Activity Report 2017

Section Software

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ASAP Project-Team

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5. New Software and Platforms

5.1. WebGC

Web-based Gossip Communication

KEYWORDS: WebRTC - Recommendation systems - Decentralized architectures - Personalized systems - Web - Peer-to-peer - Gossip protocols - Epidemic protocols - Decentralized web

SCIENTIFIC DESCRIPTION: The library currently includes the implementation of two peer sampling protocols, Cyclon and the generic peer-sampling protocol from, as well as a clustering protocol. All protocols implement a common GossipProtocol "interface"

FUNCTIONAL DESCRIPTION: WebGC consists of a WebRTC-based library that supports gossip-based communication between web browsers and enables them to operate with Node-JS applications. WebGC comprises the implementation of standard gossip protocols such as Peer Sampling or Clustering, and simplifies the development of new protocols. It comprises a decentralized signaling service that makes it easier to build completely decentralized browser-based applications.

- Participants: Anne-Marie Kermarrec, Davide Frey, Matthieu Simonin and Raziel Carvajal Gomez
- Contact: Davide Frey

5.2. Asapknn (MediEgo)

KEYWORDS: Widget web - Social network - Recommendation

FUNCTIONAL DESCRIPTION: Asapknn (MediEgo) is a solution for content recommendation based on the users navigation history. The solution 1) collects the usages of the Web users and store them in a profile, 2) uses this profile to associate to each user her most similar users, 3) leverages this implicit network of close users in order to infer their preferences and recommend advertisements and recommendations. MediEgo achieves scalability using a sampling method, which provides very good results at a drastically reduced cost.

- Participants: Anne Marie Kermarrec, Antoine Boutet, Arnaud Jegou, Davide Frey, Jacques Falcou, Jean-Francois Verdonck, Rachid Guerraoui and Sébastien Campion
- Partner: EPFL - Ecole Polytechnique Fédérale de Lausanne
- Contact: Sébastien Campion

5.3. YALPS

KEYWORDS: Simulator - Peer-to-peer - Experimentation - Nat traversal - Traffic-shaping - Deployment

FUNCTIONAL DESCRIPTION: YALPS is an open-source Java library designed to facilitate the development, deployment, and testing of distributed applications. Applications written using YALPS can be run both in simulation and in real-world mode without changing a line of code or even recompiling the sources. A simple change in a configuration file will load the application in the proper environment. A number of features make YALPS useful both for the design and evaluation of research prototypes and for the development of applications to be released to the public. Specifically, YALPS makes it possible to run the same application as a simulation or in a real deployment. Applications communicate by means of application-defined messages which are then routed either through UDP/TCP or through YALPS's simulation infrastructure. In both cases, YALPS's communication layer offers features for testing and evaluating distributed protocols and applications. Communication channels can be tuned to incorporate message losses or to constrain their outgoing bandwidth. Finally, YALPS includes facilities to support operation in the presence of NATs and firewalls using relaying and NAT-traversal techniques. The implementation of YALPS includes approximately 16K lines of code, and is used in several projects by ASAP, including HEAP, AllYours-P2P, and Behave.

- Participants: Anne Marie Kermarrec, Arnaud Jegou, Davide Frey, Heverson Borba Ribeiro and Maxime Monod
- Contact: Davide Frey
- URL: http://yalps.gforge.inria.fr/

5.4. GossipLib

KEYWORDS: Nat traversal - Epidemic protocols - Gossip protocols - Overlay maintenance - Peer-to-peer - Dissemination

FUNCTIONAL DESCRIPTION: GossipLib is a library consisting of a set of Java classes aimed to facilitate the development of gossip-based application in a large-scale setting. It provides developers with a set of support classes that constitute a solid starting point for building any gossip-based application. GossipLib is designed to facilitate code reuse and testing of distributed application and as thus also provides the implementation of a number of standard gossip protocols that may be used out of the box or extended to build more complex protocols and applications. These include for example the peer-sampling protocols for overlay management.

GossipLib also provides facility for the configuration and deployment of applications as final-product but also as research prototype in environments like PlanetLab, clusters, network emulators, and even as event-based simulation. The code developed with GossipLib can be run both as a real application and in simulation simply by changing one line in a configuration file.

RELEASE FUNCTIONAL DESCRIPTION: Library for gossip-based applications and experiments

- Participants: Anne Marie Kermarrec, Davide Frey, Ilham Ikbal, Imane Al Ifdal and Ribeiro Heverson
- Contact: Davide Frey
- URL: http://gossiplib.gforge.inria.fr/

ASCOLA Project-Team

6. New Software and Platforms

6.1. btrCloud

KEYWORDS: Cloud computing - Data center - Cluster - Placement - Autonomic system - Orchestration - Energy - Grid - Virtualization - Scheduler

FUNCTIONAL DESCRIPTION: Orchestration, virtualization, energy, autonomic system, placement, cloud computing, cluster, data center, scheduler, grid

btrCloud is a virtual machine manager for clusters and provides a complete solution for the management and optimization of virtualized data centers. btrCloud (acronym of better cloud) is composed of three parts.

The analysis function enables operatives and people in charge to monitor and analyze how a data-center works - be it on a daily basis, on the long run, or in order to predict future trends. This feature includes boards for performance evaluation and analysis as well as trends estimation.

btrCloud, by the integration of btrScript, provides (semi-)automated VM lifecycle management, including provisioning, resource pool management, VM tracking, cost accounting, and scheduled deprovisioning. Key features include a thin client interface, template-based provisioning, approval workflows, and policy-based VM placement.

Finally, several kinds of optimizations are currently available, such as energy and load balancing. The former can help save up to around 20

- Participants: Frédéric Dumont, Guillaume Le Louët and Jean-Marc Menaud
- Contact: Guillaume Le Louët
- URL: http://www.btrcloud.org/btrCloud/index_EN.html

6.2. SimGrid

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

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

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

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

Release Functional Description:
- Four releases in 2017. Major changes:
    – S4U: many progress, toward SimGrid v4.0. About 80% of the features offered by SimDag and MSG are now integrated, along with examples. Users can now write plugins to extend SimGrid.
    – SMPI: Support MPI 2.2, RMA support, Convert internals to C++.
    – Java: Massive memleaks and performance issues fixed.
    – New models: Multi-core VMs, Energy consumption due to the network
    – All internals are now converted to C++, and most of our internally developped data containers were replaced with std::* constructs.
    – (+ bug fixes, cleanups and documentation improvements)
- Participants: Adrien Lèbre, Arnaud Legrand, Augustin Degomme, Florence Perronnin, Frédéric Suter, Jean-Marc Vincent, Jonathan Pastor, Jonathan Rouzaud-Cornabas, Luka Stanisic, Mario Südholt and Martin Quinson
- Partners: CNRS - ENS Rennes
- Contact: Martin Quinson
- URL: http://simgrid.gforge.inria.fr/

6.3. VMPlaces

Functional Description: VMPlaces is a dedicated framework to evaluate and compare VM placement algorithms. This framework is composed of two major components: the injector and the VM placement algorithm. The injector is the generic part of the framework (i.e. the one you can directly use) while the VM placement algorithm is the part you want to study (or compare with available algorithms). Currently, the VMPlaceS is released with three algorithms:

Entropy, a centralized approach using a constraint programming approach to solve the placement/reconfiguration VM problem

Snooze, a hierarchical approach where each manager of a group invokes Entropy to solve the placement/reconfiguration VM problem. Note that in the original implementation of Snooze, it is using a specific heuristic to solve the placement/reconfiguration VM problem. As the sake of simplicity, we have simply reused the entropy scheduling code.

DVMS, a distributed approach that dynamically partitions the system and invokes Entropy on each partition.
- Participants: Adrien Lèbre, Flavien Quesnel, Jonathan Pastor, Mario Südholt and Takahiro Hirofuchi
- Contact: Adrien Lèbre
- URL: http://beyondtheclouds.github.io/VMPlaceS/

6.4. ENOS

Experimental eNvironment for OpenStack
Keywords: OpenStack - Experimentation - Reproducibility
Functional Description: Enos workflow :

A typical experiment using Enos is the sequence of several phases:

- enos up : Enos will read the configuration file, get machines from the resource provider and will prepare the next phase - enos os : Enos will deploy OpenStack on the machines. This phase rely highly on Kolla deployment. - enos init-os : Enos will bootstrap the OpenStack installation (default quotas, security rules, ...) - enos bench : Enos will run a list of benchmarks. Enos support Rally and Shaker benchmarks. - enos backup : Enos will backup metrics gathered, logs and configuration files from the experiment.
- Partner: Orange Labs
- Contact: Adrien Lèbre

ASPI Team (section vide)

CAIRN Project-Team

6. New Software and Platforms

6.1. Gecos

Generic Compiler Suite

KEYWORDS: Source-to-source compiler - Model-driven software engineering - Retargetable compilation

SCIENTIFIC DESCRIPTION: The Gecos (Generic Compiler Suite) project is a source-to-source compiler infrastructure developed in the Cairn group since 2004. It was designed to enable fast prototyping of program analysis and transformation for hardware synthesis and retargetable compilation domains.

Gecos is Java based and takes advantage of modern model driven software engineering practices. It uses the Eclipse Modeling Framework (EMF) as an underlying infrastructure and takes benefits of its features to make it easily extensible. Gecos is open-source and is hosted on the Inria gforge.

The Gecos infrastructure is still under very active development, and serves as a backbone infrastructure to projects of the group. Part of the framework is jointly developed with Colorado State University and between 2012 and 2015 it was used in the context of the FP7 ALMA European project. The Gecos infrastructure is currently used by the EMMTRIX start-up, a spin-off from the ALMA project which aims at commercializing the results of the project, and in the context of the H2020 ARGO European project.

FUNCTIONAL DESCRIPTION: GeCoS provides a programme transformation toolbox facilitating parallelisation of applications for heterogeneous multiprocessor embedded platforms. In addition to targeting programmable processors, GeCoS can regenerate optimised code for High Level Synthesis tools.

- Participants: Tomofumi Yuki, Thomas Lefeuvre, Imèn Fassi, Mickael Dardaillon, Ali Hassan El Moussawi and Steven Derrien
- Partner: Université de Rennes 1
- Contact: Steven Derrien
- URL: http://gecos.gforge.inria.fr

6.2. ID-Fix

Infrastructure for the Design of Fixed-point systems

KEYWORDS: Energy efficiency - Dynamic range evaluation - Accuracy optimization - Fixed-point arithmetic - Analytic Evaluation - Embedded systems - Code optimisation

SCIENTIFIC DESCRIPTION: The different techniques proposed by the team for fixed-point conversion are implemented on the ID.Fix infrastructure. The application is described with a C code using floating-point data types and different pragmas, used to specify parameters (dynamic, input/output word-length, delay operations) for the fixed-point conversion. This tool determines and optimizes the fixed-point specification and then, generates a C code using fixed-point data types (ac_fixed) from Mentor Graphics. The infrastructure is made-up of two main modules corresponding to the fixed-point conversion (ID.Fix-Conv) and the accuracy evaluation (ID.Fix-Eval)

FUNCTIONAL DESCRIPTION: ID.Fix focuses on computational precision accuracy and can provide an optimised specification using fixed point arithmetic from a C source code with floating point data types. Fixed point arithmetic is very widely used in embedded systems as it provides better performance and is much more energy efficient. ID.Fix used an analytic programme model which means it can explore more solutions and thereby produce much more efficient code.

- Participant: Olivier Sentieys
- Partner: Université de Rennes 1
- Contact: Olivier Sentieys
- URL: http://idfix.gforge.inria.fr

6.3. Platforms

6.3.1. Zyggie

KEYWORDS: Health - Biomechanics - Wireless body sensor networks - Low power - Gesture recognition - Hardware platform - Software platform - Localization

SCIENTIFIC DESCRIPTION: Zyggie is a hardware and software wireless body sensor network platform. Each sensor node, attached to different parts of the human body, contains inertial sensors (IMU) (accelerometer, gyrometer, compass and barometer), an embedded processor and a low-power radio module to communicate data to a coordinator node connected to a computer, tablet or smartphone. One of the system's key innovations is that it collects data from sensors as well as on distances estimated from the power of the radio signal received to make the 3D location of the nodes more precise and thus prevent IMU sensor drift and power consumption overhead. Zyggie can be used to determine posture or gestures and mainly has applications in sport, healthcare and the multimedia industry.

FUNCTIONAL DESCRIPTION: The Zyggie sensor platform was developed to create an autonomous Wireless Body Sensor Network (WBSN) with the capabilities of monitoring body movements. The Zyggie platform is part of the BoWI project funded by CominLabs. Zyggie is composed of a processor, a radio transceiver and different sensors including an Inertial Measurement Unit (IMU) with 3-axis accelerometer, gyrometer, and magnetometer. Zyggie is used for evaluating data fusion algorithms, low power computing algorithms, wireless protocols, and body channel characterization in the BoWI project.

The Zyggie V2 prototype includes the following features: a 32-bit microcontroller to manage a custom MAC layer and processe quaternions based on IMU measures, and an UWB radio from DecaWave to measure distances between nodes with Time of Flight (ToF).

- Participants: Arnaud Carer and Olivier Sentieys
- Partners: Lab-STICC - Université de Rennes 1
- Contact: Olivier Sentieys
- URL: http://www.bowi.cominlabs.ueb.eu/fr/zyggie-wbsn-platform

Figure 3. CAIRN*'s Ziggie platform for WBSN*

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

3. New Software and Platforms

3.1. Jacal

JAvaCard AnaLyseur

KEYWORDS: JavaCard - Certification - Static program analysis - AFSCM

FUNCTIONAL DESCRIPTION: Jacal is a JAvaCard AnaLyseur developed on top of the SAWJA platform. This proprietary software verifies automatically that Javacard programs conform with the security guidelines issued by the AFSCM (Association Française du Sans Contact Mobile). Jacal is based on the theory of abstract interpretation and combines several object-oriented and numeric analyses to automatically infer sophisticated invariants about the program behaviour. The result of the analysis is thereafter harvest to check that it is sufficient to ensure the desired security properties.

- Participants: David Pichardie, Delphine Demange, Frédéric Besson and Thomas Jensen
- Contact: Thomas Jensen

3.2. Javalib

FUNCTIONAL DESCRIPTION: Javalib is an efficient library to parse Java .class files into OCaml data structures, thus enabling the OCaml programmer to extract information from class files, to manipulate and to generate valid .class files.

- Participants: David Pichardie, Frédéric Besson, Laurent Guillo, Laurent Hubert, Nicolas Barré, Pierre Vittet and Tiphaine Turpin
- Contact: Frédéric Besson
- URL: http://sawja.inria.fr/

3.3. JSCert

Certified JavaScript

FUNCTIONAL DESCRIPTION: The JSCert project aims to really understand JavaScript. JSCert itself is a mechanised specification of JavaScript, written in the Coq proof assistant, which closely follows the ECMAScript 5 English standard. JSRef is a reference interpreter for JavaScript in OCaml , which has been proved correct with respect to JSCert and tested with the Test 262 test suite.

- Participants: Alan Schmitt and Martin Bodin
- Partner: Imperial College London
- Contact: Alan Schmitt
- URL: http://jscert.org/

3.4. SAWJA

Static Analysis Workshop for Java

KEYWORDS: Security - Software - Code review - Smart card

SCIENTIFIC DESCRIPTION: Sawja is a library written in OCaml, relying on Javalib to provide a high level representation of Java bytecode programs. It name comes from Static Analysis Workshop for JAva. Whereas Javalib is dedicated to isolated classes, Sawja handles bytecode programs with their class hierarchy and with control flow algorithms.

Moreover, Sawja provides some stackless intermediate representations of code, called JBir and A3Bir. The transformation algorithm, common to these representations, has been formalized and proved to be semantics-preserving.

See also the web page http://sawja.inria.fr/ .

Version: 1.5

Programming language: Ocaml

FUNCTIONAL DESCRIPTION: Sawja is a toolbox for developing static analysis of Java code in bytecode format. Sawja provides advanced algorithms for reconstructing high-level programme representations. The SawjaCard tool dedicated to JavaCard is based on the Sawja infrastructure and automatically validates the security guidelines issued by AFSCM (http://www.afscm.org/). SawjaCard can automate the code audit process and automatic verification of functional properties.

- Participants: David Pichardie, Frédéric Besson and Laurent Guillo
- Partners: CNRS - ENS Cachan
- Contact: Frédéric Besson
- URL: http://sawja.inria.fr/

3.5. Timbuk

KEYWORDS: Demonstration - Ocaml - Vérification de programmes - Tree Automata
FUNCTIONAL DESCRIPTION: Timbuk is a collection of tools for achieving proofs of reachability over Term Rewriting Systems and for manipulating Tree Automata (bottom-up non-deterministic finite tree automata)

RELEASE FUNCTIONAL DESCRIPTION: This version does no longer include the tree automata library but focuses on reachability analysis and equational approximations.

- Participant: Thomas Genet
- Contact: Thomas Genet
- URL: http://www.irisa.fr/celtique/genet/timbuk/

CIDRE Project-Team

6. New Software and Platforms

6.1. Blare

To detect intrusion using information flows

KEYWORDS: Cybersecurity - Intrusion Detection Systems (IDS) - Data Leakage Protection

SCIENTIFIC DESCRIPTION: Blare implements our approach of illegal information flow detection for a single node (Android and Linux kernel, JVM) and a set of nodes (monitoring of flows between linux machines).

FUNCTIONAL DESCRIPTION: Blare IDS is a set of tools that implements our approach to illegal information flow detection for a single node and a set of nodes.

NEWS OF THE YEAR: During this year, Laurent Georget has modified the implementation of Blare in order to correctly monitor the kernel system calls with LSM hooks. He add also ported this new version of Blare to the Lollipop Android emulator.

- Partner: CentraleSupélec
- Contact: Frédéric Tronel
- Publications: Information Flow Tracking for Linux Handling Concurrent System Calls and Shared Memory - Verifying the Reliability of Operating System-Level Information Flow Control Systems in Linux - Monitoring both OS and program level information flows to detect intrusions against network servers - Experimenting a Policy-Based HIDS Based on an Information Flow Control Model - Introducing reference flow control for intrusion detection at the OS level - Blare Tools: A Policy-Based Intrusion Detection System Automatically Set by the Security Policy - Diagnosing intrusions in Android operating system using system flow graph - Intrusion detection in distributed systems, an approach based on taint marking - BSPL: A Language to Specify and Compose Fine-grained Information Flow Policies - Information Flow Policies vs Malware - A taint marking approach to confidentiality violation detection - Designing information flow policies for Android's operating system - Information Flow Control for Intrusion Detection derived from MAC Policy - Flow based interpretation of access control: Detection of illegal information flows - A taint marking approach to confidentiality violation detection
- URL: http://www.blare-ids.org/

6.2. GNG

Security Supervision by Alert Correlation

KEYWORDS: Intrusion Detection Systems (IDS) - SIEM

SCIENTIFIC DESCRIPTION: GNG is an intrusion detection system that correlates different sources (such as different logs) in order to identify attacks against the system. The attack scenarios are defined using the Attack Description Langage (ADeLe) proposed by our team, and are internally translated to attack recognition automatons. GNG intends to define time efficient algorithms based on these automatons to recognize complex attack scenarios.

- Partner: CentraleSupélec
- Contact: Eric Totel
- Publication: A Language Driven Intrusion Detection System for Events and Alerts Correlation
- URL: http://www.rennes.supelec.fr/ren/perso/etotel/GNG/index.html

6.3. GroddDroid

KEYWORDS: Android - Detection - Malware

SCIENTIFIC DESCRIPTION: GroddDroid automates the dynamic analysis of a malware. When a piece of suspicious code is detected, groddDroid interacts with the user interface and eventually forces the execution of the identified code. Using Blare (Information Flow Monitor), GroddDroid monitors how an execution contaminates the operating system. The output of GroddDroid can be visualized in an web browser. GroddDroid is used by the Kharon software.

FUNCTIONAL DESCRIPTION: GroddDroid 1 - locates suspicious code in Android application 2 - computes execution paths towards suspicious code 3 - forces executions of suspicious code 4 - automate the execution of a malware or a regular Android application

NEWS OF THE YEAR: In 2017, GroddDroid has integrated the work of Mourad Leslous, who have implemented GFinder. GPFinder improves the computation of control flow paths by taking into account the Android framework. The end of the year has been used to clean the code and to improves the graphical interface.

- Partners: CentraleSupélec - Insa Centre Val-de-Loire

- Contact: Valérie Viet Triem Tong

- Publications: Kharon dataset: Android malware under a microscope - GroddDroid: a Gorilla for Triggering Malicious Behaviors - GPFinder: Tracking the Invisible in Android Malware - Information flows at OS level unmask sophisticated Android malware

- URL: http://kharon.gforge.inria.fr/grodddroid.html

6.4. Kharon

KEYWORDS: Android - Malware - Dynamic Analysis

FUNCTIONAL DESCRIPTION: Kharon is a software for managing Android application analysis. Kharon uses the results of the GroddDroid software. The user can submit one or several applications to Kharon and get a graph of the innformation flows that occured at system level and that have been caused by the application.

Kharon is used in the Kharon platform for the analysis of malicious applications. This platform is deployed at the high security laboratory (LHS) of Rennes.

- Author: Sébastien Campion

- Partners: CentraleSupélec - Insa Centre Val-de-Loire

- Contact: Valérie Viet Triem Tong

- URL: http://kharon.gforge.inria.fr/

6.5. StarLord

KEYWORDS: Security - SIEM

FUNCTIONAL DESCRIPTION: In the domain of security event visualisation, we have developed a prototype called StarLord. Basically, this software is able to parse heterogeneous logs, and to extract from each line of logs a set of security objects. Moreover, some of these objects appears in several lines of different logs. These lines are thus linked by the sharing of one or more security objects. When we analyse the lines of logs, we are thus able to generate graphs that represents the links between the different objects discovered in the logs. These graphs are thus displayed in 3D in order for the administrator to investigate easily the relations between the logs and the relations between the logs and some particular indicators of compromission. The tool permits to discover visually the activity of an attacker on the supervised system.

- Authors: Ludovic Mé, Eric Totel, Nicolas Prigent and Laetitia Leichtnam

- Contact: Eric Totel

- Publication: STARLORD: Linked Security Data Exploration in a 3D Graph

6.6. SpecCert

KEYWORDS: Formal methods - Coq

FUNCTIONAL DESCRIPTION: SpecCert is a framework for specifying and verifying Hardware-based Security Enforcement (HSE) mechanisms against hardware architecture models. HSE mechanisms form a class of security enforcement mechanism such that a set of trusted software components relies on hardware functions to enforce a security policy.

- Participant: Thomas Letan

- Partners: ANSSI - CentraleSupélec

- Contact: Guillaume Hiet

- Publications: SpecCert: Specifying and Verifying Hardware-based Security Enforcement - SpecCert: Specifying and Verifying Hardware-based Software Enforcement

- URL: https://github.com/lethom/speccert

6.7. HardBlare

KEYWORDS: Intrusion Detection Systems (IDS) - FPGA - Static analysis
FUNCTIONAL DESCRIPTION: HardBlare is a hardware/software framework to implement hardware DIFC on Xilinx Zynq Platform. HardBlare consists of three components : 1) the VHDL code of the coprocessor, 2) a modified LLVM compiler to compute the static analysis, and 3) a dedicated Linux kernel. This last component is a specific version of the Blare monitor.

- Partners: CentraleSupélec - Lab-STICC

- Contact: Guillaume Hiet

- Publications: ARMHEx: A hardware extension for DIFT on ARM-based SoCs - ARMHEx: a framework for efficient DIFT in real-world SoCs - ARMHEx: embedded security through hardware-enhanced information flow tracking - HardBlare: a Hardware-Assisted Approach for Dynamic Information Flow Tracking - A portable approach for SoC-based Dynamic Information Flow Tracking implementations - Towards a hardware-assisted information flow tracking ecosystem for ARM processors - HardBlare: an efficient hardware-assisted DIFC for non-modified embedded processors

6.8. Conductor

KEYWORDS: Intrusion Detection Systems (IDS) - Static analysis - Instrumentation
FUNCTIONAL DESCRIPTION: Conductor contains three main components: a static analysis to extract the expected behavior of the target, an instrumentation module to add instructions to the target's code in order to send messages to the co-processor, and an intrusion detection engine executed on the co-processor. The latter processes the messages sent by the instrumented target, describing its current behavior. This behavior is then compared against the expected behavior previously extracted by the static analysis.

- Participants: Ronny Chevalier, Guillaume Hiet, Maugan Villatel and David Plaquin

- Partners: CentraleSupélec - HP Labs

- Contact: Ronny Chevalier

- Publication: Co-processor-based Behavior Monitoring: Application to the Detection of Attacks Against the System Management Mode

6.9. Platforms

6.9.1. Kharon platform

The Kharon platform is under development in the LHS of Rennes and should be ready to use in the beginning of 2018. This experimental platform aims to analyze Android malware using a set of software developed by the CIDRE team. Software that are involved are:

- The Blare IDS http://www.blare-ids.org/, and in particular the AndroBlare version, for tracking information flows of malware;

- The GroddDroid software http://kharon.gforge.inria.fr/grodddroid.html, for manipulating the malware statically and dynamically;

- The GPFinder software http://kharon.gforge.inria.fr/gpfinder.html, for computing paths in the malware's control flow;

- The kharon software that handles the orchestration of a bunch of malware, the server and a set of smartphones.

The Kharon platform will be used for analysing malware as soon as they appear in the wild. The analysis results will be stored for further experiments and statistics.

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DIONYSOS Project-Team

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6. New Software and Platforms

6.1. IPv6 Test Toolkit

FUNCTIONAL DESCRIPTION: These test suites are developed using the TTCN-3 environment.

The packages contains the full Abstract Test Suites written in TTCN-3 and the source files for building the codecs and adapters with the help of T3DevKit.

- Participants: Annie Floch, Anthony Baire, Ariel Sabiguero, Bruno Deniaud, César Viho and Frédéric Roudaut
- Contact: César Viho

6.2. Passive Test Tool

- Participants: Anthony Baire and César Viho
- Contact: Anthony Baire

6.3. T3DevKit

KEYWORDS: IPv6 - Conformance testing - TTCN-3

SCIENTIFIC DESCRIPTION: We have built a toolkit for easing executing tests written in the standardized TTCN-3 test specification language. This toolkit is made of a C++ library together with a highly customizable CoDec generator that allows fast development of external components (that are required to execute a test suite) such as CoDec (for message Coding/Decoding), System and Platform Adapters. It also provides a framework for representing and manipulating TTCN-3 events so as to ease the production of test reports. The toolkit addresses issues that are not yet covered by ETSI standards while being fully compatible with the existing standard interfaces: TRI (Test Runtime Interfaces) and TCI (Test Control Interfaces), it has been tested with four TTCN-3 environments (IBM, Elvior, Danet and Go4IT) and on three different platforms (Linux, Windows and Cygwin).

FUNCTIONAL DESCRIPTION: T3DevKit is a free open source toolkit to ease the development of test suites in the TTCN-3 environment. It provides:

a CoDec generator (t3cdgen) that automates the development process of the CoDec needed for coding TTCN-3 values into physically transmittable messages and decoding incoming messages a library (t3devlib) that provides an object oriented framework to manipulate TTCN-3 entities (values, ports, timers, external functions...) an implementation of the TRI and TCI standard interfaces default implementations for the system adapter (SA), platform adapter (PA), test management (TM), test logging (TL) and component handling (CH) modules default codecs build scripts for the generation of executable test suites, these are tool-independent and facilitate the distribution of test suite sources

- Participants: Annie Floch, Anthony Baire, Ariel Sabiguero, César Viho and Frédéric Roudaut
- Contact: Federico Sismondi

6.4. ttproto

Testing Tool Prototype
KEYWORDS: Interoperability - Conformance testing - TTCN-3
FUNCTIONAL DESCRIPTION: ttproto is an experimental tool for implementing testing tools, for conformance and interoperability testing.

It was first implemented to explore new features and concepts for the TTCN-3 standard, but we also used it to implement a passive interoperability test suite we provided for the CoAP interoperability event held in Paris in March 2012.

This tool is implemented in python3 and its design was influenced mainly by TTCN-3 (abstract model, templates, snapshots, behaviour trees, communication ports, logging) and by Scapy (syntax, flexibility, customisability)

Its purpose is to facilitate rapid prototyping rather than experimentations (rather than production use). We choose to maximise its modularity and readability rather than performances and real-time considerations.

Now you should have a look at the Features page: https://www.irisa.fr/tipi/wiki/doku.php/testing_tool_prototype:features

- Contact: Federico Sismondi
- URL: https://www.irisa.fr/tipi/wiki/doku.php/testing_tool_prototype

6.5. CoAP Testing Tool

KEYWORDS: Test - Interoperability - Conformance testing - Plugtests
FUNCTIONAL DESCRIPTION: The software helps developers of the CoAP protocol assessing if their implementations (either CoAP clients or CoAP servers) are conformant to protocol specifications, and interoperable with other implementations. It encompasses:

- Coordination of CoAP interoperability tests
- Analysis of CoAP traces & issuing verdicts
- Automation of open source CoAP implementations for based reference interop testing
- Authors: Federico Sismondi and César Viho
- Contact: Federico Sismondi

6.6. ioppytest

Interoperability testing
KEYWORDS: Interoperability - Conformance testing - CoAP - 6LoWPAN - OneM2M
FUNCTIONAL DESCRIPTION: The software is a framework for developing interoperability tests. The interoperability tests help developers of network protocol assessing if their implementations are conformant to protocol specifications, and interoperable with other implementations.

The software already integrates interoperability tests for CoAP, OneM2M and 6LoWPAN The framework provides the following features to the users:

- Coordination of the interoperability tests (enabling remote testing)
- VPN-like connectivity between users' implementations (enabling remote testing)
- Analysis of exchanged network traces & issuing verdicts
- Automation of open source implementations for based reference interop testing

This framework is the evolution of the CoAP Testing Tool (https://bil.inria.fr/fr/software/view/2937/tab)

- Contact: Federico Sismondi
- URL: https://gitlab.f-interop.eu/f-interop-contributors/ioppytest

6.7. AdaComp

Participants: Corentin Hardy, Bruno Sericola

Our recent works, in collaboration with Technicolor, on deep learning and distributed learning led us to study a kind of data parallelism called the Parameter Server model. This model consists in sharing the learning of a deep neural network between many devices (called the workers) via a centralized Parameter Server (PS). We deployed a platform which allow us to experiment different state-of-the-art algorithms based on the PS model. The platform is composed of a unique powerful machine where many Linux containers (LXC) are running. Each LXC executes a `Tensorflow` session and can be a worker or a PS. The first experimentations were used to validate the correct functioning of the platform, to better understand its limitations and to determine what can be measured in an unbiased way. Others experimentations helped us to understand the role of different parameters of the overall model, mainly those related to the distribution on user-devices, and their impact on the learning (accuracy of the model, number of iterations to learn the model). During these experimentations, we noted that the main bottleneck is the ingress traffic of PS during the learning phase. To reduce this ingress traffic, we chose to compress the messages sent by the workers to the PS. We proposed in [43] a method to reduce up to 2 orders of magnitude this ingress traffic, keeping a good accuracy on the learned model. This new method, called AdaComp, is available in `github` (https://github.com/Hardy-c/AdaComp).

6.8. DNN-withRNL

Participants: Corentin Hardy, Gerardo Rubino, Bruno Sericola

The extension of the AdaComp method, presented in 6.7 , to Random Neural Networks started with the introduction of Random Neural Layers, see [65]. Concerning the associated software, see https://github.com/Hardy-c/DNN-with-RNL.

DIVERSE Project-Team

6. New Software and Platforms

6.1. amiunique

KEYWORDS: Privacy - Browser fingerprinting

SCIENTIFIC DESCRIPTION: The amiunique web site has been deployed in the context of the DiverSE's research activities on browser fingerprinting and how software diversity can be leveraged in order to mitigate the impact of fingerprinting on the privacy of users. The construction of a dataset of genuine fingerprints is essential to understand in details how browser fingerprints can serve as unique identifiers and hence what should be modified in order to mitigate its impact privacy. This dataset also supports the large-scale investigation of the impact of web technology advances on fingerprinting. For example, we can analyze in details the impact of the HTML5 canvas element or the behavior of fingerprinting on mobile devices.

The whole source code of amiunique is open source and is distributed under the terms of the MIT license.

Similar sites: Panopticlick https://panopticlick.eff.org/ BrowserSpy http://browserspy.dk/ http://noc.to/ Main innovative features: canvas fingerprinting WebGL fingerprinting advanced JS features (platform, DNT, etc.)

Impact: The website has been showcased in several professional forums in 2014 and 2015 (Open World Forum 2014, FOSSA'14, FIC'15, ICT'15) and it has been visited by more than 100000 unique visitors in one year.

FUNCTIONAL DESCRIPTION: This web site aims at informing visitors about browser fingerprinting and possible tools to mitigate its effect, as well as at collecting data about the fingerprints that can be found on the web. It collects browser fingerprints with the explicit agreement of the users (they have to click on a button on the home page). Fingerprints are composed of 17 attributes, which include regular HTTP headers as well as the most recent state of the art techniques (canvas fingerprinting, WebGL information).

- Participants: Benoit Baudry and Pierre Laperdrix
- Partner: INSA Rennes
- Contact: Benoit Baudry
- URL: https://amiunique.org/

6.2. FAMILIAR

KEYWORDS: Software line product - Configators - Customisation

SCIENTIFIC DESCRIPTION: FAMILIAR (for FeAture Model scrIpt Language for manIpulation and Automatic Reasoning) is a language for importing, exporting, composing, decomposing, editing, configuring, computing "diffs", refactoring, reverse engineering, testing, and reasoning about (multiple) feature models. All these operations can be combined to realize complex variability management tasks. A comprehensive environment is proposed as well as integration facilities with the Java ecosystem.

FUNCTIONAL DESCRIPTION: Familiar is an environment for large-scale product customisation. From a model of product features (options, parameters, etc.), Familiar can automatically generate several million variants. These variants can take many forms: software, a graphical interface, a video sequence or even a manufactured product (3D printing). Familiar is particularly well suited for developing web configurators (for ordering customised products online), for providing online comparison tools and also for engineering any family of embedded or software-based products.

- Participants: Aymeric Hervieu, Benoit Baudry, Didier Vojtisek, Edward Mauricio Alferez Salinas, Guillaume Bécan, Joao Bosco Ferreira-Filho, Julien Richard-Foy, Mathieu Acher, Olivier Barais and Sana Ben Nasr
- Contact: Mathieu Acher
- URL: http://familiar-project.github.com

6.3. GEMOC Studio

KEYWORDS: DSL - Language workbench - Model debugging

SCIENTIFIC DESCRIPTION: The language workbench put together the following tools seamlessly integrated to the Eclipse Modeling Framework (EMF):

- Melange, a tool-supported meta-language to modularly define executable modeling languages with execution functions and data, and to extend (EMF-based) existing modeling languages. - MoCCML, a tool-supported meta-language dedicated to the specification of a Model of Concurrency and Communication (MoCC) and its mapping to a specific abstract syntax and associated execution functions of a modeling language. - GEL, a tool-supported meta-language dedicated to the specification of the protocol between the execution functions and the MoCC to support the feedback of the data as well as the callback of other expected execution functions. - BCOoL, a tool-supported meta-language dedicated to the specification of language coordination patterns to automatically coordinates the execution of, possibly heterogeneous, models. - Sirius Animator, an extension to the model editor designer Sirius to create graphical animators for executable modeling languages.

FUNCTIONAL DESCRIPTION: The GEMOC Studio is an eclipse package that contains components supporting the GEMOC methodology for building and composing executable Domain-Specific Modeling Languages (DSMLs). It includes the two workbenches: The GEMOC Language Workbench: intended to be used by language designers (aka domain experts), it allows to build and compose new executable DSMLs. The GEMOC Modeling Workbench: intended to be used by domain designersto create, execute and coordinate models conforming to executable DSMLs. The different concerns of a DSML, as defined with the tools of the language workbench, are automatically deployed into the modeling workbench. They parametrize a generic execution framework that provide various generic services such as graphical animation, debugging tools, trace and event managers, timeline, etc.

- Participants: Didier Vojtisek, Dorian Leroy, Erwan Bousse, Fabien Coulon and Julien Deantoni
- Partners: IRIT - ENSTA - I3S - OBEO - Thales TRT
- Contact: Benoît Combemale
- URL: http://gemoc.org/studio.html

6.4. Kevoree

Kevoree Core

KEYWORDS: M2M - Dynamic components - Iot - Heterogeneity - Smart home - Cloud - Software architecture - Dynamic deployment

SCIENTIFIC DESCRIPTION: Kevoree is an open-source models@runtime platform (http://www.kevoree.org) to properly support the dynamic adaptation of distributed systems. Models@runtime basically pushes the idea of reflection [132] one step further by considering the reflection layer as a real model that can be uncoupled from the running architecture (e.g. for reasoning, validation, and simulation purposes) and later automatically resynchronized with its running instance.

Kevoree has been influenced by previous work that we carried out in the DiVA project [132] and the Entimid project [135] . With Kevoree we push our vision of models@runtime [131] farther. In particular, Kevoree provides a proper support for distributed models@runtime. To this aim we introduced the Node concept to model the infrastructure topology and the Group concept to model semantics of inter node communication during synchronization of the reflection model among nodes. Kevoree includes a Channel concept to allow for multiple communication semantics between remoteComponents deployed on heterogeneous nodes. All Kevoree concepts (Component, Channel, Node, Group) obey the object type design pattern to separate deployment artifacts from running artifacts. Kevoree supports multiple kinds of very different execution node technology (e.g. Java, Android, MiniCloud, FreeBSD, Arduino, ...).

Kevoree is distributed under the terms of the LGPL open source license.

Main competitors:

- the Fractal/Frascati eco-system (http://frascati.ow2.org).
- SpringSource Dynamic Module (http://spring.io/)

GCM-Proactive (http://proactive.inria.fr/)

OSGi (http://www.osgi.org)

Chef

Vagran (http://vagrantup.com/)

Main innovative features:

distributed models@runtime platform (with a distributed reflection model and an extensible models@runtime dissemination set of strategies).

Support for heterogeneous node type (from Cyber Physical System with few resources until cloud computing infrastructure).

Fully automated provisioning model to correctly deploy software modules and their dependencies.

Communication and concurrency access between software modules expressed at the model level (not in the module implementation).

Impact:

Several tutorials and courses have been performed this year at EJCP for French PhD student, at ECNU summer school for 82 chineese PhD students. See also the web page http://www.kevoree.org .

In 2015, we mainly created a new implementation in C# and we created an implementation for system containers for driving resources using Kevoree. We also use Kevoree in the context of Mohammed's PhD to create testing infrastructure on-demand.

FUNCTIONAL DESCRIPTION: Kevoree is an open-source models@runtime platform to properly support the dynamic adaptation of distributed systems. Models@runtime basically pushes the idea of reflection one step further by considering the reflection layer as a real model that can be uncoupled from the running architecture (e.g. for reasoning, validation, and simulation purposes) and later automatically resynchronized with its running instance.

- Participants: Aymeric Hervieu, Benoit Baudry, Francisco-Javier Acosta Padilla, Inti Gonzalez Herrera, Ivan Paez Anaya, Jacky Bourgeois, Jean Emile Dartois, Johann Bourcier, Manuel Leduc, Maxime Tricoire, Mohamed Boussaa, Noël Plouzeau and Olivier Barais
- Contact: Olivier Barais
- URL: http://kevoree.org/

6.5. Melange

KEYWORDS: Modeling language - Meta-modelisation - Language workbench - Dedicated langage - Model-driven software engineering - DSL - MDE - Meta model - Model-driven engineering - Meta-modeling

SCIENTIFIC DESCRIPTION: Melange is a follow-up of the executable metamodeling language Kermeta, which provides a tool-supported dedicated meta-language to safely assemble language modules, customize them and produce new DSMLs. Melange provides specific constructs to assemble together various abstract syntax and operational semantics artifacts into a DSML. DSMLs can then be used as first class entities to be reused, extended, restricted or adapted into other DSMLs. Melange relies on a particular model-oriented type system that provides model polymorphism and language substitutability, i.e. the possibility to manipulate a model through different interfaces and to define generic transformations that can be invoked on models written using different DSLs. Newly produced DSMLs are correct by construction, ready for production (i.e., the result can be deployed and used as-is), and reusable in a new assembly.

Melange is tightly integrated with the Eclipse Modeling Framework ecosystem and relies on the meta-language Ecore for the definition of the abstract syntax of DSLs. Executable meta-modeling is supported by weaving operational semantics defined with Xtend. Designers can thus easily design an interpreter for their DSL in a non-intrusive way. Melange is bundled as a set of Eclipse plug-ins.

FUNCTIONAL DESCRIPTION: Melange is a language workbench which helps language engineers to mashup their various language concerns as language design choices, to manage their variability, and support their reuse. It provides a modular and reusable approach for customizing, assembling and integrating DSMLs specifications and implementations.

- Participants: Arnaud Blouin, Benoît Combemale, David Mendez Acuna, Didier Vojtisek, Dorian Leroy, Erwan Bousse, Fabien Coulon, Jean-Marc Jézéquel, Olivier Barais and Thomas Degueule

- Contact: Benoît Combemale

- URL: http://melange-lang.org

6.6. Opencompare

KEYWORD: Software Product Line

FUNCTIONAL DESCRIPTION: Product comparison matrices (PCMs) are tabular data: supported and unsupported features are documented for both describing the product itself and for discriminating one product compared to another. PCMs abound – we are all using PCMs – and constitute a rich source of knowledge for easily comparing and choosing product. Yet the current practice is suboptimal both for humans and computers, mainly due to unclear semantics, heterogeneous forms of data, and lack of dedicated support.

OpenCompare.org is an ambitious project for the collaborative edition, the sharing, the standardisation, and the open exploitation of PCMs. The goal of OpenCompare.org is to provide an integrated set of tools (e.g., APIs, visualizations, configurators, editors) for democratizing their creation, import, maintenance, and exploitation.

- Participants: Guillaume Bécan, Mathieu Acher and Sana Ben Nasr

- Contact: Mathieu Acher

- URL: http://opencompare.org

<p style="text-align:center">**DYLISS Project-Team**</p>

6. New Software and Platforms

6.1. AskOmics

KEYWORDS: RDF - SPARQL - Querying - Graph - LOD - Linked open data

FUNCTIONAL DESCRIPTION: AskOmics allows to load heterogeneous bioinformatics data (formatted as tabular files) into a Triple Store system using a user-friendly web interface. AskOmics also provides an intuitive graph-based user interface supporting the creation of complex queries that currently require hours of manual searches across tens of spreadsheet files. The elements of interest selected in the graph are then automatically converted into a SPARQL query that is executed on the users' data.

NEWS OF THE YEAR: Several functionalities have been developed: 1) capacity of integrating genomics data (import of GFF and BED files and generation of RDF compliant with the FALDO ontology), 2) integration of data and knowledge in the OWL format to exploit biological information from external repositories, particularly from EBI and NCBI. Notably, this functionality allows AskOmics to support the Gene Ontology, the Taxonomy ontology as well as BioPAX biological networks. 3) improved user interface expressivity for generating SPARQL queries, 4) implementation of a support for multiple concurrent user sessions, with the distcintion between public and user-specific datasets 5) deployment of AskOmics on the GenOuest cloud infrastructure to facilitate its release and diffusion 6) interoperability between AskOmics and the Galaxy workflow environment.

- Authors: Charles Bettembourg, Xavier Garnier, Anthony Bretaudeau, Fabrice Legeai, Olivier Dameron, Olivier Filangi and Yvanne Chaussin
- Partners: Université de Rennes 1 - CNRS - INRA
- Contact: Fabrice Legeai
- URL: https://github.com/askomics/askomics

6.2. PADMet-utils

KEYWORDS: Metabolic networks - Bioinformatics - Workflow - Omic data - Toolbox - Data management - LOD - Linked open data

FUNCTIONAL DESCRIPTION: The main concept underlying padmet-utils is to provide solutions that ensure the consistency, the internal standardization and the reconciliation of the information used within any workflow that combines several tools involving metabolic networks reconstruction or analysis.

NEWS OF THE YEAR: In 2017, Padmet-utils was enriched with a RDF export to allow the interoperability of the AuReMe workspace for the reconstruction of metabolic networks with the Askomics Tool for querying heterogeneous data. Padmet-utils was also extended to handle metabolic networks in the SBML3 format.

- Participants: Alejandro Maass, Meziane Aite and Anne Siegel
- Partner: University of Chile
- Contact: Anne Siegel
- URL: https://gitlab.inria.fr/maite/padmet-utils

6.3. CADBIOM

Computer Aided Design of Biological Models

KEYWORDS: Health - Biology - Biotechnology - Bioinformatics - Systems Biology

FUNCTIONAL DESCRIPTION: Based on Guarded transition semantic, this software provides a formal framework to help the modeling of biological systems such as cell signaling network. It allows investigating synchronization events in biological networks. Software development has been restarted since November 2016. The source code is available at the following address: https://gitlab.irisa.fr/0000B8EG/Cadbiom

- Participants: Geoffroy Andrieux, Michel Le Borgne, Nathalie Theret, Nolwenn Le Meur and Pierre Vignet
- Contact: Anne Siegel
- URL: http://cadbiom.genouest.org

6.4. conquests

Crossroads in Metabolic Network from Stoechiometric and Topologic Studies

KEYWORDS: Bioinformatics - ASP - Answer Set Programming - Constraint-based programming

FUNCTIONAL DESCRIPTION: This Python package in systems biology allows the identification of essential metabolites with respect to the production of targeted elements in a metabolic network, by comparing flux and graph-based analysis. Conquests's inputs are a sbml file corresponding to a metabolic network and the biomass reaction name. The outputs are three sets of essential metabolites. They are computed according to three complementary criteria: graph-based accessibility of targeted metabolites, the presence of flux in the biomass reaction and the maximisation of flux in the biomass reaction.

NEWS OF THE YEAR: Conquest was released in 2017.

- Contact: Julie Laniau

<p style="text-align:center">**FLUMINANCE Project-Team**</p>

6. New Software and Platforms

6.1. 2DLayeredMotion

Estimation of 2D independent mesoscale layered atmospheric motion fields

FUNCTIONAL DESCRIPTION: This software enables to estimate a stack of 2D horizontal wind fields corresponding to a mesoscale dynamics of atmospheric pressure layers. This estimator is formulated as the minimization of a global energy function. It relies on a vertical decomposition of the atmosphere into pressure layers. This estimator uses pressure data and classification clouds maps and top of clouds pressure maps (or infra-red images). All these images are routinely supplied by the EUMETSAT consortium which handles the Meteosat and MSG satellite data distribution. The energy function relies on a data model built from the integration of the mass conservation on each layer. The estimator also includes a simplified and filtered shallow water dynamical model as temporal smoother and second-order div-curl spatial regularizer. The estimator may also incorporate correlation-based vector fields as additional observations. These correlation vectors are also routinely provided by the Eumetsat consortium.

- Participant: Étienne Mémin
- Contact: Étienne Mémin
- URL: http://fluid.irisa.fr/index.html

6.2. 3DLayeredMotion

Estimation of 3D interconnected layered atmospheric motion fields

FUNCTIONAL DESCRIPTION: This software extends the previous 2D version. It allows (for the first time to our knowledge) the recovery of 3D wind fields from satellite image sequences. As with the previous techniques, the atmosphere is decomposed into a stack of pressure layers. The estimation relies also on pressure data and classification clouds maps and top of clouds pressure maps. In order to recover the 3D missing velocity information, physical knowledge on 3D mass exchanges between layers has been introduced in the data model. The corresponding data model appears to be a generalization of the previous data model constructed from a vertical integration of the continuity equation.

- Contact: Étienne Mémin
- URL: http://fluid.irisa.fr

6.3. DenseMotion

Estimation of 2D dense motion fields

FUNCTIONAL DESCRIPTION: This code allows the computation from two consecutive images of a dense motion field. The estimator is expressed as a global energy function minimization. The code enables the choice of different data models and different regularization functionals depending on the targeted application. Generic motion estimators for video sequences or fluid flows dedicated estimators can be set up. This software allows in addition the users to specify additional correlation based matching measurements. It enables also the inclusion of a temporal smoothing prior relying on a velocity vorticity formulation of the Navier-Stoke equation for Fluid motion analysis applications.

- Participant: Étienne Mémin
- Contact: Étienne Mémin
- URL: http://fluid.irisa.fr/index.html

6.4. Low-Order-Motion

Estimation of low order representation of fluid motion

FUNCTIONAL DESCRIPTION: This code enables the estimation of a low order representation of a fluid motion field from two consecutive images.The fluid motion representation is obtained using a discretization of the vorticity and divergence maps through regularized Dirac measure. The irrotational and solenoidal components of the motion fields are expressed as linear combinations of basis functions obtained through the Biot-Savart law. The coefficient values and the basis function parameters are formalized as the minimizer of a functional relying on an intensity variation model obtained from an integrated version of the mass conservation principle of fluid mechanics.

- Participants: Anne Cuzol and Étienne Mémin
- Contact: Étienne Mémin
- URL: http://fluid.irisa.fr

6.5. TYPHOON

- Participants: Christopher Mauzey, Étienne Mémin and Pierre Dérian
- Partner: CSU Chico
- Contact: Étienne Mémin
- URL: http://phys.csuchico.edu/lidar/typhoon/

6.6. H2OLab

KEYWORDS: Energy - Contamination - Groundwater - Hydrogeology - Heterogeneity - Uncertainly - Multi-scale - Simulation

SCIENTIFIC DESCRIPTION: The software platform contains a database which is interfaced through the web portal H2OWeb. It contains also software modules which can be used through the interface H2OGuilde. The platform H2OLab is an essential tool for the dissemination of scientific results. Currently, software and database are shared by the partners of the h2mno4 project.

FUNCTIONAL DESCRIPTION: The software platform H2OLab is devoted to stochastic simulations of groundwater flow and contaminant transport in highly heterogeneous porous and fractured geological media.

-Modeling and numerical simulation of aquifers -Porous and fractured heterogeneous media -Flow with mixed finite elements -Solute transport with a Lagrangian method -Stochastic modeling for data uncertainty.

- Participants: Géraldine Pichot, Grégoire Lecourt, Jean-Raynald De Dreuzy and Jocelyne Erhel
- Partners: Université de Rennes 1 - CNRS - Université de Lyon - Université de Poitiers
- Contact: Jocelyne Erhel
- URL: http://h2olab.inria.fr/

6.7. PALMTREE

KEYWORD: Monte-Clarlo

FUNCTIONAL DESCRIPTION: We present an easy-to-use package for the parallelization of Lagrangian methods for partial differential equations. In addition to the reduction of computation time, the code aims at satisfying three properties:

simplicity: the user just has to add the algorithm governing the behaviour of the particles. portability: the possibility to use the package with any compiler and OS. action-replay: the ability of the package to replay a selected batch of particles.

The last property allows the user to replay and capture the whole sample path for selected particles of a batch. This feature is very useful for debugging and catching some relevant information.

- Authors: Lionel Lenôtre, Géraldine Pichot, Lionel Lenôtre and Lionel Lenôtre
- Contact: Géraldine Pichot

6.8. GRT3D

KEYWORDS: Geochemistry - Dispersion - Scientific calculation - Simulation - Advection
SCIENTIFIC DESCRIPTION: Participants : Édouard Canot, Jocelyne Erhel [correspondant] .

Version: version 2.0, April 2014

APP: registered

Programming language: C

Abstract: Reactive transport modeling has become an essential tool for understanding complex environmental problems. It is an important issue for MoMaS and C2S@EXA partners (see sections 8.2.5 , 8.2.3), in particular Andra. We have developed a method coupling transport and chemistry, based on a method of lines such that spatial discretization leads to a semi-discrete system of algebraic differential equations (DAE system). The main advantage is to use a complex DAE solver, which controls simultaneously the timestep and the convergence of Newton algorithm. The approach SIA uses a fixed-point method to solve the nonlinear system at each timestep, whereas the approach SNIA uses an explicit scheme.

The software suite GRT3D has four executable modules:

SIA1D: Sequential Iterative Approach for 1D domains,

GDAE1D: Global DAE approach for 1D domains,

SNIA3D: Sequential Non Iterative Approach for 1D, 2D or 3D domains.

GDAE3D: Global DAE approach for 1D, 2D or 3D domains. This module has three variants: the original one with logarithms, an optimized one still with logarithms, an optimized one which does not use logarithms.

Current work: extension of the chemistry module and parallelization.

FUNCTIONAL DESCRIPTION: Reactive transport modeling has become an essential tool for understanding complex environmental problems. It is an important issue for MoMaS and C2S@EXA partners, in particular Andra. We have developed a method coupling transport and chemistry, based on a method of lines such that spatial discretization leads to a semi-discrete system of algebraic differential equations (DAE system). The main advantage is to use a complex DAE solver, which controls simultaneously the timestep and the convergence of Newton algorithm. The approach SIA uses a fixed-point method to solve the nonlinear system at each timestep, whereas the approach SNIA uses an explicit scheme.

The software suite GRT3D has four executable modules:

SIA1D: Sequential Iterative Approach for 1D domains,

GDAE1D: Global DAE approach for 1D domains,

SNIA3D: Sequential Non Iterative Approach for 1D, 2D or 3D domains.

GDAE3D: Global DAE approach for 1D, 2D or 3D domains. This module has three variants: the original one with logarithms, an optimized one still with logarithms, an optimized one which does not use logarithms.

- Participants: Caroline De Dieuleveult, Édouard Canot, Jocelyne Erhel, Nadir Soualem and Souhila Sabit
- Partner: ANDRA
- Contact: Jocelyne Erhel

GENSCALE Project-Team

6. New Software and Platforms

6.1. GATB-Core

Genome Assembly and Analysis Tool Box
KEYWORDS: Bioinformatics - NGS - Genomics - Genome assembling
FUNCTIONAL DESCRIPTION: The GATB-Core library aims to lighten the design of NGS algorithms. It offers a panel of high-level optimized building blocks to speed-up the development of NGS tools related to genome assembly and/or genome analysis. The underlying data structure is the de Bruijn graph, and the general parallelism model is multithreading. The GATB library targets standard computing resources such as current multicore processor (laptop computer, small server) with a few GB of memory. From high-level API, NGS programming designers can rapidly elaborate their own software based on domain state-of-the-art algorithms and data structures. The GATB-Core library is written in C++.

RELEASE FUNCTIONAL DESCRIPTION: speed up from x2 to x4 for kmer counting and graph construction phases (optimizations based on minimizers and improved Bloom filters). GATB's k-mer counter has been improved using techniques from KMC2, to achieve competitive running times compared to KMC2. ability to store arbitrary information associated to each kmer of the graph, enabled by a minimal perfect hash function (costs only 2.61 bits/kmer of memory) improved API with new possibilities (banks and kmers management) many new snippets showing how to use the library.

- Participants: Charles Deltel, Claire Lemaitre, Dominique Lavenier, Guillaume Rizk, Patrick Durand and Pierre Peterlongo
- Contact: Dominique Lavenier
- URL: http://gatb.inria.fr/

6.2. DiscoSnpRad

DISCOvering Single Nucleotide Polymorphism, Indels in RAD seq data
KEYWORD: RAD-seq
FUNCTIONAL DESCRIPTION: Software discoSnpRad is designed for discovering Single Nucleotide Polymorphism (SNP) and insertions/deletions (indels) from raw set(s) of RAD-seq data. Note that number of input read sets is not constrained, it can be one, two, or more. Note also that no other data as reference genome or annotations are needed. The software is composed of several modules. First module, kissnp2, detects SNPs from read sets. A second module, kissreads2, enhances the kissnp2 results by computing per read set and for each variant found i/ its mean read coverage and ii/ the (phred) quality of reads generating the polymorphism. Then, variants are grouped by RAD locus, and a VCF file is finally generated. We also provide several scripts to further filter and select informative variants for downstream population genetics studies.

This tool relies on the GATB-Core library.

- Contact: Pierre Peterlongo
- URL: https://github.com/GATB/DiscoSnp

6.3. GWASDM

Genome Wide Association Study using Data Mining strategy
KEYWORDS: GWAS - Data mining

FUNCTIONAL DESCRIPTION: From two cohorts of genotyped individuals (case and control), the GWASDM software performs a Genome Wide Association Study based on data mining techniques and generates several patterns of SNPs that correlate with a given phenotype. The algorithm implemented in GWASDM directly uses relative risk measures such as risk ratio, odds ratio and absolute risk reduction combined with confidence intervals as anti-monotonic properties to efficiently prune the search space. The algorithm discovers a complete set of discriminating patterns with regard to given thresholds or applies heuristic strategies to extract the largest statistically significant discriminating patterns in a given dataset.

- Contact: Dominique Lavenier

6.4. bcool

de Bruijn graph cOrrectiOn from graph aLignment
KEYWORDS: De Bruijn graphs - Reads correction - Short reads - Read mapping
FUNCTIONAL DESCRIPTION: BCool includes two steps. As a first step, Bcool constructs a corrected compacted de Bruijn graph from the reads. This graph is then used as a reference and the reads are corrected according to their mapping on the graph.This approach yields a better correction than kmer-spectrum techniques, while being scalable, making it possible to apply it to human-size genomic datasets and beyond. The implementation is open source and available at github.com/Malfoy/BCOOL

- Partner: Université libre de Bruxelles
- Contact: Pierre Peterlongo
- URL: http://github.com/Malfoy/BCOOL

6.5. CARNAC-LR

Clustering coefficient-based Acquisition of RNA Communities in Long Reads
KEYWORDS: Transcriptomics - Clustering - Bioinformatics
FUNCTIONAL DESCRIPTION: Carnac-LR is a clustering method for third generation sequencing data. Used on RNA sequences it retrieves all sequences that describes a gene and put them in a cluster. CARNAC-LR is an efficient implementation of a novel clustering algorithm for detecting communities in a graph of reads from Third Generation Sequencing. It is a part of a pipeline that allows to retrieve expressed variants from each gene de novo (without reference genome/transcriptome), for transcriptomic sequencing data.

- Contact: Camille Marchet

HYBRID Project-Team

6. New Software and Platforms

6.1. #FIVE

Framework for Interactive Virtual Environments

KEYWORDS: Virtual reality - 3D - 3D interaction - Behavior modeling

SCIENTIFIC DESCRIPTION: #FIVE (Framework for Interactive Virtual Environments) is a framework for the development of interactive and collaborative virtual environments. #FIVE was developed to answer the need for an easier and a faster design and development of virtual reality applications. #FIVE provides a toolkit that simplifies the declaration of possible actions and behaviours of objects in a VE. It also provides a toolkit that facilitates the setting and the management of collaborative interactions in a VE. It is compliant with a distribution of the VE on different setups. It also proposes guidelines to efficiently create a collaborative and interactive VE. The current implementation is in C# and comes with a Unity3D engine integration, compatible with MiddleVR framework.

FUNCTIONAL DESCRIPTION: #FIVE contains software modules that can be interconnected and helps in building interactive and collaborative virtual environments. The user can focus on domain-specific aspects for his/her application (industrial training, medical training, etc) thanks to #FIVE's modules. These modules can be used in a vast range of domains using virtual reality applications and requiring interactive environments and collaboration, such as in training for example.

- Participants: Florian Nouviale, Valérie Gouranton, Bruno Arnaldi, Thomas Boggini, Guillaume Claude, Thomas Lopez and Quentin Petit
- Contact: Valérie Gouranton
- Publication: #FIVE : High-Level Components for Developing Collaborative and Interactive Virtual Environments
- URL: https://bil.inria.fr/fr/software/view/2527/tab

6.2. #SEVEN

Sensor Effector Based Scenarios Model for Driving Collaborative Virtual Environments

KEYWORDS: Virtual reality - Interactive Scenarios - 3D interaction

SCIENTIFIC DESCRIPTION: #SEVEN (Sensor Effector Based Scenarios Model for Driving Collaborative Virtual Environments) is a model and an engine based on petri nets extended with sensors and effectors, enabling the description and execution of complex and interactive scenarios

FUNCTIONAL DESCRIPTION: #SEVEN enables the execution of complex scenarios for driving Virtual Reality applications. #SEVEN's scenarios are based on an enhanced Petri net model which is able to describe and solve intricate event sequences. #SEVEN comes with an editor for creating, editing and remotely controlling and running scenarios. #SEVEN is implemented in C# and can be used as a stand-alone application or as a library. An integration to the Unity3D engine, compatible with MiddleVR, also exists.

- Participants: Florian Nouviale, Valérie Gouranton, Bruno Arnaldi, Guillaume Claude, Thomas Boggini and Rozenn Bouville Berthelot
- Contact: Valérie Gouranton
- Publications: Actions sequencing incollaborative virtual environment - Short Paper: #SEVEN, a Sensor Effector Based Scenarios Model for Driving Collaborative Virtual Environment
- URL: https://bil.inria.fr/fr/software/view/2528/tab

6.3. OpenVIBE

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

FUNCTIONAL DESCRIPTION: OpenViBE is a free and open-source software platform devoted to the design, test and use of Brain-Computer Interfaces (BCI). The platform consists of a set of software modules that can be integrated easily and efficiently to design BCI applications. The key features of OpenViBE software are its modularity, its high-performance, its portability, its multiple-users facilities and its connection with high-end/VR displays. The designer of the platform enables to build complete scenarios based on existing software modules using a dedicated graphical language and a simple Graphical User Interface (GUI). This software is available on the Inria Forge under the terms of the AGPL licence, and it was officially released in June 2009. Since then, the OpenViBE software has already been downloaded more than 40000 times, and it is used by numerous laboratories, projects, or individuals worldwide. More information, downloads, tutorials, videos, documentations are available on the OpenViBE website.

- Participants: Cédric Riou, Thierry Gaugry, Anatole Lécuyer, Fabien Lotte, Jussi Tapio Lindgren, Laurent Bougrain, Maureen Clerc Gallagher and Théodore Papadopoulo
- Partners: INSERM - CEA-List - GIPSA-Lab
- Contact: Anatole Lécuyer
- URL: http://openvibe.inria.fr

6.4. Platforms

6.4.1. Immerstar

- Participants : Florian Nouviale, Ronan Gaugne

With the two platforms of virtual reality, Immersia and Immermove, grouped under the name Immerstar, the team has access to high level scientific facilities. This equipment benefits the research teams of the center and has allowed them to extend their local, national and international collaborations. The Immerstar platform is granted by a Inria CPER funding for 20152019 that enables important evolutions of the equipment. In 2017, WQXGA laser projectors were installed in Immersia as well as a new tracking system and a new cluster of computers, improving the quality, homogeneity and latency of the platform

HYCOMES Project-Team

4. New Software and Platforms

4.1. Demodocos

Demodocos (Examples to Generic Scenario Models Generator)
KEYWORDS: Surgical process modelling - Net synthesis - Process mining
SCIENTIFIC DESCRIPTION: Demodocos is used to construct a Test and Flip net (Petri net variant) from a collection of instances of a given procedure. The tool takes as input either standard XES log files (a standard XML file format for process mining tools) or a specific XML file format for surgical applications. The result is a Test and Flip net and its marking graph. The tool can also build a #SEVEN scenario for integration into a virtual reality environment. The scenario obtained corresponds to the generalization of the input instances, namely the instances synthesis enriched with new behaviors respecting the relations of causality, conflicts and competition observed.

Demodocos is a synthesis tool implementing a linear algebraic polynomial time algorithm. Computations are done in the Z/2Z ring. Test and Flip nets extend Elementary Net Systems by allowing test to zero, test to one and flip arcs. The effect of flip arcs is to complement the marking of the place. While the net synthesis problem has been proved to be NP hard for Elementary Net Systems, thanks to flip arcs, the synthesis of Test and Flip nets can be done in polynomial time. Test and flip nets have the required expressivity to give concise and accurate representations of surgical processes (models of types of surgical operations). Test and Flip nets can express causality and conflict relations. The tool takes as input either standard XES log files (a standard XML file format for process mining tools) or a specific XML file format for surgical applications. The output is a Test and Flip net, solution of the following synthesis problem: Given a finite input language (log file), compute a net, which language is the least language in the class of Test and Flip net languages, containing the input language.

FUNCTIONAL DESCRIPTION: The tool Demodocos allows to build a generic model for a given procedure from some examples of instances of this procedure. The generated model can take the form of a graph, a Test 'n Flip net or a SEVEN scenario (intended for integration into a virtual reality environment).

The classic use of the tool is to apply the summary operation to a set of files describing instances of the target procedure. Several file formats are supported, including the standard XES format for log events. As output, several files are generated. These files represent the generic procedure in different forms, responding to varied uses.

This application is of limited interest in the case of an isolated use, out of context and without a specific objective when using the model generated. It was developed as part of a research project focusing in particular on surgical procedures, and requiring the generation of a generic model for integration into a virtual reality training environment. It is also quite possible to apply the same method in another context.

- Participants: Aurélien Lamercerie and Benoît Caillaud
- Contact: Benoît Caillaud
- Publication: Surgical Process Mining with Test and Flip Net Synthesis
- URL: http://tinyurl.com/oql6f3y

4.2. MICA

Model Interface Compositional Analysis Library
KEYWORDS: Modal interfaces - Contract-based desing

SCIENTIFIC DESCRIPTION: In Mica, systems and interfaces are represented by extension. However, a careful design of the state and event heap enables the definition, composition and analysis of reasonably large systems and interfaces. The heap stores states and events in a hash table and ensures structural equality (there is no duplication). Therefore complex data-structures for states and events induce a very low overhead, as checking equality is done in constant time.

Thanks to the Inter module and the mica interactive environment, users can define complex systems and interfaces using Ocaml syntax. It is even possible to define parameterized components as Ocaml functions.
FUNCTIONAL DESCRIPTION: Mica is an Ocaml library implementing the Modal Interface algebra. The purpose of Modal Interfaces is to provide a formal support to contract based design methods in the field of system engineering. Modal Interfaces enable compositional reasoning methods on I/O reactive systems.

- Participant: Benoît Caillaud
- Contact: Benoît Caillaud
- URL: http://www.irisa.fr/s4/tools/mica/

4.3. TnF-C++

FUNCTIONAL DESCRIPTION: TnF-C++ is a robust and portable re-implementation of Flipflop, developed in 2014 and integrated in the S3PM toolchain. Both software have been designed in the context of the S3PM project on surgical procedure modeling and simulation,

- Contact: Benoît Caillaud

<h1 style="text-align:center;color:red">I4S Project-Team</h1>

6. New Software and Platforms

6.1. PEGASE

Plate-forme Experte Générique pour Applications Sans-fil Embarquées
KEYWORD: SHM (Structural Health Monitoring)
FUNCTIONAL DESCRIPTION: PEGASE is a generic high level wireless sensor platform. The main characteristics of PEGASE to reach this genericity are obtained by :

- Software genericity: use of a Linux embedded OS to make any developed application independent from the hardware, and to enable the user to manage the system without any physical operations.
- Hardware genericity: with a principle of daughter and mother boards, each redundant need is embedded (processing, memory, timing, GPS, energy, etc) where each pluggable daughter board implements a specific function (e.g., sensing, 3G, Lora/Sigfox and Ethernet wireless communications, signal processing and relay control).
- Accurate time synchronization: based on an original GPS and PPS algorithm, PEGASE platform is one of few boards able to time-stamp data from sensors or any event with an accuracy of some micro-seconds Universal Time.

After the industrial exploitation of PEGASE 1 (hundreds are sold), PEGASE 2 and the future PEGASE 3 version maintain and extend the previous platform. Focus on main characteristics is subject of electronic research and development:

- embed a "Debian" Linux operating system able to be validated for critical applications (such as SHM applications)
- embed a module dedicated to energy autonomy, to harvest energy from solar cells while considering the dis/charge of Lithium battery
- integrate a 3D accelerometer based on a MEMs to propose motion applications (train detection by vibration for example)
- new original daughter boards for new wireless IOT industrial protocols: LorA and Sigfox
- convert the proposed SDK (Single Development Kit) fully from C to C++ language
- a generic embedded front-end development called Zeus able to manage time control of Linux enslaved to the UTC synchronization, applications manager, network manager (from WiFi, Lora to 3G...), ...

Since 2017, PEGASE 2 platform is also used as the support for some lectures given at University of Nantes.

Associated to PEGASE hardware platform, I4S has also designed and programmed a generic Cloud Supervisor that allows to manage wireless sensors. In 2017 this application has matured, and has been licensed to two companies for industrial exploitation and distribution (Stimio and Power-Lan).

- Participants: Laurent Mevel, Mathieu Le Pen, Michael Doehler and Vincent Le Cam
- Contact: Michael Doehler
- URL: http://www.a3ip.com/joomla/index.php?option=com_content&view=article&id=12&Itemid=8

6.2. TrackingMecaSysEvo

KEYWORDS: Particular filter - Kalman filter - Monte-Clarlo - Bayesian estimation - Vibrating system
FUNCTIONAL DESCRIPTION: Based on a IPKF (Interacting Particles and Kalman Filter) implementation, TrackingMecaSysEvo allow mechanical parameters traking over the time for a 1-2-3D vibrating model. The algorithme insure also, input force and ambiant noise estimation

- Participants: Antoine Crinière, Laurent Mevel and Subhamoy Sen
- Partner: IFSTTAR
- Contact: Laurent Mevel

IPSO Project-Team (section vide)

KERDATA Project-Team

5. New Software and Platforms

5.1. BlobSeer

BlobSeer : A Storage System For The Exascale Era

KEYWORDS: Versioning - HPC - Cloud storage - Distributed metadata - MapReduce

SCIENTIFIC DESCRIPTION: BlobSeer is a large-scale distributed storage service that addresses advanced data management requirements resulting from ever-increasing data sizes. It is centered around the idea of leveraging versioning for concurrent manipulation of binary large objects in order to efficiently exploit data-level parallelism and sustain a high throughput despite massively parallel data access.

FUNCTIONAL DESCRIPTION: BlobSeer is a large-scale distributed storage service for advanced management of massive data. Validated on Nimbus, OpenNebula and Microsoft Azure cloud platforms.

- Participants: Bogdan Nicolae, Gabriel Antoniu and Luc Bougé
- Partners: Université de Rennes 1 - ENS Cachan
- Contact: Gabriel Antoniu
- URL: http://blobseer.gforge.inria.fr/

5.2. Damaris

KEYWORDS: Big data - Visualization - I/O - HPC - Exascale

SCIENTIFIC DESCRIPTION: Damaris is a middleware for multicore SMP nodes enabling them to efficiently handle data transfers for storage and visualization. The key idea is to dedicate one or a few cores of each SMP node to the application I/O. It is developed within the framework of a collaboration between KerData and the Joint Laboratory for Petascale Computing (JLPC). The current version enables efficient asynchronous I/O, hiding all I/O related overheads such as data compression and post-processing, as well as direct (in situ) interactive visualization of the generated data.

Damaris has been preliminarily evaluated at NCSA (Urbana-Champaign) with the CM1 tornado simulation code. CM1 is one of the target applications of the Blue Waters supercomputer in production at NCSA/UIUC (USA), in the framework of the Inria-UIUC-ANL Joint Lab (JLPC). Damaris now has external users, including (to our knowledge) visualization specialists from NCSA and researchers from the France/Brazil Associated research team on Parallel Computing (joint team between Inria/LIG Grenoble and the UFRGS in Brazil). Damaris has been successfully integrated into three large-scale simulations (CM1, OLAM, Nek5000). Works are in progress to evaluate it in the context of several other simulations including HACC (cosmology code) and GTC (fusion).

FUNCTIONAL DESCRIPTION: Damaris is a middleware for data management targeting large-scale HPC simulations: • «In-situ» data analysis by some dedicated cores of the simulation platform • Asynchronous and fast data transfer from HPC simulations to Damaris • Semantic-aware dataset processing through Damaris plug-ins

- Participants: Gabriel Antoniu, Lokman Rahmani, Luc Bougé, Matthieu Dorier and Orçun Yildiz
- Partner: ENS Rennes
- Contact: Matthieu Dorier
- URL: https://project.inria.fr/damaris/

5.3. iHadoop

FUNCTIONAL DESCRIPTION: iHadoop is a Hadoop simulator developed in Java on top of SimGrid to simulate the behavior of Hadoop and therefore accurately predict the performance of Hadoop in normal scenarios and under failures.

iHadoop is an internal software prototype, which was initially developed to validate our idea for exploring the behavior of Hadoop under failures. iHadoop has preliminarily evaluated within our group and it has shown very high accuracy when predicating the execution time of a Map-Reduce application. We intend to integrate iHadoop within the SimGrid distribution and make it available to the SimGrid community.

- Participants: Shadi Ibrahim and Tien Dat Phan
- Contact: Shadi Ibrahim

5.4. JetStream

FUNCTIONAL DESCRIPTION: JetStream is a middleware solution for batch-based, high-performance streaming across cloud data centers. JetStream implements a set of context-aware strategies for optimizing batch-based streaming, being able to self-adapt to changing conditions. Additionally, the system provides multi-route streaming across cloud data centers for aggregating bandwidth by leveraging the network parallelism. It enables easy deployment across .Net frameworks and seamless binding with event processing engines such as StreamInsight.

JetStream is currently used at Microsoft Research ATLE Munich for the management of the Azure cloud infrastructure.

- Participants: Alexandru Costan, Gabriel Antoniu and Radu Marius Tudoran
- Contact: Alexandru Costan

5.5. OverFlow

FUNCTIONAL DESCRIPTION: OverFlow is a uniform data management system for scientific workflows running across geographically distributed sites, aiming to reap economic benefits from this geo-diversity. The software is environment-aware, as it monitors and models the global cloud infrastructure, offering high and predictable data handling performance for transfer cost and time, within and across sites. OverFlow proposes a set of pluggable services, grouped in a data-scientist cloud kit. They provide the applications with the possibility to monitor the underlying infrastructure, to exploit smart data compression, deduplication and geo-replication, to evaluate data management costs, to set a tradeoff between money and time, and optimize the transfer strategy accordingly.

Currently, OverFlow is used for data transfers by the Microsoft Research ATLE Munich team as well as for synthetic benchmarks at the Politehnica University of Bucharest.

- Participants: Alexandru Costan, Gabriel Antoniu and Radu Marius Tudoran
- Contact: Alexandru Costan

<p style="text-align:center; color:red;">**LACODAM Project-Team**</p>

6. New Software and Platforms

6.1. EcoMata

KEYWORD: Environment perception

FUNCTIONAL DESCRIPTION: The EcoMata toolbox provides means for qualitative modeling and exploration of ecosystems in order to aid the design of environmental guidelines. We have proposed a new qualitative approach for ecosystem modeling based on the timed automata (TA) formalism combined to a high-level query language for exploring scenarios.

- Participants: Christine Largouët, Marie-Odile Cordier, Thomas Guyet and Yulong Zhao
- Contact: Christine Largouët
- URL: https://team.inria.fr/dream/fr/ecomata/

6.2. PATURMATA

KEYWORDS: Bioinformatics - Biology

SCIENTIFIC DESCRIPTION: The Paturmata tool-box provides means for qualitative modeling and the exploration of agrosystems, specifically management of herd based on pasture. The system is modeled using a hierarchical hybrid model described in the timed automata formalism.

FUNCTIONAL DESCRIPTION: In the PaturMata software, users can create a pasture system description by entering herds and plots information. For each herd, the only parameter is the number of animals. For each plot, users should enter the surface, the density, the herb height, the distance to the milking shed, a herb growth profile and an accessibility degree. Users then specify pasturing and fertilization strategies. Finally, users can launch a pasture execution. PaturMata displays the results and a detailed trace of pasture. Users can launch a batch of different strategies and compare the results in order to find the best pasture strategy. PaturMata is developed in Java (Swing for the GUI) and the model-checker that is called for the timed properties verification is UPPAAL.

- Participants: Christine Largouët and Marie-Odile Cordier
- Contact: Christine Largouët

6.3. Promise

KEYWORDS: Data mining - Monitoring

FUNCTIONAL DESCRIPTION: Promise is a software that predicts rare events in industrial production systems from data analysis of energy consumption data. The data is represented as a time series. The program takes as input the temporal series of energy consumption, an abnormal pattern (rare event) and a temporal dilatation, and outputs a set of sub-series similar (according to a similarity metric) to the abnormal pattern.

- Participants: Véronique Masson, Laurence Rozé and Mael Guilleme
- Contact: Véronique Masson

6.4. GWASDM

Genome Wide Association Study using Data Mining strategy
KEYWORDS: GWAS - Data mining

FUNCTIONAL DESCRIPTION: From two cohorts of genotyped individuals (case and control), the GWASDM software performs a Genome Wide Association Study based on data mining techniques and generates several patterns of SNPs that correlate with a given phenotype. The algorithm implemented in GWASDM directly uses relative risk measures such as risk ratio, odds ratio and absolute risk reduction combined with confidence intervals as anti-monotonic properties to efficiently prune the search space. The algorithm discovers a complete set of discriminating patterns with regard to given thresholds or applies heuristic strategies to extract the largest statistically significant discriminating patterns in a given dataset.

- Contact: Dominique Lavenier

6.5. DCM

Discriminant Chronicle Mining
KEYWORDS: Pattern extraction - Sequence - Classification
FUNCTIONAL DESCRIPTION: DCM is a temporal sequences analysis tool. It extracts discriminant chronicles from a large set of labeled sequences. A sequence is made of timestamped events. Each sequence of events is associated to a label (e.g. positive and negative sequences). A chronicle is a temporal model that characterizes a behavior by a set of events linked by temporal constraints. The DCM algorithm extracts chronicles that occurs more in positive sequences than in negative sequences.

- Participants: Yann Dauxais and Thomas Guyet
- Partners: REPERES - Université de Rennes 1
- Contact: Yann Dauxais
- Publications: Discriminant chronicles mining: Application to care pathways analytics - Extraction de chroniques discriminantes
- URL: https://gitlab.inria.fr/ydauxais/DCM

6.6. NTGSP

Negative Time-Gap Sequential Patterns
KEYWORDS: Pattern discovery - Sequence
FUNCTIONAL DESCRIPTION: The NTGSP algorithm is a sequential pattern mining algorithm. It analyses a large database of temporal sequences, i.e., events with timestamps, by extracting its regularities (the patterns). A pattern describes the behavior as a sequence of events that frequently occurred in sequences. What makes NTGSP novel is its ability to handle patterns with negations, i.e., the description of a behavior that specifies the absence of an event. More precisely, it extracts frequent sequences with positive and negative events, as well as temporal information about the delay between these events.

- Participants: Thomas Guyet and René Quiniou
- Partner: Edf
- Contact: René Quiniou
- Publication: Fouille de motifs temporels négatifs

6.7. Relevant Interval Rules Miner

KEYWORDS: Association rule - Pattern discovery - Formal concept analysis
FUNCTIONAL DESCRIPTION: This software extracts relevant rules from a dataset of labeled numerical attributes (tabular datasets). A rule is an interval-based pattern associated to a predicted label. The tool extracts a subset of rules based on the accuracy and relevance criteria where most of the algorithms are simply based on accuracy. This allow us to extract the best rules that capture the data behavior.

- Participants: René Quiniou, Véronique Masson and Thomas Guyet
- Contact: Thomas Guyet
- Publication: Mining relevant interval rules

6.8. OCL

One click learning

KEYWORDS: Data mining - Interactivity

FUNCTIONAL DESCRIPTION: This pattern mining software builds a user model preference from implicit feedback of the user in order to automatically choice the type of patterns and algorithms used. The principle builds upon the algorithm introduced by M. Boley et al, "One click mining: interactive local pattern discovery through implicit preference and performance learning". In addition OCL integrates algorithms dealing with temporal series.

- Contact: Laurence Rozé
- URL: https://github.com/Gremarti/OneClickLearning

<p style="text-align:center;color:red;font-weight:bold;">LAGADIC Project-Team</p>

6. New Software and Platforms

6.1. bib2html

Latex bibliography generator

KEYWORDS: LaTeX - Bibliography

FUNCTIONAL DESCRIPTION: The purpose of this software is to automatically produce html pages from BibTEX files, and to provide access to the BibTEX entries by several criteria: year of publication, category of publication, keywords, author name. Moreover cross-linking is generating between pages to provide an easy navigation through the pages without going back to the index.

- Contact: Éric Marchand
- URL: http://www.irisa.fr/lagadic/soft/bib2html/bib2html.html

6.2. DESlam

Dense Egocentric SLAM

KEYWORDS: Deph Perception - Robotics - Localisation

FUNCTIONAL DESCRIPTION: This software proposes a full and self content solution to the dense Slam problem. Based on a generic RGB-D representation valid for various type of sensors (stereovision, multi-cameras, RGB-D sensors...), it provides a 3D textured representation of complex large indoor and outdoor environments and it allows localizing in real time (45Hz) a robot or a person carrying out a mobile camera.

- Participants: Andrew Ian Comport, Maxime Meilland and Patrick Rives
- Contact: Patrick Rives

6.3. HandiViz

Driving assistance of a wheelchair

KEYWORDS: Health - Persons attendant - Handicap

FUNCTIONAL DESCRIPTION: The HandiViz software proposes a semi-autonomous navigation framework of a wheelchair relying on visual servoing.

It has been registered to the APP ("Agence de Protection des Programmes") as an INSA software (IDDN.FR.001.440021.000.S.P.2013.000.10000) and is under GPL license.

- Participants: François Pasteau and Marie Babel
- Contact: Marie Babel

6.4. Perception360

Robot vision and 3D mapping with omnidirectional RGB-D sensors.

KEYWORDS: Depth Perception - Localization - 3D reconstruction - Realistic rendering - Sensors - Image registration - Robotics - Computer vision - 3D rendering

FUNCTIONAL DESCRIPTION: This software is a collection of libraries and applications for robot vision and 3D mapping with omnidirectional RGB-D sensors or standard perspective cameras. This project provides the functionality to do image acquisition, semantic annotation, dense registration, localization and 3D mapping. The omnidirectional RGB-D sensors used within this project have been developed in Inria Sophia-Antipolis by the team LAGADIC.

- Contact: Patrick Rives

6.5. SINATRACK

Model-based visual tracking of complex objects
KEYWORDS: Computer vision - Robotics
FUNCTIONAL DESCRIPTION: Sinatrack is a tracking software that allows the 3D localization (translation and rotation) of an object with respect to a monocular camera. It allows to consider object with complex shape. The underlying approach is a model-based tracking techniques. It has been developed for satellite localization and on-orbit service applications but is also suitable for augmented reality purpose.

- Participants: Antoine Guillaume Petit, Éric Marchand and François Chaumette
- Contact: Éric Marchand

6.6. UsTk

Ultrasound toolkit for medical robotics applications guided from ultrasound images
KEYWORDS: Echographic imagery - Image reconstruction - Medical robotics - Visual tracking - Visual servoing (VS)
FUNCTIONAL DESCRIPTION: UsTk, standing for Ultrasound Toolkit, is a cross-platform extension of ViSP software dedicated to two- and three-dimensional ultrasound image processing and visual servoing based on ultrasound images. Written in C++, UsTk architecture provides a core module that implements all the data structures at the heart of UsTk, a grabber module that allows to acquire ultrasound images from an Ultrasonix or a Sonosite device, a GUI module to display data, an IO module for providing functionalities to read/write data from a storage device, and a set of image processing modules to compute the confidence map, to track a needle, and to track an image template. All these modules could be used to control the motion of an ultrasound probe by ultrasound visual servoing.

- Participants: Alexandre Krupa, Marc Pouliquen, Fabien Spindler and Pierre Chatelain
- Partners: Université de Rennes 1 - IRSTEA
- Contact: Alexandre Krupa
- URL: https://team.inria.fr/lagadic/

6.7. ViSP

Visual servoing platform
KEYWORDS: Augmented reality - Computer vision - Robotics - Visual servoing (VS)
SCIENTIFIC DESCRIPTION: Since 2005, we develop and release ViSP [1], an open source library available from https://visp.inria.fr. ViSP standing for Visual Servoing Platform allows prototyping and developing applications using visual tracking and visual servoing techniques at the heart of the Lagadic research. ViSP was designed to be independent from the hardware, to be simple to use, expandable and cross-platform. ViSP allows to design vision-based tasks for eye-in-hand and eye-to-hand visual servoing that contains the most classical visual features that are used in practice. It involves a large set of elementary positioning tasks with respect to various visual features (points, segments, straight lines, circles, spheres, cylinders, image moments, pose...) that can be combined together, and image processing algorithms that allow tracking of visual cues (dots, segments, ellipses...) or 3D model-based tracking of known objects or template tracking. Simulation capabilities are also available.

[1] E. Marchand, F. Spindler, F. Chaumette. ViSP for visual servoing: a generic software platform with a wide class of robot control skills. IEEE Robotics and Automation Magazine, Special Issue on "Software Packages for Vision-Based Control of Motion", P. Oh, D. Burschka (Eds.), 12(4):40-52, December 2005.

FUNCTIONAL DESCRIPTION: ViSP provides simple ways to integrate and validate new algorithms with already existing tools. It follows a module-based software engineering design where data types, algorithms, sensors, viewers and user interaction are made available. Written in C++, ViSP is based on open-source cross-platform libraries (such as OpenCV) and builds with CMake. Several platforms are supported, including OSX, iOS, Windows and Linux. ViSP online documentation allows to ease learning. More than 280 fully documented classes organized in 17 different modules, with more than 300 examples and 64 tutorials are proposed to the user. ViSP is released under a dual licensing model. It is open-source with a GNU GPLv2 license. A professional edition license that replaces GNU GPLv2 is also available.

- Participants: Aurélien Yol, Éric Marchand, Fabien Spindler, François Chaumette and Souriya Trinh
- Partner: Université de Rennes 1
- Contact: Fabien Spindler
- URL: http://visp.inria.fr

6.8. Platforms

6.8.1. *Robot Vision Platform*

Participant: Fabien Spindler [contact].

We exploit two industrial robotic systems built by Afma Robots in the nineties to validate our researches in visual servoing and active vision. The first one is a 6 DoF Gantry robot, the other one is a 4 DoF cylindrical robot (see Fig. 2 .a). These robots are equipped with cameras. The Gantry robot also allows embedding grippers on its end-effector.

We are also using a haptic Virtuose 6D device from Haption company (see Fig. 2 .b). This device is used as master device in many of our shared control activities (see Sections 9.3.1.3 , 7.3.3 , and 7.3.4).

Note that eight papers published by Lagadic in 2017 enclose results validated on this platform [35], [37], [15], [63], [58], [48], [51], [52].

6.8.2. *Mobile Robots*

Participants: Fabien Spindler [contact], Marie Babel, Patrick Rives.

6.8.2.1. *Indoor Mobile Robots*

For fast prototyping of algorithms in perception, control and autonomous navigation, the team uses Hannibal in Sophia Antipolis, a cart-like platform built by Neobotix (see Fig. 3 .a), and, in Rennes, a Pioneer 3DX from Adept (see Fig. 3 .b). These platforms are equipped with various sensors needed for SLAM purposes, autonomous navigation, and sensor-based control.

Moreover, to validate the researches in personally assisted living topic (see Section 7.5.3), we have three electric wheelchairs in Rennes, one from Permobil, one from Sunrise and the last from YouQ (see Fig. 3 .c). The control of the wheelchair is performed using a plug and play system between the joystick and the low level control of the wheelchair. Such a system lets us acquire the user intention through the joystick position and control the wheelchair by applying corrections to its motion. The wheelchairs have been fitted with cameras and ultrasound sensors to perform the required servoing for assisting handicapped people.

Note that five papers exploiting the indoors mobile robots were published this year [15], [30], [31], [53], [60].

6.8.2.2. *Outdoor Vehicles*

A camera rig has been developed in Sophia Antipolis. It can be fixed to a standard car (see Fig. 4), which is driven at a variable speed depending on the road/traffic conditions, with an average speed of 30 km/h and a maximum speed of 80 km/h. The sequences are recorded at a frame rate of 20 Hz, whith a synchronization of the six global shutter cameras of the stereo system, producing spherical images with a resolution of 2048x665 pixels (see Fig. 4). Such sequences are fused offline to obtain maps that can be used later for localization or for scene rendering (in a similar fashion to Google Street View) as shown in the video http://www-sop.inria.fr/members/Renato-Jose.Martins/iros15.html.
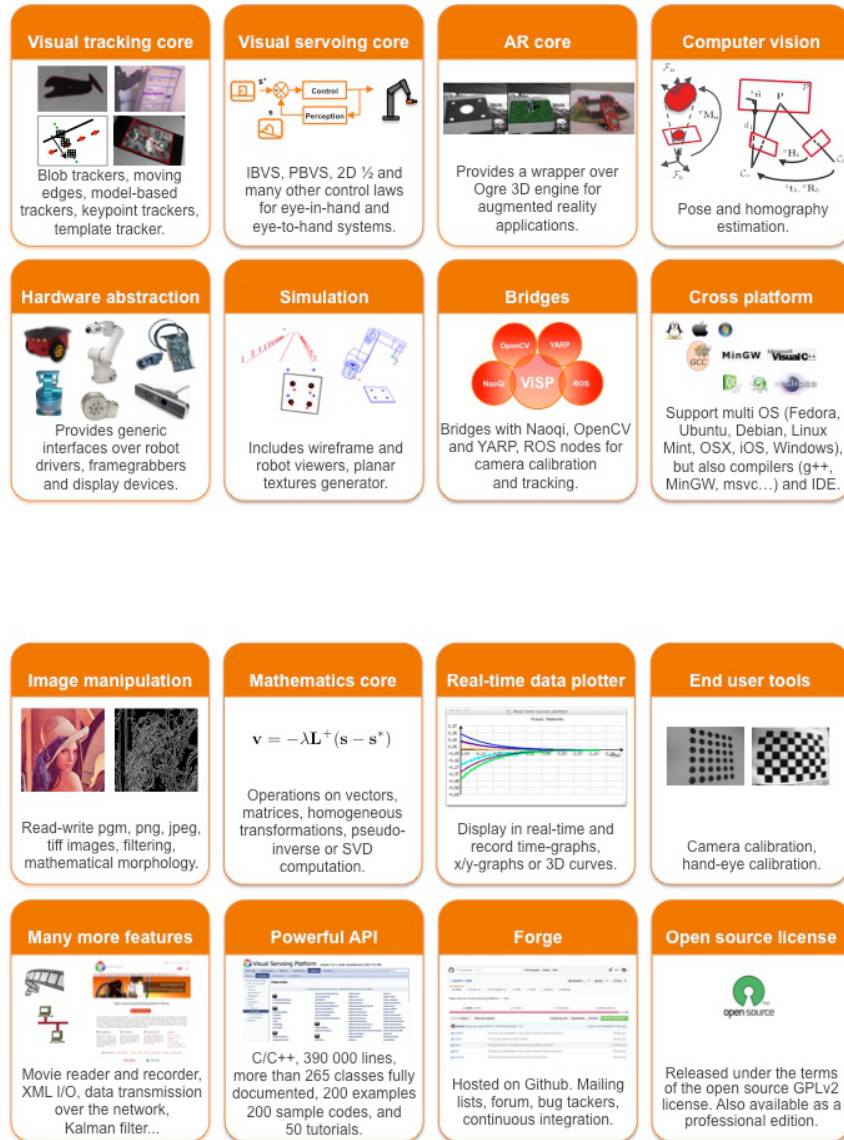
Figure 1. This figure highlights ViSP main capabilities for visual tracking, visual servoing, and augmented reality that may benefit from computer vision algorithms. ViSP allows controlling specific platforms through hardware abstraction or in simulation. ViSP provides also bridges over other frameworks such as OpenCV and ROS. All these capabilities are cross-platform. Moreover, for easing the prototyping of applications, ViSP provides tools for image manipulation, mathematics, data plotting, camera calibration, and many other features. ViSP powerful API is fully documented and available on Github as an open source software under GPLv2 license.
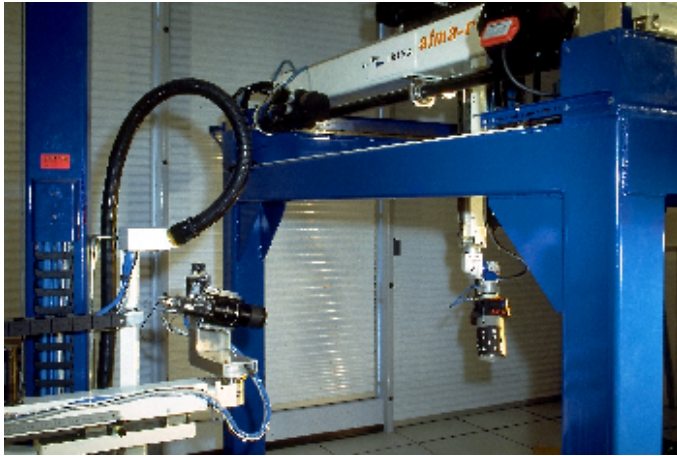
(a)

(b)

Figure 2. a) Lagadic robotics platform for vision-based manipulation, b) Virtuose 6D haptic device

6.8.3. Medical Robotic Platform

Participants: Marc Pouliquen, Fabien Spindler [contact], Alexandre Krupa.

This platform is composed by two 6 DoF Adept Viper arms (see Fig. 5 .a). Ultrasound probes connected either to a SonoSite 180 Plus or an Ultrasonix SonixTouch imaging system can be mounted on a force torque sensor attached to each robot end-effector. The haptic Virtuose 6D device (see Fig. 2 .b) can also be used within this platform.

This testbed is of primary interest for researches and experiments concerning ultrasound visual servoing applied to probe positioning, soft tissue tracking, elastography or robotic needle insertion tasks (see Section 7.3).

Note that seven papers published this year include experimental results obtained with this platform [56], [57], [72], [33], [19], [48], [37]

6.8.4. Humanoid Robots

**Participants:** Giovanni Claudio, Fabien Spindler [contact].

Romeo is a humanoid robot from SoftBank Robotics which is intended to be a genuine personal assistant and companion. Only the upper part of the body (trunk, arms, neck, head, eyes) is working. This research platform is used to validate our researches in visual servoing and visual tracking for object manipulation (see Fig. 6 .a).

Last year, this platform was extended with Pepper, another human-shaped robot designed by SoftBank Robotics to be a genuine day-to-day companion (see Fig. 6 .b). It has 17 DoF mounted on a wheeled holonomic base and a set of sensors (cameras, laser, ultrasound, inertial, microphone) that makes this platform interesting for researches in vision-based manipulation, and visual navigation (see Section 7.5.1).

Note that two papers published this year include experimental results obtained with these platforms [13], [60].

6.8.5. Unmanned Aerial Vehicles (UAVs)

Participants: Thomas Bellavoir, Pol Mordel, Paolo Robuffo Giordano [contact].
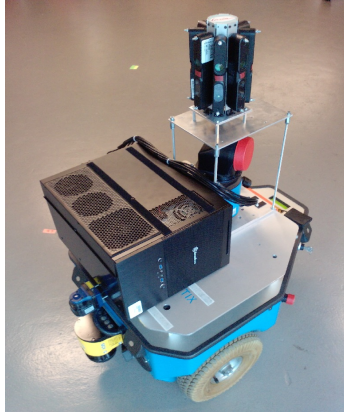
(a)

(b)

(c)

Figure 3. a) Hannibal platform, b) Pioneer P3-DX robot, c) wheelchairs from Permobil, Sunrise and YouQ.

Figure 4. Globeye stereo sensor and acquisition system.

(a)   (b)
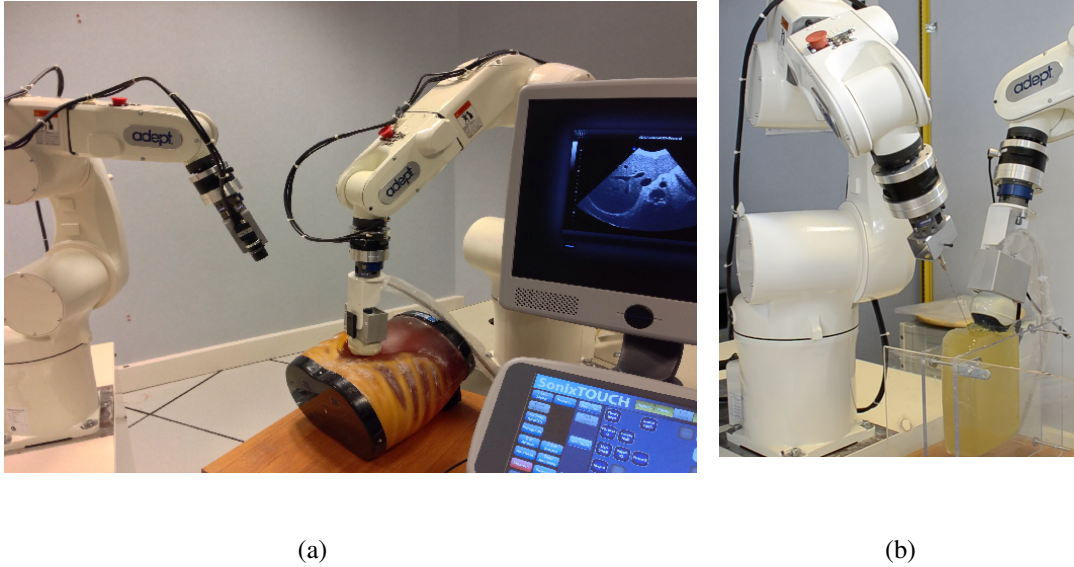
Figure 5. a) Lagadic medical robotic platforms. On the right Viper S850 robot arm equipped with a SonixTouch 3D ultrasound probe. On the left Viper S650 equipped with a tool changer that allows to attach a classical camera or biopsy needles. b) Robotic setup for autonomous needle insertion by visual servoing.
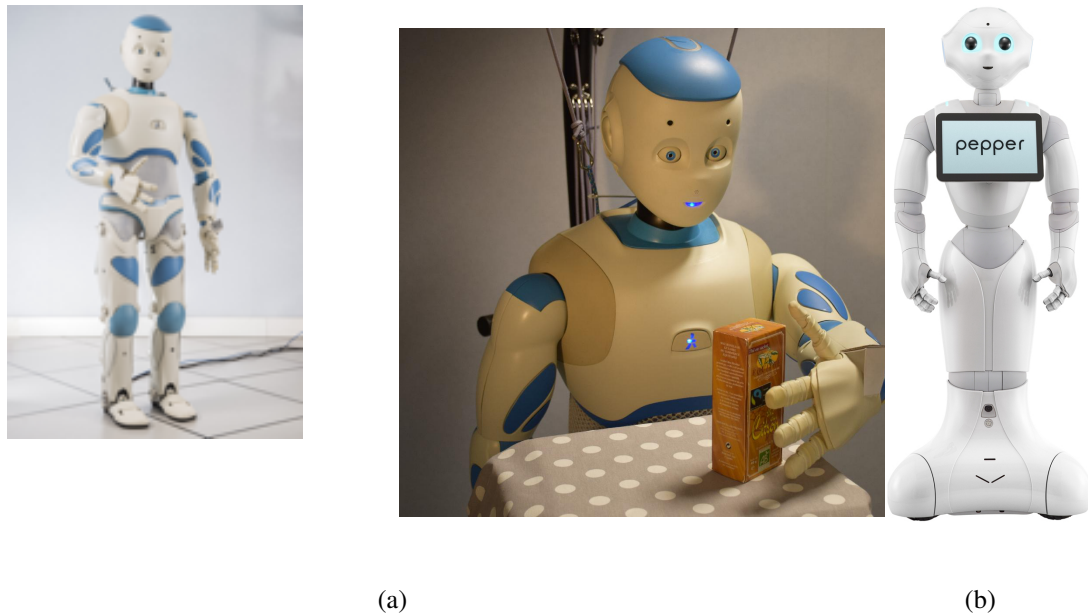

(a)   (b)

Figure 6. a) Romeo experimental platform, b) Pepper human-shaped robot

From 2014, Lagadic also started some activities involving perception and control for single and multiple quadrotor UAVs, especially thanks to a grant from "Rennes Métropole" (see Section 9.1.4) and the ANR project "SenseFly" (see Section 9.2.5). To this end, we purchased four quadrotors from Mikrokopter Gmbh, Germany (see Fig. 7 .a), and one quadrotor from 3DRobotics, USA (see Fig. 7 .b). The Mikrokopter quadrotors have been heavily customized by: (i) reprogramming from scratch the low-level attitude controller onboard the microcontroller of the quadrotors, (ii) equipping each quadrotor with an Odroid XU4 board (see Fig. 7 .d) running Linux Ubuntu and the TeleKyb software (the middleware used for managing the experiment flows and the communication among the UAVs and the base station), and (iii) purchasing the Flea Color USB3 cameras together with the gimbal needed to mount them on the UAVs (see Fig. 7 .c). The quadrotor group is used as robotic platforms for testing a number of single and multiple flight control schemes with a special attention on the use of onboard vision as main sensory modality.

This year four papers published enclose experimental results obtained with this platform [49], [50], [42], [62].

(a)

(b)

(c)

(d)

Figure 7. a) Quadrotor XL1 from Mikrokopter, b) Quadrotor Iris from 3DRobotics, c) Flea Color USB3 camera, d) Odroid XU4 board

<p style="text-align:center; color:red;">**LINKMEDIA Project-Team**</p>

6. New Software and Platforms

6.1. Platforms

6.1.1. A‖GO multimedia web services

Participants: Vincent Claveau, Clément Dalloux, Guillaume Gravier [correspondent], Gabriel Sargent.

Available at http://allgo.irisa.fr, the A‖GO platform allows for the easy deployment of the technology developed in the team as web services. Based on the A‖GO infrastructure, LINKMEDIA has continued making available a number of web services related to multimedia content analysis. In 2017, we continued our effort towards the interoperability of the services available (silence detection, face detection, text-based fragmentation) and added speaker diarization and negative sentence detection services.

MIMETIC Project-Team

6. New Software and Platforms

6.1. AsymGait

Asymmetry index for clinical gait analysis based on depth images

KEYWORDS: Motion analysis - Kinect - Clinical analysis

SCIENTIFIC DESCRIPTION: The system uses depth images delivered by the Microsoft Kinect to retrieve the gait cycles first. To this end it is based on a analyzing the knees trajectories instead of the feet to obtain more robust gait event detection. Based on these cycles, the system computes a mean gait cycle model to decrease the effect of noise of the system. Asymmetry is then computed at each frame of the gait cycle as the spatial difference between the left and right parts of the body. This information is computed for each frame of the cycle.

FUNCTIONAL DESCRIPTION: AsymGait is a software package that works with Microsoft Kinect data, especially depth images, in order to carry-out clinical gait analysis. First it identifies the main gait events using the depth information (footstrike, toe-off) to isolate gait cycles. Then it computes a continuous asymmetry index within the gait cycle. Asymmetry is viewed as a spatial difference between the two sides of the body.

- Participants: Edouard Auvinet and Franck Multon
- Contact: Franck Multon

6.2. Cinematic Viewpoint Generator

KEYWORD: 3D animation

FUNCTIONAL DESCRIPTION: The software, developed as an API, provides a mean to automatically compute a collection of viewpoints over one or two specified geometric entities, in a given 3D scene, at a given time. These viewpoints satisfy classical cinematographic framing conventions and guidelines including different shot scales (from extreme long shot to extreme close-up), different shot angles (internal, external, parallel, apex), and different screen compositions (thirds,fifths, symmetric of di-symmetric). The viewpoints allow to cover the range of possible framings for the specified entities. The computation of such viewpoints relies on a database of framings that are dynamically adapted to the 3D scene by using a manifold parametric representation and guarantee the visibility of the specified entities. The set of viewpoints is also automatically annotated with cinematographic tags such as shot scales, angles, compositions, relative placement of entities, line of interest.

- Participants: Christophe Lino, Emmanuel Badier and Marc Christie
- Partners: Université d'Udine - Université de Nantes
- Contact: Marc Christie

6.3. Directors Lens Motion Builder

KEYWORDS: Previzualisation - Virtual camera - 3D animation

FUNCTIONAL DESCRIPTION: Directors Lens Motion Builder is a software plugin for Autodesk's Motion Builder animation tool. This plugin features a novel workflow to rapidly prototype cinematographic sequences in a 3D scene, and is dedicated to the 3D animation and movie previsualization industries. The workflow integrates the automated computation of viewpoints (using the Cinematic Viewpoint Generator) to interactively explore different framings of the scene, proposes means to interactively control framings in the image space, and proposes a technique to automatically retarget a camera trajectory from one scene to another while enforcing visual properties. The tool also proposes to edit the cinematographic sequence and export the animation. The software can be linked to different virtual camera systems available on the market.

- Participants: Christophe Lino, Emmanuel Badier and Marc Christie
- Partner: Université de Rennes 1
- Contact: Marc Christie

6.4. Kimea

Kinect IMprovement for Egronomics Assessment

KEYWORDS: Biomechanics - Motion analysis - Kinect

SCIENTIFIC DESCRIPTION: Kimea consists in correcting skeleton data delivered by a Microsoft Kinect in an ergonomics purpose. Kimea is able to manage most of the occlultations that can occur in real working situation, on workstations. To this end, Kimea relies on a database of examples/poses organized as a graph, in order to replace unreliable body segments reconstruction by poses that have already been measured on real subject. The potential pose candidates are used in an optimization framework.

FUNCTIONAL DESCRIPTION: Kimea gets Kinect data as input data (skeleton data) and correct most of measurement errors to carry-out ergonomic assessment at workstation.

- Participants: Franck Multon, Hubert Shum and Pierre Plantard

- Partner: Faurecia

- Contact: Franck Multon

- Publications: Usability of corrected Kinect measurement for ergonomic evaluation in constrained environment - Validation of an ergonomic assessment method using Kinect data in real workplace conditions - Ergonomics Measurements using Kinect with a Pose Correction Framework - Filtered Pose Graph for Efficient Kinect Pose Reconstruction - Reliability of Kinect measurements for assessing the movement of operators in ergonomic studies

6.5. Populate

KEYWORDS: Behavior modeling - Agent - Scheduling

SCIENTIFIC DESCRIPTION: The software provides the following functionalities:

- A high level XML dialect that is dedicated to the description of agents activities in terms of tasks and sub activities that can be combined with different kind of operators: sequential, without order, interlaced. This dialect also enables the description of time and location constraints associated to tasks.

- An XML dialect that enables the description of agent's personal characteristics.

- An informed graph describes the topology of the environment as well as the locations where tasks can be performed. A bridge between TopoPlan and Populate has also been designed. It provides an automatic analysis of an informed 3D environment that is used to generate an informed graph compatible with Populate.

- The generation of a valid task schedule based on the previously mentioned descriptions.

With a good configuration of agents characteristics (based on statistics), we demonstrated that tasks schedules produced by Populate are representative of human ones. In conjunction with TopoPlan, it has been used to populate a district of Paris as well as imaginary cities with several thousands of pedestrians navigating in real time.

FUNCTIONAL DESCRIPTION: Populate is a toolkit dedicated to task scheduling under time and space constraints in the field of behavioral animation. It is currently used to populate virtual cities with pedestrian performing different kind of activities implying travels between different locations. However the generic aspect of the algorithm and underlying representations enable its use in a wide range of applications that need to link activity, time and space. The main scheduling algorithm relies on the following inputs: an informed environment description, an activity an agent needs to perform and individual characteristics of this agent. The algorithm produces a valid task schedule compatible with time and spatial constraints imposed by the activity description and the environment. In this task schedule, time intervals relating to travel and task fulfillment are identified and locations where tasks should be performed are automatically selected.

- Participants: Carl-Johan Jorgensen and Fabrice Lamarche
- Contact: Fabrice Lamarche

6.6. The Theater

KEYWORDS: 3D animation - Interactive Scenarios
FUNCTIONAL DESCRIPTION: The Theater is a software framework to develop interactive scenarios in virtual 3D environements. The framework provides means to author and orchestrate 3D character behaviors and simulate them in real-time. The tools provides a basis to build a range of 3D applications, from simple simulations with reactive behaviors, to complex storytelling applications including narrative mechanisms such as flashbacks.

- Participant: Marc Christie
- Contact: Marc Christie

6.7. CusToM

Customizable Toolbox for Musculoskeletal simulation
KEYWORDS: Biomechanics - Dynamic Analysis - Kinematics - Simulation - Mechanical multi-body systems
SCIENTIFIC DESCRIPTION: The present toolbox aims at performing a motion analysis thanks to an inverse dynamics method.

Before performing motion analysis steps, a musculoskeletal model is generated. Its consists of, first, generating the desire anthropometric model thanks to models libraries. The generated model is then kinematical calibrated by using data of a motion capture. The inverse kinematics step, the inverse dynamics step and the muscle forces estimation step are then successively performed from motion capture and external forces data. Two folders and one script are available on the toolbox root. The Main script collects all the different functions of the motion analysis pipeline. The Functions folder contains all functions used in the toolbox. It is necessary to add this folder and all the subfolders to the Matlab path. The Problems folder is used to contain the different study. The user has to create one subfolder for each new study. Once a new musculoskeletal model is used, a new study is necessary. Different files will be automaticaly generated and saved in this folder. All files located on its root are related to the model and are valuable whatever the motion considered. A new folder will be added for each new motion capture. All files located on a folder are only related to this considered motion.
FUNCTIONAL DESCRIPTION: Inverse kinematics Inverse dynamics Muscle forces estimation External forces prediction

- Participants: Antoine Muller, Charles Pontonnier and Georges Dumont
- Contact: Antoine Muller

6.8. MotionGraphVR

KEYWORDS: Virtual reality - Motion capture - Movement analysis
FUNCTIONAL DESCRIPTION: MotionGraphVR is a tool enabling users to automatically create motion graphs in Unity. It is particularly targeting Virtual Reality applications, where with the development of Head Mounted Displays users are now unable to see their real body unless they use expensive motion capture system, or animation techniques (e.g., Inverse Kinematics) which suffer from a lack of visual realism. To lever these limitations, MotionGraphVR automatically builds a graph of human motions from a set of examples captured on a real actor, and identify which motion path is the graph is closest to the user's actions. Additionally, this plugin also provides analysing tools to allow developers of VR applications to visualise similarities between movements to use in their applications before seamlessly connecting them in Motion Graphs.

- Participants: Tiffany Luong, Ludovic Hoyet and Fernando Argelaguet Sanz
- Contact: Ludovic Hoyet

6.9. Platforms

6.9.1. Immerstar Platform

Participants: Georges Dumont [contact], Ronan Gaugne, Anthony Sorel, Richard Kulpa.

With the two platforms of virtual reality, Immersia and Immermove, grouped under the name Immerstar, the team has access to high level scientific facilities. This equipment benefits the research teams of the center and has allowed them to extend their local, national and international collaborations. The Immerstar platform is granted by a Inria CPER funding for 2015-2019 that enables important evolutions of the equipment. In 2016, the first technical evolutions have been decided and, in 2017, these evolutions have been implemented. On one side, for Immermove, the addition of a third face to the immersive space, and the extension of the Vicon tracking system have been realized. And, on the second side, for Immersia, the installation of WQXGA laser projectors with augmented global resolution, of a new tracking system with higher frequency and of new computers for simulation and image generation.

MYRIADS Project-Team

6. New Software and Platforms

6.1. ConPaaS

KEYWORDS: Cloud computing - PaaS
SCIENTIFIC DESCRIPTION: Contact:

Guillaume Pierre, Guillaume.Pierre@irisa.fr URL:

http://www.conpaas.eu/ Status:

Version 1.4.2 License:

BSD Presentation:

ConPaaS [60] is a runtime environment for hosting applications in the cloud. It aims at offering the full power of the cloud to application developers while shielding them from the associated complexity of the cloud. ConPaaS is designed to host both high-performance scientific applications and online Web applications. It automates the entire life-cycle of an application, including collaborative development, deployment, performance monitoring, and automatic scaling. This allows developers to focus their attention on application-specific concerns rather than on cloud-specific details. Active contributors (from the Myriads team):

Eliya Buyukkaya, Ancuta Iordache, Morteza Neishaboori, Guillaume Pierre, Dzenan Softic, Genc Tato, Teodor Crivat. Impact:

ConPaaS is recognized as one of the major open-source PaaS environments. It is being developed by teams in Rennes, Amsterdan, Berlin and Ljubljana. Technology transfer of ConPaaS technology is ongoing in the context of the MC-DATA EIT ICT Labs project.

FUNCTIONAL DESCRIPTION: ConPaaS is a runtime environment for hosting applications in the cloud. It aims at offering the full power of the cloud to application developers while shielding them from the associated complexity of the cloud. ConPaaS is designed to host both high-performance scientific applications and online Web applications. It automates the entire life-cycle of an application, including collaborative development, deployment, performance monitoring, and automatic scaling. This allows developers to focus their attention on application-specific concerns rather than on cloud-specific details.

- Participants: Ancuta Iordache, Dzenan Softic, Eliya Buyukkaya, Genc Tato, Guillaume Pierre, Morteza Neishaboori and Teodor Crivat
- Contact: Guillaume Pierre
- URL: http://www.conpaas.eu/

6.2. GinFlow

KEYWORDS: Dynamic adaptation - Distributed Applications - Distributed - Distributed computing - Workflow - Framework
FUNCTIONAL DESCRIPTION: GinFlow decentralizes the coordination of the execution of workflow-based applications. GinFlow relyies on an architecture where multiple service agents (SA) coordinate each others through a shared space containing the workflow description and current status. GinFlow allows the user to define several variants of a workflow and to switch from one to the other during run time.

- Participants: Cédric Tedeschi, Hector Fernandez, Javier Rojas Balderrama, Matthieu Simonin and Thierry Priol
- Partner: Université de Rennes 1
- Contact: Cédric Tedeschi
- URL: http://ginflow.inria.fr

6.3. Merkat

FUNCTIONAL DESCRIPTION: Merkat is a platform that allows users of an organization to automatically manage and scale their applications while maximizing the infrastructure's utilization. Merkat is generic and extensible, allowing users to automate the application deployment and management process. Users have the flexibility to control how many resources are allocated to their applications and to define their own resource demand adaptation policies. Merkat applies an unique approach to multiplex the infrastructure capacity between the applications, by implementing a proportional-share market and allowing applications to adapt autonomously to resource price and their given performance objectives. The price of the acquired resources acts as a control mechanism to ensure that resources are distributed to applications according to the user's value for them. Merkat was evaluated on Grid'5000 with several scientific applications.

- Participants: Christine Morin, Nikolaos Parlavantzas and Stefania Costache
- Contact: Nikolaos Parlavantzas
- URL: http://www.irisa.fr/myriads/software/Merkat/

6.4. PaaSage Adapter

KEYWORDS: Cloud computing - Dynamic adaptation - Cloud applications management
FUNCTIONAL DESCRIPTION: The purpose of the Adapter is to transform the current configuration of a cloud application into a target configuration in an efficient and safe way. The Adapter is part of PaaSage, an open-source platform for modeling, deploying and executing applications on different clouds in an optimal manner. The Adapter has the following responsibilities: (1) validating reconfiguration plans, (2) applying the plans to the running system, and (3) maintaining an up-to-date representation of the current system state.

- Contact: Nikolaos Parlavantzas
- URL: https://team.inria.fr/myriads/software-and-platforms/paasage-adapter/

6.5. SAIDS

self-adaptable intrusion detection system
KEYWORDS: Cloud - Security
FUNCTIONAL DESCRIPTION: SAIDS is a self-adaptable intrusion detection system for IaaS clouds. To maintain an effective level of intrusion detection, SAIDS monitors changes in the virtual infrastructure of a Cloud environment and reconfigures its components (security probes) accordingly. SAIDS can also reconfigure probes in the case of a change in the list of running services.

- Authors: Anna Giannakou and Jean-Léon Cusinato
- Contact: Christine Morin

6.6. SimGrid

KEYWORDS: Large-scale Emulators - Grid Computing - Distributed Applications
SCIENTIFIC DESCRIPTION: SimGrid is a toolkit that provides core functionalities for the simulation of distributed applications in heterogeneous distributed environments. The simulation engine uses algorithmic and implementation techniques toward the fast simulation of large systems on a single machine. The models are theoretically grounded and experimentally validated. The results are reproducible, enabling better scientific practices.

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

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

RELEASE FUNCTIONAL DESCRIPTION:

- Four releases in 2017. Major changes:
    - S4U: many progress, toward SimGrid v4.0. About 80% of the features offered by SimDag and MSG are now integrated, along with examples. Users can now write plugins to extend SimGrid.
    - SMPI: Support MPI 2.2, RMA support, Convert internals to C++.
    - Java: Massive memleaks and performance issues fixed.
    - New models: Multi-core VMs, Energy consumption due to the network
    - All internals are now converted to C++, and most of our internally developed data containers were replaced with std::* constructs.
    - (+ bug fixes, cleanups and documentation improvements)
- Participants: Adrien Lèbre, Arnaud Legrand, Augustin Degomme, Florence Perronnin, Frédéric Suter, Jean-Marc Vincent, Jonathan Pastor, Jonathan Rouzaud-Cornabas, Luka Stanisic, Mario Südholt and Martin Quinson
- Partners: CNRS - ENS Rennes
- Contact: Martin Quinson
- URL: http://simgrid.gforge.inria.fr/

6.7. DiFFuSE

Distributed framework for cloud-based epidemic simulations

KEYWORDS: Simulation - Cloud

FUNCTIONAL DESCRIPTION: The DiFFuSE framework enables simulations of epidemics to take full advantage of cloud environments. The framework provides design support, reusable code, and tools for building and executing epidemic simulations. Notably, the framework automatically handles failures and supports elastic allocation of resources from multiple clouds.

- Contact: Nikolaos Parlavantzas
- URL: https://team.inria.fr/myriads/software-and-platforms/diffuse/

PACAP Project-Team

5. New Software and Platforms

5.1. ATMI

KEYWORDS: Analytic model - Chip design - Temperature

SCIENTIFIC DESCRIPTION: Research on temperature-aware computer architecture requires a chip temperature model. General purpose models based on classical numerical methods like finite differences or finite elements are not appropriate for such research, because they are generally too slow for modeling the time-varying thermal behavior of a processing chip.

We have developed an ad hoc temperature model, ATMI (Analytical model of Temperature in MIcroprocessors), for studying thermal behaviors over a time scale ranging from microseconds to several minutes. ATMI is based on an explicit solution to the heat equation and on the principle of superposition. ATMI can model any power density map that can be described as a superposition of rectangle sources, which is appropriate for modeling the microarchitectural units of a microprocessor.

FUNCTIONAL DESCRIPTION: ATMI is a library for modelling steady-state and time-varying temperature in microprocessors. ATMI uses a simplified representation of microprocessor packaging.

- Participant: Pierre Michaud
- Contact: Pierre Michaud
- URL: https://team.inria.fr/pacap/software/atmi/

5.2. HEPTANE

KEYWORDS: IPET - WCET - Performance - Real time - Static analysis - Worst Case Execution Time
SCIENTIFIC DESCRIPTION: WCET estimation

Status: Registered with APP (Agence de Protection des Programmes). Available under GNU General Public License v3, with number IDDN.FR.001.510039.000.S.P.2003.000.10600.

The aim of Heptane is to produce upper bounds of the execution times of applications. It is targeted at applications with hard real-time requirements (automotive, railway, aerospace domains). Heptane computes WCETs using static analysis at the binary code level. It includes static analyses of microarchitectural elements such as caches and cache hierarchies.

For more information, please contact Damien Hardy or Isabelle Puaut.

FUNCTIONAL DESCRIPTION: In a hard real-time system, it is essential to comply with timing constraints, and Worst Case Execution Time (WCET) in particular. Timing analysis is performed at two levels: analysis of the WCET for each task in isolation taking account of the hardware architecture, and schedulability analysis of all the tasks in the system. Heptane is a static WCET analyser designed to address the first issue.

- Participants: Benjamin Lesage, Loïc Besnard, Damien Hardy, François Joulaud, Isabelle Puaut and Thomas Piquet
- Partner: Université de Rennes 1
- Contact: Isabelle Puaut
- URL: https://team.inria.fr/pacap/software/heptane/

5.3. tiptop

KEYWORDS: Instructions - Cycles - Cache - CPU - Performance - HPC - Branch predictor
SCIENTIFIC DESCRIPTION: Tiptop is written in C. It can take advantage of libncurses when available for pseudo-graphic display.

Performance, hardware counters, analysis tool.

Status: Registered with APP (Agence de Protection des Programmes). Available under GNU General Public License v2, with number IDDN.FR.001.450006.000.S.P.2011.000.10800. Current version is 2.3.1, released October 2017.

Tiptop has been integrated in major Linux distributions, such as Fedora, Debian, Ubuntu.

Tiptop is a new simple and flexible user-level tool that collects hardware counter data on Linux platforms (version 2.6.31+). The goal is to make the collection of performance and bottleneck data as simple as possible, including simple installation and usage. In particular, we stress the following points.

Installation is only a matter of compiling the source code. No patching of the Linux kernel is needed, and no special-purpose module needs to be loaded.

No privilege is required, any user can run tiptop

FUNCTIONAL DESCRIPTION: Today's microprocessors have become extremely complex. To better understand the multitude of internal events, manufacturers have integrated many monitoring counters. Tiptop can be used to collect and display the values from these performance counters very easily. Tiptop may be of interest to anyone who wants to optimise the performance of their HPC applications.

- Participant: Erven Rohou
- Contact: Erven Rohou
- URL: http://tiptop.gforge.inria.fr

5.4. PADRONE

KEYWORDS: Legacy code - Optimization - Performance analysis - Dynamic Optimization

FUNCTIONAL DESCRIPTION: Padrone is new platform for dynamic binary analysis and optimization. It provides an API to help clients design and develop analysis and optimization tools for binary executables. Padrone attaches to running applications, only needing the executable binary in memory. No source code or debug information is needed. No application restart is needed either. This is especially interesting for legacy or commercial applications, but also in the context of cloud deployment, where actual hardware is unknown, and other applications competing for hardware resources can vary. The profiling overhead is minimum.

- Participants: Emmanuel Riou and Erven Rohou
- Contact: Erven Rohou
- URL: https://team.inria.fr/alf/software/padrone

5.5. If-memo

KEYWORD: Performance

SCIENTIFIC DESCRIPTION: We propose a linker based technique for enabling software memorizing of any dynamically linked pure function by function interception and we illustrate our framework using a set of computationally expensive pure functions - the transcendental functions. Our technique does not need the availability of source code and thus can even be applied to commercial applications as well as applications with legacy codes. As far as users are concerned, enabling memoization is as simple as setting an environment variable. Our framework does not make any specific assumptions about the underlying architecture or compiler too-chains, and can work with a variety of current architectures.

- Participants: Arjun Suresh and Erven Rohou
- Contact: Erven Rohou
- URL: https://team.inria.fr/alf/software/if-memo/

5.6. Simty

KEYWORDS: RISC-V - Multi-threading - SIMT - FPGA - Softcore - GPU

FUNCTIONAL DESCRIPTION: Simty is a massively multi-threaded processor core that dynamically assembles SIMD instructions from scalar multi-thread code. It runs the RISC-V (RV32-I) instruction set. Unlike existing SIMD or SIMT processors like GPUs, Simty takes binaries compiled for general-purpose processors without any instruction set extension or compiler changes. Simty is described in synthesizable VHDL.

- Author: Sylvain Collange
- Contact: Sylvain Collange
- URL: https://gforge.inria.fr/projects/simty

5.7. Barra

KEYWORDS: Performance - Computer architecture - Debug - Tesla ISA - GPU - Profiling - CUDA - HPC - Simulator - GPGPU

SCIENTIFIC DESCRIPTION: Research on throughout-oriented architectures demands accurate and representative models of GPU architectures in order to be able to evaluate new architectural ideas, explore design spaces and characterize applications. The Barra project is a simulator of the NVIDIA Tesla GPU architecture.

Barra builds upon knowledge acquired through micro-benchmarking, in order to provide a baseline model representative of industry practice. The simulator provides detailed statistics to identify optimization opportunities and is fully customizable to experiment ideas of architectural modifications. Barra incorporates both a functional model and a cycle-level performance model.

FUNCTIONAL DESCRIPTION: Barra is a Graphics Processing Unit (GPU) architecture simulator. It simulates NVIDIA CUDA programs at the assembly language level. Barra is a tool for research on computer architecture, and can also be used to debug, profile and optimize CUDA programs at the lowest level.

RELEASE FUNCTIONAL DESCRIPTION: Timing model Tesla-like architecture model Fermi-like architecture model New per-PC control-flow divergence management Simultaneous branch and warp interweaving Affine vector cache

- Participants: Alexandre Kouyoumdjian, David Defour, Fabrice Mouhartem and Sylvain Collange
- Partners: ENS Lyon - UPVD
- Contact: Sylvain Collange
- URL: http://barra.gforge.inria.fr/

PANAMA Project-Team

6. New Software and Platforms

6.1. VoiceHome Corpus

KEYWORDS: Audio - Source Separation

FUNCTIONAL DESCRIPTION: This corpus includes reverberated, noisy speech signals spoken by native French talkers in a lounge and recorded by an 8-microphone device at various angles and distances and in various noise conditions. Room impulse responses and noise-only signals recorded in various real rooms and homes and baseline speaker localization and enhancement software are also provided.

- Participants: Ewen Camberlein, Romain Lebarbenchon, Nancy Bertin and Frédéric Bimbot
- Contact: Nancy Bertin
- URL: http://voice-home.gforge.inria.fr/voiceHome_corpus.html

6.2. FAuST

KEYWORDS: Learning - Sparsity - Fast transform - Multilayer sparse factorisation

SCIENTIFIC DESCRIPTION: FAuST allows to approximate a given dense matrix by a product of sparse matrices, with considerable potential gains in terms of storage and speedup for matrix-vector multiplications.

FUNCTIONAL DESCRIPTION: Faust 1.x contains Matlab routines to reproduce experiments of the PANAMA team on learned fast transforms.

Faust 2.x contains a C++ implementation with Matlab / Python wrappers (work in progress).

NEWS OF THE YEAR: In 2017, new Matlab code for fast approximate Fourier Graph Transforms have been included. based on the approach described in the papers:

-Luc Le Magoarou, Rémi Gribonval, "Are There Approximate Fast Fourier Transforms On Graphs?", ICASSP 2016 .

-Luc Le Magoarou, Rémi Gribonval, Nicolas Tremblay, "Approximate fast graph Fourier transforms via multi-layer sparse approximations", IEEE Transactions on Signal and Information Processing over Networks,2017.

- Participants: Luc Le Magoarou, Nicolas Tremblay, Rémi Gribonval, Nicolas Bellot and Adrien Leman
- Contact: Rémi Gribonval
- Publications: Approximate fast graph Fourier transforms via multi-layer sparse approximations - Analyzing the Approximation Error of the Fast Graph Fourier Transform - Flexible Multi-layer Sparse Approximations of Matrices and Applications - Are There Approximate Fast Fourier Transforms On Graphs? - Efficient matrices for signal processing and machine learning - FAμST: speeding up linear transforms for tractable inverse problems - Chasing butterflies: In search of efficient dictionaries - Multi-layer Sparse Matrix Factorization
- URL: http://faust.inria.fr/

6.3. SketchMLBox

KEYWORD: Clustering

SCIENTIFIC DESCRIPTION: The SketchMLbox is a Matlab toolbox for fitting mixture models to large collections of training vectors using sketching techniques. The collection is first compressed into a vector called sketch, then a mixture model (e.g. a Gaussian Mixture Model) is estimated from this sketch using greedy algorithms typical of sparse recovery. The size of the sketch does not depend on the number of elements in the collection, but rather on the complexity of the problem at hand [2,3]. Its computation can be massively parallelized and distributed over several units. It can also be maintained in an online setting at low cost. Mixtures of Diracs ("K-means") and Gaussian Mixture Models with diagonal covariance are currently available, the toolbox is structured so that new mixture models can be easily implemented

FUNCTIONAL DESCRIPTION: Matlab toolbox for fitting mixture models to large databases using sketching techniques.

- Authors: Nicolas Keriven, Nicolas Tremblay and Rémi Gribonval
- Partner: Université de Rennes 1
- Contact: Rémi Gribonval
- Publications: Sketching for Large-Scale Learning of Mixture Models - Compressive K-means - Spikes super-resolution with random Fourier sampling - Sketching for large-scale learning of mixture models - Blind Source Separation Using Mixtures of Alpha-Stable Distributions - Sketching for Large-Scale Learning of Mixture Models - Compressive Gaussian Mixture Estimation by Orthogonal Matching Pursuit with Replacement
- URL: http://sketchml.gforge.inria.fr

6.4. SPADE

Sparse Audio Declipper

KEYWORDS: Audio - Sparse regularization - Declipping

SCIENTIFIC DESCRIPTION: SPADE (the Sparse Audio Declipper) allows to reproduce audio declipping experiments from the papers:

- Srdan Kitic, Nancy Bertin, Remi Gribonval. Audio Declipping by Cosparse Hard Thresholding. iTwist - 2nd international - Traveling Workshop on Interactions between Sparse models and Technology, Aug 2014, Namur, Belgium.

- Srdan Kitic, Nancy Bertin, Remi Gribonval. Sparsity and cosparsity for audio declipping: a flexible non-convex approach. LVA/ICA 2015 - The 12th International Conference on Latent Variable Analysis and Signal Separation, Aug 2015, Liberec, Czech Republic.

FUNCTIONAL DESCRIPTION: SPADE is a declipping algorithm developed by the PANAMA project-team. To the best of our knowledge SPADE achieves state-of-the-art audio declipping quality. Real-time processing of audio streams is possible.

The web site http://spade.inria.fr provides example audio files and allows users to test SPADE on their own files, either by downloading Matlab routines or using Inria's software demonstration platform, Al∥go, to test it on the web.

NEWS OF THE YEAR: In 2017, a web interface to demonstrate the potential of SPADE has been setup using the Al∥go platform.

- Participants: Nancy Bertin, Clement Gaultier, Ewen Camberlein, Romain Lebarbenchon, Rémi Gribonval and Srdan Kitic
- Contact: Rémi Gribonval
- Publications: Audio Declipping by Cosparse Hard Thresholding - Sparsity and cosparsity for audio declipping: a flexible non-convex approach
- URL: http://spade.inria.fr/

6.5. FASST

Flexible Audio Source Separation Toolbox

KEYWORD: Audio signal processing

SCIENTIFIC DESCRIPTION: FASST is a Flexible Audio Source Separation Toolbox, designed to speed up the conception and automate the implementation of new model-based audio source separation algorithms.

FASST 1.0 development was achieved by the METISS team in Rennes and is now deprecated.

FASST 2.1 (current version) development was jointly achieved by the PAROLE team in Nancy and the (former) TEXMEX team in Rennes through an Inria funded ADT (Action de Développement Technologique). PANAMA contributed to the development by coordinating and performing user tests, and to the dissemination in a Show-and-Tell ICASSP poster [58]. While the first implementation was in Matlab, the new implementation is in C++ (for core functions), with Matlab and Python user scripts. Version 2, including speedup and new features was released in 2014 and can be downloaded from http://bass-db.gforge.inria.fr/fasst/ .

A new version is currently under development in the PANAMA team through the Inria funded ADT "FFWD" (FASST For Wider Dissemination) and will be released in 2018.

FUNCTIONAL DESCRIPTION: FASST is a Flexible Audio Source Separation Toolbox designed to speed up the conception and automate the implementation of new model-based audio source separation algorithms. It is the only audio source separation software available to the public (QPL licence) which simultaneously exploits spatial and spectral cues on the sources to separate.

- Participants: Alexey Ozerov, Nancy Bertin, Ewen Camberlein, Romain Lebarbenchon, Emmanuel Vincent, Frédéric Bimbot and Yann Salaun
- Contact: Emmanuel Vincent
- URL: http://bass-db.gforge.inria.fr/fasst/

6.6. PHYSALIS

KEYWORDS: Source localization - Cosparsity

SCIENTIFIC DESCRIPTION: PHYSALIS (Physics-Driven Cosparse Analysis) gathers algorithms for (joint) source localization and estimation, expressed as inverse problems and addressed with co-sparse regularization. A particular emphasis is put on the acoustic and EEG settings.

FUNCTIONAL DESCRIPTION: PHYSALIS is distributed as a set of Matlab routines to reproduce experimental results from the Ph.D. thesis of Srdan Kitic.

NEWS OF THE YEAR: In 2017, the code of PHYSALIS has been packaged at the occasion of the writing of an overview chapter on co-sparse source localization.

- Participants: Laurent Albera, Nancy Bertin, Rémi Gribonval and Srdan Kitic
- Contact: Rémi Gribonval
- Publications: Physics-driven inverse problems made tractable with cosparse regularization - Cosparse regularization of physics-driven inverse problems - Versatile and scalable cosparse methods for physics-driven inverse problems - Hearing behind walls: localizing sources in the room next door with cosparsity - Sparse Acoustic Source Localization with Blind Calibration for Unknown Medium Characteristics - The best of both worlds: synthesis-based acceleration for physics-driven cosparse regularization
- URL: http://cosoloc.gforge.inria.fr/

SERPICO Project-Team

6. New Software and Platforms

6.1. ATLAS

KEYWORDS: Image segmentation - Object detection - Photonic imaging - Image analysis - Fluorescence microscopy

FUNCTIONAL DESCRIPTION: The ATLAS software enables to detect spots in 2D fluorescence images. The spot size is automatically selected and the detection threshold adapts to the local image contrasts. ATLAS relies on the Laplacian of Gaussian (LoG) filter, which both reduces noise and enhances spots. A multiscale representation of the image is built to automatically select the optimal LoG variance. Local statistics of the LoG image are estimated in a Gaussian window, and the detection threshold is pointwise inferred from a probability of false alarm (PFA). The user only has to specify: i/ size of the Gaussian window, ii/ PFA value. The Gaussian window must be about the size of the background structures, increasing the PFA increases the number of detections.

- Participants: Patrick Bouthemy, Charles Kervrann, Jean Salamero, Jérôme Boulanger and Antoine Basset
- Partner: UMR 144 CNRS - Institut Curie
- Contact: Patrick Bouthemy
- Publication: Adaptive spot detection with optimal scale selection in fluorescence microscopy images
- URL: http://mobyle-serpico.rennes.inria.fr/cgi-bin/portal.py#forms::ATLAS

6.2. C-CRAFT

KEYWORDS: Fluorescence microscopy - Photonic imaging - Image analysis - Detection - 3D - Health - Biology - Segmentation

FUNCTIONAL DESCRIPTION: The C-CRAFT software enables to jointly segment small particles and estimate background in 2D or 3D fluorescence microscopy image sequences. The vesicle segmentation and background estimation problem is formulated as a global energy minimization problem in the Conditional Random Field framework. A patch-based image representation is used to detect spatial irregularity in the image. An iterative scheme based on graph-cut algorithm is proposed for energy minimization.

- Participants: Patrick Bouthemy, Jean Salamero, Charles Kervrann and Thierry Pécot
- Partner: UMR 144 CNRS - Institut Curie
- Contact: Charles Kervrann
- Publication: Background Fluorescence Estimation and Vesicle Segmentation in Live Cell Imaging with Conditional Random Fields
- URL: http://mobyle-serpico.rennes.inria.fr/cgi-bin/portal.py#forms::C-CRAFT

6.3. F2D-SAFIR

KEYWORDS: Biomedical imaging - Photonic imaging - Fluorescence microscopy - Image processing

FUNCTIONAL DESCRIPTION: The F2D-SAFIR software removes mixed Gaussian-Poisson noise in large 2D images, typically 10000 x 10000 pixels, in a few seconds. The method is unsupervised and is a simplified version of the method related to the ND-SAFIR software. The software is dedicated to microarrays image denoising for disease diagnosis and multiple applications (gene expression, genotyping, aCGH, ChIP-chip, microRNA, ...).

- Participant: Charles Kervrann
- Partner: INRA
- Contact: Charles Kervrann

6.4. GcoPS

KEYWORDS: Photonic imaging - Fluorescence microscopy - Image processing - Statistic analysis
FUNCTIONAL DESCRIPTION: The GCOPS (Geo-Co-Positioning System) software is dedicated to the co-localization of fluorescence image pairs for both conventional and super-resolution microscopy. The procedure is only controlled by a p-value and tests whether the Pearson correlation between two binary images is significantly positive. It amounts to quantifying the interaction strength by the area/volume of the intersection between the two binary images viewed as random distributions of geometrical objects. Under mild assumptions, it turns out that the appropriately normalized Pearson correlation follows a standard normal distribution under the null hypothesis if the number of image pixels is large. Unlike previous methods, GcoPS handles 2D and 3D images, variable SNRs and any kind of cell shapes. It is able to co-localize large regions with small dots, as it is the case in TIRF-PALM experiments and to detect negative co-localization. The typical processing time is two milliseconds per image pair in 2D and a few seconds in 3D, with no dependence on the number of objects per image. In addition, the method provides maps to geo-co-localize molecule interactions in specific image regions.

- Participants: Frédéric Lavancier, Thierry Pécot and Liu Zengzhen
- Partners: Université de Nantes - UMR 144 CNRS - Institut Curie
- Contact: Charles Kervrann
- Publication: A Fast Automatic Colocalization Method for 3D Live Cell and Super-Resolution Microscopy
- URL: http://icy.bioimageanalysis.org/plugin/GcoPS

6.5. Hullkground

KEYWORDS: Biomedical imaging - Photonic imaging - Fluorescence microscopy - Image processing
FUNCTIONAL DESCRIPTION: The HullkGround software decomposes a fluorescence microscopy image sequence into two dynamic components: i) an image sequence showing mobile objects, ii) an image sequence showing the slightly moving background. Each temporal signal of the sequence is processed individually and analyzed with computational geometry tools. The convex hull is estimated automatically for each pixel and subtracted to the original signal. The method is unsupervised, requires no parameter tuning and is a simplified version of the shapes-based scale-space method.

- Participants: Anatole Chessel, Charles Kervrann and Jean Salamero
- Partner: UMR 144 CNRS - Institut Curie
- Contact: Charles Kervrann
- URL: http://mobyle-serpico.rennes.inria.fr/cgi-bin/portal.py#forms::Hullkground

6.6. Motion2D

KEYWORDS: Image sequence - Motion model - 2D

FUNCTIONAL DESCRIPTION: The Motion2D software is a multi-platform object-oriented library to estimate 2D parametric motion models in an image sequence. It can handle several types of motion models, namely, constant (translation), affine, and quadratic models. Moreover, it includes the possibility of accounting for a global variation of illumination and more recently for temporal image intensity decay (e.g. due to photo-bleaching decay in fluorescence microscopy). The use of such motion models has been proved adequate and efficient for solving problems such as optic flow computation, motion segmentation, detection of independent moving objects, object tracking, or camera motion estimation, and in numerous application domains (video surveillance, visual servoing for robots, video coding, video indexing), including biological imaging (image stack registration, motion compensation in videomicroscopy). Motion2D is an extended and optimized implementation of the robust, multi-resolution and incremental estimation method (exploiting only the spatio-temporal derivatives of the image intensity function). Real-time processing is achievable for motion models involving up to six parameters. Motion2D can be applied to the entire image or to any pre-defined window or region in the image.

RELEASE FUNCTIONAL DESCRIPTION: Modifications and improvements in the PNG image file support. Support RAW and Mpeg2 video format as input (see CReader). The available video format which can be handled by the motion estimator are given by CReader::EReaderFormat. For the results, video sequences can be writen using the format specified by CWriter::EWriterFormat. Support Fedora 3 (g++ 3.4.2).

- Participants: Charles Kervrann, Fabien Spindler, Jean Marc Odobez, Patrick Bouthemy and Thierry Pécot
- Contact: Patrick Bouthemy
- URL: http://www.irisa.fr/vista/Motion2D/

6.7. ND-SAFIR

KEYWORDS: Fluorescence microscopy - Photonic imaging - Image analysis - Health - Biomedical imaging
SCIENTIFIC DESCRIPTION: ND-SAFIR is a software for denoising n-dimentionnal images especially dedicated to microscopy image sequence analysis. It is able to deal with 2D, 3D, 2D+time, 3D+time images have one or more color channel. It is adapted to Gaussian and Poisson-Gaussian noise which are usually encountered in photonic imaging. Several papers describe the detail of the method used in ndsafir to recover noise free images (see references).

- Participants: Charles Kervrann, Patrick Bouthemy, Jean Salamero and Jérôme Boulanger
- Partners: INRA - PiCT - UMR 144 CNRS - Institut Curie
- Contact: Charles Kervrann
- URL: http://serpico.rennes.inria.fr/doku.php?id=software:nd-safir:index

6.8. OWF

KEYWORDS: Image filter - Image processing - Statistics
FUNCTIONAL DESCRIPTION: The OWF software enables to denoise images corrupted by additive white Gaussian noise. In the line of work of the Non-Local means and ND-SAFIR algorithms, this adaptive estimator is based on the weighted average of observations taken in a neighborhood with weights depending on the similarity of local patches. The idea is to compute adaptive weights that best minimize an upper bound of the pointwise L2 risk. The spatially varying smoothing parameter is automatically adjusted to the image context. The proposed algorithm is fast and easy to control and is competitive when compared to the more sophisticated NL-means filters.

- Participants: Ion Grama, Quansheng Liu and Qiyu Jin
- Partner: University of Bretagne-Sud
- Contact: Charles Kervrann
- Publication: Non-local means and optimal weights for noise removal
- URL: http://serpico.rennes.inria.fr/doku.php?id=software:owf

6.9. QuantEv

KEYWORDS: Photonic imaging - Fluorescence microscopy - Biomedical imaging - Image analysis - Image sequence - Statistic analysis

FUNCTIONAL DESCRIPTION: The QUANTEV software analyzes the spatial distribution of intracellular events represented by any static or dynamical descriptor, provided that the descriptors are associated with spatial coordinates. QUANTEV first computes 3D histograms of descriptors in a cylindrical coordinate system with computational cell shape normalization, enabling comparisons between cells of different shape. Densities are obtained via adaptive kernel density estimation, and we use the Circular Earth Mover's Distance to measure the dissimilarity between densities associated to different experimental conditions. A statistical analysis on these distances reliably takes into account the biological variability over replicated experiments.

- Participants: Jean Salamero, Jérôme Boulanger and Liu Zengzhen
- Partner: UMR 144 CNRS - Institut Curie
- Contact: Charles Kervrann
- Publication: QuantEv: quantifying the spatial distribution of intracellular events
- URL: http://mobyle-serpico.rennes.inria.fr/cgi-bin/portal.py#forms::QuantEv-Densities

6.10. TMA-Lib

KEYWORDS: Photonic imaging - Fluorescence microscopy - Biomedical imaging - Image processing

FUNCTIONAL DESCRIPTION: The TMA-LIB enables to jointly detect suing adaptive wavelet transform, segment with parametric active contours and restore (i.e., artifact correction and deconvolution) TMA (Tissue MicroArrays) images.

- Participants: Cyril Cauchois, Vincent Paveau and Hoai Nam Nguyen
- Partner: Innopsys
- Contact: Charles Kervrann
- Publications: A variational method for dejittering large fluorescence line scanner images - Generalized Sparse Variation Regularization for Large Fluorescence Image Deconvolution - ATMAD : robust image analysis for Automatic Tissue MicroArray De-arraying

6.11. TOTH

KEYWORDS: Photonic imaging - Fluorescence microscopy - Biomedical imaging - Classification - Statistical categorisation techniques - Statistics - Image sequence - Visual tracking

FUNCTIONAL DESCRIPTION: The TOTH software classifies trajectories of biomolecules computed with tracking algorithms. Trajectories in living cells are generally modelled with three types of diffusion processes: (i) free diffusion, (ii) subdiffusion or (iii) superdiffusion. We used a test approach with the Brownian motion as the null hypothesis, and developed a non-parametric three-decision test whose alternatives are subdiffusion and superdiffusion. First, we built a single test procedure for testing a single trajectory. Second, we proposed a multiple test procedure for testing a collection of trajectories. These procedures control respectively the type I error and the false discovery rate. Our approach can be considered as an alternative to the Mean Square Displacement (MSD) method commonly used to address this issue. It gives more reliable results as confirmed by our Monte Carlo simulations and evaluations on real sequences of images depicting protein dynamics acquired with TIRF or SPT-PALM microscopy.

- Participants: Vincent Briane and Myriam Vimond
- Partner: ENSAI
- Contact: Charles Kervrann
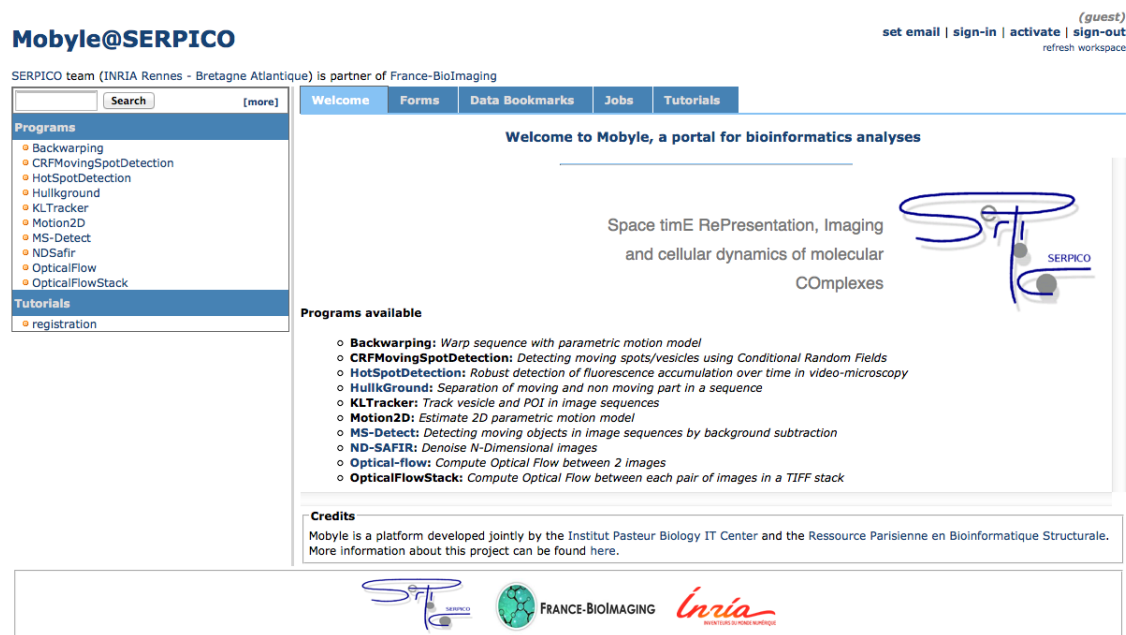- Publication: A Statistical Analysis of Particle Trajectories in Living Cells
- URL: http://serpico.rennes.inria.fr/doku.php?id=software:thot:index

Figure 2. Mobyle@SERPICO web portal.

6.12. Platforms

6.12.1. Mobyle@Serpico plateform and software distribution

The objective is to disseminate the distribution of SERPICO image processing software in the community of cell biology and cell imaging.

Free binaries: software packages have been compiled for the main operating systems (Linux, MacOS, Windows) using CMake (see http://www.cmake.org/). They are freely available on the team website under a proprietary license (e.g. ND-SAFIR and HULLKGROUND are distributed this way at http://serpico.rennes. inria.fr/doku.php?id=software:index).

Mobyle@Serpico web portal: An on-line version (http://mobyle-serpico.rennes.inria.fr) of the image processing algorithms has been developped using the Mobyle framework (Institut Pasteur, see http://mobyle. pasteur.fr/). The main role of this web portal (see Fig. 2) is to demonstrate the performance of the programs developed by the team: QUANTEV, C-CRAFT[14], ATLAS[1], HULLKGROUND[40], KLTRACKER[44], MO-TION2D[43], MS-DETECT[41], ND-SAFIR[6], OPTICALFLOW and FLUX ESTIMATION [14]. The web interface makes our image processing methods available for biologists at Mobyle@SERPICO (http://mobyle-serpico.rennes.inria.fr/cgi-bin/portal.py#welcome) without any installation or configuration on their own. The size of submitted images is limited to 200 MegaBytes per user and all the results are kept 15 days. The web portal and calculations run on a server with 2 CPU x 8 cores, 64 GigaBytes of RAM (500 MegaBytes for each user / Data is saved for 3 months).

ImageJ plugins: IMAGEJ (see http://rsb.info.nih.gov/ij/) is a widely used image visualization and analysis software for biologist users. We have developed IMAGEJ plug-in JAVA versions of the following software: ND-SAFIR [6], HULLKGROUND [40], MOTION2D [43], ATLAS [1]. The C-CRAFT algorithm [14] has been developed for the image processing ICY platform (http://icy.bioimageanalysis.org/).

- **Contact:** Charles Kervrann, Charles Deltel (Inria Rennes SED).
- **Partner:** UMR 144 CNRS-Institut Curie and France-BioImaging.

6.12.2. IGRIDA-Serpico cluster

The IGRIDA-Serpico cluster of 200 nodes is opened for end-users for large scale computing and data sets processing (200 TeraBytes).

- **Batch Scheduler:** OAR
- **File management:** Puppet / Git / Capistrano
- **OS:** Linux Debian 7
- **User connexion:** public ssh key
- **Contact:** Charles Kervrann, Charles Deltel (Inria Rennes SED).

<p align="center">**SIROCCO Project-Team**</p>

6. New Software and Platforms

6.1. SaccadicModel

Saccadic model of visual attention

KEYWORDS: Visual saliency maps - Visual scanpath

FUNCTIONAL DESCRIPTION: Saliency models compute a saliency map from an input image. Saliency maps are a 2D map encoding the ability of every location to attract our gaze. There exist many models in the literature and tremendous progresses have been made. However, they remain quite limited when applied to natural scene exploration. Indeed, the vast majority of these models ignore fundamental properties of our visual system. The most important one is that they overlook the sequential and time-varying aspects of overt attention. Saccadic models aim to predict the visual scanpath itself, i.e. the series of fixations and saccades an observer would perform to sample the visual environment. We propose a new and efficient method to simulate the visual scanpath. It provides scanpaths in close agreement with human behavior and the model can be tailored to simulate scanpaths in specific conditions and for various observer profiles.

- Author: Olivier Le Meur
- Contact: Olivier Le Meur

6.2. QuantizationAE

KEYWORDS: Compression - Machine learning

FUNCTIONAL DESCRIPTION: This code learns an autoencoder to compress images. The learning is performed under a rate-distortion criterion, and jointly learns a transform (the autoencoder) and the quantization step for target rate points.The code is organized as follows. It first builds a set of luminance images (B1) for the auto-encoder training, a set of luminance images (B2) to analyze how the auto-encoder training advances and a set of luminance images (B3) to evaluate the auto-encoders in terms of rate-distortion. It then trains several auto-encoders using a rate-distortion criterion on the set B1. The quantization can be either fixed or learned during this training stage. The set B2 enables to periodically compute indicators to detect overfitting. It finally compares the auto-encoders in terms of rate-distortion on the set B3. The quantization can be either fixed or variable during this test.

- Participants: Aline Roumy, Christine Guillemot and Thierry Dumas
- Contact: Aline Roumy

6.3. LF-Inpainting

Light field inpainting based on a low rank model

KEYWORDS: Light fields - Low rank models - Inpainting

FUNCTIONAL DESCRIPTION: This code implements a method for propagating the inpainting of the central view of a light field to all the other views. To this end, it also implements a new matrix completion algorithm, better suited to the inpainting application than existing methods. A first option does not require any depth prior, unlike most existing light field inpainting algorithms. The code also implements an extended version to better handle the case where the area to inpaint contains depth discontinuities.

- Participants: Mikael Le Pendu and Christine Guillemot
- Contact: Christine Guillemot

6.4. LF-HLRA

Light fields homography-based low rank approximation

KEYWORDS: Compression - Light fields - Low rank models - Dimensionality reduction

FUNCTIONAL DESCRIPTION: This code jointly searches for homographies to align the views of an input light field together with the components of its low rank approximation model. The code either uses a global homography per view or multiple homographies, one per region, the region being extracted using depth information.

- Participants: Xiaoran Jiang, Mikael Le Pendu and Christine Guillemot
- Contact: Christine Guillemot

6.5. GBR-MVimages

Graph-based Representation for multi-view and light field images

KEYWORDS: Light fields - Multi-View reconstruction - Graph

FUNCTIONAL DESCRIPTION: Graph-Based Representation (GBR) describes color and geometry of multiview or light field image content using a graph. The graph vertices represent the color information, while the edges represent the geometry information, i.e. the disparity, by connecting corresponding pixels in neighboring images.

- Participants: Xin Su and Thomas Maugey
- Contact: Thomas Maugey

6.6. Platforms

6.6.1. *Light field editor*

Participants: Pierre Allain, Laurent Guillo, Christine Guillemot.

As part of the ERC Clim project, the EPI Sirocco is developing a light field editor, a tool analogous to traditional image editors such as the GNU image manipulation program Gimp or the raster graphic editor Photoshop but dedicated to light fields. As input data, this tool accepts for instance sparse light fields acquired with High Density Camera Arrays (HDCA) or denser light fields captured with microlens array (MLA). Two kinds of features are provided. Traditional features such as changing the angle of view, refocusing or depth map extraction are or will be soon supported. More advanced features are being integrated in our tool as libraries we have developed, such as segmenation or inpainting. For instance, a segmentation on a specific subaperture/view of light fields can be propagated to all subapertures/views. Thus, the so-segmented objects or zones can be colourized or even removed, the emptied zone being then inpainted. The tool and libraries are developed in C++ and the graphical user interface relies on Qt.

6.6.2. *Acquisition of multi-view sequences for Free viewpoint Television*

Participants: Cédric Le Cam, Laurent Guillo, Thomas Maugey.

The scientific and industrial community is nowadays exploring new multimedia applications using 3D data (beyond stereoscopy). In particular, Free Viewpoint Television (FTV) has attracted much attention in the recent years. In those systems, user can choose in real time its view angle from which he wants to observe the scene. Despite the great interest for FTV, the lack of realistic and ambitious datasets penalizes the research effort. The acquisition of such sequences is very costly in terms of hardware and working effort, which explains why no multi-view videos suitable for FTV has been proposed yet.

In 2017, in the context of the project ADT ATeP (funded by Inriahub), such datasets have been acquired and some calibration tools have been developed. First 40 omnidirectional cameras and their associated equipments have been acquired by the team (thanks to Rennes Metropole funding). We have first focused on the calibration of this camera, *i.e.,* the development of the relationship between a 3D point and its projection in the omnidirectional image. In particular, we have shown that the unified spherical model fits the acquired omnidirectional cameras. Second, we have developed tools to calibrate the cameras in relation to each other. Finally, we have made a capture of 3 multiview sequences that are currently in preparation for a sharing with the community (Fig. 1). This work has been published in [41].

Figure 1. The 40 omnidirectional cameras positioned for an indoor scene capture.

6.6.3. Light fields datasets

Participants: Pierre Allain, Christine Guillemot, Laurent Guillo.

The EPI Sirocco makes extensive use of light field datasets with sparse or dense contents provided by the scientific community to run tests. However,it has also generated its own natural and synthetic contents.

Natural content has been created with Lytro cameras (the original first generation Lytro and the Lytro Illum) and is already available to the community (https://www.irisa.fr/temics/demos/lightField/CLIM/DataSoftware.html). The team also owns a R8 Raytrix plenoptic cameras with which still and video contents have been captured. Applications taking advantage of the Raytrix API have been developed to extract views from the Raytrix lightfield. The number of views per frame is configurable and can be set for instance to 3x3 or 9x9 according to the desired sparsity.

Synthetic content has been generated from the Sintel film (https://durian.blender.org/download/), which is a short computer animated film by the Blender institute, part of the Blender Foundation. A specific Blender add-on is used to extract views from a frame. As previously, the number of views is configurable. Synthetic contents present the advantage to provide a ground truth useful to evaluate how efficient our algorithms are to compute, for instance, the depth maps.

SUMO Project-Team

6. New Software and Platforms

6.1. Active Workspaces

KEYWORDS: Active workspace - Collaborative systems - Artifact centric workflow system
SCIENTIFIC DESCRIPTION: Tool for computer supported cooperative work where a user's workspace is given by an active structured repository containing the pending tasks together with information needed to perform the tasks. Communication between active workspaces is asynchronous using message passing. The tool is based on the model of guarded attribute grammars.

- Authors: Éric Badouel and Robert Nsaibirni
- Contact: Éric Badouel
- URL: http://people.rennes.inria.fr/Eric.Badouel/Research/ActiveWorkspaces.html

6.2. DAXML

KEYWORDS: XML - Web Services - Distributed Software - Active documents
SCIENTIFIC DESCRIPTION: DAXML is an interpreter and implementation of Distributed Active Documents, a formalism for data centric design of Web Services. This implementation is based on a REST framework, and can run on a network of machines connected to internet and equiped with JAVA.
FUNCTIONAL DESCRIPTION: This prototype interprets distributed Active XML documents. It can be used to deploy services defined as active documents over the web.

- Participants: Benoît Masson and Loïc Hélouët
- Contact: Loïc Hélouët
- URL: http://www.irisa.fr/sumo/Software/DAXML/

6.3. Sigali

FUNCTIONAL DESCRIPTION: Sigali is a model-checking tool that operates on ILTS (Implicit Labeled Transition Systems, an equational representation of an automaton), an intermediate model for discrete event systems. It offers functionalities for verification of reactive systems and discrete controller synthesis. The techniques used consist in manipulating the system of equations instead of the set of solutions, which avoids the enumeration of the state space. Each set of states is uniquely characterized by a predicate and the operations on sets can be equivalently performed on the associated predicates. Therefore, a wide spectrum of properties, such as liveness, invariance, reachability and attractivity, can be checked. Algorithms for the computation of predicates on states are also available. Sigali is connected with the Polychrony environment (Tea project-team) as well as the Matou environment (VERIMAG), thus allowing the modeling of reactive systems by means of Signal Specification or Mode Automata and the visualization of the synthesized controller by an interactive simulation of the controlled system.

- Contact: Hervé Marchand

6.4. SIMSTORS

Simulator for stochastic regulated systems
KEYWORDS: Simulation - Public transport - Stochastic models - Distributed systems

FUNCTIONAL DESCRIPTION: SIMSTORS is a software for the simulation of stochastic concurrent timed systems. The heart of the software is a variant of stochastic and timed Petri nets, whose execution is controlled by a regulation policy (a controller), or a predetermined theoretical schedule. The role of the regulation policy is to control the system to realize obbjectives or a schedule when it exists with the best possible precision. SIMSTORS is well adapted to represent systems with randomness, parallelism, tasks scheduling, and resources. It is currently in use within collaboration P22 with Asltom Transport, where it is used to model metro traffic and evaluate performance of regulation solutions. This software allows for step by step simulation, but also for efficient performance analysis of systems such as production cells or train systems. The initial implementation was released in 2015, and the software is protected by the APP.

In 2017, SIMSTORS has been extended along two main axes: on one hand, SIMSTORS models were extended to handle situations where shared resources can be occupied by more than one object (this is of paramount importance to represent conveyors, roads occupied by cars, or train tracks with smoothed scheduling allowing shared sections among trains) with priorities, constraint on their ordering and individual characteristics. This allows for instance to model vehicles with different speeds on a road, while handling safety distance constraints. On the other hand, SIMSTORS models were extended to allow control of stochastic nets based on decision rules that follow optimization schemes.

- Participants: Abd El Karim Kecir and Loïc Hélouët
- Contact: Loïc Hélouët
- URL: http://www.irisa.fr/sumo/Software/SIMSTORS/

6.5. Tipex

TImed Properties Enforcement during eXecution
KEYWORDS: Monitoring - Controller synthesis - Formal methods
FUNCTIONAL DESCRIPTION: We are implementing a prototype tool named Tipex (TImed Properties Enforcement during eXecution) for the enforcement of timed properties. Tipex is based on the theory and algorithms that we develop for the synthesis of enforcement monitors for properties specified by timed automata (TA). The prototype is developed in python, and uses the PyUPPAAL and DBMpyuppaal libraries of the UPPAAL tool . It is currently restricted to safety and co-safety timed property. The property provided as input to the tool is a TA that can be specified using the UPPAAL tool, and is stored in XML format. The tool synthesizes an enforcement monitor from this TA, which can then be used to enforce a sequence of timed events to satisfy the property. Experiments have been conducted on a set of case studies. This allowed to validate the architecture and feasibility of enforcement monitoring in a timed setting and to have a first assessment of performance (and to what extent the overhead induced by monitoring is negligible).

- Participants: Thierry Jéron, Srinivas Pinisetty and Hervé Marchand
- Contact: Thierry Jéron

<p style="text-align:center;color:red;">**TACOMA Team**</p>

5. New Software and Platforms

5.1. THEGAME

SCIENTIFIC DESCRIPTION: Context-aware applications have to sense the environment in order to adapt themselves and provide with contextual services. This is the case of Smart Homes equipped with sensors and augmented appliances. However, sensors can be numerous, heterogeneous and unreliable. Thus the data fusion is complex and requires a solid theory to handle those problems. The aim of the data fusion, in our case, is to compute small pieces of context we call context attributes. Those context attributes are diverse and could be for example the presence in a room, the number of people in a room or even that someone may be sleeping in a room. For this purpose, we developed an implementation of the belief functions theory (BFT). THE GAME (THeory of Evidence in a lanGuage Adapted for Many Embedded systems) is made of a set of C-Libraries. It provides the basics of belief functions theory, computations are optimized for an embedded environment (binary representation of sets, conditional compilation and diverse algorithmic optimizations).

THE GAME is published under apache licence (https://github.com/bpietropaoli/THEGAME/). It is maintained and experimented by Aurélien Richez within a sensor network platform developed by TACOMA since June 2013.

FUNCTIONAL DESCRIPTION: THEGAME is a set of software services for detecting different types of situation in a building (presence in a room, activity level, etc.) based on a set of raw data sourced from all sorts of sensors. Written in C or Java, it can be integrated in an embedded computer: tablet, smartphone, box, etc., and can be connected to different sensor networks. It can be used to implement context-aware services: for example, to alert the user if s/he forgets to close a window when leaving the building, or to turn off the heating in an empty room, etc.

- Participants: Aurélien Richez and Bastien Pietropaoli
- Contact: Frédéric Weis
- URL: https://github.com/bpietropaoli/THEGAME/

5.2. Platform Pervasive_RFID

KEYWORDS: Composite objects - RFID
- Participants: Paul Couderc and Anthony Blair (Univ. Rennes 1)
- Partner: Univ. Rennes 1 (IETR)
- Contact: Paul Couderc

SCIENTIFIC DESCRIPTION

The RFID experiment testbed has been designed and deployed in collaboration with IETR (see Figure 2). This system allows both interactive testing as well as long running experiments of RFID reading protocols. It comprises a software platform allowing fine control over all dynamic aspects influencing RFID readings: movements for target and antenna, RFID reader configuration, and smart antenna configuration (diversity and power control).

5.3. Metamorphic Housing platform and Software - On-demand room

KEYWORDS: Smart Home - Metamorphic House - Sharing
- Participants: Ghislain Nouvel (Univ. Rennes 1), Guillermo Andrade Barroso and Michele Dominici
- Partner: Univ. Rennes 1
- Partner: Delta Dore - Néotoa [0]
- Contact: Michele Dominici and Frédéric Weis

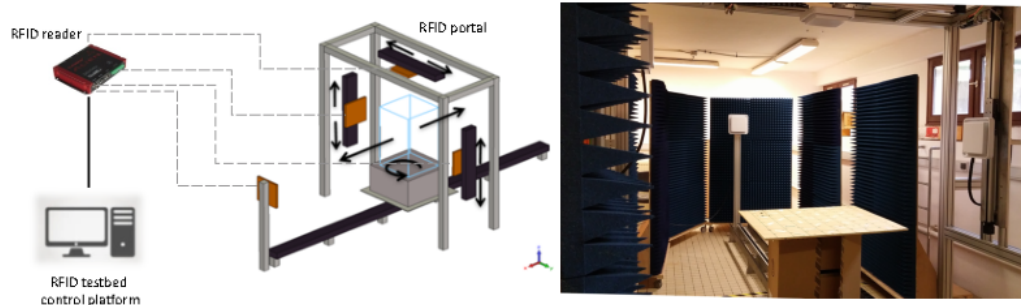[0] http://www.neotoa.fr/

Figure 2. RFID testbed

SCIENTIFIC DESCRIPTION- SOFTWARE

As part of the experimentation of the On-demand room, we have developed a software system that will be used to manage the room and provide functionalities to end users and building managers (access control, electrical and time consumption monitoring and report, room state display...). The software has been deployed in the building that hosts the experimentation. This software is co-developed by Michele Dominici (Univ. Rennes 1), Guillermo Andrade (SED Inria) and Ghislain Nouvel (MobBI platform [0]). Contributions are provided by members of the Diverse project-team. Intellectual protection is expected to be applied on such software.

SCIENTIFIC DESCRIPTION- PLATFORM

We realized a prototype of the on-demand room as an immersive interactive virtual-reality application, leveraging the Immersia platform (see https://raweb.inria.fr/rapportsactivite/RA2015/tacoma/uid29.html), with real domestic appliances connected to Immersa. In 2016-2017, the experimentation of the On-demand room is organized in the following steps: modification of the original building to create a common, On-demand room between two apartments; deployment of the computer and hardware and software that we are developing; rental of the apartments to two households, for an estimated duration of one year. The building that hosted the experimentation is showed in Figure 3 . During the rental of the apartments, data has been collected and stored about the use of the room by households. Data included time of occupation, mode (private or shared), consumptions, errors etc. The On-demand room thus constitutes an experimentation platform, where real people live and produce data that can be analyzed for statistical purposes. Produced data could also be used in combination with interviews of the occupants to improve the functionalities of the On-demand room, evaluate acceptance and appropriation.

5.4. ISO/IEC 15118-2 Open source Implementation

KEYWORDS: Smart Grid - Intelligent Transport System

- Partner: IMT Atlantique
- Participants: Guillaume Le Gall
- Contact: Jean-Marie Bonnin

SCIENTIFIC DESCRIPTION

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[0] https://mobbi.univ-rennes1.fr/

Figure 3. On-demand room real experimentation

The ISO/IEC 15118 standard, named "Road vehicles – Vehicle-to-Grid Communication Interface", defines how an electric vehicle and a charging station should communicate. It enables the Smart Charging of electric vehicles by allowing them to plan their charging sessions. As we want to be able to manage the charge of electric vehicles in our micro Smart Grid systems, we decided to implement the protocol defined by this standard. The goal is also to participate actively in the design of the new version of this protocol. During a charging session the charging station provides the vehicle with the status of the electric power grid. The vehicle is then able to plan its sharing session accordingly. It sends back its charge plan to the charging station, so that the Smart Grid is aware of it. The protocol also provides security and authentication features.

This software platform was implemented onto small PCs, and was used to control the charge in a small and portable demonstration platform, to demonstrate how it is possible to interconnect this high level decision and communication software with low level components, such as a Battery Management System (BMS), and a battery charger. In 2016, in the context of the Greenfeed project our software has been demonstrated to control the charge of the electric vehicle during the final demonstration of the project. The integration work has been done in collaboration with VeDeCom [0].

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[0] http://www.vedecom.fr/

<p style="text-align:center;color:red;">**TAMIS Team**</p>

6. New Software and Platforms

6.1. GNUnet

SCIENTIFIC DESCRIPTION: The GNUnet project seeks to answer the question what a modern Internet architecture should look like for a society that care about security and privacy. We are considering all layers of the existing well-known Internet, but are also providing new and higher-level abstractions (such as voting protocols, Byzantine consensus, etc.) that are today solved in application-specific ways. Research questions include the desired functionality of the overall stack, protocol design for the various layers as well as implementation considerations, i.e. how to implement the design securely.

FUNCTIONAL DESCRIPTION: GNUnet is a framework for secure peer-to-peer networking that does not use any centralized or otherwise trusted services. Our high-level goal is to provide a strong free software foundation for a global network that provides security and in particular respects privacy.

GNUnet started with an idea for anonymous censorship-resistant file-sharing, but has grown to incorporate other applications as well as many generic building blocks for secure networking applications. In particular, GNUnet now includes the GNU Name System, a privacy-preserving, decentralized public key infrastructure.

- Participants: Alvaro Garcia Recuero, Florian Dold, Gabor Toth, Hans Grothoff, Jeffrey Paul Burdges and Sree Hrsha Totakura
- Partner: The GNU Project
- Contact: Hans Grothoff
- URL: https://gnunet.org/

6.2. MHD

GNU libmicrohttpd

KEYWORDS: Embedded - Web 2.0

SCIENTIFIC DESCRIPTION: We are providing a standards compliant and complete implementation of the HTTP server protocol that allows developers to easily write correct HTTP servers. Key challenges include code size minimization (for IoT devices), performance (zero copy, scalability to 100k concurrent connections), portability and security. MHD is already widely used in production by both academic and industrial users. Ongoing research challenges include formal verification.

FUNCTIONAL DESCRIPTION: GNU libmicrohttpd is a small C library that is supposed to make it easy to run an HTTP server as part of another application.

- Participants: Evgeny Grin, Hans Grothoff and Sree Hrsha Totakura
- Partner: The GNU Project
- Contact: Hans Grothoff
- URL: http://www.gnu.org/software/libmicrohttpd/

6.3. PLASMA Lab

KEYWORDS: Energy - Statistics - Security - Runtime Analysis - Model Checker - Statistical - Model Checking - Aeronautics - Distributed systems

SCIENTIFIC DESCRIPTION: Statistical model checking (SMC) is a fast emerging technology for industrial scale verification and optimisation problems. SMC only requires an executable semantics and is not constrained by decidability. Therefore we can easily apply it to different modelling languages and logics. We have implemented in PLASMA Lab several advanced SMC algorithms that combine formal methods with statistical tests, which include techniques for rare events estimation and non-deterministic models.

FUNCTIONAL DESCRIPTION: PLASMA Lab is a compact, efficient and flexible platform for statistical model checking of stochastic models. PLASMA Lab includes simulators for PRISM models (Reactives Modules Language-RML) and Biological models. It also provides plugins that interface external simulators in order to support Matlab/Simulink, SytemC and LLVM . PLASMA Lab can be extended with new plugins to support other external simulators, and PLASMA Lab API can be used to embed the tool in other softwares. PLASMA Lab provide fast SMC algorithms, including advanced techniques for rare events simulation and nondeterministic models. These algorithms are designed in a distributed architecture to run large number of simulations on several computers, either on a local area network or grid. PLASMA Lab is implemented in Java with efficient data structures and low memory consumption

NEWS OF THE YEAR: In 2017 we have extended PLASMA Lab with a new simulator plugin that allows to verify LLVM code.

- Participants: Axel Legay, Jean Quilbeuf, Benoît Boyer, Kevin Corre, Louis-Marie Traonouez, Matthieu Simonin and Sean Sedwards

- Contact: Axel Legay

- URL: https://project.inria.fr/plasma-lab/

6.4. Taler

GNU Taler

KEYWORD: Privacy

SCIENTIFIC DESCRIPTION: Taler is a Chaum-style digital payment system that enables anonymous payments while ensuring that entities that receive payments are auditable. In Taler, customers can never defraud anyone, merchants can only fail to deliver the merchandise to the customer, and payment service providers can be fully audited. All parties receive cryptographic evidence for all transactions, still, each party only receives the minimum information required to execute transactions. Enforcement of honest behavior is timely, and is at least as strict as with legacy credit card payment systems that do not provide for privacy.

The key technical contribution underpinning Taler is a new refresh protocol which allows fractional payments and refunds while maintaining untraceability of the customer and unlinkability of transactions. The refresh protocol combines an efficient cut-and-choose mechanism with a link step to ensure that refreshing is not abused for transactional payments.

We argue that Taler provides a secure digital currency for modern liberal societies as it is a flexible, libre and efficient protocol and adequately balances the state's need for monetary control with the citizen's needs for private economic activity.

FUNCTIONAL DESCRIPTION: Taler is a new electronic payment system. It includes an electronic wallet for customers, a payment backend for merchants and the main payment service provider logic called the exchange. Taler offers Chaum-style anonymous payments for citizens, and income-transparency for taxability.

- Participants: Florian Dold, Gabor Toth, Hans Grothoff, Jeffrey Paul Burdges and Marcello Stanisci

- Partner: The GNU Project

- Contact: Hans Grothoff

- URL: http://taler.net/

6.5. HyLeak

Hybrid Analysis Tool for Information Leakage

KEYWORD: Information leakage

FUNCTIONAL DESCRIPTION: HyLeak is an evolution of the QUAIL tool, also developed by the TAMIS team. HyLeak divides the input program into (terminal) components and decides for each of them whether to analyze it using precise or statistical analysis, by applying heuristics that evaluate the analysis cost of each component. Then, HyLeak composes the analysis results of all components into an approximate joint probability distribution of the secret and observable variables in the program. Finally, the tool estimates the Shannon leakage and its confidence interval.

- Partner: AIST Tsukuba
- Contact: Fabrizio Biondi

6.6. SimFI

Tool for Simulation Fault injection
KEYWORDS: Fault injection - Fault-tolerance
FUNCTIONAL DESCRIPTION: Fault injections are used to test the robust and security of systems. We have developed SimFI, a tool that can be used to simulate fault injection attacks against binary files. SimFI is lightweight utility designed to be integrated into larger environments as part of robustness testing and fault injection vulnerability detection.

- Contact: Nisrine Jafri
- URL: https://github.com/nisrine/Fault-Injection-Tool

6.7. DaD

Data-aware Defense
KEYWORD: Ransomware
FUNCTIONAL DESCRIPTION: DaD is a ransomware countermeasure based on a file system minifilter driver. It is a proof of concept and in its present condition cannot be used as a replacement of the existing antivirus solutions. DaD detects randomness of the data by monitoring the write operations on the file system. We monitor all the userland threads, and also the whole file system (i.e., not restricted to Documents). It blocks the threads that exceed a specific threshold. The malicious thread is not killed, we only block its next I/O operations.

- Contact: Aurélien Palisse

6.8. MASSE

Modular Automated Syntactic Signature Extraction
KEYWORDS: Malware - Syntactic analysis
FUNCTIONAL DESCRIPTION: The Modular Automated Syntactic Signature Extraction (MASSE) architecture is a new integrated open source client-server architecture for syntactic malware detection and analysis based on the YARA, developed with Teclib'. MASSE includes highly effective automated syntactic malware detection rule generation for the clients based on a server-side modular malware detection system. Multiple techniques are used to make MASSE effective at detecting malware while keeping it from disrupting users and hindering reverse-engineering of its malware analysis by malware creators. MASSE integrates YARA in a distributed system able to detect malware on endpoint systems using YARA, analyze malware with multiple analysis techniques, automatically generate syntactic malware detection rules, and deploy the new rules to the endpoints. The MASSE architecture is freely available to companies and institutions as a complete, modular, self-maintained antivirus solution. Using MASSE, a security department can immediately update the rule database of the whole company, stopping an infection on its tracks and preventing future ones.

- Contact: Axel Legay

6.9. Behavioral Malware Analysis

KEYWORDS: Artificial intelligence - Malware - Automatic Learning - Concolic Execution

FUNCTIONAL DESCRIPTION: Our approach is based on artificial intelligence. We extract graphs from programs, that represent their behaviors. Such graphs are called system call dependency graphs (SCDGs). Our software learns to distinguish malware from cleanware on a large set of malwares and cleanwares. Whenever we want to analyze a new program, we extract its graphs and use the result of the training to decide whether the new program to analyze is a malware.

- Partner: Cisco
- Contact: Axel Legay
- URL: https://team.inria.fr/tamis/

6.10. VITRAIL - Visualisation Tool

Real-Time, Advanced, Immersive Visualization of Software / Visualizer
KEYWORD: Visualization of software
SCIENTIFIC DESCRIPTION: It is difficult for developers to explore and understand the source code of large programs, for example in objet-oriented languages programs featuring thousands of classes. Visualization methods based on daily life metaphors have thus been proposed. The VITRAIL Visualization tool (or VITRAIL Vizualizer) makes it possible to display, visualize and explore Java programs in a metaphorical way, using the city metaphor. An execution trace of the Java (byte)code provided by VITRAIL JBInstrace tool, is provided as input to VITRAIL Visualizer which displays a city-like metaphorical world showing the static structure of the code as well as some dynamic elements (calls).
FUNCTIONAL DESCRIPTION: This program makes it possible to displays, visualizes and explores Java programs in a metaphorical way (using the city metaphore). Useful for complex application developers/architects.

RELEASE FUNCTIONAL DESCRIPTION: Early release

- Participants: Damien Bodenes, Olivier Demengeon and Olivier Zendra
- Contact: Olivier Zendra
- URL: http://vitrail.loria.fr

6.11. VITRAIL 6 JBInsTrace

Real-Time, Advanced, Immersive Visualization of Software / Java Bytecode Instrumenter and Tracer
KEYWORDS: Execution trace - Profiling - Instrumentation - Bytecode - Java - Basic block
SCIENTIFIC DESCRIPTION: VITRAIL JBInsTrace is a program to instrument Java bytecode to trace its execution. The trace contains both static and dynamic information (calls). It is produced by intercepting the JVM class loader and replacing it by ours. Thus Java bytecode file are not modified, since instrumentation is performed on the fly, in memory. This makes it possible to instrument the whole program code, including libraries. Java source code is not needed. The trace which is then fed into our program VITRAIL Visualizer is an XML-like file.
FUNCTIONAL DESCRIPTION: VITRAIL JBInsTrace is a program to instrument Java bytecode files to trace their execution. The trace is then fed into our VITRAIL Visualizer tool.

- Participants: Olivier Zendra and Pierre Caserta
- Contact: Olivier Zendra
- URL: http://vitrail.loria.fr

6.12. Platforms

6.12.1. Malware'o'Matic

This LHS platform is dedicated to the collect, the categorization and the analyze of malware. We are currently interested in a specific kind of malware the ransomware. The platform grabs periodically samples of public data bases, executes the ransomware without virtualization on a victim PC and evaluate the implemented detection mechanisms. Once a ransomware has been executed the image of the OS is automatically restored and a new sample is evaluated. The platform is fully automatic and target Windows platforms (seven, W10) in both 32 bits and 64 bits versions. More recent developments can be seen in the LHS Activity Report.

6.12.2. Faustine

This LHS platform is dedicated to the EM fault injection experiments. It is composed of a motion table (XY), a pulse generator, an amplifier and a control PC. It injects EM pulses in a controlled way on a targeted device using an EM probe. It controls with a high precision the timing and the edges of the pulse. A recent development consists in adding a FPGA board to control the trigger in a more convenient and precise way. Then, the pulse can be triggered while a specific information is sent to the board under attack. More recent developments can be seen in the LHS Activity Report.

<p style="text-align:center;color:red;font-weight:bold;">TEA Project-Team</p>

6. New Software and Platforms

6.1. ADFG

Affine data-flow graphs schedule synthesizer

KEYWORDS: Code generation - Scheduling - Static program analysis

FUNCTIONAL DESCRIPTION: ADFG is a synthesis tool of real-time system scheduling parameters: ADFG computes task periods and buffer sizes of systems resulting in a trade-off between throughput maximization and buffer size minimization. ADFG synthesizes systems modeled by ultimately cyclo-static dataflow (UCSDF) graphs, an extension of the standard CSDF model.

Knowing the WCET (Worst Case Execute Time) of the actors and their exchanges on the channels, ADFG tries to synthezise the scheduler of the application. ADFG offers several scheduling policies and can detect unschedulable systems. It ensures that the real scheduling does not cause overflows or underflows and tries to maximize the throughput (the processors utilization) while minimizing the storage space needed between the actors (i.e. the buffer sizes).

Abstract affine scheduling is first applied on the dataflow graph, that consists only of periodic actors, to compute timeless scheduling constraints (e.g. relation between the speeds of two actors) and buffering parameters. Then, symbolic schedulability policies analysis (i.e., synthesis of timing and scheduling parameters of actors) is applied to produce the scheduller for the actors.

ADFG, initially defined to synthesize real-time schedulers for SCJ/L1 applications, may be used for scheduling analysis of AADL programs.

- Authors: Thierry Gautier, Jean-Pierre Talpin, Adnan Bouakaz, Alexandre Honorat and Loïc Besnard
- Contact: Loïc Besnard

6.2. POLYCHRONY

KEYWORDS: Code generation - AADL - Proof - Optimization - Multi-clock - GALS - Architecture - Cosimulation - Real time - Synchronous Language

FUNCTIONAL DESCRIPTION: Polychrony is an Open Source development environment for critical/embedded systems. It is based on Signal, a real-time polychronous data-flow language. It provides a unified model-driven environment to perform design exploration by using top-down and bottom-up design methodologies formally supported by design model transformations from specification to implementation and from synchrony to asynchrony. It can be included in heterogeneous design systems with various input formalisms and output languages. The Polychrony tool-set provides a formal framework to: validate a design at different levels, by the way of formal verification and/or simulation, refine descriptions in a top-down approach, abstract properties needed for black-box composition, compose heterogeneous components (bottom-up with COTS), generate executable code for various architectures. The Polychrony tool-set contains three main components and an experimental interface to GNU Compiler Collection (GCC):

* The Signal toolbox, a batch compiler for the Signal language, and a structured API that provides a set of program transformations. Itcan be installed without other components and is distributed under GPL V2 license.

* The Signal GUI, a Graphical User Interface to the Signal toolbox (editor + interactive access to compiling functionalities). It can be used either as a specific tool or as a graphical view under Eclipse. It has been transformed and restructured, in order to get a more up-to-date interface allowing multi-window manipulation of programs. It is distributed under GPL V2 license.

* The POP Eclipse platform, a front-end to the Signal toolbox in the Eclipse environment. It is distributed under EPL license.

- Participants: Loïc Besnard, Paul Le Guernic and Thierry Gautier
- Partners: CNRS - Inria
- Contact: Loïc Besnard
- URL: https://www.polarsys.org/projects/polarsys.pop

6.3. Polychrony AADL2SIGNAL

KEYWORDS: Real-time application - Polychrone - Synchronous model - Polarsys - Polychrony - Signal - AADL - Eclipse - Meta model

FUNCTIONAL DESCRIPTION: This polychronous MoC has been used previously as semantic model for systems described in the core AADL standard. The core AADL is extended with annexes, such as the Behavior Annex, which allows to specify more precisely architectural behaviors. The translation from AADL specifications into the polychronous model should take into account these behavior specifications, which are based on description of automata.

For that purpose, the AADL state transition systems are translated as Signal automata (a slight extension of the Signal language has been defined to support the model of polychronous automata).

Once the AADL model of a system transformed into a Signal program, one can analyze the program using the Polychrony framework in order to check if timing, scheduling and logical requirements over the whole system are met.

We have implemented the translation and experimented it using a concrete case study, which is the AADL modeling of an Adaptive Cruise Control (ACC) system, a highly safety-critical system embedded in recent cars.

- Participants: Huafeng Yu, Loïc Besnard, Paul Le Guernic, Thierry Gautier and Yue Ma
- Partner: CNRS
- Contact: Loïc Besnard
- URL: http://www.inria.fr/equipes/tea

6.4. POP

Polychrony on Polarsys

KEYWORDS: Synchronous model - Model-driven engineering

FUNCTIONAL DESCRIPTION: The Eclipse project POP is a model-driven engineering front-end to our open-source toolset Polychrony. a major achievement of the ESPRESSO (and now TEA) project-team. The Eclipse project POP is a model-driven engineering front-end to our open-source toolset Polychrony. It was finalised in the frame of project OPEES, as a case study: by passing the POLARSYS qualification kit as a computer aided simulation and verification tool. This qualification was implemented by CS Toulouse in conformance with relevant generic (platform independent) qualification documents. Polychrony is now distributed by the Eclipse project POP on the platform of the POLARSYS industrial working group. Team TEA aims at continuing its dissemination to academic partners, as to its principles and features, and industrial partners, as to the services it can offer.

Project POP is composed of the Polychrony tool set, under GPL license, and its Eclipse framework, under EPL license. SSME (Syntactic Signal-Meta under Eclipse), is the meta-model of the Signal language implemented with Eclipse/Ecore. It describes all syntactic elements specified in Signal Reference Manual [0]: all Signal operators (e.g. arithmetic, clock synchronization), model (e.g. process frame, module), and construction (e.g. iteration, type declaration). The meta-model primarily aims at making the language and services of the Polychrony environment available to inter-operation and composition with other components (e.g. AADL, Simulink, GeneAuto, P) within an Eclipse-based development tool-chain. Polychrony now comprises the capability to directly import and export Ecore models instead of textual Signal programs, in order to facilitate interaction between components within such a tool-chain. The download site for project POP has opened in 2015 at https://www.polarsys.org/projects/polarsys.pop. It should be noted that the Eclipse Foundation does not host code under GPL license. So, the Signal toolbox useful to compile Signal code from Eclipse is hosted on our web server.

- Participants: Jean-Pierre Talpin, Loïc Besnard, Paul Le Guernic and Thierry Gautier

- Contact: Loïc Besnard

- URL: https://www.polarsys.org/projects/polarsys.pop

6.5. Sigali

FUNCTIONAL DESCRIPTION: Sigali is a model-checking tool that operates on ILTS (Implicit Labeled Transition Systems, an equational representation of an automaton), an intermediate model for discrete event systems. It offers functionalities for verification of reactive systems and discrete controller synthesis. The techniques used consist in manipulating the system of equations instead of the set of solutions, which avoids the enumeration of the state space. Each set of states is uniquely characterized by a predicate and the operations on sets can be equivalently performed on the associated predicates. Therefore, a wide spectrum of properties, such as liveness, invariance, reachability and attractivity, can be checked. Algorithms for the computation of predicates on states are also available. Sigali is connected with the Polychrony environment (Tea project-team) as well as the Matou environment (VERIMAG), thus allowing the modeling of reactive systems by means of Signal Specification or Mode Automata and the visualization of the synthesized controller by an interactive simulation of the controlled system.

- Contact: Hervé Marchand

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[0]

SIGNAL V4-Inria version: Reference Manual. Besnard, L., Gautier, T. and Le Guernic, P. http://www.irisa.fr/espresso/Polychrony, 2010

VISAGES Project-Team

6. New Software and Platforms

6.1. Anima

KEYWORDS: Registration - Diffusion imaging - Medical imaging - Filtering - Relaxometry

SCIENTIFIC DESCRIPTION: Anima is a set of libraries and tools developed by the team as a common repository of research algorithms. As of now, it contains tools for image registration, statistical analysis (group comparison, patient to group comparison), diffusion imaging (model estimation, tractography, etc.), quantitative MRI processing (quantitative relaxation times estimation, MR simulation), image denoising and filtering, and segmentation tools. All of these tools are based on stable libraries (ITK, VTK), making it simple to maintain.

- Participants: Aymeric Stamm, Fang Cao, Florent Leray, Guillaume Pasquier, Laurence Catanese, Olivier Commowick, Renaud Hedouin and René-Paul Debroize
- Contact: Olivier Commowick
- URL: https://github.com/Inria-Visages/Anima-Public/wiki

6.2. autoMRI

KEYWORDS: FMRI - MRI - ASL - FASL - SPM - Automation

SCIENTIFIC DESCRIPTION: This software is highly configurable in order to fit to a wide range of needs. Pre-processing includes segmentation of anatomical data, as well as co-registration, spatial normalization and atlas building of all data types. The analysis pipelines perform either within-group analysis or between-group or one subject-versus-group comparison and produce statistical maps of regions with significant differences. These pipelines can be applied to structural data to exhibit patterns of atrophy or lesions, to ASL (both pulsed or pseudo-continuous sequences) or PET data to detect perfusion or metabolic abnormalities, to relaxometry data to detect deviations from a template, to functional data - either BOLD or ASL - to outline brain activations related to block or event-related paradigms. In addition to the standard General Linear Model approach, the ASL pipelines implement an a contrario approach and, for patient-specific perfusion study, an heteroscedastic variance model. Besides, the vascular pipeline processes 4D MRA data and enables accurate assessment of hemodynamic patterns.

FUNCTIONAL DESCRIPTION: AutoMRI Based on MATLAB and the SPM8 toolbox, autoMRI provides complete pipelines to pre-process and analyze various types of images (anatomical, functional, perfusion, metabolic, relaxometry, vascular).

- Participants: Camille Maumet, Cédric Meurée, Elise Bannier, Fang Cao, Isabelle Corouge and Pierre Maurel
- Contact: Isabelle Corouge
- URL: http://www.irisa.fr/visages/

6.3. MedInria

KEYWORDS: Visualization - DWI - Health - Segmentation - Medical imaging

SCIENTIFIC DESCRIPTION: It aims at creating an easily extensible platform for the distribution of research algorithms developed at Inria for medical image processing. This project has been funded by the D2T (ADT MedInria-NT) in 2010, renewed in 2012. A fast-track ADT was awarded in 2017 to transition the software core to more recent dependencies and study the possibility of a consortium creation.The Visages team leads this Inria national project and participates in the development of the common core architecture and features of the software as well as in the development of specific plugins for the team's algorithm.

FUNCTIONAL DESCRIPTION: MedInria is a free software platform dedicated to medical data visualization and processing.

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6.4. QtShanoir

KEYWORDS: Webservices - Soap - C++ - Health - DICOM - Plug-in - Medical imaging - Qt - Shanoir - Nifti
SCIENTIFIC DESCRIPTION: QtShanoir is based on Qt/C++ librairie. It interacts with the Shanoir server using SOAP web services provided. This application queries the server and displays hierarchical data extracted in tree view. Data could also be easily downloaded or uploaded on the server. In order to extend the Shanoir environment, QtShanoir is developed to contain two shared libraries: - « GUI » that represents all user interfaces. - « DAO » that takes in charge the data model. This library assures the connection to the server and provides all QtShanoir services : research, download and upload of Processed Dataset (NIfTI). QtShanoir dynamic libraries are already reused and integrated in other projects: in the software medInria and in an under development command line program.

FUNCTIONAL DESCRIPTION: QtShanoir is a graphical client application of the medical imaging database Shanoir. This application provides various functionalities to satisfy researchers' needs. It allows users to: - explore neuroimaging data derived from multicenter research trials. Through an intuitive user interface, users could easily visualize voluminous amount of structured data: studies, patients and datasets extracted from Shanoir - download and to upload data from the server. This application is available on Windows, UNIX, MacOs X. It is integrated as a plugin in medInria, a multi-plateform for medical image processing and visualization.

- Participants: Alexandre Abadie, Guillaume Renard, Nicolas Wiest Daessle, Olivier Commowick and Wefa Hakem
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6.5. Shanoir

SHAring NeurOImaging Resources
KEYWORDS: Neuroimaging - Medical imaging - PACS - Nifti - Data Sharing - DICOM - Health - Shanoir - Webservices - Data base - Biology - Web Application
FUNCTIONAL DESCRIPTION: SHAring NeurOImaging Resources (Shanoir, Previously InriaNeuroTk) is an open source software platform designed to structure, manage, archive, visualize and share neuroimaging data with an emphasis on multi-centric collaborative research projects. It provides common features of neuroimaging data management systems along with research-oriented data organization and enhanced accessibility.

Shanoir is a secured J2EE application running on a JBoss server, reachable via graphical interfaces in a browser or by third party programs via web services. It behaves as a repository of neuroimaging files coupled with a relational database hoding meta-data. The data model, based on OntoNeurolog, an ontology devoted to the neuroimaging field, is structured around research studies where of involved patients have examinations which either produce image acquisitions or clinical scores. Each image acquisition is composed of datasets represented by their acquisition parameters and image files. The system only keeps anonymous data.

Image files imports are possible from various sources (DICOM CDs, PACs, image files in NIfTI / Analyze format) using either online wizards, with completions of related meta-data, or commande line tools. Once de-identified during the import phase, DICOM header's customizable feature. Shanoir can also record any executed processing allowing to retrieve workflows applied to a particular dataset along with the intermediate data.

The clinical scores resulting from instrument based assessments (e.g. neuropsychological tests) can also be entered and easily retrieved and exported in different formats (Excel, CSV, Xml). Scores and image acquisitions are bound together which makes relationship analysis possible. The instrument database is scalable an new measures can be added in order to meet specific project needs, by use of intuitive graphical interfaces.

Using cross-data navigation and advanced search criteria, the users can quickly point to a subset of data of data to be downloaded. Client side applications have as well been developed to illustrate how to locally access and exploit data through the available web services. With regards to security, the system requires authentication and user rights are tunable for each hosted studies. A study responsible can thereby define the users allowed to see, download or import data into his study or simply make it public.

Shanoir serves neuroimaging researchers in organizing efficiently their studies while cooperating with other laboratories. By managing patient privacy, Shanoir allows the exploitation of clinical data in a research context. It is finally a handy solution to publish and share data with a broader community.

Shanoir integrates the enterprise search platform, Apache Solr, to provide the users a vast array of advanced features such as near real-time indexing and queries, full-text search, faceted navigation, autosuggestion and autocomplete.

- Participants: Adrien Férial, Anthony Baire, Bernard Gibaud, Christian Barillot, Guillaume Renard, Justine Guillaumont, Michael Kain and Yao Yao

- Partners: Université de Rennes 1 - CNRS - INSERM

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- URL: http://shanoir.gforge.inria.fr

6.6. ShanoirUploader

KEYWORDS: PACS - Medical imaging - Neuroimaging - DICOM - Health - Biology - Java - Webservices - Shanoir

SCIENTIFIC DESCRIPTION: ShanoirUploader is a desktop application on base of JavaWebStart (JWS). The application can be downloaded and installed using an internet browser. It interacts with a PACS to query and retrieve the data stored on it. After this ShanoirUploader sends the data to a Shanoir server instance in order to import these data. This application bypasses the situation, that in most of the clinical network infrastructures a server to server connection is complicated to set up between the PACS and a Shanoir server instance.

FUNCTIONAL DESCRIPTION: ShanoirUploader is a Java desktop application that transfers data securely between a PACS and a Shanoir server instance (e.g., within a hospital). It uses either a DICOM query/retrieve connection or a local CD/DVD access to search and access images from a local PACS or the local CD/DVD. After having retrieved the data, the DICOM files are locally anonymized and then uploaded to the Shanoir server. A possible integration of a hash creation application for patient identifiers is provided as well. The primary goals of that application are to enable mass data transfers between different remote server instances and therefore reduce the waiting time of the users, when importing data into Shanoir. Most of the time during import is spent with data transfers.

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6.7. Platforms

6.7.1. The Neurinfo Platform

VisAGeS is the founding actor of an experimental research platform which was installed in August 2009 at the University Hospital of Rennes. The University of Rennes 1, Inria, Inserm for the academic side, and the University Hospital of Rennes and the Cancer Institute "Eugene Marquis" for the clinical side, are partners of this neuroinformatics platform called Neurinfo [0]. This platform has been supported under the "Contrat de Projets Etat-Région" (Christian Barillot is the PI) and has received a total amount of 4.01 M€ for the period 2007–2014. European (FEDER), National (through Ministry of research, Inria, Inserm and ANR) and local councils (Brittany Region, Ille et Vilaine, and Rennes Metropole) have joined their effort to support this operation for a total amount of 4 010 k€ (600 k€ for the infrastructures, 2 850 k€ for the equipments and 560 k€ for the functioning). This application was set up through the Regional PIMATGI initiative coordinated by INSERM in Brittany (C. Roux). The overall PIMATGI initiative served for the financing of three distinct, but complementary, platforms: Neurinfo, TheraFONC as a technical platform dedicated to therapy guided by functional imaging especially in the oncology domain (Inserm U650 - LaTIM, Dir. Ch. Roux, Brest), and TherA-Image as a platform dedicated to image guided mini-invasive surgery and therapy especially in the domain of cardio-vascular diseases (U642 -LTSI, Dir. L. Senhadji, Rennes).

Concerning the Neurinfo Platform, the activity domain is a continuum between methodological and technological research built around specific clinical research projects. The ambition is to do innovation in science, technology and medical technology transfer for the implementation on the clinical field. On the medical field, the translational research domain mainly concerns medical imaging and more specifically the clinical neurosciences. Among them are multiple sclerosis, epilepsy, neurodegenerative, neurodevelopmental and psychiatric diseases, surgical procedures of brain lesions, neuro-oncology and radiotherapy planning. Beyond these CNS applications, the platform is also open to alternative applications. Neurinfo ambitions to support the emergence of research projects based on their level of innovation, their pluri-disciplinarity and their ability to foster collaborations between different actors (public and private research entities, different medical specialties, different scientific profiles).

In this context, a research 3T MRI system (Siemens Verio) was acquired in summer 2009 in order to develop the clinical research in the domain of morphological, functional, structural and cellular in-vivo imaging. In 2014 a new equipment for simultaneous recording of EEG and MRI images was acquired from Brain Product. In 2015, a mock scanner for experimental set-up was acquired as well as a new High Performance Computing environment made of one large computing cluster and a data center that is shared and operated by the Inria center at IRISA (UMR CNRS 6074). The computation cluster (240 cores) and the data center (up to 50 TB) are dedicated to host and process imaging data produced by the Neurinfo platform, but also by other research partners that share their protocols on the Neurinfo neuroinformatics system (currently more than 30 sites).

VisAGeS and its partners in the Neurinfo project are committed to use this new research platform for developing new regional, national and international collaborations around fundamental and applied clinical research projects dealing with in-vivo medical imaging.

In 2016, VisAGeS has been awarded by IBISA as a "Plateforme d'excellence".

In 2017, funding was collected to replace the 3T Siemens Verio MRI. A 3T Siemens Prisma will be installed early 2018.

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[0] http://www.neurinfo.org