving data with ease, even on highly dynamic and volatile environments. The BitDew programming model relies on 5 abstractions to manage the data : i) replication indicates how many occurrences of a data should be available at the same time on the network, ii) fault-tolerance controls the policy in presence of machine crash, iii) lifetime is an attribute absolute or relative to the existence of other data, which decides the life cycle of a data in the system, iv) affinity drives movement of data according to dependency rules, v) protocol gives the runtime environment hints about the protocol to distribute the data (http, ftp or bittorrent). Programmers define for every data these simple criteria, and let the BitDew runtime environment manage operations of data creation, deletion, movement, replication, and fault-tolerance operation.

- URL: <http://www.bitdew.net>

6.3. DIET

Participants: Daniel Balouek Thomert, Eddy Caron [correspondant], Maurice Faye, Arnaud Lefray.

FUNCTIONAL DESCRIPTION

Middleware for grids and clouds. Toolbox for the use and porting of intensive computing applications on heterogeneous architectures.

In 2015 we have published a new release of DIET. A short list of the major improvements over the version 2.9 of DIET:

Security: SSL communications are now available.

Cloud: some improvements

More information are provided to the user

OAR binding improvement

QuickStart documentation is provided

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

6.4. Kwapi

Participants: Laurent Lefèvre [correspondant], Jean-Patrick Gelas, Laurent Pouilloux.

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.

- URL: <https://launchpad.net/kwapi>

6.5. DirectL2C

Participants: Vincent Lanore, Christian Perez [correspondant].

KEYWORDS: HPC, Software Components, Reconfiguration

FUNCTIONAL DESCRIPTION

L2C (<http://hlcm.gforge.inria.fr/l2c:start>) 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.

In 2015, we have prototyped DirectL2C on top of L2C. DirectL2C enables efficient and consistent reconfiguration of large scale L2C based assemblies. It provides an assembly model enhanced with domains, transformations, and transformation adapters.

- URL: <http://hlcm.gforge.inria.fr/l2c:start>

6.6. Sam4C

Participants: Eddy Caron [correspondant], Arnaud Lefray.

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 (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.

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

6.7. SimGrid

Participant: Frédéric Suter [correspondant].

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

FUNCTIONAL DESCRIPTION

Scientific Instrument for the study of Large-Scale Distributed Systems. SimGrid is a toolkit that provides core functionalities for the simulation of distributed applications in heterogeneous distributed environments. In 2015, we published a new release, SimGrid 3.12.

- Partners: CNRS - Ecole Normale Supérieure de Rennes - University of Hawaii - Université de Reims Champagne-Ardenne - Femto-st
- URL: <http://simgrid.gforge.inria.fr/>

6.8. execo

Participants: Matthieu Imbert [correspondant], Laurent Pouilloux.

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.

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

6.9. Grid'5000 Experimental Platform

Participants: Laurent Lefèvre [correspondant], Simon Delamare, David Loup, Christian Perez, Marc Pinhède, Laurent Pouilloux.

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.

- URL: <https://www.grid5000.fr/mediawiki/index.php/Grid5000:Home>

BEAGLE Project-Team

6. New Software and Platforms

6.1. DeCo

Detection of Co-evolution

KEYWORDS: Bioinformatics - Evolution

SCIENTIFIC DESCRIPTION

The software DeCo computes adjacencies (or any type of relation, like regulation, interaction, functional relationships) between ancestral genes from gene phylogenies reconciled with a species phylogeny according to duplications and losses. It takes as input (1) a species tree (2) a set of extant genes (3) a set of extant adjacencies (relations) between extant genes and (4) gene trees which leaves are the extant genes. It outputs ancestral species, genes, and adjacencies. It also highlights the duplications involving several genes.

FUNCTIONAL DESCRIPTION

DeCo for Detection of Co-evolution, reconstructs neighborhood relationships between genes of ancient genomes, in the presence of gene duplications, transfer and losses.

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

6.2. DeCoLT

Detection of Co-evolution with Lateral gene Transfer

KEYWORDS: Bioinformatics - Evolution

SCIENTIFIC DESCRIPTION

The software DeCoLT computes adjacencies (or any type of relation, like regulation, interaction, functional relationships) between ancestral genes from gene phylogenies reconciled with a species phylogeny according to duplications, losses and lateral gene transfer. It takes as input a species tree a set of extant genes a set of extant adjacencies (relations) between extant genes and reconciled gene trees which leaves are the extant genes. It outputs ancestral species, genes, and adjacencies. It also highlights the duplications or transfers involving several genes.

FUNCTIONAL DESCRIPTION

The software DeCoLT computes adjacencies (or any type of relation, like regulation, interaction, functional relationships) between ancestral genes from gene phylogenies reconciled with a species phylogeny according to duplications, losses and lateral gene transfer.

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

6.3. 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, Priscila Do Nascimento Biller, Yoram Vadee Le Brun, David Parsons and Vincent Liard
- Partners: UCBL Lyon 1 - INSERM - Universite Paris-Descartes - Insa de Lyon
- Contact: Carole Knibbe
- URL: <http://www.aevol.fr/>

6.4. EvoEvo

In silico experimental 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/>

6.5. 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 : i) Select regions of interest in each image (detect the colony), (ii) Denoise and renormalize the images, (iii) Identify each cells in each image (segmentation), (iv) Follow cells through the whole movie (tracking) and (v) Detect divisions and construct cell lineage in the population

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

BIPOP Project-Team

5. New Software and Platforms

5.1. ACEF

- Participants: Vincent Acary and Olivier Bonnefon

5.2. Approche

- Participants: Alexandre Derouet-Jourdan, Florence Bertails-Descoubes and Joëlle Thollot
- Contact: Florence Bertails-Descoubes
- URL: [Approche](#)

5.3. CloC

- Participants: Florence Bertails-Descoubes and Romain Casati
- Partner: UJF
- Contact: Florence Bertails-Descoubes
- URL: [Cloc](#)

5.4. MECHE-COSM

5.4.1. MECHE: Modeling Entangling within Contacting hair fibErs

Participants: Florence Bertails-Descoubes, Gilles Daviet, Alexandre Derouet-Jourdan, Romain Casati, Laurence Boissieux.

The software MECHE was essentially developed during the MECHE ADT (2009-2011, research engineer: Gilles Daviet), for simulating the dynamics of assemblies of thin rods (such as hair), subject to contact and friction. Currently, this software is extensively used by two PhD students (A. Derouet-Jourdan and R. Casati) and continues to be enriched with new rod models and inversion modules. This software combines a panel of well-accepted models for rods (ranging from reduced coordinates to maximal coordinates models, and including models recently developed by some members of the group) with classical as well as innovative schemes for solving the problem of frictional contact (incorporating the most recent results of the group, as well as the new contact solver we published in [11]). The aim of this software is twofold: first, to compare and analyze the performance of nonsmooth schemes for the frictional contact problem, in terms of realism (capture of dry friction, typically), robustness, and computational efficiency. A first study of this kind was conducted in 2010-2011 onto the different rod models that were available in the software. New studies are planned for evaluating further rod models. Second, we believe such a software will help us understand the behavior of a fibrous material (such as hair) through virtual experiments, thanks to which we hope to identify and understand some important emergent phenomena. A careful validation study against experiments started to be conducted in 2011 in collaboration with physicists from L'Oréal. Once this discrete elements model will be fully validated, our ultimate goal would be to build a continuous macroscopic model for the hair medium relying on nonsmooth laws (which we have started to build in Gilles Daviet's PhD thesis). The core of this software was transferred to L'Oréal in 2011, and to AGT Digital in early 2013, by Gilles Daviet and Florence Bertails-Descoubes. It was also used for generating a number of simulations supporting at least 4 of our research publications.

5.5. Platforms: SICONOS

5.5.1. 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

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

6.2. DATMO (Detection and Tracking of Moving Objects)

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

6.3. E.R.C.I.

Estimation du risque de collision aux 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

- 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

Experimentary the closed Form Solution for usual-initial data fusion against real and simulated fusion

- Authors: Jacques Kaiser and Agostino Martinelli
- Contact: Agostino Martinelli

6.8. kinetics

- Contact: Jilles Dibangoye

COMPSYS Project-Team

6. New Software and Platforms

6.1. Aspic

Accelerated Symbolic Polyhedral Invariant Generation

KEYWORDS: Abstract Interpretation - Invariant Generation

FUNCTIONAL DESCRIPTION

Aspic is an invariant generator for general counter automata. Combined with C2fsm (a tool developed by P. Feautrier in Compsys), it can be used to derive 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>

6.2. 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
- Contact: Christophe Alias

6.3. 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.

- Partner: ENS Lyon
- Contact: Alexandre Isoard

6.4. OpenOrdo

OpenStream scheduler

FUNCTIONAL DESCRIPTION

Finding polynomial schedules for the streaming language OpenStream. Main use: detecting deadlocks.

- Contact: Paul Feautrier

6.5. 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 (dependences, affine scheduling, code generation) 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 license.

- Participant: Christophe Alias
- Contact: Christophe Alias

6.6. PolyOrdo

Polynomial Scheduler

FUNCTIONAL DESCRIPTION

Computes a polynomial schedule for a sequential polyhedral program having no affine schedule. Uses algorithms for finding positive polynomials in semi-algebraic sets. Status: proof of concept software.

- Contact: Paul Feautrier

6.7. 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.

- Partner: ENS Lyon
- Contact: Alexandre Isoard

6.8. Termite

Termination of C programs

KEYWORDS: Abstract Interpretation - Termination

FUNCTIONAL DESCRIPTION

TERMITE is the implementation of our new algorithm “Counter-example based generation of ranking functions” (see Section 7.4). 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/>

6.9. 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 our new algorithm “An encoding of array verification problems into array-free Horn clauses” (see Section 7.3). The tool implements a translation 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
- URL: not yet published, under consolidation.

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 engineering⁰. In this toolbox, we develop and maintain the following tools:

- CAESAR.ADT [42] 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 [47], [46] 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 [43] 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,

⁰<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 [51], CTL [39], ACTL [41], etc.) to be defined in XTL.
- PBG (*Partitioned BCG Graph*) is a file format implementing the theoretical concept of *Partitioned LTS* [45] 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 [56] 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 [44] 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 PMC Partial Model Checker

Participants: Radu Mateescu, Frédéric Lang.

We develop a tool named PMC (*Partial Model Checker*, see § 6.4), which performs the compositional model checking of dataless MCL formulas on networks of communicating automata described in the EXP language.

PMC can be freely downloaded from the CONVECS Web site ⁰.

⁰<http://convecs.inria.fr/software/pmc>

CORSE 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 the cleanup and maintenance of the existing tools and web site and, secondly, implementing new backends for emitting TIREX.

The existing TIREX transformation and analysis tools as well the web site have been updated to make sure they work with the newest versions of their respective platforms (Java and PHP). They have also been refactored to make better use of newer or safer APIs. This work also included a redesign of the web site of the TIREX project and a rewrite of the build system.

The existing Open64 based backend has been updated to comply with the TIREX v2 specification so its output can be used with the rest of the tool chain.

We have also developed two new backends allowing us to generate TIREX code from any language the LLVM frontends support (including C, C++ and LLVM IR) as well as directly from assembly code. Preliminary work for generating TIREX directly from binaries has also been done, and the assembly backend is designed to allow most of its code to be reused for this purpose. These new developments required a partial rewrite of LLVMs internal machine description system to expose more machine information in an easily accessible manner. As a positive side effect we were able to reuse several parts used in earlier stages of the LLVM pipeline to write a simple type analysis on machine code used in the assembly backend. We also implemented a control flow reconstruction pass in the assembly backend to improve the quality of the generated code.

Lastly we have adopted continuous integration and started curating a regression test suite for our new developments.

5.2. LLVM plugins

Work has been started on multiple plugins for the LLVM compiler framework that implement the code optimization that have been elaborated by the team. While being work in progress this already provides us with crucial information for program analysis such as data-dependencies.

- Polly pointer disambiguation (publicly available): Status: Published. Description: A llvm-Polly patch that generates versioned SCoP, where the optimized version is guarded by run-time tests to validate that there are no hazardous aliasing.
- More on pointer disambiguation (to STMicroelectronics): Status: Implemented. Allows the use of malloc identifiers to quickly evaluate possible aliasing at run-time.
- Dynamic-dependence graph (to STMicroelectronics): Status: Under development. The run-time process is close to completion. Requires to treat function calls as sub-loops to allow optimization of recursive functions. The static analysis is capable of reading the trace file. The next step is to use a memory model to identify code transformations that would have better memory locality.

5.3. The klang-omp OpenMP compiler

Klang-Omp is a C and C++ source-to-source OpenMP compiler based on LLVM framework and on Intel's Clang-OMP front-end. It translates OpenMP directives into calls to task-based runtime system APIs. Klang-Omp currently targets both the StarPU runtime and the Kaapi runtime. The compiler supports independent tasks as defined by the 3.1 revision of the OpenMP specification as well as dependent tasks introduced with OpenMP 4. It also has been extended to support the omp target construct, making OpenMP applications able to offload computation to accelerators. This support also relies on the StarPU and XKaapi accelerator support capabilities. This work has been funded by the KSTAR Inria ADT project, involving the AVALON, STORM, MOAIS and CORSE Inria team. While the KSTAR project will end in January 2016, the klang-omp compiler will still be maintained and extended to support future OpenMP-oriented research actions, such as the ones promoted by the HEAVEN Persyval project.

5.4. mcGDB: Debugging of Multithreaded Applications

mcGDB is a new debugger for multithreaded applications. It implements a novel approach for interactive debugging named Programming Model-Centric Debugging. mcGDB raises interactive debugging to the level of programming models, by capturing and interpreting events generated during the application execution (e.g. through breakpointed API function calls). This new approach debugging is applied to four different programming models: software components (ST/NPM), Data flow (ST/PEDF), OpenCL and OpenMP. MCGDB was initially developed by Kevin Pouget with STMicrometronics (CIFRE thesis). mcGDG uses the [Temanejo](#) graphical interface to display task graphs. mcGDB is currently extended in the DEMA/Nano2017 project with ST Microelectronics, Inria/Parkas and UPMC.

5.5. 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 was used to generate and optimize the computing kernels of two scientific applications:

- [BigDFT](#)
- [SPECFEM](#)

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

CTRL-A Team

6. New Software and Platforms

6.1. Heptagon/BZR

We want to produce results concretely usable by third parties, either in cooperative projects, or by free diffusion of tools. One perspective is to build tool boxes for the design of continuous control solutions for computing systems: it will be explored in the future. A readily available result concerns discrete control and programming.

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 hierarchical 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.

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

HEPTAGON has been used to build BZR⁰, which is an extension of the former with contracts constructs. These contracts allow to express dynamic temporal properties on the inputs and outputs of HEPTAGON node. These properties are then enforced, within the compilation of a BZR program, by discrete controller synthesis, using the SIGALI tool⁰. The synthesized controller is itself generated in HEPTAGON, allowing its analysis and compilation towards different target languages (C, Java, VHDL).

Heptagon/BZR has been recently integrated with the ReaX verification and controller synthesis tool. The ReaX tool allows the handling of numerico-boolean programs by using abstract interpretation for controller synthesis.

Prospects about Heptagon/BZR lie in developing methodological and programming tools for : precise diagnosis in case of controller synthesis failure ; identification of relevant domain of abstractions, in relation with the use of the ReaX tool ; integration in various execution platforms (Fractal, reconfigurable FPGA, etc.)

⁰<http://bzs.inria.fr>

⁰<http://www.irisa.fr/vertecs/Logiciels/sigali.html>

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: <http://perso.ens-lyon.fr/benjamin.girault/>

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: Éric 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: Éric 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. IoT-LAB robots

KEYWORDS: Internet of things - Robotics

FUNCTIONAL DESCRIPTION

IoT-LAB robots is an embedded robot controller on a Turtlebot2 providing the IoT-LAB node mobility functionality

- Partner: Université de Strasbourg
- Contact: Frédéric Saint-Marcel

6.6. Queueing Systems

KEYWORDS: Performance Evaluation - Queueing Models

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/>

6.7. WSNet

KEYWORD: Network simulator

FUNCTIONAL DESCRIPTION

The WSNet-3.0 project objective is to develop the next evolution of the WSNet simulator. It 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.

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

6.8. Platforms

6.8.1. 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/>

DICE Team

5. New Software and Platforms

5.1. BitBallot

The BitBallot voting protocol is designed to avoid the concentration of data by third party. The protocol allows users to cast their ballot on their mobile device, and then share only restricted amounts of their data with other peers to compute the tally. Unlike other protocols, voters pull data from others instead of pushing their own votes.

Convinced by the need of new election mechanisms, to support emerging forms of more continuous democracy, we are developing BitBallot, to allow elections with distributed tallying that incorporate individual verification. As such, it provides anonymity of the data sources, non interruptible run-time, global access to results, and non-predictability of results through partial communication spying. Cryptography is not essential to protect the privacy of the voters or the secrecy of the ballots. On the basis of this protocol, a SaaS platform that allows to run public tests online is under development.

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

5.2. C3PO

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 these networks. They rely in general 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 (C3PO stands for Collaborative Creation of Contents and Publishing using Opportunistic networks) 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. (Supported by an ANR project.)

- Contact: Stéphane Frénot, Damien Reimert

5.3. Fluxion

This joint project with Worldline aims at managing mobile code in complex Web architectures. We design a fast and reactive framework, transparently moving functions between running systems to cope with the load variation in high performance Web architectures. The Fluxion model is our approach to design mobile application modules that are a mix of functional programming and flow based reactive systems. We work on compilation techniques to transform a Javascript event-loop into a parallelized pipeline where each stage is made independent from the main event-loop.

- Contact: Stéphane Frénot, Etienne Brodu

5.4. 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.

- Contact: Stéphane Frénot, Stéphane Grumbach, Auguste Caen
- 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 Verdesi
- 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 Tannier
- 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 DESCRIPTIONCIDANE 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 visualisator for host-parasite and gene-specie trees evolution..

- Participants: Laurent Bulteau
- Contact: Laurent Bulteau (not Inria), Blerina Sinimeri (for Inria)
- 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
- 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, Pierluigi Crescenzi, Marie-France Sagot, Blerina Sinimeri,
- Contact: Christian Baudet (not Inria), Beatrice Donati (not Inria), and Marie-France Sagot
- 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
- 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: <https://github.com/AlgoLab/HapCol>

5.13. KisSNP & DiscoSNP

FUNCTIONAL DESCRIPTION

Algorithm for identifying SNPs without a reference genome by comparing raw reads. KISNP has now given birth to DISCOSNP in a work involving V. Lacroix from ERABLE and the GenScale Inria Team at Rennes.

- Participants: Vincent Lacroix, Pierre Peterlongo
- Contact: Pierre Peterlongo (EPI GenScale)

5.14. KisSplice & KisSplice2igv7

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. KISSPLICE2IGV is a pipeline that combines the outputs of KISSPLICE to a reference transcriptome (obtained with a full-length transcriptome assembler or a reference database). It provides a visualisation of the events found by KISSPLICE in a longer context using a genome browser (IGV).

- Participants: Lilia Brinza, Alice Julien-Laferrrière, Janice Kielbassa, Vincent Lacroix, Leandro Ishi Soares de Lima, Camille Marchet, Vincent Miele, Gustavo Sacomoto
- Contact: Vincent Lacroix
- URL: <http://kisssplice.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: 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-Lafferri re, 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/

5.24. PhEVER

FUNCTIONAL DESCRIPTION

Database of homologous gene families built from the complete genomes of all available viruses, prokaryotes and eukaryotes and aimed at the detection of virus/virus and virus/host lateral gene transfers.

- Participants: Christian Gautier, Vincent Lotteau, Leonor Palmeira, Simon Penel, Chantal Rabourdin-Combe
- Contact: Christian Gautier, Leonor Palmeira (not EPI)
- URL: <http://pbil.univ-lyon1.fr/databases/phever>

5.25. PepLine

FUNCTIONAL DESCRIPTION

Pipeline for the high-throughput analysis of proteomic data.

- Participant: Jérôme Garin, Alain Viari
- Contact: Alain Viari

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. Smile

FUNCTIONAL DESCRIPTION

Motif inference algorithm taking as input a set of biological sequences.

- Participants: Laurent Marsan, Marie-France Sagot
- Contact: Marie-France Sagot
- URL: Not available

5.30. UniPathway

FUNCTIONAL DESCRIPTION

Database of manually curated pathways developed with the Swiss-Prot group.

- Participants: Eric Coissac, Anne Morgat, Alain Viari
- Contact: Anne Morgat
- URL: <http://www.unipathway.org/>

5.31. WhatsHap and pWH

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. PWH 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>

EXMO Project-Team

6. New Software and Platforms

6.1. Alignment API

Participants: Jérôme Euzenat [Correspondent], Jérôme David, Nicolas Guillouet, Armen Inants.

We have designed a format for expressing alignments in a uniform way [2]. 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.

The API itself [2] 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 algebras of relations;
- a library of sample matchers;
- a library of renderers (XSLT, RDF, SKOS, SWRL, OWL, C-OWL, SPARQL);
- 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 API;
- a parser for the format.

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.

In 2015, we further integrated the implementation of link keys and their transformations into SPARQL queries (§3.3). We developed the transformation aspect of the EDOAL language. Finally, we provided the interface with alignment algebras into the API implementation (§7.1.2).

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. It has been used this year in the Ready4SmartCities project (§9.2.1.1) [14], [20].

The Alignment API is used in the Ontology Alignment Evaluation Initiative data and result processing (§7.1.1). 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>.

6.2. The OntoSim library

Participants: Jérôme David [Correspondent], Jérôme Euzenat.

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

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 provides a framework for designing various kinds of similarities. In particular, we distinguish similarities in the ontology space from those in the alignment space. The latter ones use available alignments in an ontology network 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.

In 2015, OntoSim only supported a maintenance upgrade.

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>.

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 the implementation of methods 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 8.7.1. In comparison with the previously distributed versions, GNA 8.7.1 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 Joseph Fourier, Université Pierre Mendès-France
- 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, Michel Page, Delphine Ropers, Valentin Zulkower
- Partners: Université Joseph Fourier, Université Pierre Mendès-France
- 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, Michel Page, Delphine Ropers, Valentin Zulkower
- Partners: Université Joseph Fourier, Université Pierre Mendès-France
- Contact: Hidde de Jong
- URL: <http://ibis.inrialpes.fr/article1080.html>

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 Joseph Fourier, Université Pierre Mendès-France
- Contact: Hidde de Jong
- URL: <http://ibis.inrialpes.fr/article957.html>

IMAGINE Project-Team

5. New Software and Platforms

5.1. Expressive

FUNCTIONAL DESCRIPTION

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, Rémi Brouet, Even Entem, Thomas Delame, Ulysse Vimont and Cédric Zanni
- Contact: Marie-Paule Cani

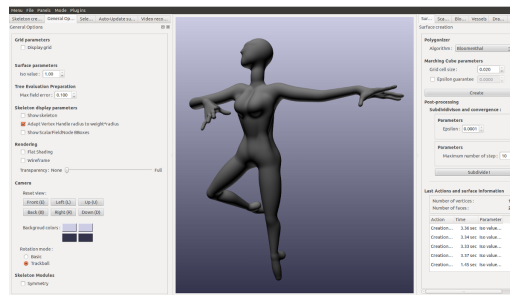


Figure 2. GUI and Example of implicit surface and modeled with the Expressive platform.

5.2. MyCF

KEYWORDS: 3D modeling - Simulation - Health - Ontologies - Anatomy - Patientspecific - Medical imaging
 FUNCTIONAL DESCRIPTION

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>

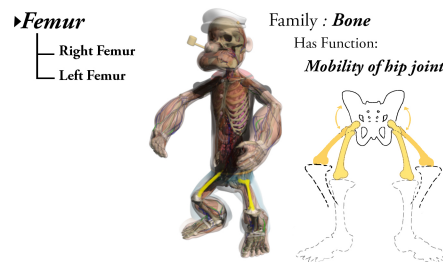


Figure 3. My Corporis Fabrica is an anatomical knowledge database developed in our team.

5.3. SOFA

Simulation Open Framework Architecture

KEYWORDS: Physical simulation - Health - Biomechanics - GPU - Computer-assisted surgery

FUNCTIONAL DESCRIPTION

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

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

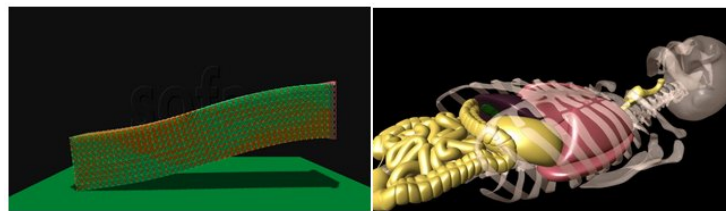


Figure 4. SOFA is an open source simulator for physically based modeling.

LEAR Project-Team

6. New Software and Platforms

6.1. Video descriptors

Participants: Heng Wang, Dan Oneata, Cordelia Schmid [correspondant], Jakob Verbeek.

We have developed and made on-line available software for video description based on dense trajectories and motion boundary histograms, which are presented in [9]. The trajectories capture the local motion information of the video. A state-of-the-art optical flow algorithm enables a robust and efficient extraction of the dense trajectories. Descriptors are aligned with the trajectories and based on motion boundary histograms (MBH) which are robust to camera motion. The code is available at http://lear.inrialpes.fr/~wang/improved_trajectories.

6.2. Patch CKN

Participants: Mattis Paulin, Julien Mairal, Matthijs Douze, Zaid Harchaoui, Florent Perronnin [Facebook], Cordelia Schmid.

This is an open-source software package implementing the image retrieval technique of [17]. It is available at <http://lear.inrialpes.fr/people/paulin/projects/RomePatches/>. The code relies on the software “Convolutional Kernel Networks” below.

6.3. Convolutional Kernel Networks

Participants: Julien Mairal, Piotr Koniusz, Zaid Harchaoui, Cordelia Schmid.

This is an open-source software package corresponding to a paper published at NIPS in 2014, available at <http://ckn.gforge.inria.fr/>, and which is continuously updated. In this software package, convolutional neural networks are learned in an unsupervised manner. We control what the non-linearities of the network are really doing: the network tries to approximate the kernel map of a reproducing kernel.

6.4. DeepFlow

Participants: Philippe Weinzaepfel, Jerome Revaud, Zaid Harchaoui, Cordelia Schmid.

We developed a package for the “deep flow” algorithm. “Deep flow” combines a standard variational framework with a our new matching algorithm “deep matching”, presented in the publication [31]. The code for “deep matching” is in python and the code for “deep flow” in C. The code is available on-line at <http://lear.inrialpes.fr/src/deepmatching>. In 2015, we have released a GPU version of “deep matching”.

6.5. EpicFlow

Participants: Jerome Revaud, Philippe Weinzaepfel, Zaid Harchaoui, Cordelia Schmid.

We developed a package for the EpicFlow method [18], [32]. EpicFlow computes a dense correspondence field by performing a sparse-to-dense interpolation from an initial sparse set of matches, leveraging contour cues using an edge-aware geodesic distance. The resulting dense correspondence field is fed as an initial optical flow estimate to a one-level variational energy minimization. The code is written in C/C++ and is available at <http://lear.inrialpes.fr/src/epicflow>.

6.6. Motion Boundaries Detection

Participants: Philippe Weinzaepfel, Jerome Revaud, Zaid Harchaoui, Cordelia Schmid.

We make our source code for detecting motion boundaries [23] publicly available. The method is based on structured random forest and leverages both appearance and motion cues at the patch level. The source code is written in Matlab with C++ Mex-file and is available at <http://lear.inrialpes.fr/research/motionboundaries/>

6.7. Pose estimation and segmentation of multiple people

Participants: Guillaume Seguin, Karteek Alahari, Josef Sivic, Ivan Laptev.

We developed a method to obtain a pixel-wise segmentation and pose estimation of multiple people in stereoscopic videos. The codebase is composed of a set of patches for the various components in our pipeline, as well as the full pose mask generation and segmentation. It is available for download on the project website: <http://www.di.ens.fr/willow/research/stereoseg>.

6.8. FlipFlop: Fast Lasso-based Isoform Prediction as a Flow Problem

Participants: Elsa Bernard [Institut Curie, Ecoles des Mines-ParisTech], Laurent Jacob [CNRS, LBBE Laboratory], Julien Mairal [correspondant], Jean-Philippe Vert [Institut Curie, Ecoles des Mines-ParisTech].

FlipFlop is an open-source software, implementing a fast method for de novo transcript discovery and abundance estimation from RNA-Seq data. It differs from classical approaches such as Cufflinks by simultaneously performing the identification and quantitation tasks using a penalized maximum likelihood approach, which leads to improved precision/recall. Other software taking this approach have an exponential complexity in the number of exons of a gene. We use a novel algorithm based on network flow formalism, which gives us a polynomial runtime. In practice, FlipFlop was shown to outperform penalized maximum likelihood based softwares in terms of speed and to perform transcript discovery in less than 1/2 second for large genes.

FlipFlop is a user friendly bioconductor R package, which was released in October 2014. It is freely available on the Bioconductor website under a GPL licence: <http://bioconductor.org/packages/release/bioc/html/flipflop.html>. In 2015, we released a new version to process multiple samples [4].

MAVERICK Project-Team

5. New Software and Platforms

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

5.2. Freestyle

FUNCTIONAL DESCRIPTION

Freestyle is a software for Non-Photorealistic Line Drawing rendering from 3D scenes. It is designed as a programmable interface to allow maximum control over the style of the final drawing: the user "programs" how the silhouettes and other feature lines from the 3D model should be turned into stylized strokes using a set of programmable operators dedicated to style description. This programmable approach, inspired by the shading languages available in photorealistic renderers such as Pixar's RenderMan, overcomes the limitations of integrated software with access to a limited number of parameters and permits the design of an infinite variety of rich and complex styles. The system currently focuses on pure line drawing as a first step. The style description language is Python augmented with our set of operators. Freestyle was developed in the framework of a research project dedicated to the study of stylized line drawing rendering from 3D scenes.

- Participant: Joëlle Thollot
- Contact: Joëlle Thollot
- URL: <http://freestyle.sourceforge.net>

5.3. 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, Gautier Ciaudo and Romain Vergne
- Partner: UJF
- Contact: Romain Vergne
- URL: <http://gratin.gforge.inria.fr>

5.4. 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. GigaVoxels is currently used for the quality real-time exploration of the detailed galaxy in ANR RTIGE.

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

5.5. HQR: High Quality Renderer

KEYWORDS: Lighting simulation - Materials - Plug-in

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 development 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>
- URL: <https://launchpad.net/~csoler-users/+archive/ubuntu/hqr>

5.6. Spherical harmonic library

KEYWORDS: Lighting simulation - Materials - Plug-in

FUNCTIONAL DESCRIPTION

The spherical harmonic library regroups a set of tools to decompose spherical functions in to spherical and rotated zonal harmonics. It also implements two spherical harmonic rotation formulas (Jan Kautz' ZXZXZ method, and the rotation formula derived in Cyril Soler's PhD thesis). A graphical tool called `shdisplay` is also included and allows to visualize and manipulate distributions of spherical harmonics.

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

5.7. MobiNet

KEYWORD: Simulation

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).

- Partners: CNRS - LJK - INP Grenoble - Inria - IREM - Cies
- Contact: Fabrice Neyret
- URL: <http://mobinet.imag.fr/index.en.html>

5.8. PLANTRAD

KEYWORDS: Bioinformatics - Biology

FUNCTIONAL DESCRIPTION

PlantRad is a software program for computing solutions to the equation of light equilibrium in a complex scene including vegetation. The technology used is hierarchical radiosity with clustering and instantiation. Thanks to the latter, PlantRad is capable of treating scenes with a very high geometric complexity (up to millions of polygons) such as plants or any kind of vegetation scene where a high degree of approximate self-similarity permits a significant gain in memory requirements.

- Participants: George Drettakis, François Sillion and Cyril Soler
- Contact: Cyril Soler
- URL: no URL available

5.9. 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.

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

5.10. 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/>

MESCAL Project-Team

5. New Software and Platforms

5.1. CiGri

FUNCTIONAL DESCRIPTION

CiGri is a middleware which gathers the unused computing resource from intranet infrastructure and makes it available for the processing of large set of tasks. It manages the execution of large sets of parametric tasks on lightweight grid by submitting individual jobs to each batch scheduler. It is associated to the OAR resource management system (batch scheduler). Users can easily monitor and control their set of jobs through a web portal. CiGri provides mechanisms to identify job error causes, to isolate faulty components and to resubmit jobs in a safer context.

- Contact: Olivier Richard
- URL: <https://www.projet-plume.org/fiche/cigri>

5.2. ComputeMode

ComputeMode: On-demand HPC cluster manager

KEYWORDS: HPC - Clusters - Operating system provisioning

FUNCTIONAL DESCRIPTION

ComputeMode is a on-demand HPC cluster manager, it allows deploying lightweight clustering framework on intranets.

ComputeMode is a software infrastructure that allows to extend or create a Grid through the aggregation of unused computing resources. For instance, a virtual cluster can be built using anyone's PC while not in use. Indeed, most PCs in large companies or university campus are idle at night, on weekends, and during vacations, training periods or business trips.

The main benefits of ComputeMode are the following

Easy deployment: the integration into an existing infrastructure is very easy: no modification is required on your PCs. ComputeMode comes as a software-only solution. The integration with major batch manager systems such as Sun Grid Engine, Platform LSF and Portable Batch System (PBS) can also be achieved. Seamless integration for the scientist: he/she submits unmodified computational jobs through his/her usual interface (batch submission engine), just like with any Beowulf type cluster. Seamless integration for the PC owner/user: ComputeMode runs when his/her PC is idle (night, weekends, ...) so annoyance is minimal if existant

Using ComputeMode, the life cycle of the PCs is basically split between 2 modes of operation a user mode, where the company's installation of Microsoft Windows or GNU/Linux remains a computation mode (hence the product name): uses a diskless boot of a GNU/Linux system and offers the PC's CPU power, RAM and connectivity to the Grid.

- Participants: Pierre Neyron, Olivier Richard and Bruno Bzeznik
- Partners: LIG - ANDRA
- Contact: Olivier Richard
- URL: <http://computemode.imag.fr>

5.3. 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: Jean-Marc Vincent
- URL: <http://soctrace-inria.github.io/framesoc/>

5.4. 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 whole point behind GameSeer is to provide a dynamic graphical interface that allows the user to employ Mathematica's vast numerical capabilities from a simple and intuitive front-end. So, even if you've never used Mathematica before, you should be able to generate fully editable and customizable portraits quickly and painlessly.

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

5.5. KA-Tools

FUNCTIONAL DESCRIPTION

The KA-Tools is a software suite developed by MESCAL for exploitation of clusters and grids. It uses a parallelization technique based on spanning trees with a recursive starting of programs on nodes. Industrial collaborations were carried out with Mandrake, BULL, HP and Microsoft.

- Contact: Olivier Richard
- URL: <http://ka-tools.imag.fr/>

5.6. Kadeploy

KEYWORD: Operating system provisioning

FUNCTIONAL DESCRIPTION

Kadeploy is a scalable, efficient and reliable deployment system (cluster provisioning solution) for cluster and grid computing. It provides a set of tools for cloning, configuring (post installation) and managing cluster nodes. It can deploy a 300-nodes cluster in a few minutes, without intervention from the system administrator.

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

5.7. Kameleon

FUNCTIONAL DESCRIPTION

Kameleon is a simple but powerful tool to generate customized appliances. With Kameleon, you make your recipe that describes how to create step by step your own distribution. At start Kameleon is used to create custom kvm, docker, VirtualBox, ..., but as it is designed to be very generic you can probably do a lot more than that.

- Participant: Olivier Richard
- Partner: Grid'5000
- Contact: Olivier Richard
- URL: <http://kameleon.imag.fr/>

5.8. 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).

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

5.9. 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/>

5.10. PEPS

FUNCTIONAL DESCRIPTION

The main objective of PEPS is to facilitate the solution of large discrete event systems, in situations where classical methods fail. PEPS may be applied to the modelling of computer systems, telecommunication systems, road traffic, or manufacturing systems.

- Participants: Luka Stanasic, Arnaud Legrand, Augustin Degomme, Jean-Marc Vincent and Florence Perronnin
- Contact: Arnaud Legrand
- URL: <http://www-id.imag.fr/Logiciels/peps/>

5.11. 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: Arnaud Legrand
- URL: <https://gforge.inria.fr/projects/psi/>

5.12. Pajé

FUNCTIONAL DESCRIPTION

The Pajé generic tool provides interactive and scalable behavioral visualizations of parallel and distributed applications, helping to capture the dynamics of their executions, because of its genericity, it can be used unchanged in a large variety of contexts.

- Participants: Arnaud Legrand and Jean-Marc Vincent
- Contact: Jean-Marc Vincent
- URL: <http://paje.sourceforge.net/>

5.13. PajéNG

Pajé Next Generation

FUNCTIONAL DESCRIPTION

Pajé Next Generation is a re-implementation (in C++) and direct heir of the well-known Paje visualization tool for the analysis of execution traces (in the Paje File Format) through trace visualization (space/time view). The tool is released under the GNU General Public License 3. PajeNG comprises the libpaje library, the space-time visualization tool in pajeng and a set of auxiliary tools to manage Paje trace files (such as pj_dump and pj_validate).

- Participants: Jean-Marc Vincent and Arnaud Legrand
- Contact: Jean-Marc Vincent
- URL: <https://github.com/schnorr/pajeng>

5.14. SimGrid

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

FUNCTIONAL DESCRIPTION

Scientific Instrument for the study of Large-Scale Distributed Systems. SimGrid is a toolkit that provides core functionalities for the simulation of distributed applications in heterogeneous distributed environments.

- Participants: Jonathan Rouzaud-Cornabas, Frédéric Suter, Martin Quinson, Arnaud Legrand, Takahiro Hirofuchi, Adrien Lèbre, Jonathan Pastor, Mario Südholt, Flavien Quesnel, Luka Stanisic, Augustin Degomme, Jean-Marc Vincent and Florence Perronnin
- Partners: CNRS - Université de Nancy - University of Hawaii - Université de Reims Champagne-Ardenne - Femto-st
- Contact: Arnaud Legrand
- URL: <http://simgrid.gforge.inria.fr/>

5.15. Viva

FUNCTIONAL DESCRIPTION

Viva is an open-source tool used to analyze traces (in the Paje File Format) registered during the execution of parallel or distributed applications. The tool also serves as a sandbox to the development of new visualization techniques. Current features include: Temporal integration using dynamic time-intervals Spatial aggregation through hierarchical traces Interactive Graph Visualization with a force-directed algorithm, with viva Squarified Treemap to compare processes behavior on scale, with vv_treemap.

- Contact: Arnaud Legrand
- URL: <https://github.com/schnorr/viva>

5.16. Platforms

5.16.1. Grid'5000

The MESCAL project-team is involved in development and management of Grid'5000 platform. The Digitalis and IDPot clusters are integrated in Grid'5000 as well as of CIMENT.

5.16.2. Local cluster computing platforms: ICluster-2, IDPot, Digitalis

The MESCAL project-team manages a cluster computing center on the Grenoble campus. The center manages different architectures: a 48 bi-processors PC (ID-POT), and the center is involved with a cluster based on 110 bi-processors Itanium2 (ICluster-2) and another based on 34 bi-processor quad-core XEON (Digitalis) located at Inria. The three of them are integrated in the Grid'5000 grid platform.

More than 60 research projects in France have used the architectures, especially the 204 processors Icluster-2. Half of them have run typical numerical applications on this machine, the remainder has worked on middleware and new technology for cluster and grid computing. The Digitalis cluster is also meant to replace the Grimage platform in which the MOAIS project-team is very involved.

5.16.3. The Bull Machine

In the context of our collaboration with Bull the MESCAL project-team exploits a Novascale NUMA machine. The configuration is based on 8 Itanium II processors at 1.5 Ghz and 16 GB of RAM. This platform is mainly used by the Bull PhD students. This machine is also connected to the CIMENT Grid.

MISTIS Project-Team

6. New Software and Platforms

6.1. 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 generalisation 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>

6.2. P-LOCUS

KEYWORDS: Health - Neuroimaging - Cancer - Brain MRI - Medical imaging

FUNCTIONAL DESCRIPTION

The Locus software was extended to address the delineation of lesions in pathological brains. Its extension P-LOCUS software analyses, in few minutes, a 3D MR brain scan and performs fully automatic brain lesion delineation using a combined dataset of various 3D MRI sequences.

- Participants: Senan Doyle, Florence Forbes, Michel Dojat and Pascal Rubini
- Partner: INSERM
- Contact: Florence Forbes
- URL: <http://p-locus.com/>

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 and Aina Frau Pascual
- Partners: CEA - NeuroSpin
- Contact: Florence Forbes
- URL: <http://pyhrf.org>

MOAIS Project-Team

4. New Software and Platforms

4.1. FlowVR

FUNCTIONAL DESCRIPTION

The goal of the FlowVR library is to provide users with the necessary tools to develop and run high performance interactive applications on PC clusters and Grids. The main target applications include virtual reality, scientific visualization and Web3D. FlowVR enforces a modular programming that leverages software engineering issues while enabling high performance executions on distributed and parallel architectures.

- Participants: Jérémie Allard, Valérie Gourantou, Jean Denis Lesage, Sébastien Limet, Emmanuel Melin, Clément Ménier, Bruno Raffin, Sophie Robert, Matthieu Dreher and Jérémy Jaussaud
- Contact: Bruno Raffin
- URL: <http://flowvr.sf.net>

4.2. K'Star

K'Star Action

KEYWORDS: Parallel computing - Task-based algorithm - Runtime system - Task scheduling - OpenMP - Source-to-source compiler - Data parallelism

FUNCTIONAL DESCRIPTION

The K'Star action supports the development of Klang-Omp, a source-to-source compiler that turns C and C++ programs with OpenMP pragmas to C programs with calls to either the StarPU or the XKaapi runtime system, as well as the development of the KaStORS benchmarks suite for experimenting with OpenMP dependent tasks.

- Participants: Philippe Virouleau, Pierrick Brunet, Thierry Gautier, Olivier Aumage, Samuel Thibault, Nathalie Furmento, Samuel Pitoiset and François Broquedis
- Contact: Thierry Gautier
- URL: <http://kstar.gforge.inria.fr/>

4.3. KAAPI

KAAPI – *Kernel for Adaptive, Asynchronous Parallel and Interactive programming* – is a C library that allows to execute fine/medium grain multithreaded computation with dynamic data flow synchronizations.

FUNCTIONAL DESCRIPTION

KAAPI means Kernel for Adaptive, Asynchronous Parallel and Interactive programming. It is a C library that allows to execute multithreaded computation with data flow synchronization between threads. The library is able to schedule fine/medium size grain programs on a multicore machine with several GPUs. The data flow graph is unfold at runtime.

- Contact: Thierry Gautier
- URL: <http://kaapi.gforge.inria.fr>

4.4. KaStORS

The KaStORS OpenMP Benchmark Suite

KEYWORDS: Benchmarking - HPC - Task-based algorithm - Task scheduling - OpenMP - Data parallelism

FUNCTIONAL DESCRIPTION

The KaStORS benchmarks suite has been designed to evaluate implementations of the OpenMP dependent task paradigm, introduced as part of the OpenMP 4.0 specification.

- Participants: Olivier Aumage, François Broquedis, Pierrick Brunet, Nathalie Furmento, Thierry Gautier, Samuel Thibault and Philippe Virouleau
- Contact: Thierry Gautier
- URL: <http://kastors.gforge.inria.fr/>

4.5. LinBox

FUNCTIONAL DESCRIPTION

LinBox is an open-source C++ template library for exact, high-performance linear algebra computations. It is considered as the reference library for numerous computations (such as linear system solving, rank, characteristic polynomial, Smith normal forms,...) over finite fields and integers with dense, sparse, and structured matrices.

- Participants: Clément Pernet and Thierry Gautier
- Contact: Clément Pernet
- URL: <http://linalg.org/>

4.6. 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).

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

4.7. 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.

- Participants: Matthys Douze, Jean-Sébastien Franco and Bruno Raffin
- Partner: Grenoble-INP
- Contact: Matthys Douze
- URL: <http://pascal.inrialpes.fr/data2/douze/QuickCSG>

4.8. Triva

FUNCTIONAL DESCRIPTION

Triva is an open-source tool used to analyze traces (in the pajé format) registered during the execution of parallel applications. The tool serves also as a sandbox to the development of new visualization techniques.

- Participant: Guillaume Huard
- Contact: Guillaume Huard
- URL: <http://triva.gforge.inria.fr/>

4.9. XKaapi

FUNCTIONAL DESCRIPTION

XKaapi is a library for high performance applications running on multi-cores/multi-processors with support for multi-GPUs. XKaapi provides ABI compliant implementations of libGOMP (GCC runtime for OpenMP) and was one of the target runtime of the K*Star compiler,

- Contact: Thierry Gautier
- URL: <http://kaapi.gforge.inria.fr>

4.10. TakTuk

TakTuk: Adaptive large scale remote executions deployment

KEYWORD: Deployment

FUNCTIONAL DESCRIPTION

TakTuk is a tool for deploying parallel remote executions of commands to a potentially large set of remote nodes. It spreads itself using an adaptive algorithm and sets up an interconnection network to transport commands and perform I/Os multiplexing/demultiplexing. The TakTuk mechanics dynamically adapt to environment (machine performance and current load, network contention) by using a reactive work-stealing algorithm that mixes local parallelization and work distribution.

- Participants: Guillaume Huard, Pierre Neyron, Benoît Claudel, Johann Bourcier and Olivier Richard
- Partner: LIG
- Contact: Guillaume Huard
- URL: <http://taktuk.gforge.inria.fr/>

4.11. Platforms

4.11.1. Multi-camera Platforms Grimage and Kinovis

MOAIS has managed with the LJK-Inria Morpheo team the Grimage platform (<http://grimage.inrialpes.fr>) dedicated to off-line and on-line 3D modeling from multiple cameras and telepresence. In 2012, we received an Equipex funding, Kinovis (<http://kinovis.inrialpes.fr>), to renew this platform with an installation which consists of a significantly larger acquisition space with 68 cameras connected to a new computation cluster. Moais participated to the installation and setup of the new platform (in charge of the network, compute and storage infrastructures) which is operational since summer 2015. FlowVR is the software backbone of both platforms for live processing. MOAIS is participating to the FP7 infrastructure project Visionair to enable European research teams to experiment on both platforms.

4.11.2. HPC experimentation platforms: Digitalis, Grid'5000 and Ciment

MOAIS (with MESCAL) develops and operates the Digitalis experimental platform (<http://digitalis.inria.fr>) which hosts local experimental HPC machines as well as a site of the Grid'5000 national testbed and nodes of the CIMENT regional HPC center (mesocentre of the University of Grenoble). MOAIS with the Mescal and LIG-Erods team obtained in 2014 a grant (FAIRE from Grenoble-INP and LIG) to acquire new experimental machines. 2 ARM64 development boards and one last generation 4 CPU machine which can hosts up to 4 accelerators are now part of the platform.

MORPHEO Project-Team

6. New Software and Platforms

6.1. 4D repository

FUNCTIONAL DESCRIPTION

This website 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: Bruno Raffin
- URL: <http://4drepository.inrialpes.fr/>

6.2. ETHOMICE

KEYWORDS: Biology - Health - Biomechanics - Motion analysis - Ethology - Mouse

FUNCTIONAL DESCRIPTION

Ethomice is a motion analysis software to characterize motor behavior of small vertebrates such as mice or rats. From a multiple views video input, a biomechanical model of the skeleton is registered. Study on animal model is the first important step in Biology and Clinical research. In this context, the analysis of the neuro-motor behaviour is a frequent cue to test the effect of a gene or a drug. Ethomice is a platform for simulation and analysis of the small laboratory animal, such as rat or mouse. This platform links the internal skeletal structure with 3D measurements of the external appearance of the animal under study. From a stream of multiple views video, the platform aims at delivering a three dimensional analysis of the body posture and the behaviour of the animal.

- Participants: Lionel Reveret
- Partners: CNRS - Inria - Université Descartes - ICS
- Contact: Lionel Reveret
- URL: <http://morpheo.inrialpes.fr/people/reveret/ethomice>

6.3. Lucy Viewer

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, in terms of images captured from multiple cameras at each frame.

- Participants: Edmond Boyer and Florent Lagaye
- Contact: Edmond Boyer
- URL: http://4drepository.inrialpes.fr/lucy_viewer/

6.4. 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: Matthys Douze, Jean-Sébastien Franco and Bruno Raffin
- Partner: INP Grenoble
- Contact: Matthys Douze
- URL: <http://kinovis.inrialpes.fr/static/QuickCSG/>

6.5. 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 estimates the template deformations over the sequence that fit the observed 3D models. This software is particularly developed in the context of the FUI project Creamove.

- Contact: Edmond Boyer

6.6. Platforms

6.6.1. 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. Thomas Pasquier, Mickaël Heudre and Julien Pansiot are managing the technical resources of both platforms.

6.6.2. Multicamera platform for video analysis of mice behavior

This project is a follow-up of the experimental set-up developed for a CNES project with Mathieu Beraneck from the CESeM laboratory (centre for the study of sensorimotor control, CNRS UMR 8194) at the Paris-Descartes University. The goal of this project was to analyze the 3D body postures of mice with various vestibular deficiencies in low gravity condition (3D posturography) during a parabolic flight campaign. The set-up has been now adapted for new experiments on motor-control disorders for other mice models. This experimental platform is currently under development for a broader deployment for high throughput phenotyping with the technology transfer project ETHOMICE. This project involves a close relationship with the CESeM laboratory and the European Mouse Clinical Institute in Strasbourg (Institut Clinique de la Souris, ICS).

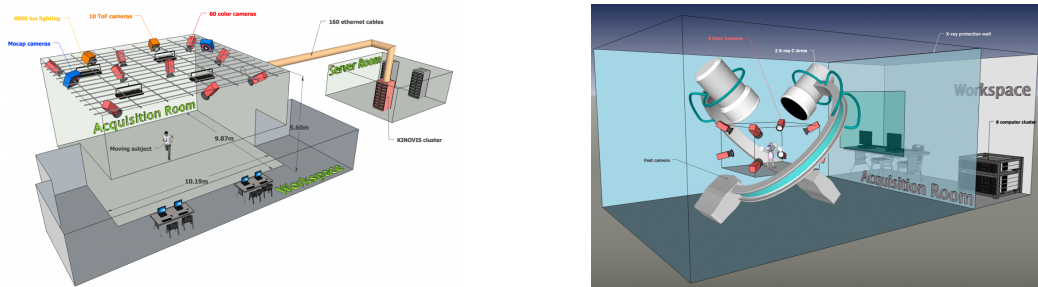


Figure 1. Kinovis platforms: on the left the Inria platform; on the right Grenoble Hospital platform.

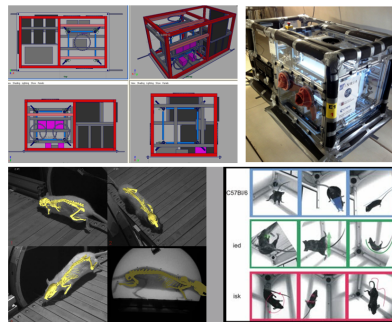


Figure 2. Ethomice: Experimental platform for video analysis of mice behavior.

NANO-D Project-Team

6. New Software and Platforms

6.1. SAMSON

SAMSON (Software for Adaptive Modeling and Simulation Of Nanosystems) is a software platform for computational nanoscience. SAMSON has a modular architecture that makes it suitable for different domains of nanoscience, including material science, life science, physics, electronics, chemistry, and education.

SAMSON Elements are modules for SAMSON, developed with the SAMSON Software Development Kit (SDK). SAMSON Elements help users perform tasks in SAMSON, including building new models, performing calculations, running interactive or offline simulations, and visualizing and interpreting results.

SAMSON Elements may contain different class types, including for example:

- Apps - generic classes with a graphical user interface that extend the functions of SAMSON
- Editors - classes that receive user interaction events to provide editing functions (e.g., model generation, structure deformation, etc.)
- Models - classes that describe properties of nanosystems (see below)
- Parsers - classes that may parse files to add content to SAMSON's data graph (see below)

SAMSON Elements expose their functions to SAMSON and other Elements through an introspection mechanism, and may thus be integrated and pipelined.

SAMSON represents nanosystems using five categories of models:

- Structural models - describe geometry and topology
- Visual models - provide graphical representations
- Dynamical models - describe dynamical degrees of freedom
- Interaction models - describe energies and forces
- Property models - describe traits that do not enter in the first four model categories

Simulators (potentially interactive ones) are used to build physically-based models, and predict properties. All models and simulators are integrated into a hierarchical, layered structure that form the SAMSON data graph. SAMSON Elements interact with each other and with the data graph to perform modeling and simulation tasks. A signals and slots mechanism makes it possible for data graph nodes to send events when they are updated, which makes it possible to develop e.g., adaptive simulation algorithms.

SAMSON is developed in C++ and implements many features to ease development of SAMSON Elements, including:

- Managed memory
- Signals and slots
- Serialization
- Multilevel undo-redo
- Introspection
- Referencing
- Unit system
- SAMSON Element source code generators

SAMSON, SAMSON Elements and the SAMSON Software Development Kit are distributed via the SAMSON Connect website (<http://www.samson-connect.net>). The site acts as a repository for the SAMSON Elements being uploaded by developers, and users of SAMSON choose and add Elements from SAMSON Connect.

NECS Project-Team

6. New Software and Platforms

6.1. GTL – Grenoble Traffic Lab

Participants: C. Canudas de Wit [contact person], I. Bellicot, P. Bellemain, L. Leon Ojeda, D. Pisarski, A. Kibangou, H. Fourati, F. Morbidi, F. Garin, A. Ladino Lopez, P. Grandinetti, E. Lovisari, R. Singhal, A. Andreev, R. Piotaix.

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 traffic control policies (ramp metering for the south-ring and optimization of urban signals); the micro-simulator is developed using AIMSUN.

More details at <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

NUMED Project-Team

4. New Software and Platforms

4.1. 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 obtain the stationary states which are linked to the stopping of the snow avalanche for this highly non-linear type of fluid.

- Contact: Paul Vigneaux

4.2. 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

4.3. 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 and 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). SETIS is filed under APP number IDN.FR.001.150013.000.S.A.2014.000.21000.

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

4.4. SIMPHYT

KEYWORDS: Bioinformatics - Cancer - Drug development

FUNCTIONAL DESCRIPTION

SimPHYt is an implementation in Python of the low grad glioma model. The aim is to predict the evolution of the glioma size of patients.

- Participant: Benjamin Ribba
- Contact: Benjamin Ribba

4.5. VAXSIMSTAB

KEYWORDS: Bioinformatics - Health - Drug development

FUNCTIONAL DESCRIPTION

VAXSIMSTAB is a modeler stability prediction of vaccine software, property of Sanofi Pasteur.

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

PERCEPTION Project-Team

5. New Software and Platforms

5.1. Associations of Audio Cues with 3D Locations Library

FUNCTIONAL DESCRIPTION

Library to associate some auditory cues with 3D locations (points). It provides an estimation of the emitting state of each of the input locations. There are two main assumptions:

1. The 3D locations are valid during the acquisition interval related to the audio cues
2. The 3D locations are the only possible locations for the sound sources, no new locations will be created in this module

The software provides also a multimodal fusion library.

- Participants: Xavier Alameda-Pineda, Antoine Deleforge, Jordi Sanchez-Riera and Radu Horaud
- Contact: Radu Horaud

5.2. Supervised Binaural Mapping Software

FUNCTIONAL DESCRIPTION

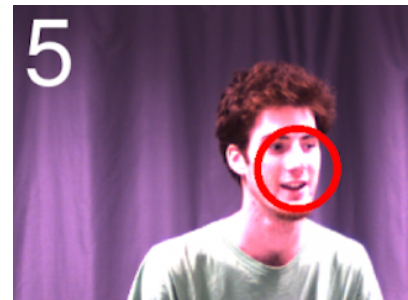
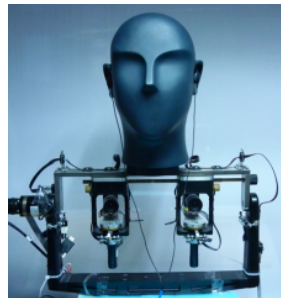


Figure 2. An audio-visual sound source (left) that emits white noise is moved in front of the POPEYE robot (middle). These input-output observation pairs are used to estimate a regression function that is then used to predict the location of a sound (right).

The SBM Matlab toolbox for “Supervised Binaural Mapping”, contains a set of functions and scripts for supervised binaural sound source separation and localization. The approach consists in learning the acoustic space of a system using a set of white-noise measurements. Once the acoustic space is learned, it can be used to efficiently localize one or several natural sound sources such as speech, and to separate their signals.

- Participants: Antoine Deleforge, Soraya Arias and Radu Horaud
- Contact: Radu Horaud
- URL: <https://team.inria.fr/perception/supervised-binaural-mapping/>

5.3. Audiovisual Robotic Heads

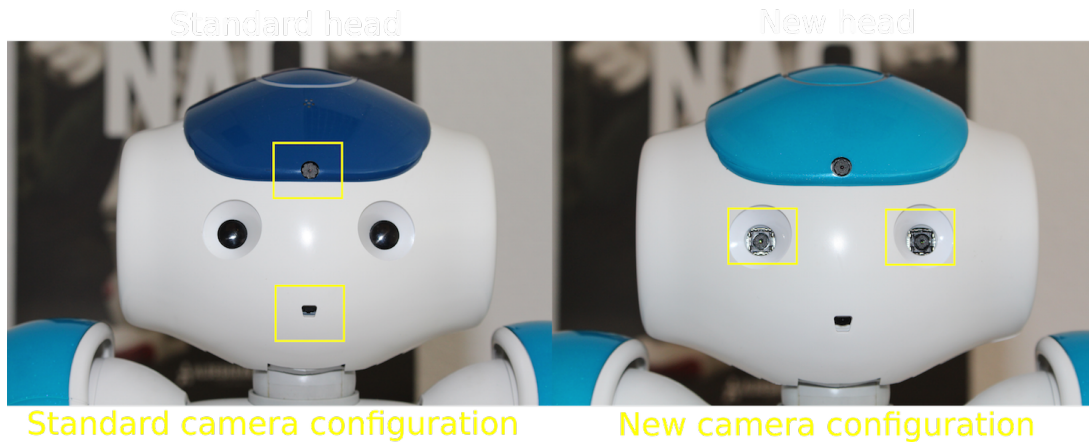


Figure 3. In collaboration with Aldebaran Robotics the team has developed a stereoscopic head for the humanoid robot NAO. Unlike the standard head that has a vertical pair of unsynchronized cameras (top-left), the new head has a horizontal pair of synchronized cameras (top-right). The latest prototype delivers VGA image pairs at 15 FPS. Based on the NAOLab library, we developed a stereo reconstruction method that delivers depth maps at 5 FPS (bottom).

FUNCTIONAL DESCRIPTION

The team has developed two audiovisual (AV) robot heads: the POPEYE head and the NAO stereo head. Both are equipped with a binocular vision system and with four microphones. The software modules comprise stereo matching and reconstruction, sound-source localization and audio-visual fusion. POPEYE has been developed within the European project POP in collaboration with the project-team MISTIS and with two other POP partners: the Speech and Hearing group of the University of Sheffield and the Institute for Systems and Robotics of the University of Coimbra. The NAO stereo head was developed under the European project HUMAVIPS in collaboration with Aldebaran Robotics (which manufactures the humanoid robot NAO) and with the University of Bielefeld, the Czech Technical Institute, and IDIAP. The software modules that we develop are compatible with both these robot heads.

- Contact: Radu Horaud
- URL: <https://team.inria.fr/perception/popeye/>

5.4. MIXCAM Platform



Figure 4. MIXCAM is a multiple-camera multiple-PC hardware/software platform that combines high-resolution color (RGB) cameras with low-resolution time-of-flight (TOF) cameras. The cameras are arranged in TOF-stereo “units”, where each unit is composed of two RGB cameras and one TOF camera. Currently the system is composed of four such units, or a total of eight RGB and four TOF cameras. In 2015 we completed algorithms and software packages for the calibration of individual TOF cameras [3] and of the whole system composed of four units, e.g. left image, [24]. The system allows high-resolution reconstruction of people, e.g. right image, [23].

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 2011-2015 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: Quentin Pelorson, Georgios Evangelidis, Soraya Arias, Radu Horaud.

- Contact: Radu Horaud
- URL: <https://team.inria.fr/perception/mixcam-project/>

5.5. NaoLAB

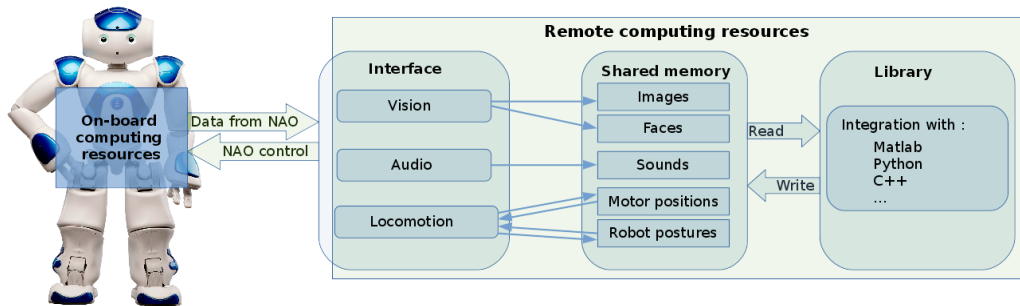


Figure 5. Overview of the proposed distributed architecture that allows fast development of interactive applications using the humanoid robot NAO.

FUNCTIONAL DESCRIPTION

NAOLab [27] is a middleware for the development of robotic applications in C, C++, Python and Matlab, using the humanoid robot NAO networked with a PC. NAOLab enables the joint use of NAO's on-board computing resources and external resources. More precisely, it allows the development of applications that combine embedded libraries, e.g. motion control, image/sound acquisition and transmission, etc., with external toolboxes, e.g. OpenCV, Matlab toolboxes, etc. The NAOLab toolbox has the following characteristic. The middleware complexity is transparent to the users. A user-friendly interface is provided through C++ and Python libraries extended with mex functions for Matlab. This enables the development of sophisticated audio and visual processing algorithms without the stringent constraints of the NAOqi SDK. NAOLab and NAOqi share the same modular approach, namely there are three categories of modules: vision, audio and motion. An interface (vision, audio, motion) is associated with each NAOqi module. Each interface deals with sensor-data access and actuator control. The role of these interfaces is twofold: (i) to feed the sensor data into a memory space that is subsequently shared with existing software or with software under development, and (ii) to send to the robot commands generated by the external modules.

- Participants: Fabien Badeig, Quentin Pelorson, Soraya Arias, Radu Horaud.
- Contact: Radu Horaud
- URL: <https://team.inria.fr/perception/research/naolab/>

PRIMA Project-Team

5. New Software and Platforms

5.1. OMISCID

An Object Oriented Open-Source Middleware for Service Communication Inspection and Discovery

- Participants: Patrick Reignier, Dominique Vaufreydaz, Amaury Negre,
- Contact: Dominique Vaufreydaz
- URL: <http://omiscid.gforge.inria.fr/>

KEYWORDS: Middleware - Pervasive computing - Service Oriented Software (SOA)

FUNCTIONAL DESCRIPTION

OMISCID is lightweight middleware for dynamic integration of perceptual services in interactive environments. This middleware abstracts network communications and provides service introspection and discovery using DNS-SD (DNS-based Service Discovery). Services can declare simplex or duplex communication channels and variables. The middleware supports the low-latency, high-bandwidth communications required in interactive perceptual applications. It is designed to allow independently developed perceptual components to be integrated to construct user services. Thus our system has been designed to be cross-language, cross-platform, and easy to learn. It provides low latency communications suitable for audio and visual perception for interactive services.

5.2. AppsGate

FUNCTIONAL DESCRIPTION

The AppsGate architecture is based on the HMI Middleware developed in cooperation with the IIHM and Adele groups of the UMR Laboratoire Informatique de Grenoble (LIG). The HMI Middleware is designed to facilitate the development of end-user applications on top of the core software components described in the sections above, while ensuring service continuity and usability. The key features of the HMI Middleware include:

Integration of sensors and actuators managed by a variety of protocols, and provision of a uniform abstraction for these devices as component-oriented-services,

Integration of Web services made available on the cloud by a variety of web service providers, and provision of a uniform abstraction for these services as component-oriented-services,

Communication between the HMI middleware and client applications - typically, user interfaces for controlling and programming the smart home, that run on high-end devices such as smartphones, tablets, and TVs.

- Participants: Alexandre Demeure, James Crowley, Eméric Grange, Cédric Gérard, Camille Lenoir and Kouzma Petoukhov
- Contact: James Crowley, Alexandre Demeure
- <http://iihm.imag.fr/demos/appsgate/appsgate2013.mp4>
- http://www.catrene.org/web/downloads/profiles_catrene/CATRENE_PP-CA110_AppsGate.pdf

5.3. SPOK

SPOK: Simple Programming Kit pour Smart Homes

KEYWORDS: End User Development - Smart Home

- Contact: James Crowley, Alexandre Demeurre

SPOK is an End-User Development Environment that permits people to monitor, control, and configure smart home services and devices. SPOK provides the end-user with the following services: (1) A syntax-oriented program editor that enforces the construction of syntactically-correct programs (see sidebar on next page). (2) A program interpreter and a clock simulator to test program execution in “simulated time”. (3) Debugging aids to support the detection and correction of programming errors or system malfunctions along with a Trace Manager. (4) A dashboard to remotely control devices and programs in a centralized and uniform manner.

Compared to the state-of-the art, the key features of SPOK are three-fold: Expressive power of the SPOK language along with a pseudo-natural concrete syntax, dynamic adaptation to the arrival/departure of devices and services, and debugging aids.

SPOK was developed as part of the EU CATRENE APPSGATE project (CA 110) and is supported by the EquipEx AmiQual4Home, ANR-11-EQPX-00.

5.4. DomiCube

- Participant: Remi Pincent
- Contact: Remi Pincent
- <https://amiqual4home.inria.fr/domicube/>

The DomiCube is a home-made device designed by 5 retired seniors as the result of a 3 hour focus group. It contains an accelerometer and a gyroscope, and is Bluetooth enabled. It sends events when its state changes (e.g., new orientation, top face, and battery level). The DomiCube was built in the Creativity Lab of the EquipEx AmiQual4Home, ANR-11-EQPX-00.

5.5. EmoPRAMAD

KEYWORDS: Health - Home care

- Contact: Dominique Vaufreydaz
- <https://pramad.inria.fr>

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.

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. Online Movie Director

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

Online Movie director is a network online video editing program. It can handle several video and audio streams over the network and resynchronize them to produce a video either for streaming or either for direct video production. The system can record lectures using multiple cameras and microphones. The system uses PRIMA techniques for modelling context to select the most appropriate camera and microphone, based on the current situation.

5.8. PALGate

KEYWORDS: Health - Home care - Handicap

- Contact: Dominique Vaufreydaz, Amaury Negre
- <https://pal.inria.fr>

A part of our efforts in the PAL project has been put toward developing a solution that would ease the integration of our multi-partners' software components.

The design of PAL Middleware responds to a requirement that within the PAL project, each partner is responsible for maintaining 1) its software heritage 2) its resources 3) its competences and fields of research and expertise; 4) current practices in terms of programming language, (c/c++, Java, Python), computing platforms (OSx, Linux, Windows, Android, etc.) and interconnect software components (OSGi, OMiSCID, MPI, PVM, etc.); and 5) its particular needs and constraints.

For it to be widely accepted, the PAL middleware must be designed to be ecologic and pragmatic. Ecologic in the sense that the solution does not perturb the ecology of each ecosystem, pragmatic in the sense that setting up this solution did not require an heavy development effort, also because PAL and is required to reuse existing software solutions.

For developing PALGate we introduced a novel concept: software gate. Unlike software components/services which can be instantiated, a software gate is only a concept, it is defined as an ecologic and hermetic interface between different ecosystems. A software gate is characterized by the subset of functionalities it exposes to other gates, where the functionalities it exposes are provided by the software components/services of its belonging ecosystem. A software gate is hermetic in the sense that only a selected subset of functionalities of an ecosystem are exposed but also because it propagates only filtered information exposed by other gates into its ecosystem. The last characteristic of a software gate is that it makes explicit to other gates the communication mechanisms it uses.

While a software gate is only conceptual, the PAL middleware is an implementation of a gate oriented middleware. The PAL Middleware uses ROS to support the basic communication between gates. Within PALGate, each ecosystem is associated to only one software gate. Practically, PAL middleware 1) is a ROS stack containing gates definition 2) is a set of conventions (e.g. stack organization, package/node/topic/service names, namespaces, etc.) 3) it provides dedicated tools to ease the integration and its usage by partners. A software gate in PAL is a ROS package containing definition of ROS types (i.e. msgs and srvs types), but also exposed ROS communication channels (i.e. topics and RPCs).

With this architecture each partner has to provide the PAL middleware with a package containing the definition of its gate. Then in order a) to expose functionalities out of their ecosystem and b) to propagate information into their ecosystem, each partner must create ROS nodes. These ROS nodes let each partner interface their ecosystem through ROS topics and ROS services without having to change anything about their architecture. For instance if a partner is using Java and OSGi, it can create nodes in ROS Java that will expose/register functionalities through ROS services, publish/subscribe information using ROS topics.

5.9. PERFECT MATCH STEREO

- Participants: Frédéric Devernay, Pau Gargallo and Sergi Pujades
- Contact: Frédéric Devernay

5.10. PrimaCV

- Participants: Rémi Barraquand, Claudine Combe, Lukas Rummelhard, Amaury Negre, Sergi Pujades-Rocamora and James Crowley
- Contact: James Crowley

FUNCTIONAL DESCRIPTION

PrimaCV is a software library for detecting, observing and tracking faces and emotions using the cameras on mobile devices. The PrimaCV library uses a scale invariant pyramid to construct receptive field descriptors for images. These are used by a coarse to fine multiscale "scanning window" face detector constructed as a cascade classifier constructed using an highly optimised version of Ada Boost. Because the system uses coarse to fine search within a scale invariant pyramid it automatically adapts to the number of pixels and scale of the imager. The coarse-to-fine search algorithm has been shown to provide a dramatic gain in performance over classic scanning window detectors. The algorithm produces a probability of a face for each possible scale and position in the image. Local maximum in probability are fed to a Bayesian face tracker.

Normalized imaggettes of tracked faces can be fed to procedures for estimating face orientation, recognising identity, estimating parameters of emotions.

5.11. STEREO VIEWFINDER

FUNCTIONAL DESCRIPTION

Stereoscopy, Auto-calibration, Real-time video processing, Feature matching

- Participants: Frédéric Devernay, Loïc Lefort, Elise Mansilla and Sergi Pujades
- Contact: Frédéric Devernay

5.12. 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

5.13. SmartServoFramework

- Participants: Dominique Vaufreydaz and Eméric Grange
- Contact: Dominique Vaufreydaz
- <https://github.com/emericg/SmartServoFramework>

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 supports 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.

PRIVATICS Project-Team

5. New Software and Platforms

5.1. 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 Acharya, 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/fr/mobilities/>

5.2. 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

5.3. 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/>

5.4. FECFRAME

FUNCTIONAL DESCRIPTION

FECFRAME implements IETF FECFRAME (RFC 6363). It allows to transmit multimedia streams to one or several receivers at the same time while being robust to packet losses occurring on the network (par ex. 3G/4G or Wifi). This software is compatible with OpenFec which provides error-correcting codes.

- Participants: Vincent Roca
- Contact: Vincent Roca

5.5. WALTER

Walter experiment: "Is My Web Content Altered?". A web based tool detecting the unwanted injection of scripts and other contents in unencrypted webpages.

FUNCTIONAL DESCRIPTION

Disputable network agents, namely free Wi-Fi hotspots providers such as those found in airports or coffee shops, have been found to monetize their networks by injecting advertisements and trackers into their customers' traffic. Such adverts are served by network agents instead of website publishers. This is a relatively new approach, and we are trying to determine its usage worldwide. This website is designed to assess whether your internet connection is affected by such practices. We also detect local page alterations that come from browser extensions and programs that may run on your machine.

- Participants: Mathieu Cunche, Leo Letaro.
- Contact: Mathieu Cunche

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 has been developed by INPT(ENSEEIH)-IRIT, Inria, CERFACS, University of Bordeaux, CNRS and ENS Lyon.

- 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 and François-Henry Rouet
- Partners: Université de Bordeaux - CNRS - CERFACS - ENS Lyon - INPT - IRIT - Université de Lyon - Université de Toulouse - LIP
- Contact: Jean-Yves L'Excellent
- Public releases in 2015: MUMPS 5.0.0 (February 2015), including major improvements in terms of performance and robustness, and MUMPS 5.0.1 (July 2015)
- URL: <http://mumps-solver.org/>

Following the creation in 2014 of a consortium for industrial users of MUMPS (<http://mumps-consortium.org>), some collaborations with industry (scientific exchanges, support, releases in advance) are mentioned in Section 8.1 . We pursued our work on block low-rank solvers [2] (Section 7.13), which was extended and applied to 3D frequency domain seismic modeling [19], [18] (Section 7.15) in the context of an on-going collaboration with the Seiscope consortium (<https://seiscope2.obs.ujf-grenoble.fr/?lang=en?>). We also worked on the parallel computation of selected entries of the inverse of a sparse matrix [3] (Section 7.14).

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
- Contact: Christophe Alias
- Software transferred by Inria under an exclusive license, no web page.

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 (dependences, affine scheduling, code generation) 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
- Software transferred by Inria under an exclusive license, no web page.

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 derive 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 our new algorithm “Counter-example based generation of ranking functions” (see Section 7.29). 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 our new algorithm “An encoding of array verification problems into array-free Horn clauses” (see Section 7.30). 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
- Software not yet published, under consolidation.

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

5.2. 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>

5.3. 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>

5.4. WSNet

KEYWORD: Network simulator

FUNCTIONAL DESCRIPTION

The WSNNet-3.0 project objective is to develop the next evolution of the WSNNet simulator. It 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.

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

5.5. 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 JM 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

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 composed of four main parts: a Network Operations Center (NOC), a set of Embedded Communicating Object (ECO) test-beds, 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 on the 28th October 2014⁰, 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.

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

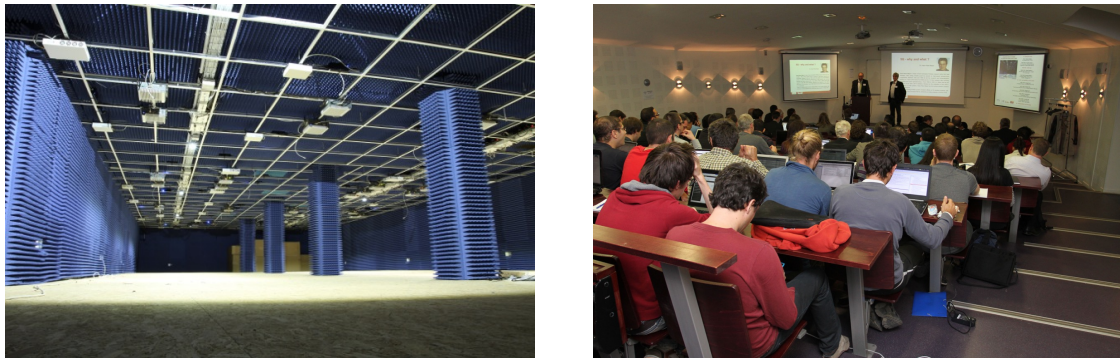


Figure 5. Photo of the FIT/CortexLab experimentation room installed and a snapshot of the inauguration meeting

SPADES Project-Team

5. New Software and Platforms

5.1. COSYMA: Controller synthesis using multi-scale abstractions

FUNCTIONAL DESCRIPTION

CoSyMA is a tool for automatic controller synthesis for incrementally stable switched systems based on multi-scale discrete abstractions. The tool accepts as input a switched system defined by differential equations indexed by a set of modes, time and space sampling parameters used to define an approximation of the continuous state-space, and a safety or a time-bounded reachability specification. CoSyMA computes and refines discrete abstractions of the state space so as to generate a controller, if one exists, for the system that enforces the specification.

- Authors: Antoine Girard, Gregor Gössler, and Sebti Mouelhi.
- Partner: LJK.
- Contact: Gregor Gössler.

5.2. LoCa: Logical Causality Analyzer

FUNCTIONAL DESCRIPTION

Based on an execution trace, the component specifications, and a required property P , LoCA analyzes the causes of a violation of P in a component-based system. LoCA currently supports causality analysis in BIP and networks of timed automata. The core analysis engine is implemented as an abstract class, such that support for other models of computation (MoC) can be added by instantiating the class with the basic operations of the MoC.

- Authors: Lacramioara Astefanoaei, Yoann Geoffroy, and Gregor Gössler.
- Contact: Gregor Gössler.

5.3. LDDL: Coq proofs of circuit transformations for fault-tolerance

FUNCTIONAL DESCRIPTION

We have been developing a COQ-based framework to formally verify the functional and fault-tolerance properties of circuit transformations. Circuits are described at the gate level using LDDL, a Low-level Dependent Description Language inspired from μ FP [87]. Our combinator language, equipped with dependent types, ensures that circuits are well-formed by construction (gates correctly plugged, no dangling wires, no combinational loops, ...). Faults like Single-Event Upsets (SEUs) (*i.e.*, bit-flips in flipflops) and SETs (*i.e.*, glitches propagating in the combinational circuit) and fault-models like “*at most 1 SEU or SET within n clock cycles*” are described in the operational semantics of LDDL. Fault-tolerance techniques are described as transformations of LDDL circuits.

The framework has been used to prove the correctness of three fault-tolerance techniques: TMR, TTR and DTR (see Section 6.3.3). The size of specifications and proofs for the common part (LDDL syntax and semantics, libraries) is 5000 lines of COQ (excluding comments and blank lines), 700 for TMR, 3500 for TTR and 7000 for DTR.

- Authors: Dmitry Burlyayev and Pascal Fradet.
- Contact: Pascal Fradet.
- URL: <https://team.inria.fr/spades/fthwproofs>

5.4. 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 and Zain Hammadeh (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. So far, pyCPA_TWCA is restricted to uniprocessor systems of independent tasks, scheduled according to static priority scheduling. A public release is planned for 2016.

- Contact: Sophie Quinton.

STEPP Project-Team

5. New Software and Platforms

5.1. QGISTranusReports

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 â 2D or 3D â 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.

- Contact: Peter Sturm

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

5.3. 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 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 environmental questions.

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

5.4. Contribution to the R package “sensitivity”

FUNCTIONAL DESCRIPTION

The contribution to the R package “sensitivity” includes the development of the function “sobolroahs” performing global sensitivity analysis of a numerical model. This function implements the estimation of the Sobol’ sensitivity indices introduced by [19] using two Orthogonal Array-based Latin Hypercubes. This function allows the estimation of all first-order indices or all closed second-order indices (containing the sum of the second-order effect between two inputs and the individual effects of each input) at a total cost of $2 \times N$. For closed second-order indices, $N = q^2$ where $q \geq d - 1$ is a prime number denoting the number of levels of the orthogonal array, and where d is the number of factors of the model.

- Participants: Laurent Gilquin, Elise Arnaud, Clémentine Prieur
- Partners: AIRSEA (Inria / UJF)
- Contact: Laurent Gilquin
- URL: <https://cran.r-project.org/web/packages/sensitivity/index.html>

TYREX Project-Team

5. New Software and Platforms

5.1. CSS Analyzer

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% while preserving their semantics [18].

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

5.2. Interactive eXtensible Engine (IXE)

Interactive eXtensible Engine

FUNCTIONAL DESCRIPTION

PDRTrack is a localization utility running on iOS or Android smartphones used for recording and playing data sets (accelerometer, gyroscope, barometer and magnetometer values) to study the effect of different pedometer and map matching parameters on indoor and outdoor localization accuracy. This application uses the PDR library, written in C++, which provides the user's location in real time based on the interpretation of mobile phone sensors. Three main modules have been designed to build this localization system:

- a pedometer that estimates the distance the user has walked and his speed
- a motion manager that enables data set recording and simulation but also the creation of virtual sensors or filters (e.g gyroscope drift compensation, linear acceleration, altimeter)
- a map-matching algorithm that provides location estimates on a given OpenStreetMap description and the current user's trajectory

The PDR library is a central component of the VENTURI project. It has been used for applications such guiding a visually impaired people. Others partners have used this localisation system for retrieving a scale factor needed for the computer vision part (i.e SLAM).

GPS navigation systems, when used in an urban environment, are limited in precision and can only give instructions at the level of the street and not of the pavement or corridor. GPS is also limited to outdoor navigation and requires some transitioning system when switching to indoor navigation.

PDRTrack is embedded in IXE. IXE is an urban pedestrian navigation system based on Inertial Measurement Units (IMU) and running on mobile phones with onboard geographic data and a routing engine. IXE allows augmented reality queries on customised embedded geographical data. Queries on route nodes or POIs, on ways and relations are predefined for efficiency and quality of information. Following a web paradigm, IXE can be seen as web browser for XML documents describing navigation networks. by using the micro-format concept, one can define inside OpenStreetMap a complex format for pedestrian navigation networks allowing navigation at the level of pavements or corridors.

The big advantage of IXE is that it relies on a standard OpenStreetMap editor called JOSM to create navigation networks and augmented reality content. IXE browser reads OSM documents and produces from them visible or audible navigation information. IXE is composed of three engines, one for dead-reckoning navigation, one for interactive audio and the last one for Augmented Reality visual information.

- Participants: Nabil Layaïda, Pierre Genevès, Thibaud Michel and Mathieu Razafimahazo
- Contact: Nabil Layaïda
- URL: <http://tyrex.inria.fr/mobile/>

5.3. XML Reasoning Solver

XML Reasoning Solver

FUNCTIONAL DESCRIPTION

The XML Reasoning Solver is a tool for the static analysis of queries and schemas based on our theoretical advances [12]. It allows automated verification of properties that are expressed as logical formulas over trees. A logical formula may for instance express structural constraints or navigation properties (like e.g. path existence and node selection) in finite trees.

The reasoner is built on top of a finite tree logic solver for a new modal logic equipped with recursion and backward axes. The solver is very fast in practice and uses symbolic techniques (Binary Decision Diagrams). The solver has been recently extended to support functions, parametric functions and polymorphic subtyping. One notable difficulty was to elaborate many advanced optimizations with symbolic implementation techniques. The logical solver significantly advances the state of the art. In particular, it is the first implementation that effectively solves the query containment problem for a large fragment of the XPath query language. It supports all navigation axes and regular tree constraints. Although researchers had studied XPath satisfiability before, such prior works were either unimplementable or deemed to explode even for tiny examples. As of 2014, it is still the only implementation actually capable of solving this problem in practice for real world instances.

The reasoner includes compilers and various static analyzers for web query and schema languages. This includes compilers for XPath, for XML schemas (DTDs, XML Schemas, Relax NGs) into logical formulas, parsers, benchmarks, and libraries for automated testing. Various difficulties reside in the compilation of real-world queries, including compiling XPath queries into fixed-point logics, developing specific implementation techniques in order to avoid worst case blow-ups as much as possible when e.g. supporting unordered XML attributes among (ordered) XML elements, etc. The reasoner also generates counter-examples that allow program defects to be reproduced independently from the analyzer.

The off-line version of the solver (with a native library) is fast and up-to-date with the latest advances. We developed and deployed an interactive web interface to make the solver available to the international scientific community. For this purpose, we redesigned the libraries used for the manipulation of binary decision diagrams (BDDs) so that they could be used in a fully concurrent and multithreaded manner. This is in order to allow several instances of the logical solver to run concurrently for several users on a web server (GWT-based), while decreasing performance as less as possible.

The reasoner helps us to guide and validate our approach. We continue to develop, maintain and use it on an almost-daily basis.

- Participants: Pierre Genevès, Nabil Layaïda, Louis Jachiet and Nils Gesbert
- Contact: Pierre Genevès
- URL: <http://tyrex.inria.fr/websolver/>

5.4. XQuery type-checker

XQuery type-checker

FUNCTIONAL DESCRIPTION

This prototype implements a sound static type-system for XQuery, which, as of december 2014, is the most precise type system known for XQuery. It supports the static typing of backward axes that no other does nor is supported in the XQuery recommendation. It also includes precise typing for conditional statements which is challenging as such statement are usually sensitive to the program context. 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. This prototype is described in preprint [20].

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

5.5. claireCourseMaker

Claire CourseMaker Library

FUNCTIONAL DESCRIPTION

The goal of the ClaireCourseMaker is to provide direct and visual editing tools for structuring, annotating and timeline-based authoring of continuous content such as audio or video. It is mainly devoted to the synchronisation and layout of pedagogical material (video, slides, chaptering, etc.) and enables the incorporation of rich media content in MOOCs. The underlying technology is based on Web standards and relies on the open source JavaScript Popcorn library and Popcorn Maker web application developed by the Mozilla Foundation. The tool is a wysiwyg web-based authoring tool which benefits from the generic features of Popcorn and offers structuring methods such chaptering and container-based synchronisation.

ClaireCourseMaker is the direct follow-up tool of the Timesheet library developed in the project. Timesheet library is a cross-browser JavaScript implementation for scheduling the dynamic behaviour of HTML5 content. It uses and provides a reference implementation for declarative synchronisation markup such as [SMIL Timing and Synchronization](#) and [SMIL Timesheets](#).

ClaireCourseMaker has been developed in collaboration with the OpenClassrooms company in the context of the Claire project.

- Participants: Cécile Roisin, Nabil Layaïda and Nicolas Hairon
- Contact: Cécile Roisin
- URL: <https://github.com/NicolasHairon/popcorn.webmaker.org>

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: Patrice Raveneau, Hervé Rivano, Razvan Stanica.
- 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, Diala Naboulsi and Razvan Stanica.
- Contact: Marco Fiore
- URL: <http://kolntrace.project.citi-lab.fr/#download>

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