RESEARCH CENTER

FIELD
Perception, Cognition and Interaction

Activity Report 2014

Section Software

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DAHU Project-Team

5. New Software and Platforms

5.1. New Software

5.1.1. The Webdamlog system

The Webdamlog system is a distributed knowledge management system. A new version of the system has been developed in collaboration with Drexel University (Prof. Julia Stoyanovich). The new version includes access control.

DREAM Project-Team

5. New Software and Platforms

5.1. Introduction

The pieces of software described in this section are prototypes implemented by members of the project. Any interested person should contact relevant members of the project.

5.2. Platforms

The Dream project-team, in collaboration with their applicative partners, has proposed and maintains several important software platforms for its main research topics.

5.2.1. Platform: Environmental decision-support systems

Participants: Marie-Odile Cordier, Christine Largouët, Véronique Masson, Yulong Zhao.

SACADEAU: the SACADEAU system is an environmental decision software (cf. 4.2) that implements the SACADEAU transfer model. The SACADEAU simulation model couples two qualitative models, a transfer model describing the pesticide transfer through the catchment and a management model describing the farmer decisions. Giving as inputs a climate file, a topological description of a catchment, and a cadastral repartition of the plots, the SACADEAU model simulates the application of herbicides by the farmers on the maize plots, and the transfer of these pollutants through the catchment until the river. The two main simulated processes are the runoff and the leaching. The output of the model simulation is the quantity of herbicides arriving daily to the stream and its concentration at the outlets. The originality of the model is the representation of water and pesticide runoffs with tree structures where leaves and roots are respectively up-streams and down-streams of the catchment.

The software allows the user to see the relationships between these tree structures and the rules learnt from simulations. A more elaborated version allows to launch simulations, to learn rules on-line and to access to two recommendation action algorithms. This year, we have developed a new visualization tool designed to compare two sets of rules learnt from simulations. The user can choose one (or more) rule(s) to compare from one set of rules, and a distance to apply from several multidimensional distances. The most similar rules in the second set of rules are found and the comparison can be easily visualized. The examples covered by "similar" rules can also be presented to the user by highlighting shared positive and negative covered examples. The software is mainly in Java.

The following website is devoted to the presentation of the SACADEAU: http://www.irisa.fr/dream/SACADEAU/. See also [57] for a presentation.

ECOMATA: The ECOMATA tool-box provides means for qualitative modeling and exploring ecosystems and for aiding to design environmental guidelines.We have proposed a new qualitative approach for ecosystem modeling (cf. 4.2) based on timed automata (TA) formalism combined to a high-level query language for exploring scenarios.

To date, ECOMATA is dedicated to ecosystems that can be modeled as a collection of species (prey-predator systems) under various human pressures and submitted to environmental disturbances. It has two main parts: the Network Editor and the Query Launcher. The Network Editor let a stakeholder describe the trophic food web in a graphical way (the species icons and interactions between them). Only few ecological parameters are required and the user can save species in a library. The number of qualitative biomass levels is set as desired. An efficient algorithm generates automatically the network of timed automata. EcoMata provides also a dedicated window to help the user define different fishing pressures, a nice way being by using chronograms. In the Query Launcher, the user selects the kind of query and the needed parameters (for example the species biomass levels to define a situation). Results are provided in a control panel or in files that can be exploited later.

Several additional features are proposed in EcoMata: building a species library, import/export of ecosystem model, batch processing for long queries, etc. EcoMata is developed in Java (Swing for the GUI) and the model-checker called for the timed properties verification is UPPAAL.

The following website is devoted to the presentation of ECOMATA: http://oban.agrocampus-ouest.fr:8080/ecomata.

PATURMATA: The Paturmata tool-box provides means for qualitative modeling and exploring agrosystems, specifically management of herd based on pasture [5]. The system is modelled using a hierarchical hybrid model described in timed automata formalism.

In 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.

Another feature which will be soon added to PaturMata is strategy synthesis. Users choose a pasture configuration or a type of pasture configuration and PaturMata proposes the best pasture and fertilization strategy in order to minimize the pasture procedure cost and use of nitrogen fertilizer.

5.2.2. *Platform: Pattern Mining*

Participants: Thomas Guyet, René Quiniou.

QTempIntMiner: the QTEMPINTMINER (Quantitative Temporal Interval Miner) data mining software implements several algorithms presented in [46] and [3] (QTIAPRIORI and QTIPREFIXSPAN). The software is mainly implemented in Matlab. It uses the Mixmod toolbox [33] to compute multi-dimensional Gaussian distributions. The main features of QTEMPINTMINER are:

- a tool for generating synthetic noisy sequences of temporal events,
- an implementation of the QTEMPINTMINER, QTIAPRIORI and QTIPREFIXSPAN algorithms,
- a graphical interface that enables the user to generate or import data set and to define the parameters of the algorithm and that displays the extracted temporal patterns.
- a sequence transformer to process long sequences of temporal events. Long sequences are transformed into a database of short temporal sequences that are used as input instances for the available algorithms.

The software includes one new algorithm based on the separation of the set of interval to extract more efficiently but less accurately the time interval in temporal patterns. This new algorithm version is still under evaluation on simulated and real datasets (care pathways).

The following website gives many details about the algorithms and provides the latest stable implementation of QTEMPINTMINER: http://www.irisa.fr/dream/QTempIntMiner/.

5.2.3. *Platform: Diagnostic and Monitoring Systems*

Participants: Marie-Odile Cordier, René Quiniou, Sophie Robin.

Odisseptale: the Odisseptale software implements disease detectors using monitoring of data provided by sensors placed on calves or cows. Sensors record streams of data such as body temperature, physical activity, feeding behavior, etc. These data are transmitted regularly to a monitoring software that aims to detect if a noticeable change has occurred on the data streams. Several detectors can be simultaneously active and each contribute to the final decision (detection of a disease). Two kinds of detectors have been implemented: a generic detector based on adaptive CUSUM and a symbolic pattern-based detector. Odisseptale provides also facilities for parameter setting and performance evaluation.

ManageYourself: the ManageYourself software comes from a collaborative project between Dream and the Telelogos company aiming at monitoring smartphones from a stream of observations made on the smartphone state.

Today's smartphones are able to perform calls, as well as to realize much more complex activities. They are small computers. But as in computers, the set of applications embedded on the smartphone can lead to problems. The aim of the project ManageYourself is to monitor smartphones in order to avoid problems or to detect problems and to repair them.

The ManageYourself application includes three parts :

- A monitoring part which triggers preventive rules at regular time to insure that the system is working correctly, e.g. *if the memory is full then delete the tmp directory*. This part is always running on the smartphone.
- A reporting part which records regularly the state of the smartphone (the memory state - free vs allocated -, the connection state, which applications are running, etc.). This part also is always running on the smartphone. The current state is stored in a report at regular period and is labeled *normal*. When an application or the system bugs, the current buggy state is stored in a report and is labeled *abnormal*. At regular timestamps, all the reports are sent to a server where the learning process is executed.
- A learning part which learns new bug rules from the report dataset. This part is executed offline on the server. Once the bug rules are learnt, human experts translates them into preventive rules which are downloaded and integrated in the monitoring part of the smartphones.

5.3. TraceSquiz: reduction of captured trace volume

Participants: Serge Vladimir Emteu Tchagou, Alexandre Termier.

TraceSquiz is a software developped in collaboration with STMicroelectronics. Its goal is to reduce the volume of execution trace captured during endurance tests of multimedia applications. It uses anomaly detection techniques to "learn" regular parts of the trace and only capture the irregular ones. The software is written in C++.

EXMO Project-Team

5. New Software and Platforms

5.1. Alignment API

Participants: Jérôme Euzenat [Correspondent], Jérôme David, Nicolas Guillouet, Armen Inants, Luz Maria Priego-Roche.

We have designed a format for expressing alignments in a uniform way [1]. The goal of this format is to share available alignments on the web. It should help systems using alignments, e.g., mediators, translators, to take advantage of any matching algorithm and it will help matching algorithms to be used in many different tasks. This format is expressed in RDF, so it is freely extensible.

The API itself [1] is a JAVA description of tools for accessing the common format. It defines five main interfaces (OntologyNetwork, Alignment, Cell, Relation and Evaluator).

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

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

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

In 2014, the Alignment API integrated an implementation of link keys (§6.3.4) and transformations of these into SPARQL queries.

We have developed, on top of the Alignment API, an Alignment server that can be used by remote clients for matching ontologies and for storing and sharing alignments. It is developed as an extensible platform which allows to plug-in new interfaces. The Alignment server can be accessed through HTML, web service (SOAP and REST) and agent communication interfaces. It has been used this year in the Ready4SmartCities project (§7.2.1.1).

The Alignment API is used in the Ontology Alignment Evaluation Initiative data and result processing (§6.2.1). It is also used by more than 50 other teams worldwide.

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

5.2. The OntoSim library

Participants: Jérôme David [Correspondent], Jérôme Euzenat.

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

There are many reasons for measuring a distance between ontologies. For example, in semantic social networks, when a peer looks for particular information, it could be more appropriate to send queries to peers having closer ontologies because it will be easier to translate them and it is more likely that such a peer has the information of interest. OntoSim provides a framework for designing various kinds of similarities. In particular, we distinguish similarities in the ontology space from those in the alignment space. The latter ones use available alignments in an ontology network while the former only rely on ontology data. OntoSim is provided with 4 entity measures which can be combined using various aggregation schemes (average linkage, Hausdorff, maximum weight coupling, etc.), 2 kinds of vector space measures (boolean and TFIDF), and 4 alignment space measures. It also features original comparison methods such as agreement/disagreement measures. In addition, the framework embeds external similarity libraries which can be combined to our own.

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

GRAPHIK Project-Team

5. New Software and Platforms

5.1. Cogui

Participants: Alain Gutierrez, Michel Leclère, Marie-Laure Mugnier, Michel Chein, Madalina Croitoru.

Cogui (http://www.lirmm.fr/cogui) is a tool for building and verifying knowledge bases. It is a freeware written in Java (version 1.6). Currently, it supports Conceptual Graphs and import/export in RDFS and Datalog$^+$.

This year, we have particularly improved scripts, which are interpreted pieces of code allowing to freely manipulate objects of the KB. The main improvements are the following:

- script management with better bug tracking and error reporting;
- interoperability between scripts and objects of the knowledge base;
- embedding of a Java library, which allows to import java classes into scripts (a feature required in the application developed for Qualinca).

5.2. Graal

Participants: Clément Sipieter, Jean-François Baget, Marie-Laure Mugnier, Swan Rocher.

Graal is a new software platform written in java, built since March 2014 from the Alaska platform developed during Bruno Paiva Lima Da Silva's PhD thesis. It also integrates algorithms developed by various members of the team. It is developed by Clément Sipieter thanks to the Inria ADT QUASAR.

Graal is intended to be a generic platform for ontological query answering with existential rules. It will implement and allow to compare various paradigms that fall into that framework.

In its current state, Graal allows storage of data via a generic interface in different storage paradigms and systems. Currently, the relational database management systems MySQL, PostgreSQL, Sqlite, and InMemory graph and LinkedList structures are implemented. The triple store Jena TDB and the graph database system Sparksee are coming soon. Graal also allows us to query this database taking into account an ontology represented by a set of existential rules. It provides forward chaining and backward chaining algorithms (building up on the work of Mélanie König) and a tool for the analysis of the properties of a set of rules which is an integration of Swan Rocher's tool Kiabora http://www2.lirmm.fr/~mugnier/graphik/kiabora/. The input and output of this software can be expressed in our Datalog-inspired format DLGP or in the Semantic Web language OWL. This software is designed in a modular way, hence it is possible to use only a subpart of Graal without embedding it all or to easily replace an implementation of a module by another.

LINKS Team

4. New Software and Platforms

4.1. QuiX-Tool Suite

Participants: Joachim Niehren [correspondant], Denis Debarbieux, Tom Sebastian.

The QuiX-Tool Suite provides tools to process XML streams and documents. The QuiX-Tool Suite is based on early algorithms: query answers are delivered as soon as possible and in all practical cases at the earliest time point. The QuiX-Tool Suite provides an implementation of the main XML standart over streams. XPath, XSLT, XQuery and XProc are W3C standarts while Schematron is an ISO one. The QuiX-Tool suite is developed in the Inria transfer project QuiXProc in cooperation with Innovimax. It includes among the others existing tools such as FXP and QuixPath, along with new tools, namely X-Fun. Both, a free and a professional version are available. The ownership of QuiX-Tool Suite is shared between Inria and Innovimax. The main application of QuiX-Tool Suite is its usage in QuiXProc, an professional implementation of the W3C pipeline language XProc owned by Innovimax.

The QuiXPath language is a large fragment of XPath with full support for the XML data model. The QuiXPath library provides a compiler from QuiXPath to FXP, which is a library for querying XML streams with a fragment of temporal logic.

The X-Fun language is a functional language for defining transformations between XML data trees, while providing shredding instructions. X-Fun can be understood as an extension of Frisch's XStream language with output shredding, while pattern matching is replaced by tree navigation with XPath expressions. The QuiX-Tool suite includes QuiXSLT, which is a compiler from XSLT into a fragment of X-Fun, which can be considered as the core of XSLT. It also provides QuiXSchematron, which is a compiler from Schematron to X-Fun, and QuiXQuery, which is a compiler from XQuery to X-Fun.

QuixPath now covers 100 per cent of the XPathMark, a W3C benchmark for the language Xpath (querying XML trees). In particular, it includes aggregation operators, joins and arithmetics operations.

See also the web page https://project.inria.fr/quix-tool-suite/.

- Version: QuixPath v2.0.3
- Version: X-Fun v0.5.0
- Version: QuiXSLT v0.5.0
- Version: QuiXSchematron v1.0.2

4.2. SmartHal

Participants: Joachim Niehren [correspondant], Antoine Mbaye Ndione, Guillaume Bagan.

SmartHal is a better tool for querying the HAL bibliography database, while is based on Haltool queries. The idea is that a Haltool query returns an XML document that can be queried further. In order to do so, SmartHal provides a new query language. Its queries are conjunctions of Haltool queries (for a list of laboratories or authors) with expressive Boolean queries by which answers of Haltool queries can be refined. These Boolean refinement queries are automatically translated to XQuery and executed by Saxon. A java application for extraction from the command line is available. On top of this, we have build a tool for producing the citation lists for the evaluation report of the LIFL, which can be easily adapter to other Labs.

See also the web page http://smarthal.lille.inria.fr/.

This year, Smathal has been adapted for querying the version 3.0 of Hal. Moreover, maintenance and optimization has been proceded all over the year.

- Version: SmartHal v1.0.0

MAGNET Team

5. New Software and Platforms

5.1. CoRTex

Participants: Pascal Denis [correspondent], David Chatel.

CoRTex is a LGPL-licensed Python library for Noun Phrase coreference resolution in natural language texts. This library contains implementations of various state-of-the-art coreference resolution algorithms, including those developed in our research. In addition, it provides a set of APIs and utilities for text pre-processing, reading the main annotation formats (ACE, CoNLL and MUC), and performing evaluation based on the main evaluation metrics (MUC, B-CUBED, and CEAF). As such, CoRTex provides benchmarks for researchers working on coreference resolution, but it is also of interest for developers who want to integrate a coreference resolution within a larger platform. This project is hosted on Inria gforge: https://gforge.inria.fr/projects/cortex/.

MAIA Project-Team

5. New Software and Platforms

5.1. AA4MM Suite

Participants: Vincent Chevrier [correspondant], Christine Bourjot, Benjamin Camus, Julien Vaubourg, Victorien Elvinger.

Laurent Ciarletta (Madynes team, LORIA) is a collaborator and correspondant for this software. Yannick Presse and Benjamin Segault (Madynes team, LORIA) are collaborator for this software.

AA4MM (Agents and Artefacts for Multi-modeling and Multi-simulation) is a framework for coupling existing and heterogeneous models and simulators in order to model and simulate complex systems. The first implementation of the AA4MM meta-model was proposed in Julien Siebert's PhD [54] and written in Java, and a renewed JAVA version was submitted to the APP (Agence pour la protection des programmes) the previous year.

The 2014 year was dedicated to improve existing software and to develop new components thanks to new scientific contributions.

Currently, two new software are submitted to the APP:

1. a modelling environment software that enables the graphical definition of multi-models from preexisting elements.
2. AA4MM-Visu, a plug in dedicated to the collection and visualization of information during simulation.

We plan to submit an enhanced version of the JAVA software and of the AA4MM-Visu.

5.2. MASDYNE

Participants: Vincent Chevrier [correspondant], Tomas Navarrete [CRP Henri Tudor].

This work was undertaken in the PhD Thesis of Julien Siebert, a joint thesis between the MAIA and MADYNES teams. It has been enhanced during the PhD of Tomas Navarrete.

MASDYNE (Multi-Agent Simulator of DYnamic Networks usErs) is a multi-agent simulator for modeling and simulating users behaviors in mobile ad hoc network. This software is part of joint work with MADYNES team, on modeling and simulation of ubiquitous networks.

5.3. FiatLux

Participant: Nazim Fatès.

FiatLux is a discrete dynamical systems simulator that allows the user to experiment with various models and to perturb them. It includes 1D and 2D cellular automata, moving agents, interacting particle systems, etc. Its main feature is to allow users to change the type of updating, for example from a deterministic parallel updating to an asynchronous random updating. FiatLux has a Graphical User Interface and can also be launched in a batch mode for the experiments that require statistics.

FiatLux is registered by the Agence pour la protection des programmes (APP). It is available under the CeCILL licence on the FiatLux website : fiatlux.loria.fr

In 2014, FiatLux was internally re-shaped in order to facilitate the reproducibility of experiments. In particular, attention was given to the generation of pseudo-random sequences for the stochastic models.

5.4. Platforms

Inria Research Center in Nancy has supported since 2010 the design and the construction of an innovative platform for favoring research in assistance for elderly people at home. This platform has been mainly funded by the CPER MISN (region of Lorraine , project Info-Situ (2010-2013). It consists of a standard apartment type F2, with a certain number of "smart and connected devices" such as sensor networks. This platform has been designed to make easy technical experimentation in an environment which is as close as possible to reality. Many technical developments have been done during the IPL PAL. In particular concerning MAIA Team, we have been working both (1) on the development of new algorithms to exploit the equipments, and (2) on the effective deployment of different kind of connected devices :

1. a network of depth cameras. These depth cameras are either fixed on the wall or are placed onboard wheeled mobile robots. One important achievement has been to connect these cameras to the ethernet network, each camera being considered as a Ros node with computation capabilities(using a NUC for each node). An other achievement has concerned the calibration of theses cameras. Today 7 cameras covers to whose HIS Platform.
2. Pressure sensing tiles which has been designed by Maia team (in cooperation which Hikob (http://www.hikob.com/applications/recherche/ and the Inria SED of Grenoble (Roger Pissard-Gibollet)) during the Pal evaluation period. Ninety tiles cover the floor of our experimental platform (HIS), which permit to sense activity through the natural interaction of people or robots with the floor when they are acting;
3. Mobile robots whose mobility allows a better coverage in term of perception of the environment.
4. recently we got a Qualisys motion capture system 5funded by Satelor Project).

These devices are all interconnected within the Robotic Operating System (ROS).

OAK Project-Team

5. New Software and Platforms

5.1. Amada

Name: Amada (https://team.inria.fr/oak/amada/)

Contact: Jesús Camacho-Rodríguez (jcamachor[at]gmail.com))

Other contacts: Ioana Manolescu (ioana.manolescu[at]inria.fr), Dario Colazzo (dario.colazzo[at]dauphine.fr), François Goasdoué (fg[at]irisa.fr)

Presentation: A platform for Web data management in the Amazon cloud.

5.2. PAXQuery

Name: PAXQuery (https://team.inria.fr/oak/projects/paxquery/)

Contact: Jesús Camacho-Rodríguez (jcamachor[at]gmail.com))

Other contacts: Ioana Manolescu (ioana.manolescu[at]inria.fr), Dario Colazzo (dario.colazzo[at]dauphine.fr), Juan Alvaro M. Naranjo (juan-alvaro.munoz-naranjo[at]inria.fr)

Presentation: A system for the massively parallel processing of XQuery queries, developed as an extension of the Apache Flink system (http://flink.apache.org/)

5.3. CliqueSquare

Name: CliqueSquare (https://team.inria.fr/oak/projects/cliquesquare/)

Contact: Stamatis Zampetakis (stamatis.zampetakis[at]inria.fr))

Other contacts: Ioana Manolescu (ioana.manolescu[at]inria.fr), François Goasdoué (fg[at]irisa.fr), Benjamin Djahandideh (benjamin.djahandideh[at]inria.fr)

Presentation: A system for the massively parallel evaluation of conjunctive SPARQL queries, built on top of Hadoop. The system has been released in open-source: https://sourceforge.net/projects/cliquesquare/.

5.4. FactMinder

Name: FactMinder (http://tripleo.saclay.inria.fr/xr/demo/)

Contact: Ioana Manolescu (ioana.manolescu[at]inria.fr)

Other contacts: Stamatis Zampetakis (stamatis.zampetakis[at]inria.fr), François Goasdoué (fg[at]irisa.fr).

Presentation: A system for archiving, annotating, and querying semantic-rich Web content.

5.5. Nautilus Analyzer

Name: Nautilus Analyzer (http://nautilus.saclay.inria.fr/)

Contact: Melanie Herschel (melanie.herschel[at]lri.fr)

Other contacts: n.a.

Presentation: A tool for analyzing and debugging SQL queries using why-provenance and why-not provenance.

5.6. PigReuse

Name: PigReuse

Contact: Jesús Camacho-Rodríguez (jcamachor[at]gmail.com)

Other contacts: Ioana Manolescu (ioana.manolescu[at]inria.fr), Dario Colazzo (dario.colazzo[at]dauphine.fr)

Presentation: A PigLatin optimization tool based on identifying and sharing repeated subexpressions.

5.7. WARG

Name: WARG (https://team.inria.fr/oak/warg/)

Contact: Alexandra Roatiş (alexandra.roatis[at]gmail.com)

Other contacts: Ioana Manolescu (ioana.manolescu[at]inria.fr), Sejla Cebiric (sejla.cebiric[at]inria.fr), François Goasdoué (fg[at]irisa.fr)

Presentation: A platform for specifying and exploiting warehouses of RDF data.

ORPAILLEUR Project-Team

5. New Software and Platforms

5.1. Generic Symbolic KDD Systems

5.1.1. The Coron Platform

Participants: Jérémie Bourseau, Aleksey Buzmakov, Victor Codocedo, Adrien Coulet, Amedeo Napoli [contact person], Yannick Toussaint.

Keywords: data mining, frequent itemset, closed itemset, generator, association rule, rare itemset

The Coron platform [133], [120] is a KDD toolkit organized around three main components: (1) Coron-base, (2) AssRuleX, and (3) pre- and post-processing modules. The software was registered at the "Agence pour la Protection des Programmes" (APP) and is freely available (see http://coron.loria.fr).

The Coron-base component includes a complete collection of data mining algorithms for extracting itemsets such as frequent itemsets, closed itemsets, generators and rare itemsets. In this collection we can find APriori, Close, Pascal, Eclat, Charm, and, as well, original algorithms such as ZART, Snow, Touch, and Talky-G [45]. AssRuleX generates different sets of association rules (from itemsets), such as minimal non-redundant association rules, generic basis, and informative basis. In addition, the Coron system supports the whole life-cycle of a data mining task and proposes modules for cleaning the input dataset, and for reducing its size if necessary.

The Coron toolkit is developed in Java, is operational, and was already used in several research projects.

5.1.2. Orion: Skycube Computation Software

Participant: Chedy Raïssi [contact person].

Keywords: skyline, skycube

This program implements the algorithms described in a research paper published at VLDB 2010 [127]. The software provides a list of four algorithms discussed in the paper in order to compute skycubes. This is the most efficient –in term of space usage and runtime– implementation for skycube computation (see https://github.com/leander256/Orion).

5.2. Stochastic systems for knowledge discovery and simulation

5.2.1. The CarottAge System

Participants: Florence Le Ber, Jean-François Mari [contact person].

Keywords: Hidden Markov Models, stochastic process

The system CarottAge is based on Hidden Markov Models of second order and provides a non supervised temporal clustering algorithm for data mining and a synthetic representation of temporal and spatial data [92]. CarottAge is currently used by INRA researchers interested in mining the changes in territories related to the loss of biodiversity (projects ANR BiodivAgrim and ACI Ecoger) and/or water contamination. CarottAge is also used for mining hydromorphological data. Actually a comparison was performed with three other algorithms classically used for the delineation of river continuum and CarottAge proved to give very interesting results for that purpose [121].

CarottAge is freely available under GPL license (see http://www.loria.fr/~jfmari/App/). A special effort is currently aimed at designing interactive visualization tools to provide the expert a user-friendly interface.

5.2.2. The ARPEnTAge System

Participant: Jean-François Mari [contact person].

Keywords: Hidden Markov Models, stochastic process

ARPEnTAge, for "*Analyse de Régularités dans les Paysages : Environnement, Territoires, Agronomie*" (http://www.loria.fr/~jfmari/App/) is a software based on stochastic models (HMM2 and Markov Field) for analyzing spatio-temporal data-bases [124]. ARPEnTAge is built on top of the CarottAge system to fully take into account the spatial dimension of input sequences. It takes as input an array of discrete data in which the columns contain the annual land-uses and the rows are regularly spaced locations of the studied landscape. It performs a Time-Space clustering of a landscape based on its time dynamic Land Uses (LUS). Displaying tools and the generation of Time-dominant shape files have also been defined.

ARPEnTAge is freely available (GPL license) and is currently used by INRA researchers interested in mining the changes in territories related to the loss of biodiversity (projects ANR BiodivAgrim and ACI Ecoger) and/or water contamination. In these practical applications, CarottAge and ARPEnTAge aim at building a partition –called the hidden partition– in which the inherent noise of the data is withdrawn as much as possible. The estimation of the model parameters is performed by training algorithms based on the Expectation Maximization and Mean Field theories. The ARPEnTAge system takes into account: (i) the various shapes of the territories that are not represented by square matrices of pixels, (ii) the use of pixels of different size with composite attributes representing the agricultural pieces and their attributes, (iii) the irregular neighborhood relation between those pixels, (iv) the use of shape files to facilitate the interaction with GIS (geographical information system).

ARPEnTAge and CarottAge were used for mining decision rules in a territory showing environmental issues. They provide a way of visualizing the impact of farmers decision rules in the landscape and revealing new extra hidden decision rules [132].

5.3. KDD in Systems Biology

Participants: Marie-Dominique Devignes [contact person], Malika Smaïl-Tabbone.

5.3.1. IntelliGO Online

The IntelliGO measure computes semantic similarity between terms from a structured vocabulary (Gene Ontology: GO) and uses these values for computing functional similarity between genes annotated by sets of GO terms [104]. The IntelliGO measure is available on line (http://plateforme-mbi.loria.fr/intelligo/) to be used for evaluation purposes. It is possible to compute the functional similarity between two genes, the intra-set similarity value in a given set of genes, and the inter-set similarity value for two given sets of genes.

5.3.2. WAFOBI: KNIME Nodes for Relational Mining of Biological Data

KNIME (for "Konstanz Information Miner") is an open-source visual programming environment for data integration, processing, and analysis. The KNIME platform aims at facilitating the data mining experiment settings as many tests are required for tuning the mining algorithms. Various KNIME nodes were developed for supporting relational data mining using the ALEPH program (http://www.comlab.ox.ac.uk/oucl/research/areas/machlearn/Aleph/aleph.pl). These nodes include a data preparation node for defining a set of first-order predicates from a set of relation schemes and then a set of facts from the corresponding data tables (learning set). A specific node allows to configure and run the ALEPH program to build a set of rules. Subsequent nodes allow to test the first-order rules on a test set and to perform configurable cross validations.

5.3.3. MOdel-driven Data Integration for Mining (MODIM)

The MODIM software (MOdel-driven Data Integration for Mining) is a user-friendly data integration tool which can be summarized along three functions: (i) building a data model taking into account mining requirements and existing resources; (ii) specifying a workflow for collecting data, leading to the specification of wrappers for populating a target database; (iii) defining views on the data model for identified mining scenarios.

Although MODIM is domain independent, it was used so far for biological data integration in various internal research studies and for organizing data about non ribosomal peptide syntheses. The sources can be downloaded at https://gforge.inria.fr/projects/modim/.

5.4. Knowledge-Based Systems and Semantic Web Systems

5.4.1. The Kasimir System for Decision Knowledge Management

Participants: Nicolas Jay, Jean Lieber [contact person], Amedeo Napoli.

Keywords: classification-based reasoning, case-based reasoning, decision knowledge management, knowledge edition, knowledge base maintenance, semantic portal

The objective of the Kasimir system is decision support and knowledge management for the treatment of cancer. A number of modules have been developed within the Kasimir system for editing treatment protocols, visualization, and maintenance. Kasimir is developed within a semantic portal, based on OWL. KatexOWL (Kasimir Toolkit for Exploiting OWL Ontologies, http://katexowl.loria.fr) was developed in a generic way and is applied to Kasimir. In particular, the user interface EdHibou of KatexOWL is used for querying the protocols represented within the Kasimir system In [109], this research is presented, together with an extension of Kasimir for multi-viewpoint case-based reasoning.

CabamakA (case base mining for adaptation knowledge acquisition) is a module of the Kasimir system. This system performs case base mining for adaptation knowledge acquisition and provides information units to be used for building adaptation rules. Actually, the mining process in CabamakA is based on a frequent close itemset extraction module from the Coron platform (see §5.1.1).

The Oncologik system is a collaborative editing tool aiming at facilitating the management of medical guidelines. Based on a semantic wiki, it allows the acquisition of formalized decision knowledge also includes a graphical decision tree editor called KcatoS. A version of Oncologik was released in 2012 (http://www.oncologik.fr/).

5.4.2. Taaable: a System for Retrieving and Creating New Cooking Recipes by Adaptation

Participants: Valmi Dufour-Lussier, Emmanuelle Gaillard, Florence Le Ber, Jean Lieber, Amedeo Napoli, Emmanuel Nauer [contact person].

Keywords: knowledge acquisition, ontology engineering, semantic annotation, case-based reasoning, hierarchical classification, text mining

Taaable is a system whose objectives are to retrieve textual cooking recipes and to adapt these retrieved recipes whenever needed [4]. Suppose that someone is looking for a “leek pie” but has only an “onion pie” recipe: how can the onion pie recipe be adapted?

The Taaable system combines principles, methods, and technologies such as case-based reasoning (CBR), ontology engineering, text mining, text annotation, knowledge representation, and hierarchical classification. Ontologies for representing knowledge about the cooking domain, and a terminological base for binding texts and ontology concepts, were built from textual web resources. These resources are used by an annotation process for building a formal representation of textual recipes. A CBR engine considers each recipe as a case, and uses domain knowledge for reasoning, especially for adapting an existing recipe w.r.t. constraints provided by the user, holding on ingredients and dish types.

The Taaable system is available on line since 2008 at http://taaable.fr, and is constantly evolving. This year, a new version of Taaable has been implemented in order to participate to the 7th Computer Cooking Contest which held during the International Case-Based Reasoning, in Cork, Ireland. The new version of Taaable is based on Tuuurbine, a generic ontology guided CBR engine over RDFS (see Section 5.4.3), and Revisor, an adaptation engine implementing various revision operators (see Section 5.4.5). In particular, Revisor is used to compute ingredient substitutions and to adjust the ingredient quantities.

5.4.3. *Tuuurbine: a Generic Ontology Guided Case-Based Inference Engine*

Participants: Jean Lieber, Emmanuel Nauer [contact person].

Keywords: case-based reasoning, inference engine, knowledge representation, ontology engineering, semantic web

The experience acquired since 5 years with the Taaable system conducted to the creation of a generic cased-based reasoning system, whose reasoning procedure is based on a domain ontology [63]. This new system, called Tuuurbine (http://tuuurbine.loria.fr/), takes into account the retrieval step, the case base organization, and also an adaptation procedure which is not addressed by other generic case-based reasoning tools. Moreover, Tuuurbine is built over semantic web standards that will ensure facilities for being plugged over data available on the web. The domain knowledge is represented in an RDF store, which can be interfaced with a semantic wiki, for collaborative edition and management of the knowledge involved in the reasoning system (cases, ontology, adaptation rules). The development of Tuuurbine was supported by an Inria ADT funding until October 2013. Tuuurbine is distributed under an Affero GPL License and is available from http://tuuurbine.loria.fr/.

5.4.4. *BeGoood: a Generic System for Managing Non-Regression Tests on Knowledge Bases*

Participant: Emmanuel Nauer [contact person].

Keywords: tests, non-regression, knowledge evolution

BeGoood is a system allowing to define test plans, independent of any application domain, and usable for testing any system answering queries by providing results in the form of sets of strings. BeGoood provides all the features usually found in test systems, such as tests, associated queries, assertions, and expected result sets, test plans (sets of tests) and test reports. The system is able to evaluate the impact of a system modification by running again test plans and by evaluating the assertions which define whether a test fails or succeeds. The main components of BeGoood are (1) the “test database” that stores every test artifacts, (2) the “remote query evaluator” which evaluates test queries, (3) the “assertion engine” which evaluates assertions over the expected and effective query result sets, (4) the “REST API” which offers the test functionalities as web services, and finally (5) the “Test controller” and (6) the “Test client”.

BeGoood is available under a AGPL license on github [0]. BeGoood is used by the Taaable system (see Section 5.4.2) for managing the evolution of the knowledge base used by the CBR system.

5.4.5. *Revisor: a Library of Revision Operators and Revision-Based Adaptation Operators*

Participants: Valmi Dufour-Lussier, Alice Hermann, Florence Le Ber, Jean Lieber [contact person], Emmanuel Nauer, Gabin Personeni.

Keywords: belief revision, adaptation, revision-based adaptation, case-based reasoning, inference engines, knowledge representation

Revisor is a library of inference engines dedicated to belief revision and to revision-based adaptation for case-based reasoning [3]. It is open source, under a GPL license and available on the web (http://revisor.loria.fr/). It gathers several engines developed during the previous years for various knowledge representation formalisms (propositional logic—with or without the use of adaptation knowledge [93]—conjunction of linear constraints, and qualitative algebras [61], [75], [87], [14]). Some of these engines are already used in the Taaable system. Current developments on Revisor aim at defining new engines in other formalisms.

[0] https://github.com/kolflow/begoood

SMIS Project-Team

5. New Software and Platforms

5.1. Introduction

In our research domain, developing software prototypes is mandatory to validate research solutions and is an important vector for publications, demonstrations at conferences as well as for cooperations with industry. Our software strategy is also driven by our ambition to see our research results produce a real societal impact. To reach this goal, we integrate our prototypes in experiments in the field - notably in the healthcare domain and with scientists of other disciplines - and we recently set up educational platforms to raise students awareness of privacy protection problems and embedded programming.

This prototyping task is however difficult because it requires specialized hardware platforms, themselves sometimes at an early stage of development. For a decade, we have developed successive prototypes relying on different hardware platforms provided by Schlumberger then Gemalto, e.g., PicoDBMS a full-fledged DBMS embedded in a smart card [37] [26], Chip-Secured Data Access (C-SDA) a tamper-resistant mediator between a client and an untrusted server hosting encrypted data [32], Chip-Secured XML Access (C-SXA) an XML-based access rights controller, recipient of the e-gate open 2004 Silver Award and SIMagine 2005 Gold award [33]. Today, most of our software development efforts are organized around a unified platform named PlugDB and we are designing our own hardware platforms, that are produced by electronic SMEs. This opens up new research and experiment opportunities and we are engaged in an open-source/open hardware initiative to disseminate our results at a larger scale, both for scientific, educational and business purposes.

The next subsections detail the two prototypes we are focusing on today.

5.2. PlugDB engine

Participants: Nicolas Anciaux [correspondent], Luc Bouganim, Aydogan Ersoz, Quentin Lefebvre, Philippe Pucheral.

More than a stand-alone prototype, PlugDB is part of a complete architecture dedicated to a secure and ubiquitous management of personal data. PlugDB aims at providing an alternative to a systematic centralization of personal data. To meet this objective, the PlugDB architecture lies on a new kind of hardware device called Secure Portable Token (SPT). Roughly speaking, a SPT combines a smart-card and a micro-controller with a large external Flash memory (Gigabyte sized). The SPT can host data on Flash (e.g., a personal folder) and safely run code embedded in the micro-controller. PlugDB engine is the cornerstone of this embedded code. PlugDB engine manages the database on Flash (tackling the peculiarities of NAND Flash storage), enforces the access control policy defined on this database, protects the data at rest against piracy and tampering, executes queries (tackling low RAM constraint) and ensures transaction atomicity. Part of the on-board data can be replicated on a server (then synchronized) and shared among a restricted circle of trusted parties through crypto-protected interactions. PlugDB engine has been registered at APP (Agence de Protection des Programmes) in 2009 [27] and a new version is registered each year. PlugDB has been experimented in the field in the Yvelines District to implement a secure and portable medical-social folder helping the coordination of medical care and social services provided at home to dependent people. This field experiment is being audited by ARS-Ile de France (the Regional Healthcare Agency) and CG78 (General Council of Yvelines District), in order to envision the opportunity of a larger deployment. In parallel, we are improving the PlugDB prototype to overcome the limitations identified during the experiment. Notably, we have integrated a Bluetooth module to communicate in wireless with the token, a fingerprint module to authenticate users and a microphone to record voice messages. These are key elements in the perspective of a generalization. Link: https://project.inria.fr/plugdb/.

5.3. Eagle Tree

Participants: Matias Bjørling, Philippe Bonnet, Luc Bouganim, Niv Dayan [correspondent].

Solid State Drives (SSDs) are a moving target for system designers: they are black boxes, their internals are undocumented, and their performance characteristics vary across models. There is no appropriate analytical model and experimenting with commercial SSDs is cumbersome, as it requires a careful experimental methodology to ensure repeatability. Worse, performance results obtained on a given SSD cannot be generalized. Overall, it is impossible to explore how a given algorithm, say a hash join or LSM-tree insertions, leverages the intrinsic parallelism of a modern SSD, or how a slight change in the internals of an SSD would impact its overall performance. In this paper, we propose a new SSD simulation framework, named EagleTree, which addresses these problems, and enables a principled study of SSD-Based algorithms. EagleTree is an extensible, customizable SSD simulator designed to enable deep analyses of the interplay between the FTL, block management scheme, IO scheduling policy and application workload. It is able to generate visual illustrations of a host of performance metrics. EagleTree is available for Linux, and is licensed under GPL. EagleTree's git repository is : https://github.com/nivdayan/EagleTree.

WIMMICS Project-Team

5. New Software and Platforms

5.1. Corese

Participants: Olivier Corby [correspondant], Alban Gaignard, Fabien Gandon, Fuqi Song.

Corese (COnceptual REsource Search Engine) is a Semantic Web Factory. It enables users to load and process RDFS schemas, RDF data and query and update the graph base thus created by using the SPARQL 1.1 Query & Update Language (figure 1).

Furthermore, Corese query language integrates original features such as approximate search, extended Property Path, SQL or XPath. It provides SPARQL Template Transformation Language for RDF graphs and a SPARQL based Inference Rule Language for RDF. Corese also provides distributed federated query processing, thanks to a collaboration with Alban Gaignard and Johan Montagnat from I3S.

Corese is a Semantic Web Factory that enables us to design and develop Semantic Web applications; it is available for download. In the past, Corese received two software development grants (ADT) from Inria and in 2014 we have a new grant for two more years. Corese is registered at the APP and in 2007 we decided to distribute it as open source software under license CeCILL-C.

Corese is used and has been used in more than 60 applications, 24 PhD Thesis and is used for education by several institutions. It has been used in European projects such as Ontorule, Palette, SevenPro, SeaLife and in ANR projects such as Kolflow, Ginseng, Neurolog, VIP, ISICIL, e-WOK Hub. Corese is the Semantic Web engine of Discovery Hub [0] and of the Semantic Web Import Plugin for Gephi visualization [0].

The work on Corese was published in [3], [2], [4], [58].

Web page: http://wimmics.inria.fr/corese

5.2. Question Answering Wikiframework-based System

Participant: Elena Cabrio.

The QAKiS system (figure 2) implements question answering over DBpedia. QAKiS allows end users to submit a query to an RDF triple store in English and obtain the answer in the same language, hiding the complexity of the non-intuitive formal query languages involved in the resolution process. At the same time, the expressiveness of these standards is exploited to scale to the huge amounts of available semantic data. Its major novelty is to implement a relation-based match for question interpretation, to convert the user question into a query language (e.g. SPARQL). English, French and German DBpedia chapters are the RDF data sets to be queried using a natural language interface.

Web page: http://www.qakis.org

5.3. French Chapter of DBpedia

Participants: Raphaël Boyer, Fabien Gandon.

DBpedia is an international crowd-sourced community effort to extract structured information from Wikipedia and make this information available on the semantic Web as linked open data. The DBpedia triple stores then allow anyone to solve sophisticated queries against Wikipedia extracted data, and to link the different data sets on these data. The French chapter of DBpedia was created and deployed by Wimmics and is now an online running platform providing data to several projects such as: QAKIS, Izipedia, zone47, Sépage, HdA Lab., JocondeLab, etc.

The platform can be found at: http://www.dbpedia.fr.

It is part of the Semanticpedia convention: http://www.semanticpedia.org/.

[0] http://www.discoveryhub.co
[0] https://marketplace.gephi.org/plugin/semanticwebimport/

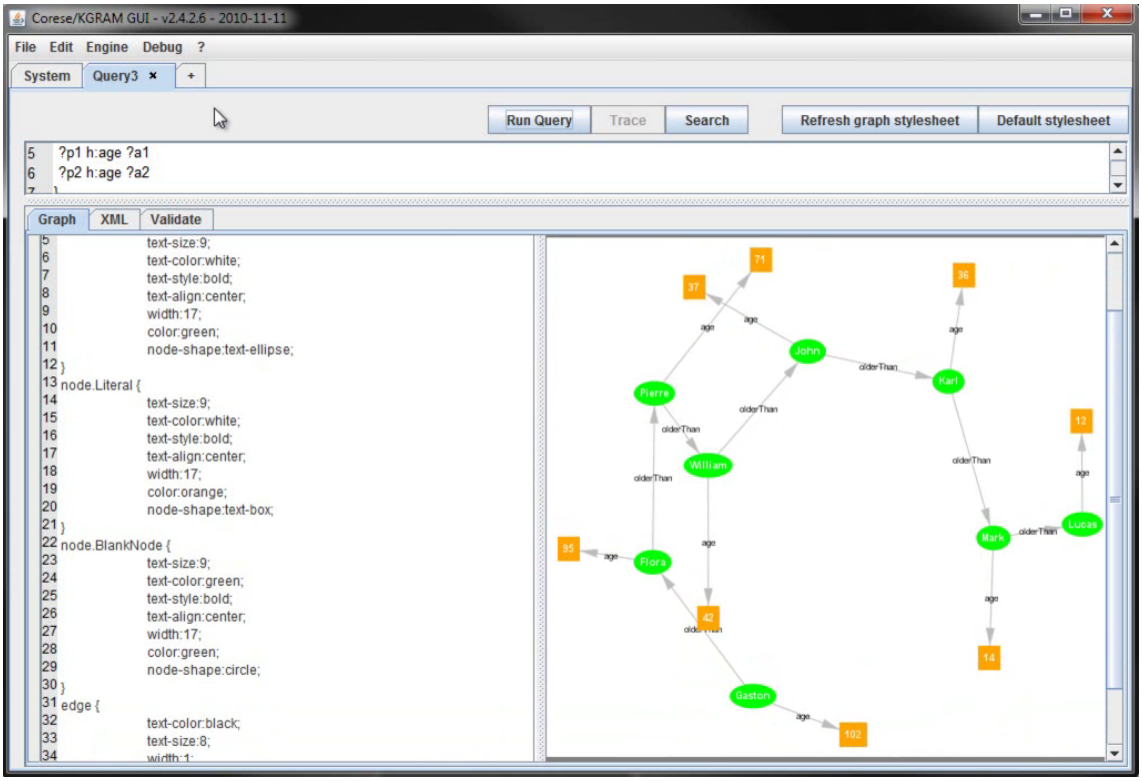


Figure 1. Corese

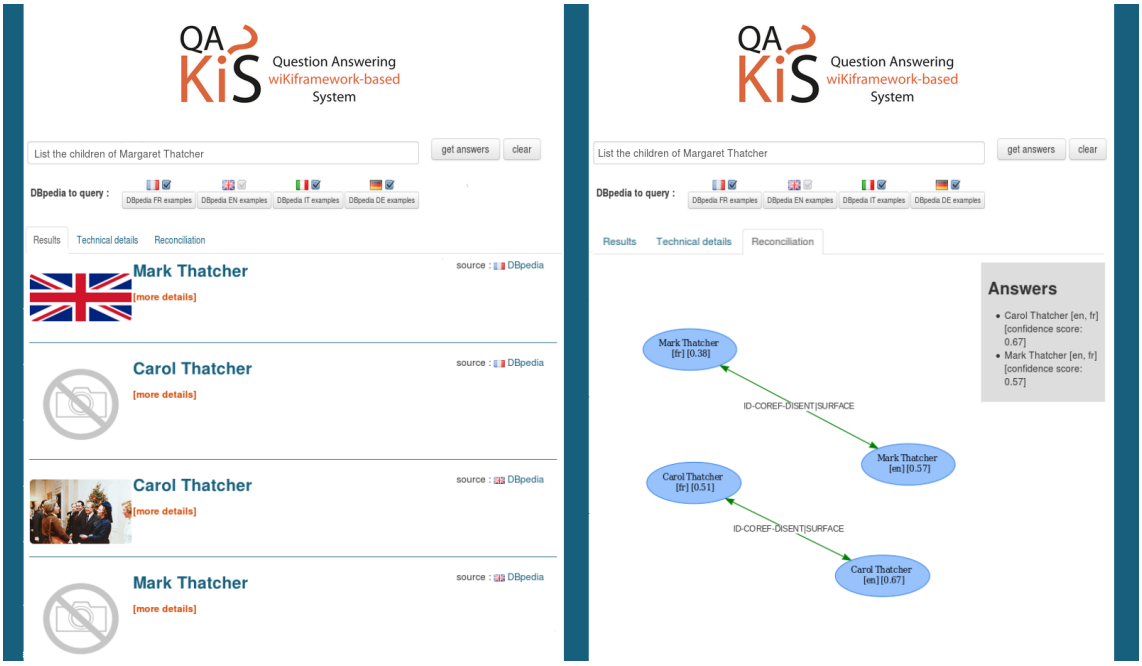


Figure 2. QAKIS

ZENITH Project-Team

5. New Software and Platforms

5.1. Hadoop_g5k

Participants: Reza Akbarinia, Miguel Liroz-Gistau, Patrick Valduriez.

URL: https://www.grid5000.fr/mediawiki/index.php/Hadoop_On_Execo

Apache Hadoop provides an open-source framework for reliable, scalable, parallel computing. It can be deployed and used in large-scale platforms such as Grid 5000. However, its configuration and management is very difficult, specially under the dynamic nature of clusters. Therefore, we built Hadoop_g5k (Hadoop easy deployment in clusters), a tool that makes it easier to manage Hadoop clusters and prepare reproducible experiments. Hadoop_g5k offers a set of scripts to be used in command-line interfaces and a Python interface. It is actually used by Grid5000 users, and helps them saving much time when doing their experiments with MapReduce.

5.2. LogMagnet

Participants: Julien Diener, Florent Masseglia.

URL: https://team.inria.fr/zenith/?s=LogMagnet

LogMagnet is a software for analyzing streaming data, and in particular log data. Log data usually arrive in the form of lines containing activities of human or machines. In the case of human activities, it may be the behavior on a Web site or the usage of an application. In the case of machines, such log may contain the activities of software and hardware components (say, for each node of a computing cluster, the calls to system functions or some hardware alerts). Analyzing such data is often difficult and crucial in the meanwhile. LogMagnet allows to summarize this data, and to provide a first analysis as a clustering. This summary may also be exploited as easily as the original data.

5.3. MultiSite-Rec

Participants: Mohamed Reda Bouadjenek, Florent Masseglia, Esther Pacitti.

URL: https://code.google.com/p/multi-site-rec/

Recommender systems are used as a mean to supply users with content that may be of interest to them. They have become a popular research topic, where many aspects and dimensions have been studied to make them more accurate and effective. In practice, recommender systems suffer from cold-start problems. However, users use many online services, which can provide information about their interest and the content of items (e.g. Google search engine, Facebook, Twitter, etc). These services may be valuable data sources, which supply information to help a recommender system in modeling users and items' preferences, and thus, make the recommender system more precise. Moreover, these data sources are distributed, and geographically distant from each other, which raise many research problems and challenges to design a distributed recommendation algorithm. MultiSite-Rec is a distributed collaborative filtering algorithm, which exploits and combine these multiple and heterogeneous data sources to improve the recommendation quality.

5.4. PlantRT: Gossip-Based Recommendation

Participants: Alexis Joly, Julien Champ, Miguel Liroz-Gistau, Esther Pacitti, Maximilien Servajean [contact].

URL: http://www2.lirmm.fr/~servajean/prototypes/plant-sharing/plant-rt.html

PlantRT is a distributed gossip-based platform for content sharing enabling plants observation keywords search and GPS position based recommendation. It combines advantages from centralized and P2P systems.

5.5. Pl@ntNet

Participants: Julien Champ, Hervé Goëau, Alexis Joly [contact].

URL: http://goo.gl/CpSrr3

Pl@ntNet is an image sharing and retrieval application for the identification of plants. It is developed in the context of the Pl@ntNet project that involves four French research organisations (Inria, Cirad, INRA, IRD) and the members of Tela Botanica social network. The key feature of the iOS and Android front ends is to help identifying plant species from photographs, through a server-side visual search engine based on several results of ZENITH team on content-based information retrieval. Since its first release in March 2013 on the apple store, the application was downloaded by around 300K users in more than 150 countries (between 500 and 5000 active users daily with peaks occurring during the week-ends). The collaborative training set that allows the content-based identification is continuously enriched by the users of the application and the members of Tela Botanica social network. At the time of writing, it includes about 100K images covering more than 5000 French plant species about 4/5 of the whole French flora (this is actually the widest identification tool built anytime).

5.6. SON (Shared-data Overlay Network)

Participants: Esther Pacitti, Didier Parigot [contact], Patrick Valduriez.

URL: http://www-sop.inria.fr/teams/zenith/SON

SON is an open source development platform for P2P networks using web services, JXTA and OSGi. SON combines three powerful paradigms: components, SOA and P2P. Components communicate by asynchronous message passing to provide weak coupling between system entities. To scale up and ease deployment, we rely on a decentralized organization based on a DHT for publishing and discovering services or data. In terms of communication, the infrastructure is based on JXTA virtual communication pipes, a technology that has been extensively used within the Grid community. Using SON, the development of a P2P application is done through the design and implementation of a set of components. Each component includes a technical code that provides the component services and a code component that provides the component logic (in Java). The complex aspects of asynchronous distributed programming (technical code) are separated from code components and automatically generated from an abstract description of services (provided or required) for each component by the component generator.

5.7. Snoop & SnoopIm

Participants: Alexis Joly [contact], Julien Champ, Jean-Christophe Lombardo.

URL: http://otmedia.lirmm.fr/

Snoop is a generalist C++ library dedicated to high-dimensional data management and efficient similarity search. Its main features are dimension reduction, high-dimensional feature vectors hashing, approximate k-nearest neighbors search and Hamming embedding. Snoop is a refactoring of a previous library called PMH developed jointly with the French National Institute of Audiovisual. It is based on the joined research work of Alexis Joly and Olivier Buisson. SnoopIm is a content-based image search engine built on top of Snoop and allowing to retrieve small visual patterns or objects in large collections of pictures. The software is being experimented in several contexts including a logo retrieval application set up in collaboration with the French Press Agency, an experimental plant identification tool mixing textual and visual information retrieval (in the context of the Pl@ntNet project) and a research project on high-throughput analysis of root architecture images.

5.8. SciFloware

Participants: Dimitri Dupuis, Didier Parigot [contact].

URL: http://www-sop.inria.fr/members/Didier.Parigot/pmwiki/Scifloware

SciFloware is an action of technology development (ADT Inria) with the goal of developing a middleware for the execution of scientific workflows in a distributed and parallel way. It capitalizes on our experience with SON and an innovative algebraic approach to the management of scientific workflows. SciFloware provides a development environment and a runtime environment for scientific workflows, interoperable with existing systems. We validate SciFloware with workflows for analyzing biological data provided by our partners CIRAD, INRA and IRD.

5.9. WebSmatch (Web Schema Matching)

Participants: Emmanuel Castanier, Patrick Valduriez [contact].

URL: http://websmatch.gforge.inria.fr/

In the context of an action of technology development (ADT) started in october 2010, WebSmatch is a flexible, open environment for discovering and matching complex schemas from many heterogeneous data sources over the Web. It provides three basic functions: (1) metadata extraction from data sources; (2) schema matching (both 2-way and n-way schema matching), (3) schema clustering to group similar schemas together. WebSmatch is being delivered through Web services, to be used directly by data integrators or other tools, with RIA clients. Implemented in Java, delivered as Open Source Software (under LGPL) and protected by a deposit at APP (Agence de Protection des Programmes). WebSmatch is being used by Datapublica and CIRAD to integrate public data sources.

ALICE Project-Team

5. New Software and Platforms

5.1. Vorpaline

Participants: Dobrina Boltcheva, Bruno Lévy, Thierry Valentin.

Vorpaline is an automatic surfacic and volumetric mesh generation software, distributed with a commercial license. Vorpaline is based on the main scientific results stemming from projects GoodShape and VORPALINE, funded by the European Research Council, about optimal quantization, centroidal Voronoi diagrams and fast/parallel computation of Voronoi diagrams in high-dimension space. The current version provides functionalities such as isotropic/adaptive/anisotropic surface re-meshing, tolerant surface re-meshing, mesh repair and mesh decimation, constrained surface meshing, quad-dominant surface meshing and hex-dominant volume meshing. It is extensively tested on industrial data with a continuous integration platform, and extensively documented. It is now proposed (since 2014) to the sponsors of the Gocad consortium, as an extension package of the Gocad software.

5.2. IceSL

Participants: Jérémie Dumas, Jean Hergel, Sylvain Lefebvre, Frédéric Claux, Jonas Martinez-Bayona, Samuel Hornus.

In the new software IceSL, we propose to exploit recent advances in GPU and Computer Graphics to accelerate the slicing process of objects modelled via a CSG [0] language. Our target are open source low cost *fused deposition modeling* printers such as RepRaps.

Our approach first inputs a CSG description of a scene which can be composed of both meshes and analytic primitives. During display and slicing the CSG model is converted on the fly into an intermediate representation enabling fast processing on the GPU. Slices can be quickly extracted, and the tool path is prepared through image erosion. The interactive preview of the final geometry uses the exact same code path as the slicer, providing an immediate, accurate visual feedback.

IceSL is the recipient software for our ERC research project “ShapeForge”, led by Sylvain Lefebvre.

Figure 1. Left. A two-colored vase is modeled in IceSL. Right. An early printed result.

[0] Constructive Solid Geometry

5.3. Graphite

Participants: Dobrina Boltcheva, Samuel Hornus, Bruno Lévy, David Lopez, Jeanne Pellerin, Nicolas Ray.

Graphite is a research platform for computer graphics, 3D modeling and numerical geometry. It comprises all the main research results of our “geometry processing” group. Data structures for cellular complexes, parameterization, multi-resolution analysis and numerical optimization are the main features of the software. Graphite is publicly available since October 2003, and is hosted by Inria GForge since September 2008. Graphite is one of the common software platforms used in the frame of the European Network of Excellence AIMShape .

Graphite and its research-plugins are actively developed and extended. The latest version was released on January 2nd, 2014 and has been downloaded 732 times as of Sept 5.

5.4. GraphiteLifeExplorer

Participant: Samuel Hornus.

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

The development of GLE is currently on hold, but it is still downloaded (freely) about twice a day (1600 downloads to date).

5.5. OpenNL - Open Numerical Library

Participants: Bruno Lévy, Nicolas Ray, Rhaleb Zayer.

OpenNL is a standalone library for numerical optimization, especially well-suited to mesh processing. The API is inspired by the graphics API OpenGL, this makes the learning curve easy for computer graphics practitioners. The included demo program implements our LSCM [24] mesh unwrapping method. It was integrated in Blender by Brecht Van Lommel and others to create automatic texture mapping methods. OpenNL is extended with two specialized modules :

- CGAL parameterization package: this software library, developed in cooperation with Pierre Alliez and Laurent Saboret, is a CGAL package for mesh parameterization.
- Concurrent Number Cruncher: this software library extends OpenNL with parallel computing on the GPU, implemented using the CUDA API.

5.6. GEOGRAM

Participant: Bruno Lévy.

GEOGRAM is a software library with geometrical algorithms. The focus is put on the ease of use, minimal memory consumption, minimal size of the code and extensively documented algorithms (whereas in existing libraries such as CGAL, the focus is put on the extensibility). GEOGRAM includes the PCK (Predicate Construction Kit), a system to automatically generate robust predicates from their equation. It provides a standalone exact number type, based on Shewchuk’s expansion arithmetics. The library is portable under Linux, Windows, MacOS, Android, and any system that has IEEE floating point arithmetics. The arithmetic kernel may be used by other programming library and proposed as extension packages (e.g. for CGAL).

5.7. LibSL

Participant: Sylvain Lefebvre.

LibSL is a Simple library for graphics. Sylvain Lefebvre continued development of the LibSL graphics library (under CeCill-C licence, filed at the APP). LibSL is a toolbox for rapid prototyping of computer graphics algorithms, under both OpenGL, DirectX 9/10, Windows and Linux. The library is actively used in both the REVES / Inria Sophia-Antipolis Méditerrannée and the ALICE / Inria Nancy Grand-Est teams.

AVIZ Project-Team

5. New Software and Platforms

5.1. MakerVis

Participants: Sai Ganesh Swaminathan, Shi Conglei, Yvonne Jansen, Pierre Dragicevic [correspondant], Lora Oehlberg, Jean-Daniel Fekete.

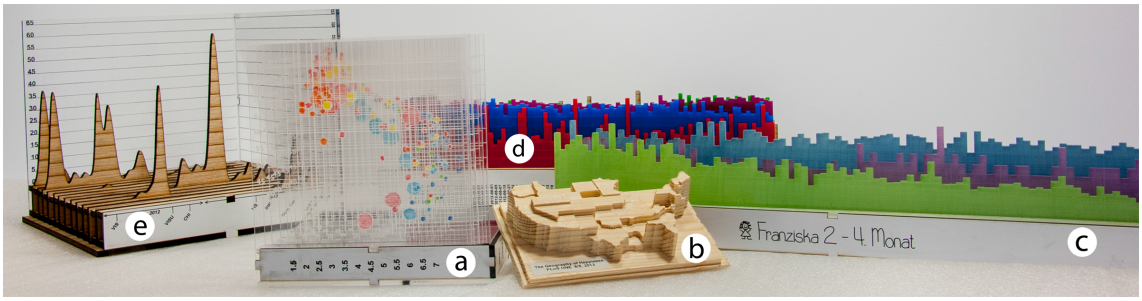


Figure 1. Physical visualizations created with our fabrication tool MakerVis: a) a scatterplot created after Hans Rosling's TED talk, b) a prism map showing happiness across the US computed from Twitter sentiments, c),d),e) visualizations created by users during design sessions.

An increasing variety of physical visualizations are being built, for purposes ranging from art and entertainment to business analytics and scientific research. However, crafting them remains a laborious process and demands expertise in both data visualization and digital fabrication. We created the MakerVis prototype [34], the first tool that integrates the whole workflow, from data filtering to physical fabrication. The design of MakerVis tries to overcome the limitations of current workflows, that we initially analyzed through three real case studies. Design sessions with three end users shows that tools such as MakerVis can dramatically lower the barriers behind producing physical visualizations. Observations and interviews also revealed important directions for future research. These include rich support for customization, and extensive software support for materials that accounts for their unique physical properties as well as their limited supply.

More details on the Web page: www.aviz.fr/makervis

5.2. Bertifier

Participants: Charles Perin, Pierre Dragicevic, Jean-Daniel Fekete.

Bertifier [20] is a web application (available at www.bertifier.com) for rapidly creating tabular visualizations from spreadsheets. Bertifier draws from Jacques Bertin's matrix analysis method, whose goal was to "simplify without destroying" by encoding cell values visually and grouping similar rows and columns. Although there were several attempts to bring this method to computers, no implementation exists today that is both exhaustive and accessible to a large audience. Bertifier remains faithful to Bertin's method while leveraging the power of today's interactive computers. Tables are formatted and manipulated through *crossets* [36], a new interaction technique for rapidly applying operations on rows and columns. Vertifier also introduces *visual reordering*, a semi-interactive reordering approach that lets users apply and tune automatic reordering algorithms in a WYSIWYG manner. We showed in an evaluation that Bertifier has the potential to bring Bertin's method to a wider audience of both technical and non-technical users, and empower them with data analysis and communication tools that were so far only accessible to a handful of specialists.

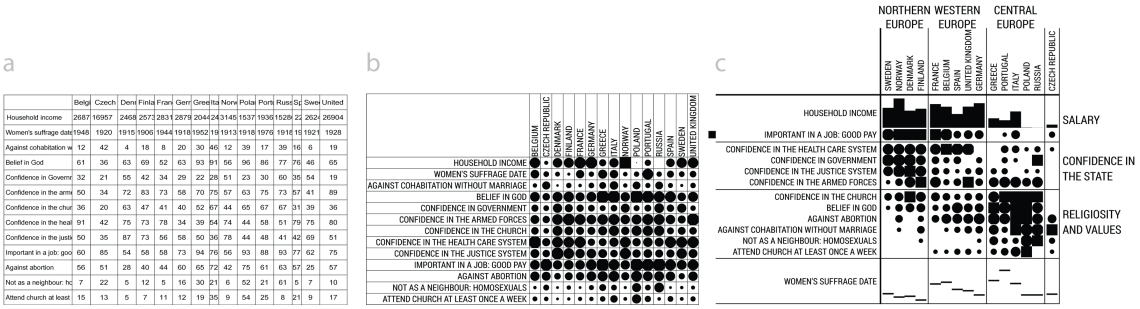


Figure 2. A spreadsheet formatted and reordered with BERTIFIER: a) the original numerical table; b) the corresponding tabular visualization; c) the final result, reordered, formatted and annotated. The final result is ready to be exported and inserted as a figure.

More details about the software are available at www.aviz.fr/bertifier

5.3. Sparklificator

Participants: Pascal Goffin, Wesley Willett, Jean-Daniel Fekete, Petra Isenberg.

Figure 3. Four examples of the integration of word-scale visualizations into HTML documents

Sparklificator [17] is a general open-source jQuery library that eases the process of integrating word-scale visualizations into HTML documents. It provides a range of options for adjusting the position (on top, to the right, as an overlay), size, and spacing of visualizations within the text. The library includes default visualizations, including small line and bar charts, and can also be used to integrate custom word-scale visualizations created using web-based visualization toolkits such as D3.

More on the project Web page: www.aviz.fr/sparklificator

5.4. GraphDiaries

Participants: Benjamin Bach [correspondant], Emmanuel Pietriga, Jean-Daniel Fekete.

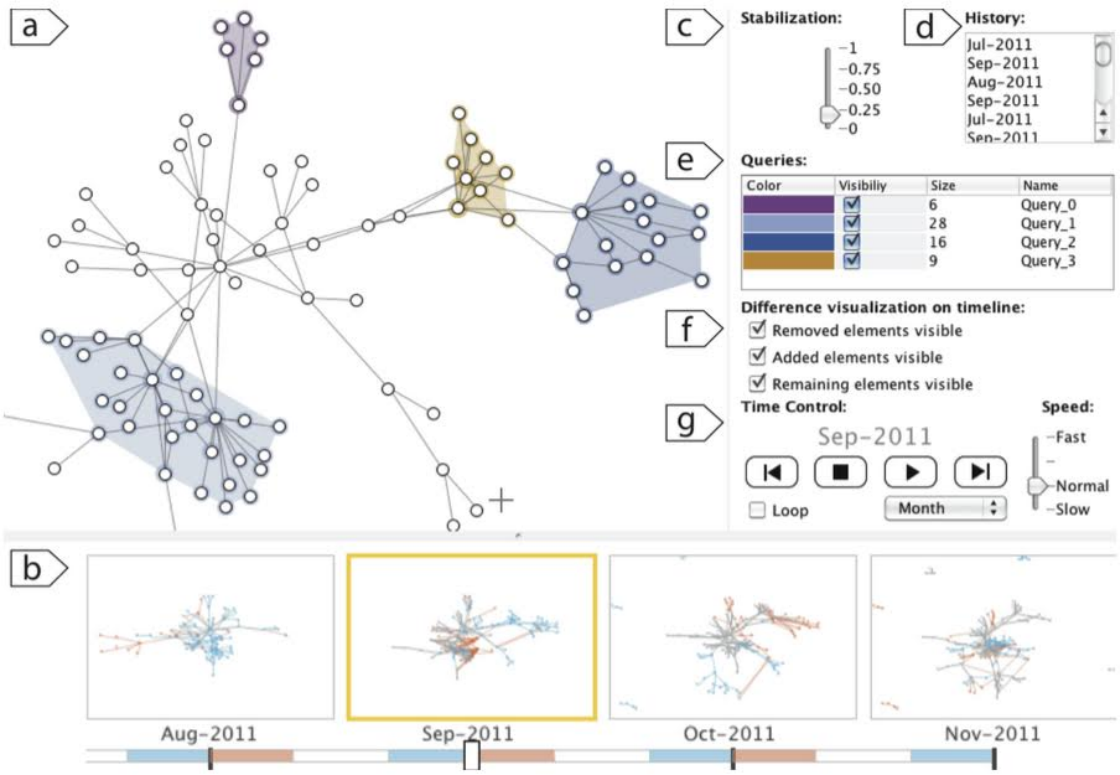


Figure 4. GraphDiaries interface: a) Network view, b) Time- line, c) Layout stabilization slider, d) Navigation history, e) Node queries, f) Panel to change visibility of red, blue or gray elements in the Timeline, g) Animation playback panel.

Identifying, tracking and understanding changes in networks that change over time, such as social networks, brain connectivy or migration flows, are complex and cognitively demanding tasks. To better understand the tasks related to the exploration of these networks, we introduced a task taxonomy which informed the design of GraphDiaries, [13], a new visual interface (Figure 4) designed to improve support for these tasks. GraphDiaries relies on animated transitions that highlight changes in the network between time steps, thus helping users identify and understand changes. GraphDiaries features interaction techniques to quickly navigate between individual time steps of the network. We conducted on a user study, based on representative tasks identified through the taxonomy, that compares GraphDiaries to existing techniques for temporal navigation in dynamic networks, showing that it outperforms them both in terms of task time and errors for several of these tasks.

5.5. Cubix

Participants: Benjamin Bach [correspondant], Emmanuel Pietriga, Jean-Daniel Fekete.

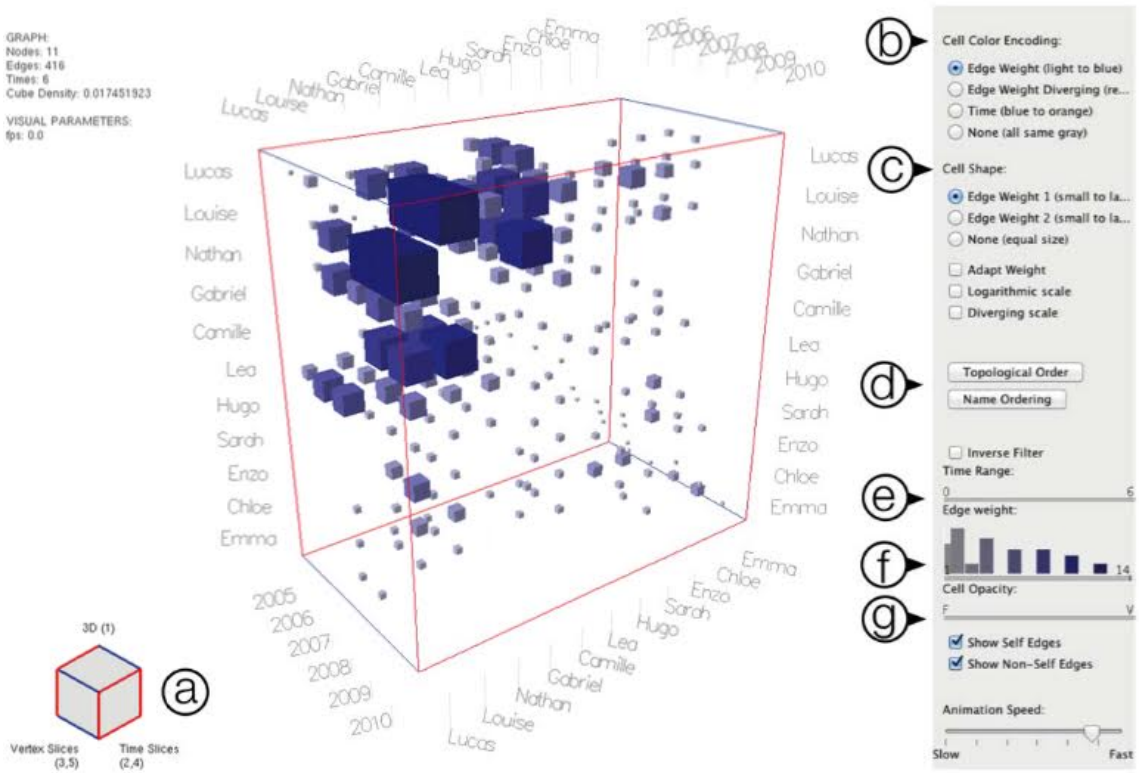


Figure 5. Cubix UI screenshot. a) Cubelet Widget, b) Cell color encod ing, c) Cell shape encoding, d) Vertex ordering, e) Time range slider, f) Cell weight filter with histogram indicating edge weight distribution, g) Cell opacity.

Designing visualizations of dynamic networks is challenging, both because the data sets tend to be complex and because the tasks associated with them are often cognitively demanding. Different tasks may require different visualizations and visual mappings, but combined in a simple interface. We developed Cubix [23] (Figure 5), a software featuring a novel visual representation and navigation model for dynamic networks,

inspired by the way people comprehend and manipulate physical cubes. Users can change their perspective on the data by rotating or decomposing the 3D cube. These manipulations can produce a range of different 2D visualizations that emphasize specific aspects of the dynamic network suited to particular analysis tasks. A range of interactions can be performed on dynamic networks using the Cubix system. We showed how two domain experts, an astronomer and a neurologist, successfully used Cubix to explore and report on their own network data.

More on the project Web page: www.aviz.fr/cubix

5.6. EditorsNotes

Participants: Jean-Daniel Fekete [correspondant], Nadia Boukhelifa, Evanthia Dimara.

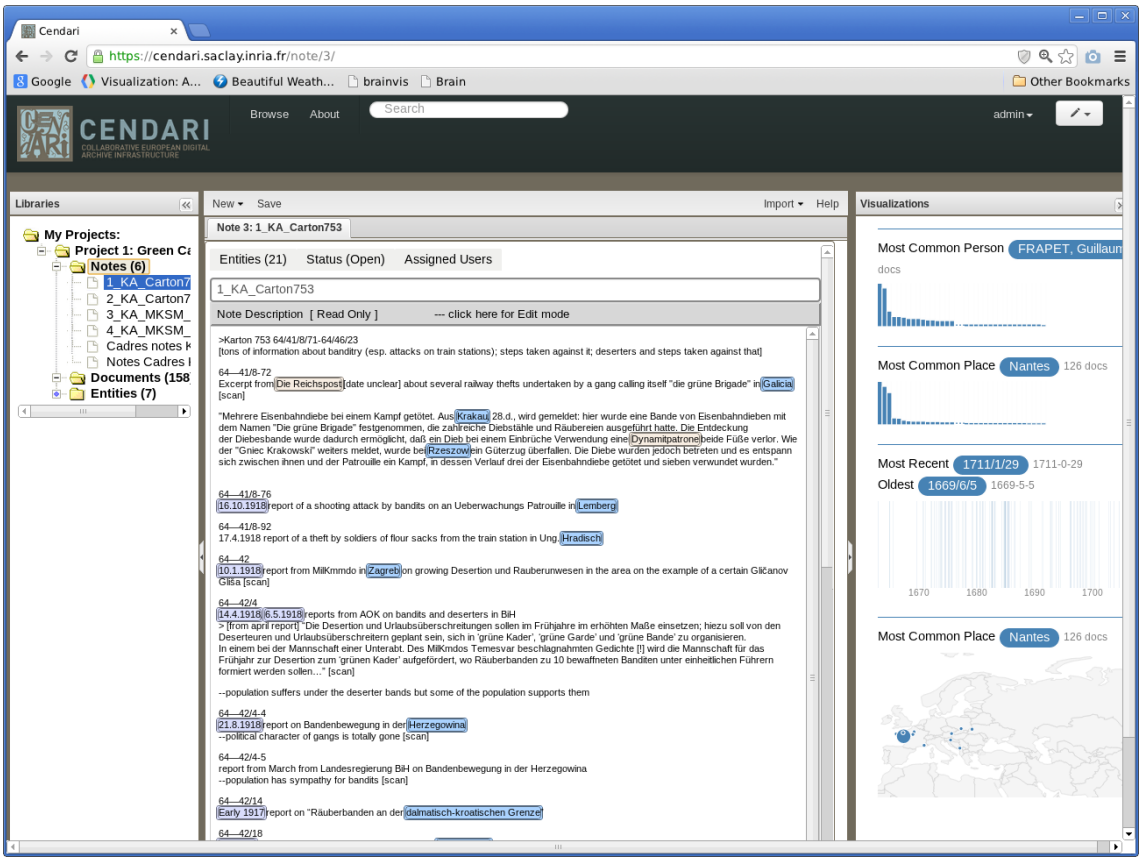


Figure 6. EditorsNotes environment with its three main panes: on the left, the list of projects, in the middle the editor and related documents, on the right the visualizations showing entities appearing in the current project.

CENDARI Is a European Infrastructure project funded by the EU for 4 years: 2012-2016. Aviz is in charge of the Human-Computer Interface for the project, and develops a tool to allow historians and archivists to take notes, enter them online, manage their images in relations with the notes and documents, and visualize the entities they find in the documents and notes. This system is an extension of the original EditorsNotes project, integrating several innovative components asked by the historians: visualizations, relations with the Semantic Web, and a management of access rights respecting the researchers' desire of privacy for their notes, as well as desire of sharing entities and relations gathered throught the notes and documents.

More on the project Web page: www.aviz.fr/Research/CENDARI

HYBRID Project-Team

5. New Software and Platforms

5.1. OpenViBE

Participants: Anatole Lécuyer [contact], Marsel Mano, Jussi Lindgren.

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 30000 times, and it is used by numerous laboratories, projects, or individuals worldwide. The OpenViBE software is supported and improved in the frame of OpenViBE-NT project (section 8.2.7). More information, downloads, tutorials, videos, documentations are available on the OpenViBE website.

5.2. Collaviz

Participants: Thierry Duval, Thi Thuong Huyen Nguyen [contact].

The aim of Collaviz software (collaborative interactive visualization) is to allow to design, deploy and share collaborative virtual environments (CVE). Collaviz allows VR developpers to concentrate on the behavior of virtual objects that can be shared between users in a CVE. Indeed, Collaviz provides a software architecture that hides the network programmation details of the distribution and the synchronization of the content of the CVE, and that facilitates the coupling with the 3D graphics API used for rendering. Collaviz is written mainly in Java and is runnable on multiple hardware configurations: laptop or desktop computer, immersive room, mobile devices. The PAC-C3D software architecture of Collaviz makes it possible to use various 3D APIs for graphic rendering: Java3D, jReality, jMonkeyEngine, OpenSG, Unity3D (work in progress) and Havok Anarchy (work in progress), and also to use various physical engines such as jBullet and SOFA. The distribution over the network can be achieved using TCP or HTTP. A collaboration with DIVERSE team intended to extend Collaviz using a Model Driven Engineering approach in order to provide high-level tools to generate a large part of java code of virtual objects.

IMAGINE Project-Team

5. New Software and Platforms

5.1. MyCorporisFabrica

Participants: Ali-Hamadi Dicko, François Faure, Olivier Palombi, Federico Ulliana.

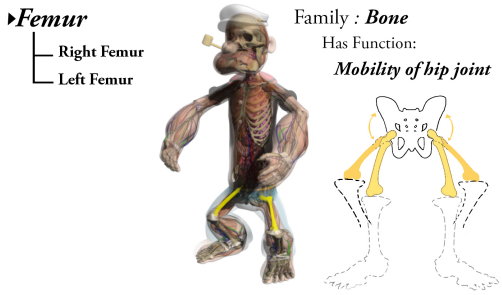


Figure 1. My Corporis Fabrica is an anatomical knowledge database developed in our team.

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

5.2. SOFA

Participants: François Faure, Armelle Bauer, Olivier Carré, Aurélie Dégletagne, Ali Hamadi Dicko, Matthieu Nesme, Romain Testylier.

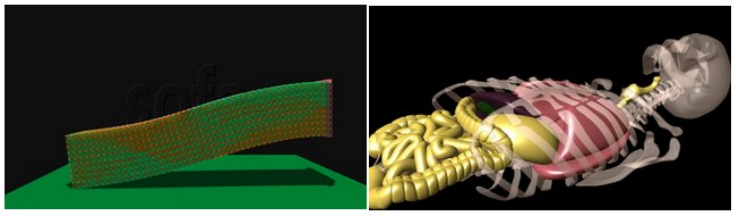


Figure 2. SOFA is an open source simulator for physically based modeling.

SOFA is a is a real-time physically based simulation library developed for more 8 years with other Inria research groups (Shacra and Asclepios). It primarily targeted medical simulation research, but we are using it as well for many other applications, from the entertainment industry (films and games) to earth science projects. Based on an advanced software architecture, it allows to (1) create complex and evolving simulations by combining new algorithms with algorithms already included in SOFA; (2) modify most features of the simulation (deformable behavior, surface representation, solver, constraints, collision algorithm, etc.) by simply editing an XML file; (3) build complex models from simpler ones using a scenegraph description; (4) efficiently simulate the dynamics of interacting objects using abstract equation solvers; and (5) reuse and easily compare a variety of available methods.

SOFA is gaining momentum. A start-up based on SOFA, InSimo, has been created in Strasbourg by Inria people, and one of our former engineers, François Jourdes, has been hired.

5.3. Expressive

Participants: Marie-Paule Cani, Antoine Begault, Rémi Brouet, Even Entem, Thomas Delame, Ulysse Vimont, Cédric Zanni.

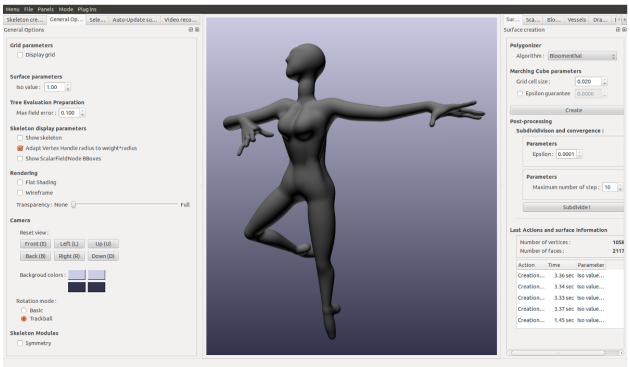


Figure 3. GUI and Example of implicit surface and modeled with the Expressive platform.

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

IN-SITU Project-Team

5. New Software and Platforms

5.1. WILDER Platform

Participants: Michel Beaudouin-Lafon [correspondant], Olivier Chapuis, Cédric Fleury, Olivier Gladin, Rémi Hellequin, Stéphane Huot, Amani Kooli, Monireh Sanaei, Gabriel Tezier, Jonathan Thorpe.

WILDER is InSitu's second experimental ultra-high-resolution interactive environment, following up on the WILD platform developed since 2009 [2] (Figure 1). It features a wall-sized display with seventy-five 20" LCD screens, i.e. a 5m50 x 1m80 (18' x 6') wall displaying 14 400 x 4 800 = 69 million pixels, powered by a 10-computer cluster and two front-end computers. The platform also features a camera-based motion tracking system supporting interaction with the wall as well as within the surrounding space, a multitouch frame making the entire wall-sized display touch sensitive and various mobile devices. WILDER is part of the DIGISCOPE Equipment of Excellence and, in combination with WILD and the other DIGISCOPE rooms, provides a unique experimental environment for collaborative interaction. In addition to using WILD and WILDER for our research, we have also developed software architectures and toolkits that enable developers to run applications on such multi-device, cluster-based systems.

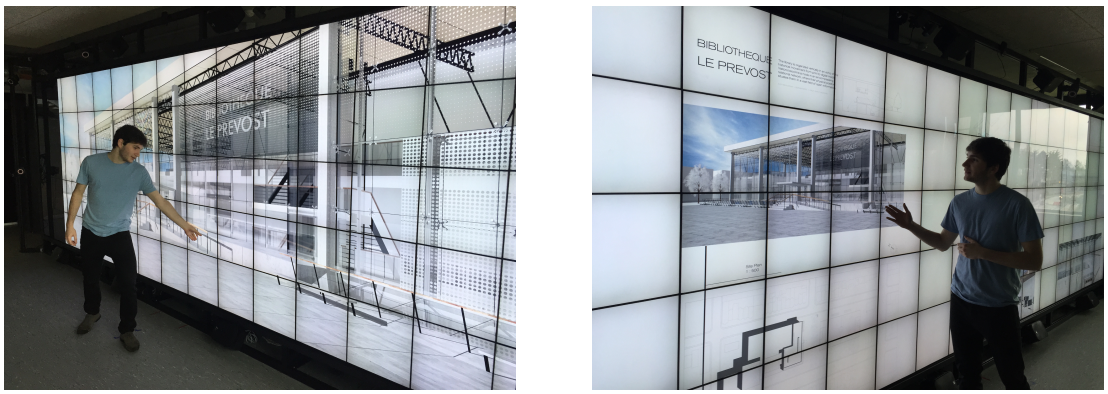


Figure 1. The WILDER platform.

5.2. Smarties

Participants: Olivier Chapuis [correspondant], Anastasia Bezerianos, Bruno Fruchard.

The Smarties system [16] provides an easy way to add mobile interactive support to collaborative applications for wall displays.

It consists of (i) a mobile interface that runs on mobile devices for input, (ii) a communication protocol between the mobiles and the wall application, and (iii) libraries that implement the protocol and handle synchronization, locking and input conflicts. The library presents the input as an event loop with callback functions and handles all communication between mobiles and wall application. Developers can customize the mobile interface from the wall application without modifying the mobile interface code.

On each mobile we find a set of cursor controllers associated with keyboards, widgets and clipboards. These controllers (pucks) can be shared by multiple collaborating users. They can control simple cursors on the wall application, or specific content (objects or groups of them). The developer can decide the types of widgets associated to pucks from the wall application side.

Smarties mobile clients currently run on Android, while server libraries have been developed in C++ and Java.

Figure 2. Left: Multiple Lenses, starting from the left a magnification lens, a DragMag and a fisheye. Right: two synchronized Smarties clients running on tablets. The four colored pucks are attached respectively to a magnification lens (left of wall), the anchor and lens of a DragMag (middle) and a fisheye (right). The active puck is the blue for the device on top, and green for the bottom. The described widgets added by the application are seen on the widget area.

Smarties is available at the http://smarties.lri.fr/ under a GNU GPL licence.

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: See O. Chapuis, A. Bezerianos, S. Franzeskakis (2014) Smarties: An Input System for Wall Display Development. In CHI '14: Proceedings of the 32nd international conference on Human factors in computing systems. ACM, pages 225-234.
- OS/Middleware: Crossplatform
- Required library or software: none
- Programming language: C++, Java

5.3. WildOS

Participant: Michel Beaudouin-Lafon [correspondant].

WildOS is middleware to support applications running in an interactive room featuring various interaction resources, such as our WILD and WILDER rooms: a tiled wall display, a motion tracking system, tablets and smartphones, etc. The conceptual model of WildOS is a *platform*, such as the WILD or WILDER room, described as a set of devices and on which one or more applications can be run.

WildOS consists of a server running on a machine that has network access to all the machines involved in the platform, and a set of clients running on the various interaction resources, such as a display cluster or a tablet. Once *WildOS* is running, applications can be started and stopped and devices can be added to / removed from the platform.

WildOS relies on Web technologies, most notably Javascript and node.js, as well as node-webkit and HTML5. This makes it inherently portable (it is currently tested on Mac OS X and Linux). While applications can be developed only with these Web technologies, it is also possible to bridge to existing applications developed in other environments if they provide sufficient access to be remote controlled.

WildOS is used in several InSitu projects, and is also deployed on several of Google's interactive rooms in Mountain View, Dublin and Paris. It is available under on Open Source licence at https://bitbucket.org/mblinsitu/wildos.

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: helps the development of multisurface applications.
- OS/Middleware: Crossplatform
- Required library or software: node.js, node-webkit
- Programming language: Javascript

5.4. GlideCursor

Participants: Michel Beaudouin-Lafon [correspondant], Stéphane Huot.

GlideCursor is a Mac OS X application that implements the inertial cursor described in [15]. The current version only works when moving the cursor with a trackpad. The application lets users configure gliding, and can also log cursor activity for later analyses.

GlideCursor is available under on Open Source licence at https://bitbucket.org.

- ACM: H.5.2 [User Interfaces]: Graphical user interfaces (GUI)
- Software benefit: can improve cursor pointing on large displays.
- OS/Middleware: Mac OS X
- Required library or software: none
- Programming language: Objective-C

MANAO Project-Team

4. New Software and Platforms

4.1. Software

4.1.1. ALTA Library

Participants: X. Granier & R. Pacanowski & L. Belcour & P. Barla

Keywords: BRDF fitting and analysis

ALTA is a multi-platform software library to analyze, fit and understand BRDFs. It provides a set of command line software to fit measured data to analytical forms, and tools to understand models and data. The targeted audience is composed of all the researchers and professionals who are working on BRDFs, and who want to benchmark new BRDF models and easily compare them with state-of-the-art BRDF models and data. It is also suitable for researchers and professionals who are working on optical measurements, and who want to experiment different fitting procedures and models, or just to perform statistical analysis on their data. The major features in the ALTA library are:

- Open common BRDF data formats (MERL, ASTM)
- Non-linear fitting of BRDF (using third party packages)
- Rational interpolation of BRDF
- Analytic BRDF models
- Scripting mechanism to automatize fitting

ALTA has been supported by the ANR ALTA (ANR-11-BS02-006).

Facts:

- Web: http://alta.gforge.inria.fr/
- License: MPLv2

4.1.2. Eigen

Participants: G. Guennebaud

Keywords: Linear algebra

Efficient numerical computation is central to many computer science domains. In particular, in computer graphics, space transformations and local regressions involve dense linear algebra, data interpolation and differential equations require sparse linear algebra, while more advanced problems involve non-linear optimization or spectral analysis. On the one hand, solutions such as MatLab are limited to prototyping. On the other hand, optimized libraries coming from the HPC (high performance computing) world are often tedious to use and more adapted for very large problems running on clusters. Moreover, all these solutions are very slow at handling very small but numerous problems which often arise in computer graphics, vision, or robotics. As a result, researchers of these domains used to waste a lot of time at either implementing their own half cooked solution, or dealing with dozens of complex to use libraries.

The objective of Eigen is to fill this gap by proposing an easy to use, efficient, and versatile C++ mathematical template library for linear algebra and related algorithms. In particular it provides fixed and dynamic size matrices and vectors, matrix decompositions (LU, LLT, LDLT, QR, eigenvalues, etc.), sparse matrices with iterative and direct solvers, some basic geometry features (transformations, quaternions, axis-angles, Euler angles, hyperplanes, lines, etc.), some non-linear solvers, automatic differentiations, etc. Thanks to expression templates, Eigen provides a very powerful and easy to use API. Explicit vectorization is performed for the SSE, AltiVec and ARM NEON instruction sets, with graceful fallback to non-vectorized code. Expression templates allow to perform global expression optimizations, and to remove unnecessary temporary objects.

Eigen is already a well established library with about 30k unique visitors of the website per month. Eigen is co-developed and maintained with a couple of other researchers and occasional contributors spread over the world. Its development started in 2008, and the last release is the 3.2 version in July 2013. Eigen has been supported by Inria through an ADT started in January 2012, and that ended in September 2013. Eigen received the **"high-quality software in geometry processing award"** from the Symposium on Geometry Processing 2013. Eigen is continuously and actively developed with this year an important refactoring of the expression evaluation mechanism, a divide & conquer SVD algorithm, support for AVX in collaboration with Google, and many other features.

Facts:

- Web: http://eigen.tuxfamily.org/
- License: MPLv2

4.1.3. PatateLib

Participants: N. Mellado, G. Ciaudo, S. Boyé, G. Guennebaud, P. Barla

Keywords: multi-scale analysis, material appearance, vector graphics, expressive rendering, 2D animation

Patate is a header only C++/CUDA library for graphics applications released under the MPL license.

It provides a collection of Computer Graphics techniques that incorporate the latest innovations from Inria research teams working in the field. It strives for efficiency and ease-of-use by focusing on low-level core operators and key algorithms, organized in modules, each tackling a specific set of issues. The central goal of the library is to drastically reduce the time and efforts required to turn a research paper into a ready-to-use solution, for both commercial and academic purposes.

Each module is initially developed by a few persons, usually those who have authored the corresponding research papers. An engineer, Gautier Ciaudo, has been recruited via the ADT program to perform unit tests, bug tracking, and make examples. Our first module provides efficient methods for the fitting and analysis of point-clouds in arbitrary dimensions. It may be used for varied purposes such as curvature computation, surface reconstruction, scale-space analysis, image processing, and sketch vectorization. More modules will be developed in 2015 by Simon Boyé.

Facts:

- Web: http://patate.gforge.inria.fr
- License: MPLv2

4.1.4. PFSTools

Participant: I. Ihrke

Keywords: high dynamic range image processing, merging, calibration and tone-mapping

The `pfstools` package is a set of command line programs for reading, writing, manipulating and viewing high-dynamic range (HDR) images and video frames. All programs in the package exchange data using a simple generic high dynamic range image format, `pfs`, and they use unix pipes to pass data between programs and to construct complex image processing operations.

`pfstools` come with a library for reading and writing pfs files. The library can be used for writing custom applications that can integrate with the existing `pfstools` programs. It also offers a good integration with high-level mathematical programming languages, such as MATLAB or GNU Octave. `pfstools` can be used as an extension for MATLAB or Octave for reading and writing HDR images or simply to effectively store large matrices. The `pfstools` package integrates existing high dynamic range image formats by providing a simple data format that can be used to exchange data between applications. It is accompanied by the `pfscalibration` and `pfstmo` packages.

The `pfscalibration` package provides algorithms for the photometric calibration of cameras and for the recovery of high dynamic range (HDR) images from a set of low dynamic range (LDR) exposures. Maintenance of the pfscalibration package is performed by Ivo Ihrke since January 2011. A major update to make the software compatible with current digital SLR cameras and their raw file formats, especially for measurement purposes, has been performed. A new set of MATLAB scripts has been developed for improved calibration performance. It is intended to merge these new procedures into the existing software.

The `pfstmo` package contains the implementation of seven state-of-the-art tone mapping operators suitable for convenient processing of both static images and animations.

The software received wider interest in the Open Source community and third party contributors prepared installation packages which are included in several Linux distributions including Debian, Fedora and Suse.
Facts:

- Web: http://pfstools.sourceforge.net/
- License: GPL

4.2. Platforms

4.2.1. COEL - Computational Optics Experimentation Laboratory

We are setting a dedicated experimentation facility up to validate our theoretical tools to design hybrid (optics & computer sciences) systems by creating real setups. Such a facility is unique thanks to the close collaboration between optics and computer science in Bordeaux. Now located in the LP2N, this laboratory consists in a set of on-the-shell elements to design optical systems combined with controllable large-band lighting systems (from pure white sources, to tunable lasers and video-projectors), with a fabrication laboratory to build non-conventional components, with large-scale mechanical elements, with display technologies, and high-performance processing resources.

After initial delays, the lab has now found its final location in LP2N. The basic equipment is in place and first experiments are being performed. We still have to work on the illumination conditions in the room, as well as on the construction of a light-sealed control area inside the experimentation room for independent experiments.

The construction and equipment is financed by a special regional grant of the "Conseil Régional d'Acquitaine" (Carer xD) in conjunction with project-specific funds.

MAVERICK Project-Team

4. New Software and Platforms

4.1. Introduction

Maverick insists on sharing the software that is developed for internal use. These are all listed in a dedicated section on the web site http://artis.imag.fr/Software.

4.2. Gratin

Participant: Romain Vergne [contact].

Gratin is a node-based compositing software for creating, manipulating and animating 2D and 3D data. It uses an internal direct acyclic multi-graph and provides an intuitive user interface that allows to quickly design complex prototypes. Gratin has several properties that make it useful for researchers and students. (1) it works in real-time: everything is executed on the GPU, using OpenGL, GLSL and/or Cuda. (2) it is easily programmable: users can directly write GLSL scripts inside the interface, or create new C++ plugins that will be loaded as new nodes in the software. (3) all the parameters can be animated using keyframe curves to generate videos and demos. (4) the system allows to easily exchange nodes, group of nodes or full pipelines between people. In a research context, Gratin aims at facilitating the creation of prototypes, testing ideas and exchanging data. For students, Gratin can be used to show real-time demos/videos, or help learning how to program with the GPU. Gratin has already been used for creating new computer graphics tools but also for designing perceptual experiments. Most of the work published by R. Vergne was done with Gratin.

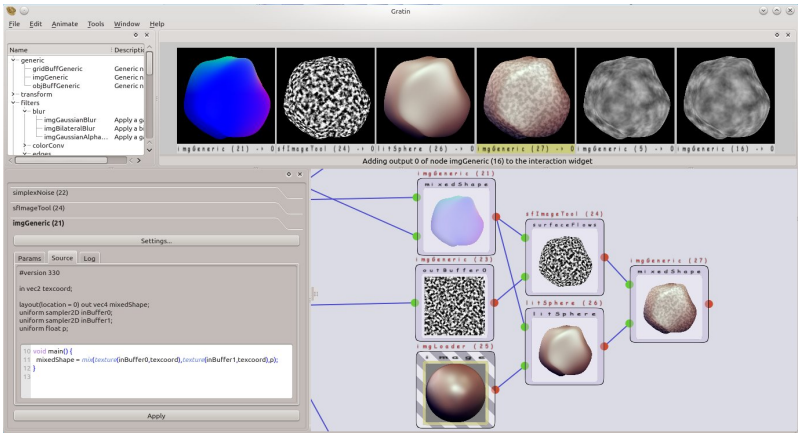


Figure 2. Gratin interface.

4.3. PlantRad

Participant: Cyril Soler [contact].

PlantRad is a software program for computing solutions to the equation of light equilibrium in a complex scene including vegetation. The technology used is hierarchical radiosity with clustering and instantiation. Thanks to the latter, PlantRad is capable of treating scenes with a very high geometric complexity (up to millions of polygons) such as plants or any kind of vegetation scene where a high degree of approximate self-similarity permits a significant gain in memory requirements. Its main domains of applications are urban simulation, remote sensing simulation (See the collaboration with Noveltis, Toulouse) and plant growth simulation, as previously demonstrated during our collaboration with the LIAMA, Beijing.

4.4. High Quality Renderer

Participant: Cyril Soler [contact].

In the context of the European project RealReflect, the Maverick team has developed the HQR software based on the photon mapping method which is capable of solving the light balance equation and of giving a high quality solution. Through a graphical user interface, it reads X3D scenes using the X3DToolKit package developed at Maverick, it allows the user to tune several parameters, computes photon maps, and reconstructs information to obtain a high quality solution. HQR also accepts plugins which considerably eases the developpement of new algorithms for global illumination, those benefiting from the existing algorithms for handling materials, geometry and light sources. HQR is freely available for download at http://artis.imag.fr/~Cyril.Soler/HQR.

4.5. MobiNet

Participants: Fabrice Neyret [contact], Joëlle Thollot.

The MobiNet software allows for the creation of simple applications such as video games, virtual physics experiments or pedagogical math illustrations. It relies on an intuitive graphical interface and language which allows the user to program a set of mobile objects (possibly through a network). It is available in public domain at http://mobinet.inrialpes.fr for Linux,Windows and MacOS, and originated in a collaboration with the EVASION project-team.

The main aim of MobiNet is to allow young students at high school level with no programming skills to experiment, with the notions they learn in math and physics, by modeling and simulating simple practical problems, and even simple video games. This platform has been massively used during the Grenoble INP "engineer weeks" since 2002: 150 senior high school pupils per year, doing a 3 hour practice. This work is partly funded by Grenoble INP. Various contacts are currently developed in the educational world. Besides "engineer weeks", several groups of "monitors" PhD students conducts experimentations based on MobiNet with a high scool class in the frame of the courses. Moreover, presentation in workshops and institutes are done, and a web site repository is maintained. A web version is currently under preliminary developpement.

4.6. Freestyle

Participant: Joëlle Thollot [contact].

Freestyle is a software for Non-Photorealistic Line Drawing rendering from 3D scenes (Figure 3). It is designed as a programmable interface to allow maximum control over the style of the final drawing: the user "programs" how the silhouettes and other feature lines from the 3D model should be turned into stylized strokes using a set of programmable operators dedicated to style description. This programmable approach, inspired by the shading languages available in photorealistic renderers such as Pixar's RenderMan, overcomes the limitations of integrated software with access to a limited number of parameters and permits the design of an infinite variety of rich and complex styles. The system currently focuses on pure line drawing as a first step. The style description language is Python augmented with our set of operators. Freestyle was developed in the framework of a research project dedicated to the study of stylized line drawing rendering from 3D scenes. This research has lead to two publications [18], [19].

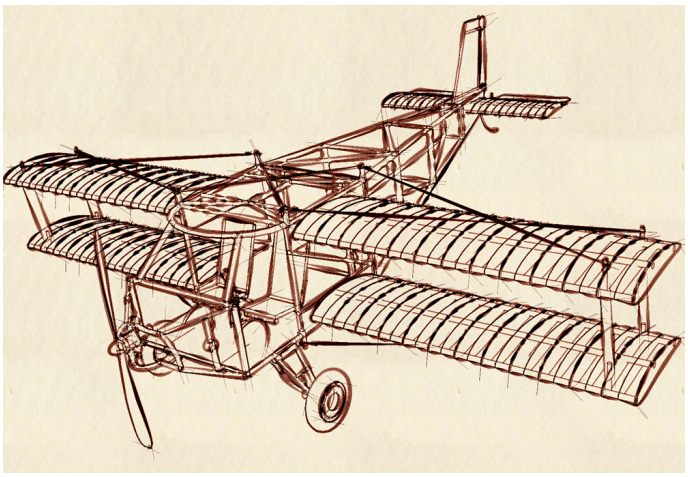


Figure 3. Stylized plane using Freestyle.

In 2008, Freestyle get a new life, completely outside Maverick or Inria: it was the basis of one of the 6 *Google Summer of Code* projects awarded to the *Blender Foundation* [0]! The goal of the project was to integrate Freestyle to the well known free 3D modeler *Blender*, as its standard NPR line-drawing renderer. Maxime Curioni (under the mentoring of Jean-Luc Peurière from the *Blender Foundation*), is currently making the integration. First beta versions are publicly available, and tested by enthusiasts around the web.

4.7. Diffusion Curves

Participant: Joëlle Thollot [contact].

We provide an implementation of the vector drawing tool described in our Diffusion Curves Siggraph paper [2] (Figure 4). This prototype is composed of the Windows binary, along with the required shader programs (ie. in source code). The software is available for download at http://artis.imag.fr/Publications/2008/OBWBTS08 for free, for non-commercial research purposes.

4.8. VRender: vector figures

Participant: Cyril Soler [contact].

The VRender library is a simple tool to render the content of an OpenGL window to a vectorial device such as Postscript, XFig, and soon SVG. The main usage of such a library is to make clean vectorial drawings for publications, books, etc.

In practice, VRender replaces the z-buffer based hidden surface removal of OpenGL by sorting the geometric primitives so that they can be rendered in a back-to-front order, possibly cutting them into pieces to solve cycles.

VRender is also responsible for the vectorial snapshot feature of the QGLViewer library. VRender is released under the LGPL licence and is freely available for download at http://artis.imag.fr/Software/VRender.

4.9. ProLand

Participants: Fabrice Neyret [contact], Eric Bruneton.

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

Figure 4. Diffusion curves freely downloadable demo.

Now available at http://proland.inrialpes.fr/ in double licencing GPL/commercial.

Proland (for procedural landscape) is a software platform originally developed at the Evasion team-project by Eric Bruneton, and currently funded by the ANR-JCJC SimOne. The goal of this platform is the real-time quality rendering and editing of large landscapes. All features can work with planet-sized terrains, for all viewpoints from ground to space. Most of the work published by Eric Bruneton and Fabrice Neyret has been done within Proland, and a large part has been integrated in the main branch. Several licences have been transfered to companies. Eric Bruneton was hired by Google-Zürich in september 2011, but will be able to keep some participation in the project.

4.10. GigaVoxels

Participants: Fabrice Neyret [contact], Prashant Goswami, Jérémy Sinoir, Cyril Crassin, Pascal Guehl, Paul Gannay, Eric Heitz.

Soon available at http://gigavoxels.inrialpes.fr/index.htm in double licencing GPL/commercial.

Gigavoxel is a software platform initiated from the PhD work of Cyril Crassin, and currently funded by the ANR CONTINT RTIGE (Figure 5). The goal of this platform is the real-time quality rendering of very large and very detailed scenes which couldn't fit memory. Performances permit showing details over deep zooms and walk through very crowdy scenes (which are rigid, for the moment). The principle is to represent data on the GPU as a Sparse Voxel Octree which multiscale voxels bricks are produced on demand only when necessary and only at the required resolution, and kept in a LRU cache. User defined producer lays accross CPU and GPU and can load, transform, or procedurally create the data. Another user defined function is called to shade each voxel according to the user-defined voxel content, so that it is user choice to distribute the appearance-making at creation (for faster rendering) or on the fly (for storageless thin procedural details). The efficient rendering is done using a GPU differential cone-tracing using the scale corresponding to the 3D-MIPmapping LOD, allowing quality rendering with one single ray per pixel. Data is produced in case of cache miss, and thus only whenever visible (accounting for view frustum and occlusion). Soft-shadows and depth-of-field is easily obtained using larger cones, and are indeed cheaper than unblurred rendering. Beside the representation, data management and base rendering algorithm themself, we also worked on realtime light transport, and on quality prefiltering of complex data. Ongoing researches are addressing animation. GigaVoxels is currently

used for the quality real-time exploration of the detailed galaxy in ANR RTIGE. This work led to several publications and several licences have been sold to companies.

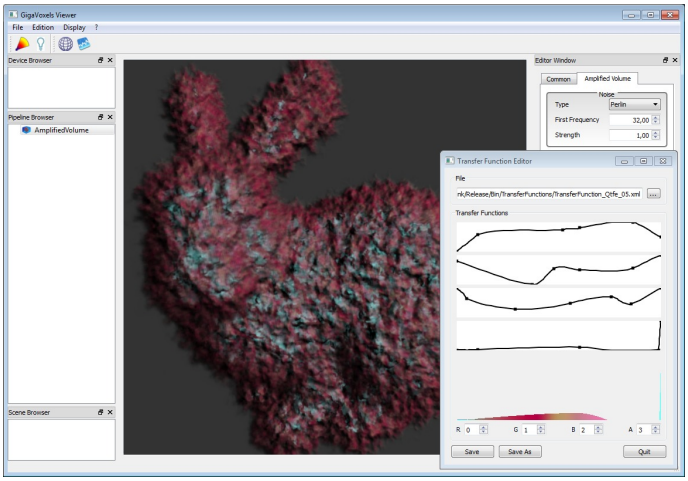


Figure 5. GigaVoxels freely downloadable demo.

MIMETIC Project-Team

5. New Software and Platforms

5.1. Populate

Participants: Carl Jorgensen, Fabrice Lamarche [contact].

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.

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, interlacedŠThis 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.

MINT Project-Team

5. New Software and Platforms

5.1. LibGINA

Participant: Laurent Grisoni [correspondant].

This year we used it with Ankama SME for a 3D videogame installation (La mine), done in collaboration with Idées-3com and LightUp. The library architecture has been rethought in order to provide ease of use and genericity.

Current version: version 1.1

Software characterization: A-2 SO-3 SM-2-up EM-3 SDL-3 OC-DA4-CD4-MS2-TPM4

5.2. 3D interaction using mobile phone

Participants: Samuel Degrande [correspondant], Laurent Grisoni.

This work has been achieved in the context of the Idées-3com I-lab. In this context a module, that allows to use any android based smartphone to control an Explorer module for navigation and interaction with VRML-based content. This module was used as a basis by Idées-3com in their commercial product this year.

Current version: version 1.0

Software characterization: A-2 SO-3 SM-2-up EM-2-up SDL-3 OC-DA4-CD4-MS2-TPM4

5.3. tIO (tactile input & output)

Participants: Marc-Antoine Dupre, Matthieu Falce, Nicolas Roussel [correspondant], Takashi Miyaki.

tIO is a library designed to facilitate the implementation of doubly tactile interaction techniques (tactile input coupled with tactile feedback) based on the STIMTAC technology. Supporting all current STIMTAC prototypes, it makes it easy to move the system pointer of the host computer according to motions detected on them and adapt their vibration amplitude based on the color of the pointed pixel or the nature of the pointed object. The library includes a set of demo applications that illustrate these two different approaches and makes it easy to "augment" existing `Qt` applications with tactile feedback. It also makes it possible to supplement or substitute tactile feedback with basic auditory feedback synthesized using `portaudio` (friction level is linearly mapped to the frequency of a sine wave). This not only facilitates the development and documentation of tactile-enhanced applications but also makes it easier to demonstrate them to a large audience.

Software characterization: A2, SO3-up, SM-2, EM2, SDL1.

5.4. libpointing

Participants: Géry Casiez [correspondant], Damien Marchal, Nicolas Roussel, Izzatbek Mukhanov.

Libpointing is a software toolkit that provides direct access to HID pointing devices and supports the design and evaluation of pointing transfer functions [2]. The toolkit provides resolution and frequency information for the available pointing and display devices and makes it easy to choose between them at run-time through the use of URIs. It allows to bypass the system's transfer functions to receive raw asynchronous events from one or more pointing devices. It replicates as faithfully as possible the transfer functions used by Microsoft Windows, Apple OS X and Xorg (the X.Org Foundation server). Running on these three platforms, it makes it possible to compare the replicated functions to the genuine ones as well as custom ones. The toolkit is written in C++ with Python and Java bindings available. It is publicly available under the GPLv2 license.

Izzatbek Mukhanov was recruited in October 2014 for two years as an engineer (IJD) to support the development and deployment of the library.

Web site: http://libpointing.org/

Software characterization: A3, SO3, SM-2, EM2, SDL4

5.5. PIRVI platform

Participants: Fabrice Aubert [correspondant], Damien Marchal.

MINT participates to the PIRVI platform (Framework for Computer Human Animation, Virtual Reality and Images, which aims at promoting research achieved by participant research teams (6 research teams, among which MINT), as well as encouraging collaborations with regional economical tissue on the knowledge fields covered within the associated research teams. The PIRVI allows these research teams to share a Virtual-Reality Room and various mid-size research equipments : multitouch tables, cameras (depth, infrared, ...), interactive devices (force-feedback, multitouch, smartphones...), a configurable multitouch wall.

POTIOC Project-Team

5. New Software and Platforms

5.1. PapARt

Participant: Jérémy Laviole [Main developer].

As part of his thesis work, Jérémy Laviole has developed a software suite for PapARt : Paper Augmented Reality Toolkit. This work is being extended to become a state-of-the-art library for projection mapping (spatial augmented reality) and tangible interfaces.

Papart is a Processing [0] library, and follows the Processing philosophy of openness and ease of use. The main features are :

1. Augmented reality rendering that enables rendering for cameras and projectors.
2. Tracking for Augmented Reality : tracking from ARToolkitPlus [0], and OpenCV SURF [0]. Extensions with other libraries are planned.
3. Camera support : in addition to the Processing Video library, PapARt support for video from OpenCV, OpenKinect, FFMPEG, FlyCapture and more is available from JavaCV [0]. It provides a wide support on Mac, Windows, Linux and possibly Android.
4. "Tactile" input on planar surface : Touch and hovering can be detected by a depth camera such as Kinect [0], the current support is Kinect XBOX 360 with openKinect drivers. Extensions are planned for Kinect 2, Kinect for Windows, Microsoft SDK (on Windows), DepthSense and most consumer market depth cameras. It scales elegantly from touch input from finger on small surfaces (such as A3 size) to large surfaces (2m x 3m size).
5. Software infrastructure to create "paper touch screens", following Processing's methods to create drawings and interactive experiences.

Technical challenges for the next few years :

- Color camera, depth camera and projector calibration made easy and more automated.
- Software and hardware installation of such cameras documented with tutorials and technical advices.

Research questions and challenges :

- Creation of tangible interfaces, tangibles elements can be tracked from cameras and depth cameras.
- Capture of part of pieces of paper for image analysis. E.g. to analyse and monitor drawings.
- Interactive projection mapping is an active research field, and such tools could power new research projects.

website: http://papart.gforge.inria.fr

5.2. OpenViBE

Participants: Fabien Lotte [local correspondant], Alison Cellard [engineer].

[0] http://www.processing.org
[0] https://launchpad.net/artoolkitplus
[0] http://opencv.org/
[0] http://bytedeco.org/
[0] http://www.microsoft.com/en-us/kinectforwindows/

Figure 4. Example of a 3D user interface where a child manipulates a 3D scene projected on a sheet of paper to prepare a drawing. Palais de la découverte, Paris, Nov. 2011.

As part of our research work on BCI, we contribute to the development of the OpenViBE [0] software, which is an open source platform dedicated to the design, evaluation and use of BCI for real and virtual applications. OpenViBE development is led by Inria, and Potioc is one of the Inria team contributing to its evolution. Moreover, Potioc is involved in the Inria ADT (Technological Development Action) OpenViBE-NT and OpenViBE-X that is dedicated to the development of OpenViBE together with 3 other Inria teams (Hybrid, Athena, Neurosys). In 2014, we developped new EEG signal processing modules for the OpenViBE software (connectivity measured, wavelets, signal denoising, etc.) and new EEG visualization tools. We also organized demonstrations and workshops about OpenViBE at international conferences (PhyCS 2014, International BCI conference 2014).

[0] http://openvibe.inria.fr

REVES Project-Team

5. New Software and Platforms

5.1. Multi-View Image-Based Relighting Suite

Participants: Clement Riant, Sylvain Duchêne, Adrien Bousseau, George Drettakis.

We have continued our development of a set of libraries for handling multi-view image-based relighting algorithms. These constitute the basis for the relighting methods developed for the EU projects VERVE and CR-PLAY.

This software package includes a set of modules for processing point clouds and meshes produced by automatic multi-view stereo computer vision solutions. It includes all file management, point cloud and mesh handling, as well as ray-tracing using the Intel Embree ray tracer to compute illumination properties on the mesh. An interactive viewer is also included. A new intrinsic image approach is included as well as a module for relighting and shadow movement, based on an image-driven approach to moving cast shadows.

5.2. IBR-Common

Participants: Jerome Esnault, Gaurav Chaurasia, George Drettakis.

This framework provides common tools, utilities and pieces of code to facilitate prototyping of new ideas related to image-based rendering algorithms. Common features include loading shaders, loading images and 3D reconstructions, setting OpenGL context, basic user interface. The factored architecture of the framework allows users to quickly instantiate custom image-based renderers and test them on common datasets. In addition, a CMake structure automates the handling of cross-platform third-party libraries, file systems and compilation. The framework also allowed us to create a version of image-based rendering dedicated to the Immersive Space, in the context of the VERVE EU project.

5.3. IBR in Unity

Participants: Jerome Esnault, Gaurav Chaurasia, George Drettakis.

We have ported our image-based rendering algorithm to the Unity game engine, in collaboration with the Testaluna game company. This technology transfer is in the context of the CR-PLAY EU project.

Our implementation offers important features to game developers:

- Automatic generation of IBR datasets (calibrated cameras and 3D reconstruction) from multiple images of a scene.
- Ability to use different structure-from-motion (Bundler or VisualSFM) and multiview-stereo algorithms (PMVS or MVE from our partner TU Darmstadt).
- Integration of the rendering algorithm in Unity for game prototyping. This port required us to translate the algorithm from C++ to C♯ and to adapt shaders to be compatible with Unity requirements.

Figure 3 shows a screenshot of our Unity package in use for the creation of a simple game.

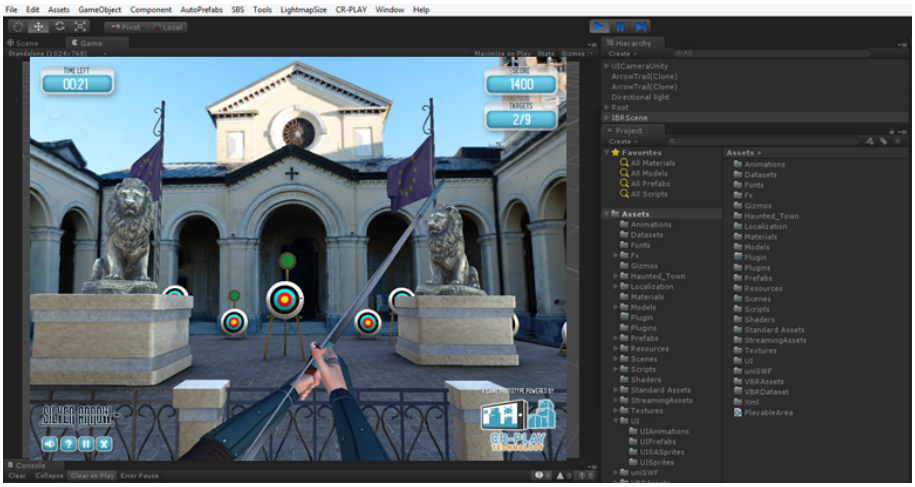


Figure 3. Screen capture of the Unity game development tool. The background buildings are rendered with our image-based rendering algorithm.

TITANE Project-Team

5. New Software and Platforms

5.1. CGAL, the Computational Geometry Algorithms Library

Participants: Pierre Alliez, Clement Jamin, Sven Oesau, Thijs Van Lankveld, Nicolas Douillet, David Bommes, Jingjing Shen.

CGAL is a C++ library of geometric algorithms and data structures. Our team is involved in several ongoing implementations: surface reconstruction, point set processing, shape detection in unstructured point sets, constrained 3D Delaunay triangulations, generalized barycentric coordinates (in collaboration with Dmitry Anisimov). Pierre Alliez is a member of the CGAL Editorial Board.

ALPAGE Project-Team

5. New Software and Platforms

5.1. Syntax

Participants: Pierre Boullier [correspondant], Benoît Sagot.

See also the web page http://syntax.gforge.inria.fr/.

The (currently beta) version 6.0 of the SYNTAX system (freely available on Inria GForge) includes various deterministic and non-deterministic CFG parser generators. It includes in particular an efficient implementation of the Earley algorithm, with many original optimizations, that is used in several of Alpage's NLP tools, including the pre-processing chain SXPipe and the LFG deep parser SXLFG. This implementation of the Earley algorithm has been recently extended to handle probabilistic CFG (PCFG), by taking into account probabilities both during parsing (beam) and after parsing (n-best computation). SYNTAX 6.0 also includes parsers for various contextual formalisms, including a parser for Range Concatenation Grammars (RCG) that can be used among others for TAG and MC-TAG parsing.

In 2014, an in-depth rewriting of the RCG parser has started, in order for RCG parsers produced by SYNTAX to handle input DAGs while remaining efficient [60], although parsing time complexity might, on such inputs, become exponential w.r.t. their length, whereas RCGs exactly cover the set of languages that are parsable in polynomial time (if the input is a string).

Direct NLP users of SYNTAX for NLP, outside Alpage, include Alexis Nasr (Marseilles) and other members of the (now closed) SEQUOIA ANR project, Owen Rambow and co-workers at Columbia University (New York), as well as (indirectly) all SXPipe and/or SXLFG users. The project-team VASY (Inria Rhône-Alpes) is one of SYNTAX' user for non-NLP applications.

5.2. DyALog

Participant: Éric Villemonte de La Clergerie [maintainer].

DYALOG *on Inria GForge: http://dyalog.gforge.inria.fr/*

DYALOG provides an environment to compile and execute grammars and logic programs. It is essentially based on the notion of tabulation, i.e. of sharing computations by tabulating traces of them. DYALOG is mainly used to build parsers for Natural Language Processing (NLP). It may nevertheless be used as a replacement for traditional PROLOG systems in the context of highly ambiguous applications where sub-computations can be shared.

The current release of DYALOG (version 1.14.0) is freely available by FTP under an open source license and runs on Linux platforms for x86 and architectures and on Mac OS intel (both 32 and 64bits architectures). In particular, it has been ported for the CLANG/LLVM compiler used in recent Mac OS systems (Mavericks).

The current release handles logic programs, DCGs (Definite Clause Grammars), FTAGs (Feature Tree Adjoining Grammars), FTIGs (Feature Tree Insertion Grammars) and XRCGs (Range Concatenation Grammars with logic arguments). Several extensions have been added to most of these formalisms such as intersection, Kleene star, and interleave operators. Typed Feature Structures (TFS) as well as finite domains may be used for writing more compact and declarative grammars [135]. Version 1.14.0 now includes an efficient handler for feature-based statistical models, derived from the work on DYALOG-SR and now used in FRMG parser.

C libraries can be used from within DYALOG to import APIs (mysql, libxml, SQLite, ...).

DYALOG is largely used within ALPAGE to build parsers but also derivative softwares, such as a compiler of Meta-Grammars (cf. 5.3). It has also been used for building FRMG, a parser from a large coverage French TIG/TAG grammar derived from a Meta-Grammar. This parser has been used for the Parsing Evaluation campaign EASy, the two Passage campaigns (Dec. 2007 and Nov. 2009) [130], [134], and very large amount of data (700 millions of words) in the SCRIBO project. New results concerning FRMG are described in 6.5 .

DYALOG is also used to run DYALOG-SR, a transition-based dependency parser (see new results in 6.5)

DYALOG and other companion modules (including DYALOG-SR) are available on Inria GForge.

5.3. Tools and resources for Meta-Grammars

Participant: Éric Villemonte de La Clergerie [maintainer].

`mgcomp`, MGTOOLS, and FRMG on Inria GForge: http://mgkit.gforge.inria.fr/

DYALOG (cf. 5.2) has been used to implement `mgcomp`, Meta-Grammar compiler. Starting from an XML representation of a MG, `mgcomp` produces an XML representation of its TAG expansion.

The current version **1.5.0** is freely available by FTP under an open source license. It is used within ALPAGE and (occasionally) at LORIA (Nancy) and at University of Pennsylvania.

The current version adds the notion of namespace, to get more compact and less error-prone meta-grammars. It also provides other extensions of the standard notion of Meta-Grammar in order to generate very compact TAG grammars. These extensions include the notion of *guarded nodes*, i.e. nodes whose existence and non-existence depend on the truth value of a guard, and the use of the regular operators provided by DYALOG on nodes, namely disjunction, interleaving and Kleene star. The current release provides a dump/restore mechanism for faster compilations on incremental changes of a meta-grammars.

The current version of `mgcomp` has been used to compile a wide coverage Meta-Grammar FRMG (version 2.0.1) to get a grammar of around 200 TAG trees [132]. Without the use of guarded nodes and regular operators, this grammar would have more than several thousand trees and would be almost intractable. FRMG has been packaged and is freely available.

To ease the design of meta-grammars, a set of tools have been implemented, mostly by Éric Villemonte de La Clergerie, and collected in MGTOOLS (version **2.2.2**). This package includes a converter from a compact format to a XML pivot format, an Emacs mode for the compact and XML formats, a graphical viewer interacting with Emacs and XSLT stylesheets to derive HTML views.

The various tools on Metagrammars are available on Inria GForge. FRMG is used directly or indirectly (through a Web service or by requiring parsed corpora) by several people and actions (ANR Rhapsodie, ANR Chronoline, ...)

5.4. The Bonsai PCFG-LA parser

Participants: Marie-Hélène Candito [correspondant], Djamé Seddah, Benoit Crabbé.

Web page:
http://alpage.inria.fr/statgram/frdep/fr_stat_dep_parsing.html

Alpage has developed as support of the research papers [75], [67], [68], [122] a statistical parser for French, named Bonsai, trained on the French Treebank. This parser provides both a phrase structure and a projective dependency structure specified in [66] as output. This parser operates sequentially: (1) it first outputs a phrase structure analysis of sentences reusing the Berkeley implementation of a PCFG-LA trained on French by Alpage (2) it applies on the resulting phrase structure trees a process of conversion to dependency parses using a combination of heuristics and classifiers trained on the French treebank. The parser currently outputs several well known formats such as Penn treebank phrase structure trees, Xerox like triples and CONLL-like format for dependencies. The parsers also comes with basic preprocessing facilities allowing to perform elementary sentence segmentation and word tokenisation, allowing in theory to process unrestricted text. However it is believed to perform better on newspaper-like text.

The parser is available under a GPL license.

5.5. Alpage's linguistic workbench, including SxPipe and MElt

Participants: Benoît Sagot [correspondant], Kata Gábor, Marion Baranes, Pierre Magistry, Pierre Boullier, Éric Villemonte de La Clergerie, Djamé Seddah.

See also the web page http://lingwb.gforge.inria.fr/.

Alpage's linguistic workbench is a set of packages for corpus processing and parsing. Among these packages, two packages are of particular importance: the SxPipe pre-processing chain, and the MElt part-of-speech tagger.

SxPipe [109] is a modular and customizable chain aimed to apply to raw corpora a cascade of surface processing steps. It is used

- as a preliminary step before Alpage's parsers (e.g., FRMG);
- for surface processing (named entities recognition, text normalization, unknown word extraction and processing...).

Developed for French and for other languages, SxPipe includes, among others, various named entities recognition modules in raw text, a sentence segmenter and tokenizer, a spelling corrector and compound words recognizer, and an original context-free patterns recognizer, used by several specialized grammars (numbers, impersonal constructions, quotations...). It can now be augmented with modules developed during the former ANR EDyLex project for analysing unknown words; this involves in particular (i) new tools for the automatic pre-classification of unknown words (acronyms, loan words...) (ii) new morphological analysis tools, most notably automatic tools for constructional morphology (both derivational and compositional), following the results of dedicated corpus-based studies. New local grammars for detecting new types of entities and improvement of existing ones, developed in the context of the PACTE project, will soon be integrated within the standard configuration.

MElt is a part-of-speech tagger, initially developed in collaboration with Pascal Denis (Magnet, Inria — then at Alpage), which was trained for French (on the French TreeBank and coupled with the Lefff), also trained on English [79], Spanish [88], Italian [124], German [38], Dutch, Polish, Kurmanji Kurdish [138] and Persian [119], [120]. It is state-of-the-art for French. It is now able to handle noisy corpora (French and English only; see below). MElt also includes a lemmatization post-processing step. A preliminary version of MElt which accepts input DAGs has been developed in 2013, and is currently under heavy rewriting and improvement in the context of the PACTE project (see 6.3).

MElt is distributed freely as a part of the Alpage linguistic workbench.

In 2014, additional efforts have been achieved for a better pre-processing of noisy input text. This covers two different scenarios:

- user-generated content (see 6.2); two sets of tools are available for processing user-generated content: (i) very noisy computer-mediated content, such as found on social media, forums or blogs, are adressed within the MElt part-of-speech tagger via a three-step procedure (normalisation, tagging, de-normalisation with tag redistribution); this work is performed in relation with the CoMeRe project, funded by the Institut de Linguistique Française [14]; (ii) less noisy customer data, for preparing shallow semantic analysis; this work is performed in collaboration with the viavoo company [17].
- output of OCR systems, in the context of the PACTE project (see 6.3).

5.6. The Alexina framework: the Lefff syntactic lexicon, the Aleda entity database and other Alexina resources

Participants: Benoît Sagot [correspondant], Laurence Danlos.

See also the web page http://gforge.inria.fr/projects/alexina/.

Alexina is Alpage's Alexina framework for the acquisition and modeling of morphological and syntactic lexical information. The first and most advanced lexical resource developed in this framework is the Le*fff*, a morphological and syntactic lexicon for French.

Historically, the Le*fff* 1 was a freely available French morphological lexicon for verbs that has been automatically extracted from a very large corpus. Since version 2, the Le*fff* covers all grammatical categories (not just verbs) and includes syntactic information (such as subcategorization frames); Alpage's tools, including Alpage's parsers, rely on the Le*fff*. The version 3 of the Le*fff*, which has been released in 2008, improves the linguistic relevance and the interoperability with other lexical models.

Other Alexina lexicons exist, at various stages of development, in particular for Spanish (the Le*ff*e), Polish, Slovak, English, Galician, Persian, Kurdish, Italian, German, as well as for Latin verbs and a subset of Maltese and Khaling verbs. These lexicons are used in various tools, including instances of the MElt POS-tagger, and for studies in quantitative morphology.

Alexina also hosts *Aleda* [128], [118] a large-scale entity database currently developed for French but under development for English, Spanish and German, extracted automatically from Wikipedia and Geonames. It is used among others in the SxPipe processing chain and its NP named entity recognition, as well as in the Nomos named entity linking system.

5.7. The free French wordnet WOLF

Participants: Benoît Sagot [correspondant], Valérie Hanoka.

The WOLF (Wordnet Libre du Français) is a wordnet for French, i.e., a lexical semantic database. The development of WOLF started in 2008 [112], [113]. At this time, we focused on benefiting from available resources of three different types: general and domain-specific bilingual dictionaries, multilingual parallel corpora and Wiki resources (Wikipedia and Wiktionaries). This work was achieved in a large part in collaboration with Darja Fišer (University of Ljubljana, Slovenia), in parallel with the development of a free Slovene wordnet, sloWNet. However, it was also impacted by specific collaborations, e.g., on adverbial synsets [114].

In 2014, updated betas of the new version of the WOLF have been published (now version 1.0b4), which integrates and extends the various efforts performed and published somewhat independently in 2012, together with the result of additional filtering, both manual and semi-automatic.

The WOLF is freely available under the Cecill-C license. It has already been used in various experiments, within and outside Alpage.

5.8. OGRE (Optimized Graph Rewriting Engine)

Participants: Corentin Ribeyre [correspondant], Djamé Seddah, Éric Villemonte de La Clergerie, Marie-Hélène Candito.

OGRE (Optimized Graph Rewriting Engine) is a graph rewriting system specifically designed for manipulating linguistic trees and graphs [105]. It relies on a rule specification language for expressing graph rewriting patterns. The transformation is performed in two steps:

1. First, the system performs simple transformations following the rewriting patterns;
2. Second, constraints can be applied on edges, which applies transformations depending on their environment that are propagated while all constraints are satisfied.

The system has been designd for the analysis and manipulation of attributed oriented and multi-relational graphs.

Web site: http://www.corentinribeyre.fr/projects/view/OGRE

5.9. LexViz

Participants: Mikaël Morardo [maintainer], Éric Villemonte de La Clergerie.

In the context of the industrial collaboration of ALPAGE with the company Lingua & Machina, we have extended their WEB plateform Libellex with a new component used to visualize and collaboratively validate lexical resources. In particular, this extension is used to manage terminological lists and lexical networks. The implemented graph-based representation has proved to be intuitive and quite useful for navigating in such large lexical resources (on the order to 10K to 100K entries).

5.10. Mgwiki

Participants: Paul Bui Quang [maintainer], Éric Villemonte de La Clergerie.

In the context of Inria ADT Mgwiki, Paul Bui Quang has developed a linguistic wiki that may used to discuss linguistic phenomena with the possibility to add annotated illustrative sentences. The work is essentially devoted to the construction of an instance for documenting and discussing FRMG, with the annotations of the sentences automatically provided by parsing them with FRMG. This instance also offers the possibility to parse small corpora with FRMG and an interface of visualization of the results. Large parsed corpora (like French Wikipedia or Wikisource) are also available. The parsed corpora can also be queried through the use of the DPath language. The resulting wiki has been officially opened in 2014 on http://alpage.inria.fr/frmgwiki.

Another instance was deployed for managing the annotation guide for the Deep version of the Sequoia treebank, confirming the potential of the notion of linguistic wiki

The source code of the wiki is available on the GForge.

MULTISPEECH Team

5. New Software and Platforms

5.1. Introduction

This software section is organized along three main axes: tools for automatic speech processing, then visualization tools used to display different aspects of speech data and which possibly feature other functionalities; and finally tools and platforms for acquiring articulatory data.

5.2. Speech processing tools

Participants: Denis Jouvet, Dominique Fohr, Odile Mella, Irina Illina, Emmanuel Vincent, Antoine Liutkus, Vincent Colotte, Yann Salaün, Antoine Chemardin.

These automatic speech processing tools deal with audio data transcription (ANTS), audio sources separation (FASST), speech-text alignment (LASTAS) and text-to-speech synthesis (SoJA).

5.2.1. ANTS (Automatic News Transcription System)

ANTS is a multipass system for transcribing audio data, and in particular radio or TV shows. The audio stream is first split into homogeneous segments of a manageable size, and then each segment is decoded using the most adequate acoustic model with a large vocabulary continuous speech recognition engine (Julius or Sphinx). Further processing passes are run in order to apply unsupervised adaptation processes on the features (VTLN: Vocal Tract Length Normalization) and/or on the model parameters (MLLR: Maximum Likelihood Linear Regression), or to use Speaker Adaptive Training (SAT) based models. Moreover decoding results of several systems can be efficiently combined for improved decoding performance. The latest version takes advantage of the multiple CPUs available on a computer, and runs on both standalone linux machines and on clusters.

5.2.2. FASST (Flexible Audio Source Separation Toolbox)

FASST [0] is a toolbox for audio source separation distributed under the Q Public License. Version 2 in C++ has been developed in the context of the ADT FASST (conducted by MULTISPEECH in collaboration with the PANAMA and TEXMEX teams from Inria Rennes - cf. 8.1.6) and released in January 2014. Its unique feature is the possibility for users to specify easily a suitable algorithm for their use case thanks to the general modeling and estimation framework proposed in [6]. It forms the basis of most of our current research in audio source separation, some results of which will be incorporated into future versions of the software.

5.2.3. KAM (Kernel Additive Modelling)

The Kernel Additive Modelling framework for source separation [13], [42] has been proposed this year by Liutkus et al. as a new and effective approach to source separation. In 2014, two different implementations of KAM have been registered with the APP: a Matlab version matKAM and a python version pyKAM. The former is under a aGPL license, while the latter is under a proprietary license. The rationale for this choice is that the Matlab version is to be mainly disseminated for research purpose to the colleagues in the field, that mainly use Matlab, while the python version is more liable to lead to industrial transferts.

5.2.4. LASTAS (Loria Automatic Speech-Text Alignment Software)

LASTAS is a software for aligning a speech signal with its corresponding orthographic transcription. Using a phonetic lexicon and automatic grapheme-to-phoneme converters, all the potential sequences of phones corresponding to the text are generated. Then, using acoustic models, the tool finds the best phone sequence and provides together the boundaries at the phone level and at the word level.

[0] http://bass-db.gforge.inria.fr/fasst/

This year, this software has been included in a web application for speech-text automatic alignement, named ASTALI, which will soon be available [0].

5.2.5. CoALT (Comparing Automatic Labeling Tools)

CoALT is a software for comparing the results of several automatic labeling processes through user defined criteria [70].

5.2.6. SoJA (Speech synthesis platform in Java)

SOJA [0] is a software for Text-To-Speech synthesis (TTS) which relies on a non uniform unit selection algorithm. It performs all steps from text to speech signal output. Moreover, a set of associated tools is available for elaborating a corpus for a TTS system (transcription, alignment...). Currently, the corpus contains 1800 sentences (about 3 hours of speech) recorded by a female speaker. Most of the modules are in Java; some are in C. The software runs under Windows and Linux. It can be launched with a graphical user interface or directly integrated in a Java code or by following the client-server paradigm. We will consider extending and making SoJA more modular and able to handle both acoustic and visual features, in order to use it for both acoustic-only synthesis and audiovisual synthesis. In the future, the text-to-speech synthesis platform will get extended to take into account expressivity features.

5.3. Speech visualization tools

Participants: Yves Laprie, Slim Ouni, Julie Busset, Aghilas Sini, Ilef Ben Farhat.

This set of tools aims at visualizing various aspects of speech data: speech audio signal (SNOORI), Electro-Magnetographic Articulography (EMA) data (VisArtico) and speech articulators from X-ray images (Xarticulators).

5.3.1. SNOORI: speech analysis and visualization software

JSnoori is written in Java and uses signal processing algorithms developed within the WinSnoori [0] software with the double objective of being a platform independent signal visualization and manipulation tool, and also for designing exercises for learning the prosody of a foreign language. Thus JSnoori currently focuses the calculation of F0, the forced alignment of non native English uttered by French speakers and the correction of prosody parameters (F0, rhythm and energy). Several tools have been incorporated to segment and annotate speech. A complete phonetic keyboard is available, several levels of annotation can be used (phonemes, syllables and words) and forced alignment can exploit pronunciation variants. In addition, JSnoori offers real time F0 calculation which can be useful from a pedagogical point of view.

We added the possibility of developing scripts for JSnoori by using Jython which allows Java classes of JSnoori to be used from Python. This required some refactoring of JSnoori classes in order to make them more independent from the JSnoori context.

5.3.2. VisArtico: Visualization of EMA Articulatory data

VisArtico [0] is a user-friendly software which allows visualizing EMA data acquired by an articulograph (AG500, AG501 or NDI Wave). This visualization software has been designed so that it can directly use the data provided by the articulograph to display the articulatory coil trajectories, synchronized with the corresponding acoustic recordings. Moreover, VisArtico not only allows viewing the coils but also enriches the visual information by indicating clearly and graphically the data for the tongue, lips and jaw [72]. Several researchers showed interest in this application. In fact, VisArtico is very useful for the speech science community, and it makes the use of articulatory data more accessible. The software is a cross-platform application (i.e., running under Windows, Linux and Mac OS).

[0] http://astali.loria.fr
[0] http://soja-tts.loria.fr
[0] http://www.loria.fr/~laprie/WinSnoori/
[0] http://visartico.loria.fr/

Within the framework of an Inria ADT project (cf. 8.1.7), we are implementing several improvements to the software. It is possible to use VisArtico to import and export several articulatory data formats. In addition, it possible to insert images (MRI or X-Ray, for instance) to compare the EMA data with data obtained through other acquisition techniques. Finally, it is possible to generate a movie for any articulatory-acoustic sequence. These improvements (and others) extend the capabilities of VisArtico and make it more useful and widely used. The software will also provide a demonstration module that will produce articulatory synthesis from EMA data or text. It animates the vocal tract, using articulatory data and generates the corresponding acoustic signal. VisArtico is freely available for research.

5.3.3. Xarticulators: delineation of speech articulators in medical images

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

We added new articulatory model construction features intended to approximate the tongue shape more correctly when the tongue contacts the palate during the stop closure of /k/ and /t/ and we added more complete modeling of the epiglottis and the larynx region. Future developments will focus on the development of time patterns to synthesize any speech sound and on the coupling between vocal folds and vocal tract.

5.4. Data acquisition

Participants: Vincent Colotte, Slim Ouni, Yves Laprie.

The nature of our research makes us highly concerned by acquisition and processing of speech data. Besides acquisition of speech audio signals, we are concerned with the acquisition of articulatory data, mainly ElectroMagnetographic Articulography (EMA) data using an articulograph and Magnetic Resonance Imaging (MRI) data. EMA captures articulatory movements in three dimensions (3D) with a high temporal resolution by tracking tiny sensors attached to speech articulators such as the tongue, teeth, and lips. MRI is a non-invasive, hazard-free medical imaging technique allowing for high-resolution scans of the vocal tract.

5.4.1. JCorpusRecorder

JCorpusRecorder is a software for the recording of audio corpora. It provides an easy tool to record with a microphone. The audio input gain is controlled during the recording. From a list of sentences, the output is a set of wav files automatically renamed according to textual information given in input (nationality, speaker language, gender...). An easy to use tagging allows for displaying a textual/visual/audio context of the sentence to pronounce. This software is suitable for recording sentences with information to guide the speaker. The sentences can be presented randomly. The software is developed in Java. It is currently used for the recording of sentences in several projects.

5.4.2. EMA acquisition platform

Since the purchase of the articulograph AG500 in 2007, we have built a strong experience with respect to the acquisition technique and we have developed an acquisition protocol (sterilization, calibration, etc.). The platform has been improved by acquiring the latest articulograph AG501 funded by the EQUIPEX ORTOLANG project. The AG501 allows tracking the movement of 24 sensors at reasonable high frequency (250Hz) to very high frequency (1250Hz). In addition, we have developed a powerful tool, VisArtico, to visualize articulatory data acquired using an articulograph.

5.4.3. MRI acquisition platform

Magnetic Resonance Imaging (MRI) takes an increasing place in the investigation of speech production because it provides a complete geometrical information of the vocal tract. We thus initiated a cooperation with the IADI laboratory (Imagerie Adaptive Diagnostique et Interventionnelle) at Nancy Hospital, which studies in particular magnetic resonance imaging. This year, we acquired static MRI data for two speakers (approximately 90 blocked articulations corresponding to vowels and consonants followed by a vowel) and we carried out preliminary experiments intended to acquire dynamic data.

PANAMA Project-Team

5. New Software and Platforms

5.1. FASST: a Flexible Audio Source Separation Toolbox

Participants: Nancy Bertin, Frédéric Bimbot.

Emmanuel Vincent [contact person]

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 development was jointly achieved by the PAROLE team in Nancy and the 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/.

SEMAGRAMME Project-Team

5. New Software and Platforms

5.1. ACG Development Toolkit

Participants: Sylvain Pogodalla [correspondent], Philippe de Groote, Jirí Marsík.

In order to support the theoretical work on ACG, we have been developing a support system. The objectives of such a system are twofold:

1. To make possible to implement and experiment grammars the modeling of linguistic phenomena.
2. To make possible to implement and experiment results related to the ACG formalisms. Such results can concern parsing algorithms, type extensions, language extensions, etc.

The ACG Development toolkit development effort is part of the POLYMNIE project (see Section 7.2.1.1). It will support the experimentation and evaluation parts of the project.

The current version of the ACG development toolkit prototype [0] is 1.1. It focuses on providing facilities to develop grammars. To this end, the type system currently implemented is the linear core system plus the (non-linear) intuitionistic implication, and a special attention has been paid to type error management. Since 1.0b released in Feb. 2014, ACGtk allows for transformations both from abstract terms to object terms, and from object terms to abstract terms (ACG parsing). The parsing algorithm follows [64]'s method which is being implemented for second-order ACGs. It is based on a translation of ACG grammars into Datalog programs and is well-suited to fine-grained optimization.

However, since we are interested not only by recognizability (hence whether some fact is provable) but also by the parsing structure (hence the proof), the Datalog solver has been adapted to produce not only yes/no answer to queries, but also all the proofs of the answers to the queries. The next steps concern optimization and efficiency. Note however that in the general case, the decidability of translating an object term to an abstract one is still an open problem.

We also have enriched the ACG development toolkit with graphical output. The new module includes a small functional OCaml library for manipulating images which enables users to customize the rendering of formulas as pictures.

The ACGtk has been made available as an OPAM (OCaml Package Manager) package. [0]

5.2. Grew

Participants: Bruno Guillaume [correspondent], Guy Perrier.

Grew (http://grew.loria.fr) is a Graph Rewriting tool dedicated to applications in NLP. It is freely-available and it is developed using the InriaGforge platform (http://gforge.inria.fr/projects/semagramme/).

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

In 2014, an online version (http://talc2.loria.fr/grew/) of the tool based on the matching part was developped to illustrate its use (it is not possible to modify graphs). The user gives a pattern (eventually with some negative constraints) and Grew searches in a corpus the occurences on the given pattern in: the French corpus Sequoia is available (two versions are available: one containing surface annotation and one with deep annotation 6.4) and the German corpus Tiger is also avalaible for online pattern search.

[0] Available at http://acg.gforge.inria.fr with a CeCILL license.
[0] https://opam.ocaml.org/packages/acgtk/acgtk.1.1/

5.3. Leopar

Participants: Bruno Guillaume [correspondent], Guy Perrier.

Leopar is a parser for natural languages which is based on the formalism of Interaction Grammars [59]. It is open-source (under the CECILL License http://www.cecill.info) and it is developed using the InriaGforge platform (http://gforge.inria.fr/projects/semagramme/).

The main features of current version of the software are:

- automatic parsing of a sentence or a set of sentences,
- dependency and parse-tree representation of sentences,
- interactive parsing (the user chooses the couple of nodes to merge),
- visualization of grammars produced by XMG-2 or of sets of description trees associated to some word in the linguistic resources.

In 2014, a new conversion from parse-tree representation to dependency representation was implemented to take benefit of the linguistic principles that were defined and used in [36].

5.4. ZombiLingo

Participants: Bruno Guillaume [correspondent], Karën Fort.

Zombilingo (http://zombilingo.loria.fr) is a prototype of a GWAP where gamers have to give linguistic information about the syntax of French natural language sentence (see 6.6 for more details).

5.5. Other developments

Participants: Maxime Amblard [correspondent], Bruno Guillaume.

Main topics: data managment, disfluencies and dependency

- Dep2pict (http://dep2pict.loria.fr) is a program for drawing graphical representation of dependency structures of natural language sentences. An online version is available (http://wikilligramme.loria.fr/doku.php/dep2pict:demo). In 2014, the Dep2pict was modified to take into account the modified format mixing surface and deep syntactic information used in deep-sequoia 6.4 .
- A management chain of the transcriptions of interviews for the SLAM project which productes of a full anonymized randomized version of the resources.
- A program based on Distagger (disfluences) and MElt (POS and lemma) and proposes different repartition analyses.

E-MOTION Project-Team

4. New Software and Platforms

4.1. PROTEUS Software

Participants: Amaury Nègre, Juan Lahera-Perez.

This toolkit offers a automatic mobile robot driver, some sensors drivers sensors as Sick laser, GPS, motion tracker, mono or stereo camera), and a 3D Simulator.

The latest developments have been focuses on the robotics simulator. This simulator is based on the simulation and 3D rendering engine “mgEngine“ (http://mgengine.sourceforge.net/) embedded with the physics engine “bullets physics” (http://bulletphysics.org) for realistic robot dynamic simulation.

We also worked on the interface with the robotics middleware “ROS“ (http://www.ros.org) in order to offer interoperability with many robotics applications.

The simulator is now fully integrated with the robotics middleware "ROS" (http://www.ros.org) which allow interoperability with a large set of robotics applications and visualization tools. This software is developed in C++ and the simulator operates with the Lua scripting language. The simulation software is used in the ANR Proteus (http://www.anr-proteus.fr), as a simulation engine for the PROTEUS Toolkit.

- Version: 2.0
- APP:IDDN.FR.001.510040.000.S.P.2005.000.10000
- Programming language: C/C++, Lua

4.2. AROSDYN

Participants: Igor Paromtchik, Mathias Perrollaz, Alexandros Makris, Amaury Nègre, Christian Laugier.

ArosDyn (http://arosdyn.gforge.inria.fr/) is a system which integrates our recently developped techniques to provide a real-time collision risk estimation in a dynamic environment. The main features of this software are:

1. The design provides high maintainability, scalability and reuseness of the models and algorithms.
2. The software has a user interface (UI) which is user-friendly.
3. The software facilitates the parameter tuning of the models.
4. It uses the GPU to accelerate the computation.
5. Working together with the Hugr middleware (http://gforge.inria.fr/projects/cycabtk), it can run on our experimental vehicle in real-time.

Another important property of this software is a large part of the computation task executed on GPU. As the processing of stereo image and the computaion in the BOF can be highly parallelized, we run these tasks on the GPU to improve the time performance. The GPU calculation is based on CUDA library and is carried out in an independent thread.

Furthermore, thanks to the design of the software, we can easily add new models to it and let them work together. The fast detection and tracking algorithm (FCTA) and the Gaussian process based collision assessment algorithm are added into this framework. The sofware is implemented on the Lexus car. In 2012, a demand for deposing the GPU BOF software to the APP is in progress.

4.3. Embedded Perception

Participants: Mathias Perrollaz, Amaury Nègre, Christian Laugier.

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

The program has been deposed to the APP in 2012, under the reference: IDDN.FR.001.270004.000.S.P.2012.000.10800

4.4. Bayesian Occupancy Filter

People involved: Kamel Mekhnacha, Tay Meng Keat Christopher, C. Laugier, M. Yguel, Pierre Bessière.
The BOF toolbox is a C++ library that implements the Bayesian Occupancy Filter. It is often used for modelling dynamic environments. It contains the relevant functions for performing bayesian filtering in grid spaces. The output from the BOF toolbox are the estimated probability distributions of each cell's occupancy and velocity. Some basic sensor models such as the laser scanner sensor model or Gaussian sensor model for gridded spaces are also included in the BOF toolbox. The sensor models and BOF mechanism in the BOF toolbox provides the necessary tools for modelling dynamic environments in most robotic applications. This toolbox is patented under two patents : "Procédé d'assistance à la conduite d'un véhicule et dispositif associé" n. 0552735 (9 september 2005) and "Procédé d'assistance à la conduite d'un véhicule et dispositif associé amélioré" n. 0552736 (9 september 2005) and commercialized by ProBayes.

- Version: 1
- Patent: 0552736 (2005), 0552735 (2005)
- Programming language: C/C++

4.5. PROBT

People involved: Juan-Manuel Ahuactzin, Kamel Mekhnacha, Pierre Bessière, Emmanuel Mazer, Manuel Yguel, Christian Laugier.
ProBT is both available as a commercial product (ProBAYES.com) and as a free library for public research and academic purposes (http://emotion.inrialpes.fr/BP/spip.php?rubrique6). Formerly known as *OPL*, *ProBT* is a C++ library for developing efficient Bayesian software. It is available for Linux, Unix, PC Windows (Visual C++), MacOS9, MacOSX and Irix systems. The ProBT library (http://www.probayes.com/) has two main components: (i) a friendly Application Program Interface (API) for building Bayesian models, and (ii) a high-performance Bayesian Inference Engine (BIE) allowing to execute all the probability calculus in exact or approximate way. *ProBT* is now commercialized by our start-up *Probayes*; it represents the main Bayesian programming tool of the *e-Motion* project-team, and it is currently used in a variety of external projects both in the academic and industrial field (e.g., for the European project BACS and for some industrial applications such as Toyota or Denso future driving assistance systems).

FLOWERS Project-Team

5. New Software and Platforms

5.1. Perception Tools

Participants: David Filliat [correspondant], Louis-Charles Caron, Alexander Gepperth.

5.1.1. Of 3-D point cloud

Participants: Louis-Charles Caron [correspondant], Alexander Gepperth, David Filliat.

This software scans the 3-D point cloud of a scene to find objects and match them against a database of known objects. The process consists in 3 stages. The segmentation step finds the objects in the point cloud, the feature extraction computes discriminating properties to be used in the classification stage for object recognition.

The segmentation is based on simple assumptions about the geometry of an indoor scene and the movement of a wheeled mobile robot. The floor plane coefficients are known a priori and are used to eliminate from the point cloud all points that are close to this plane and have a normal perpendicular to it. The floor plane coefficients also allow the detection of walls. Successive RANSACs are run to find planes that are perpendicular to the floor plane, and contain a large number of points. With these large structural regions removed, the only points remaining in the point cloud are the objects in the scene. These objects are separated by clustering the points based on a distance criteria. Close-by points are considered to form a single object.

Objects are characterized by their shape, texture. The texture information is encoded as a histogram that apprioximates the form of the distribution of color values in the object. A separate histogram is built for the red, green and blue channels. The shape of an object is encoded by computing thousands of randomly chosen Surflet-pair relation features and compiing them into a histrogram of occurrence.

The classification is done by a 3-layer feed-forward neural network. The network is trained on a dataset of point clouds of 53 objects. After training, the neural network is run on the features computed from each object detected in the segmentation stage [86].

5.1.2. PEDDETECT: GPU-accelerated person detection demo

Participant: Alexander Gepperth [correspondant].

PEDDETECT implements real-time person detection in indoor or outdoor environments. It can grab image data directly from one or several USB cameras, as well as from pre-recorded video streams. It detects mulitple persons in 800x600 color images at frame rates of >15Hz, depending on available GPU power. In addition, it also classifies the pose of detected persons in one of the four categories "seen from the front", "seen from the back", "facing left" and "facing right". The software makes use of advanced feature computation and nonlinear SVM techniques which are accelerated using the CUDA interface to GPU programming to achieve high frame rates. It was developed in the context of an ongoing collaboration with Honda Research Institute USA, Inc.

5.1.3. A Python OptiTrack client

Participant: Pierre Rouanet [correspondant].

This python library allows you to connect to an OptiTrack from NaturalPoint (http://www.naturalpoint.com/optitrack/). This camera permits the tracking of 3D markers efficiently and robustly. With this library, you can connect to the Motive software used by the OptiTrack and retrieve the 3D position and orientation of all your tracked markers directly from python.

5.2. Datasets

5.2.1. Assemblies of objects for the 3rd hand project

Participants: Yoan Mollard [correspondant], Thibaut Munzer, Manuel Lopes.

The 3rd hand project aims to develop a semi-autonomous robot assistant that acts as a third hand of a human worker. Especially, both should be able to undertake assembly tasks together, in a cooperative way. In order to analyse assembly tasks we recorded 6 datasets of two objects being assembled by a human. The experiment setup has the form of a single user assembling simple furnitures (a chair and a bench) composed by several distinct parts (seating, back, legs). Each part is tracked thanks to an Optitrack system and a set of reflective markers during the whole assembly. The experimental setup records the absolute poses of each part (position and orientation) and relative poses of each couple of objects.

5.3. Learning algorithms

5.3.1. KidLearn

Participants: Manuel Lopes [correspondant], Benjamin Clement, Pierre-Yves Oudeyer, Didier Roy.

The KidLearn software provides an Intelligent Tutoring System that optimizes teaching sequences based on the estimated level of each particular student. Two algorithms, RiARiT and ZPDES have been developped and are described in [37], [39] and [38]. We updated the Game of Money that we developped last year wich allows students between 7-8 years to learn how to use money. It still includes 3 main components: i) a webserver that handles the requests and stores the experiments in a databased; ii) a GUI that provides the interface for the game; and iii) the optimization software.

Graphical interfaces in ITS can have unwanted side effects. For this reason, the interface was entirely designed with the help of a didactician, with several specific design choices motivated by pedagogical, motivational and attention requirements. For example, the interface, shown in Figure 1 . is such that:

- display is as clear and simple as possible;
- there is no chronometer, so that students are not put under time pressure;
- coins and banknotes have realistic visual appearance, and their relative sizes are respected;
- costumer and merchant are represented to indicate clearly the role of the student;
- text quantity is kept to minimum;

Four principal regions are defined in the graphical interface, as shown in Figure 1 , on the left picture. The first is the wallet location where users can pick and drag the money items and drop them on the repository location to compose the correct price. The object and the price are present in the object location.

Figure 1. Interface with two exemple of type of exercises, Left: customer/one object, Right : merchant/two objects

We performed a more developed and complete user study than last year, considering 5 different schools in the Bordeaux metropolitan area. We had a total of 400 students between 7 and 8 years old. We divided them into 4 groups, with one control group where student does not use the software and 3 groups where exercises are proposed using : a) a predefined sequence; b) ZPDES; c) RiARiT. To measure student learning, students pass pre-test few days before using the interface, and a post test fews days after using the interface. The control group pass the pre and post test at the same time that others but without using the interface between. The results of this study have been presented in [69].

5.3.2. DMP-BBO Matlab library

Participant: Freek Stulp [correspondant].

The dmp_bbo (Black-Box Optimization for Dynamic Movement Primitives) Matlab library is a direct consequence of the insight that black-box optimization outperforms reinforcement learning when using policies represented as Dynamic Movement Primitives. It implements several variants of the PI^{BB} algorithm for direct policy search. It is currently being used and extended by several FLOWERS members (Manuel Lopes, Clément Moulin-Frier) and external collaborators (Jonas Buchli, Hwangbo Jemin of ETH Zurich). In the context of the DIGITEO-funded project "PrActIx" , CEA LIST has now started using this library. In 2014, parts have been made real-time safe for use on the Meka Humanoid robot. This has been fundamental in achieving the results for [65], [64].

5.3.3. Self-calibration BCI - Matlab library

Participants: Jonathan Grizou [correspondant], Iñaki Iturrate, Luis Montesano, Manuel Lopes, Pierre-Yves Oudeyer.

The Matlab software implements the algorithms described in [45]. Downloadable from https://github.com/jgrizou/lfui.

It allows a robot to be instructed a new task by a human using communicative signals initially totally unknown to the robot. It is was extended and improved in the context of EEG-based brain-machine interfaces (BMIs) [44].

It results in a BCI based control of sequential tasks with feedback signals that do not require any calibration process. As a by-product, the method provides an unsupervised way to train a decoder with the same performance than state-of-the-art supervised classifiers, while keeping the system operational and solving, with a lower performance during the first steps, the unknown task. The algorithm has been tested with online experiments (fig. 2), showing that the users were able to guide from scratch an agent to a desired position.

To improve the efficiency of the algorithm, we introduced a new planning method that uses the uncertainty in the signal-target estimation. This planner is inspired by exploration methods with exploration bonuses that allow guiding to reduce the uncertainty in an efficient way. We showed that trying to follow the best hypothesis does not explore the space significantly to reduce uncertainty and thus identify the correct task. Only through an approach that plans how to reduce the uncertainty multiple steps ahead are we sure that the agent will reach states that can only be explained by the correct hypothesis.

5.3.4. DyNAMoS: parallel multi-process simulation of distributed neural architectures

Participants: Alexander Gepperth [correspondant], Mathieu Lefort.

This simulation software comes in the form of a PYTHON module and allows a user to define and simulate complex neural architectures while making use of the parallelism inherent to modern multi-core processors. A special focus lies on on-line learning, processing inputs one by one, in contrast to batch processing of whole databases at a time.

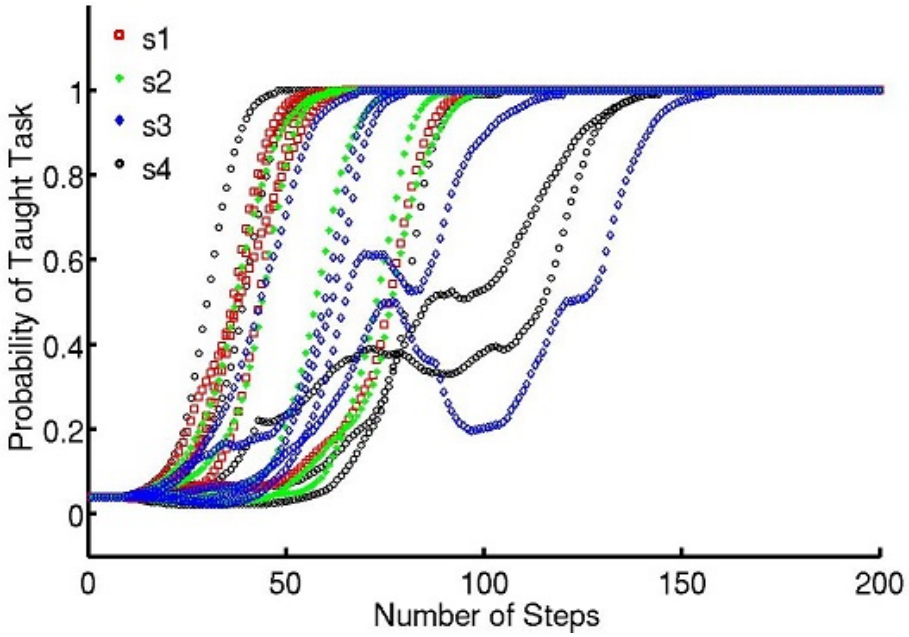


Figure 2. Results from the online BCI experiment for identifying the task. Evolution of the probability of the taught task for each subject and run

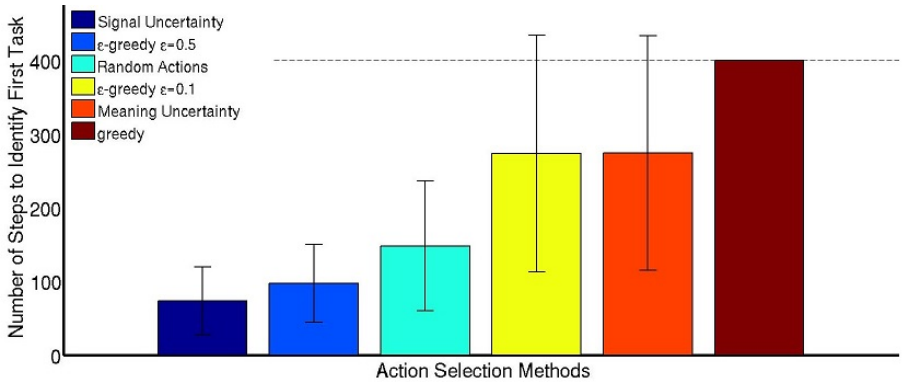


Figure 3. Comparison between different exploration methods. Planning wrt. uncertainty in noth task and signal space is the most efficient method

The connectivity of an architecture, as well as neural dynamics and learning rules, are defined by editing simple text-based configuration files. A simple instantiation of a pre-defined simulator class together with the name of the configuration file launches the simulation. Users can provide continuous input to the architecture, as well as inspect and visualize all elements of the simulation, by subclassing the simulator class and redefining the appropriate methods in a clean and Pythonic way. DyNAMoS can be, and is in fact meant to be, extended by user-defined learning methods and dynamics models, which is possible through a well-documented interface all such functions must respect. DyNAMoS distributes computation across multiple processes that are spawned dynamically, possibly on multiple computers, which communicate by TCP/IP or Linux interprocess communication depending on whether they are on the same computer. All aspects of multi-process handling and communication are completely hidden from the user who may merely specify which neural map is executed on which physical process if he wishes to.

This software has been used to speed up computations and provides a common platform for implementing online and incremental learning algorithms. Up to now, we have included linear and logistic regression, various versions of self-organizing maps, MLP and LWPR. It will be made available on GitHub in 2015 after final tests have been concluded.

5.3.5. *pyStreamPlayer: synchronized replay of multiple sensor recordings and supplementary data*

Participant: Alexander Gepperth [correspondant].

This Python software is intended to facilitate the application of machine learning algorithms by avoiding to work directly with an embodied agent but instead with data recorded in such an agent. Assuming that non-synchronous data from multiple sensors (e.g., camera, Kinect, laser etc.) have been recorded according to a flexible format defined by the pyStreamPlayer architecture, pyStreamPlayer can replay these data while retaining the exact temporal relations between different sensor measurements. As long as the current task does not involve the generation of actions, this software allows to process sensor data as if it was coming from an agent which is usually considerably easier. At the same time, pyStreamPlayer allows to replay arbitrary supplementary information such as, e.g., object information, as if it was coming from a sensor. In this way, supervision information can be stored and accessed together with sensory measurements using an unified interface. pyStreamPlayer has been used to facilitate real-world object recognition tasks, and several of the major databases in this field (CalTech Pedestrian database, HRI RoadTraffic traffic objects database, CVC person database, KITTI traffic objects database) have been converted to the pyStreamPlaer format and now serve as a source of training and test data for learning algorithms.

pyStreamPlayer has been integrated into a ROS node as well, allowing th replay and transmission across networks of distributed processes.

5.3.6. *Multimodal: framework around the NMF algorithm for multimodal learning*

Participant: Olivier Mangin [correspondant].

The python code provides a minimum set of tools and associated libraries to reproduce the experiments in [98], together with the choreography datasets. The code, publicly available at https://github.com/omangin/multimodal, under the new BSD license, is primarily intended for reproduction of the mulimodal learning experiment mentioned above. It has already been reused in several experimentations by other member of the team and is expected to play an important role in further collaborations. It is also expected that the public availability of the code encourages further experimentation by other scientists with data coming from other domains, thus increasing both the impact of the aforementioned publication and the knowledge on the algorithm behaviors. The nonnegative matrix factorization algorithm used in the experiments is also available as a third party extension to http://scikit-learn.org.

5.3.7. *Explauto: an autonomous exploration library*

Participants: Clément Moulin-Frier [correspondant], Pierre Rouanet.

Explauto is a framework developed to study, model and simulate curiosity-driven learning and exploration in virtual and robotic agents. The code repository is available at: https://github.com/flowersteam/explauto.

This library provides high-level API for an easy definition of:

- Virtual and robotics setups (Environment level)
- Sensorimotor learning iterative models (Sensorimotor level)
- Active choice of sensorimotor experiments (Interest level)

It is crossed-platform and has been tested on Linux, Windows and Mac OS. It has been released under the GPLv3 license.

Explauto's scientific roots trace back from Intelligent Adaptive Curiosity algorithmic architecture [15], which has been extended to a more general family of autonomous exploration architecture by [3] and recently expressed as a compact and unified formalism [102]. The library is detailed in [60].

This library has been used in many experiments including:

- the control of a 2D simulated arm
- the exploration of the inverse kinematics of a poppy humanoid (both on the real robot and on the simulated version)
- accoustic model of a vocal tract

5.3.8. *Explorers Framework*

Participants: Benureau Fabien [correspondant], Pierre-Yves Oudeyer.

The Explorers framework is aimed at creating, testing and comparing autonomous exploration strategies for sensorimotor spaces in robots. The framework is largely strategy-agnostic, and is aimed as expressing motor babbling, goal babbling and intrinsically motivated exploration algorithms, among other. It is also able to express strategies that feature transfer learning, such as the reuse algorithm we introduce in [34].

At the center of the framework, an explorer receives observations and provides motor commands for the environment to execute.

We can then easily express a typical goal babbling architecture (the feedback update is not pictured).

Here, the explorer interacts with the environment, rather than the inverse model. Such an architecture allows to filter motor commands that are proposed by the inverse model, and eventually to select another goal if the motor command is not satisfactory or possible to execute. The framework is organized in a modular way. This allows to create flexible hierarchical architectures made of several, atomic or themselves composite, exploration strategies.

The framework has been released this year under the *OpenScience* license (http://fabien.benureau.com/openscience.html), and made available on github (https://github.com/humm/explorers). Using provided examples, users can easily modify the exploration parameters and investigate for instance the differences between motor and goal babbling exploration strategies.

5.3.9. *PyQMC: Python library for Quasi-Metric Control*

Participant: Steve Nguyen [correspondant].

PyQMC (https://github.com/SteveNguyen/pyqmc) is a python library implementing the control method described in http://dx.doi.org/10.1371/journal.pone.0083411 It allows to solve discrete markovian decision processes by computing a Quasi-Metric on the state space. This model based method has the advantage to be goal independant and thus can produce a policy for any goal with relatively few recomputation. New addition to this method is the possibility of online learning of the transition model and the Quasi-Metric.

5.4. Software Platforms

5.4.1. *Meka robot plateform enhancement and maintenance*

Participants: Antoine Hoarau, Freek Stulp, David Filliat.

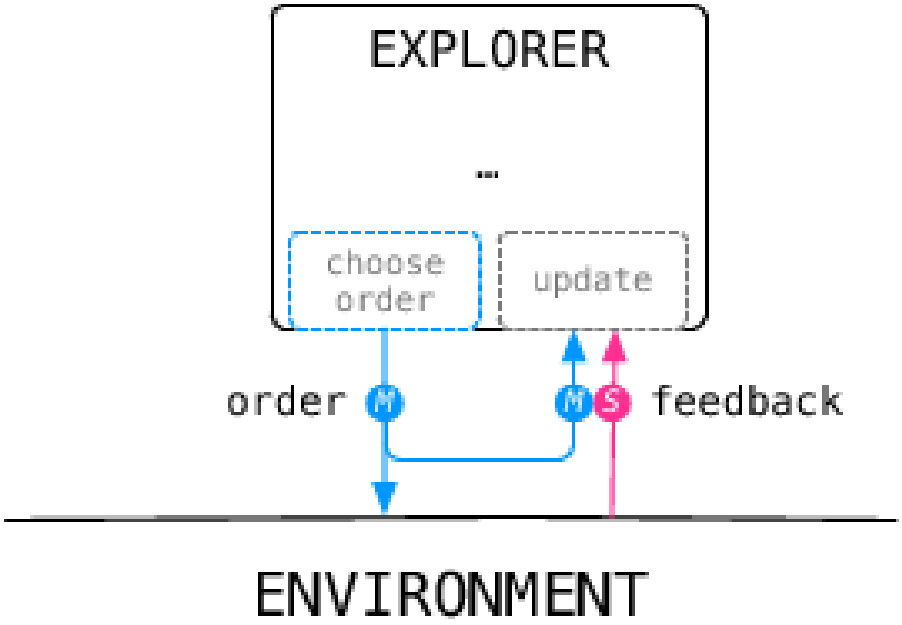


Figure 4.

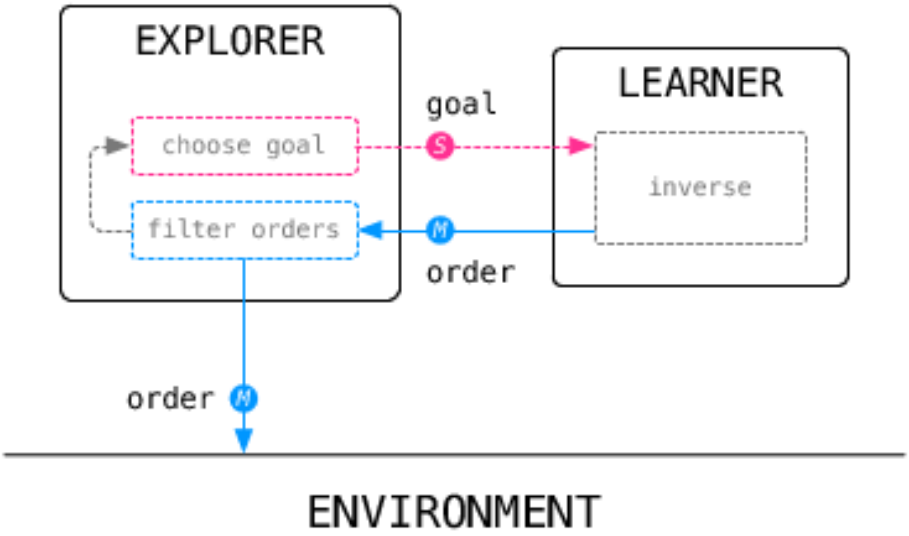


Figure 5.

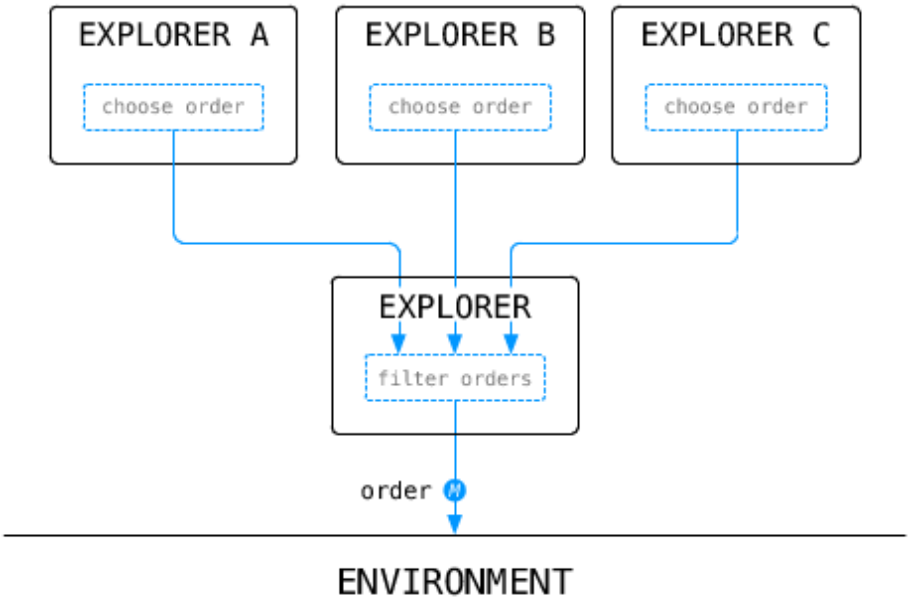


Figure 6.

Autonomous human-centered robots, for instance robots that assist people with disabilities, must be able to physically manipulate their environment. There is therefore a strong interest within the FLOWERS team to apply the developmental approach to robotics in particular to the acquisition of sophisticated skills for manipulation and perception. ENSTA-ParisTech has recently acquired a Meka (cf. 7) humanoid robot dedicated to human-robot interaction, and which is perfectly fitted to this research. The goal of this project is to install state-of-the-art software architecture and libraries for perception and control on the Meka robot, so that this robot can be jointly used by FLOWERS and ENSTA. In particular, we want to provide the robot with an initial set of manipulation skills.
The goal is to develop a set of demos, which demonstrate the capabilities of the Meka, and provide a basis on which researchers can start their experiments.

The platform is evolving as the sofware (Ubuntu, ROS, our code) is constantly updated and requires some maintenance so less is needed for later. A few demos were added, as the hand shaking demo, in which the robot detects people via kinect and initiates a hand shake with facial expressions. This demo has been used to setup a bigger human robot interaction experiment, currently tested on subjects at Ensta (cf. 8). Finally, we've seen that the robot itself also needs some maintenance; some components broke (a finger tendon), a welding got cold (in the arm) and a few cables experienced fatigue (led matrix and cameras) (cf. 9).

5.4.2. Teaching concepts to the Meka robot

Participants: Fabio Pardo [Correspondant], Olivier Mangin, Anna-Lisa Vollmer, Yuxin Chen, David Filliat.

This plateform was developped during Fabio Pardo's internship, in the dual context of the study of Anna-Lisa Vollmer's research on human robot interaction protocole during a learning task, and Olivier Mangin's research on mechanism for word learning and multimodal concept acquisition. The plateform is centered around an interaction zone where objects are presented to a Meka robot augmented with a kinect camera placed on top of the interaction zone. Several colorful objects are available to be presented and described to the robot. Several

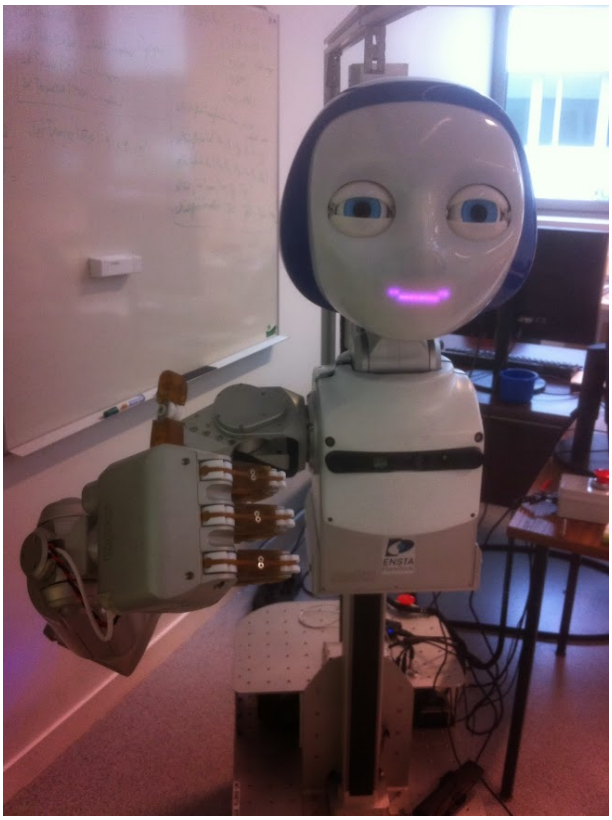


Figure 7. The Meka robot plateform acquired by ENSTA ParisTech

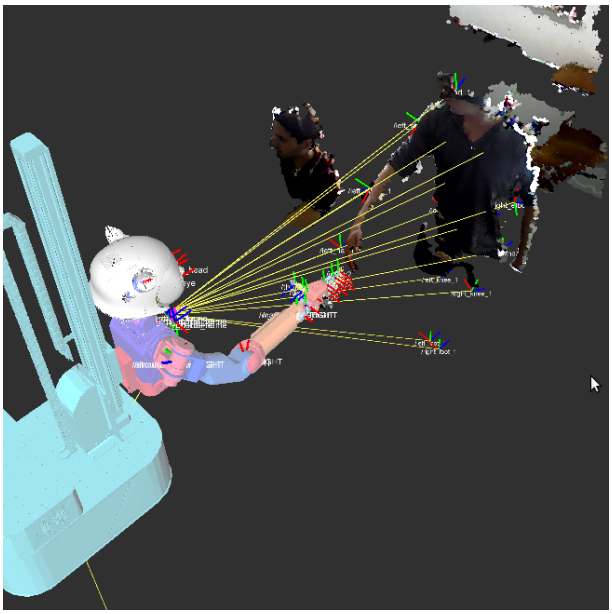


Figure 8. Hand shake demo visualized on Rviz (ROS)

object may be present at the same time on the table. Typical object are easily caracterized by their colors and shapes, such as the *red ball*, the *yellow cup*, or the *blue wagon with red wheels*.

The robot software is capable of abstracting the visual and acoustic perception in the following way. The camera image is segmented into objects; from each object, a set of descriptors is extracted, typically SIFT or shape descriptors and color histograms. An incremental clustering algorithm transforms the continuous descriptors into a histogram of descrete visual descriptors that is provided to the learning algorithm. The acoustic stream is segmented into sentences by a silence detection process and each sentence is fed to Google's text to speach API. Finally each sentence is represented as a histogram of the words recognized in the sentence.

The robot is capable of learning multimodal concepts, spanning words and visual concepts, through the nonnegative matrix factorization framework introduced by Olivier Mangin (see). In addition several behaviors are programmed in the robot such as gaze following objects or understanding a few interaction questions.

The framework is illustrated on the following video https://www.youtube.com/watch?v=Ym5aYfzoQX8. It enables to modify the interaction as well as the learning mechanisms in order to study the interaction between the teacher and the learning robot.

5.4.3. Experiment platform for multiparameters simulations

Participants: Fabien Benureau, Paul Fudal.

Simulations in robotics have many shortcommings. At the same time, they offer high customizability, rapidity of deployment, abscence of failure, consistency across time and scalability. In the context of the PhD work of Fabien Benureau, it was decided to investigate hypothesis first in simulation before moving to real hardware. In order to be able to test a high number of different hypothesis, we developped a software platform that would scale to the computing ressource available.

We designed simple continuous simulations around a of-the-shelf 2D physic engine and wrote a highly modular platform that would automatically deploy experiments on cluster environments, with proper handling

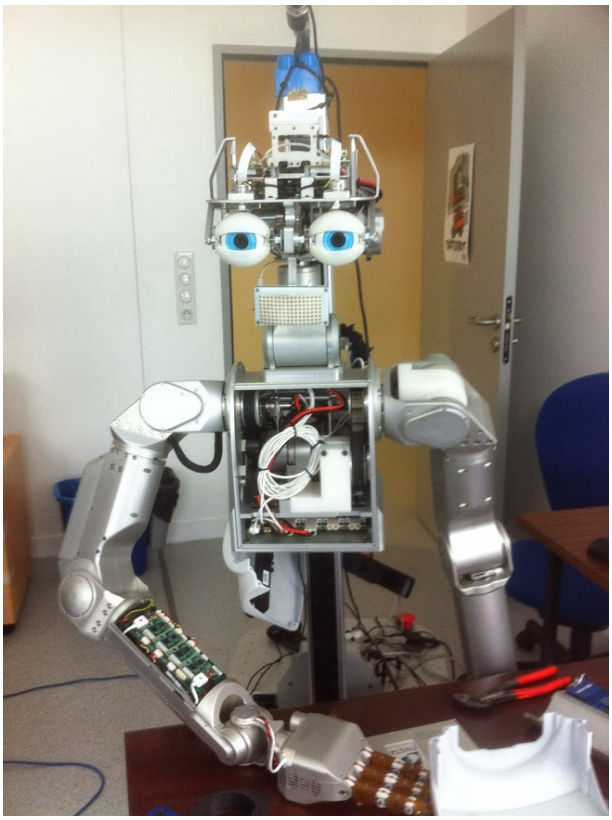


Figure 9. Maintenance is required on the robot

of dependencies; our work investigate transfer learning, and some experiments's input data is dependent of the results of another.

So far, this platform and the university cluster has allowed to conduct thousands of simulations in parallel, totaling more than 10 years of simulation time. It has led us to present many diverse experiments in our published work [34], each repeated numerous times. It has allowed us to conduct a multi-parameter analysis on the setup, which led to new insights, which are being presented in a journal article to be submitted in the beginning of this year.

Because of its high modularity, this platform is proving to be highly flexible. We are currently adaptating it to a modified, cluster-ready, version of the V-REP simulator. Those simulations will serve to back ones on similar real-world hardware that are currently setup.

5.4.4. pypot

Participants: Pierre Rouanet [correspondant], Steve N'Guyen, Matthieu Lapeyre.

Pypot is a framework developed to make it easy and fast to control custom robots based on dynamixel motors. This framework provides different levels of abstraction corresponding to different types of use. More precisely, you can use pypot to:

1. directly control robotis motors through a USB2serial device,
2. define the structure of your particular robot and control it through high-level commands,
3. define primitives and easily combine them to create complex behavior.

Pypot has been entirely written in Python to allow for fast development, easy deployment and quick scripting by non-necessary expert developers. It can also benefits from the scientific and machine learning libraries existing in Python. The serial communication is handled through the standard library and thus allows for rather high performance (10ms sensorimotor loop). It is crossed-platform and has been tested on Linux, Windows and Mac OS.

Pypot is also compatible with the V-REP simulator (http://www.coppeliarobotics.com). This allows the transparent switch from a real robot to its simulated equivalent without having to modify the code.

Pypot also defined a REST API permitting the development of web apps such as a web control interface faciliting the use of a robotic platform.

Pypot is part of the Poppy project (http://www.poppy-project.org) and has been released under an open source license GPL V3. More details are available on pypot website: https://github.com/poppy-project/pypot

5.5. Experimental Setups

5.5.1. Experimental Platform for User Study of Curiosity-driven Exploration

Participants: Pierre Rouanet [correspondant], Jonathan Grizou, Brice Miard, Julie Golliot.

This platform has been developed to investigate curiosity-driven behaviors and more precisely how humans explore new sensori-motor spaces. It consists in several simple games where users control a 2D/3D shape with the movements of their body. They have to discover the mapping between their movements and a shape displayed on the screen and learn how to make the controlled shape match the target one (fig 10).

The software is entirelly written in Python. It includes a Kinect wrapper allowing the access of 3D position of tracked skeleton joints. It provides a framework for creating new games based on the 2D drawing library (pygame). It also includes a web server used to display game instructions, cut-scene videos and questionnaire.

The presentation of the platform and the preliminary results of a user's study have been rapported in [58].

5.5.2. Learning and representing object assembly tasks

Participants: Yoan Mollard [correspondant], Thibaut Munzer, Pierre Rouanet, Manuel Lopes.

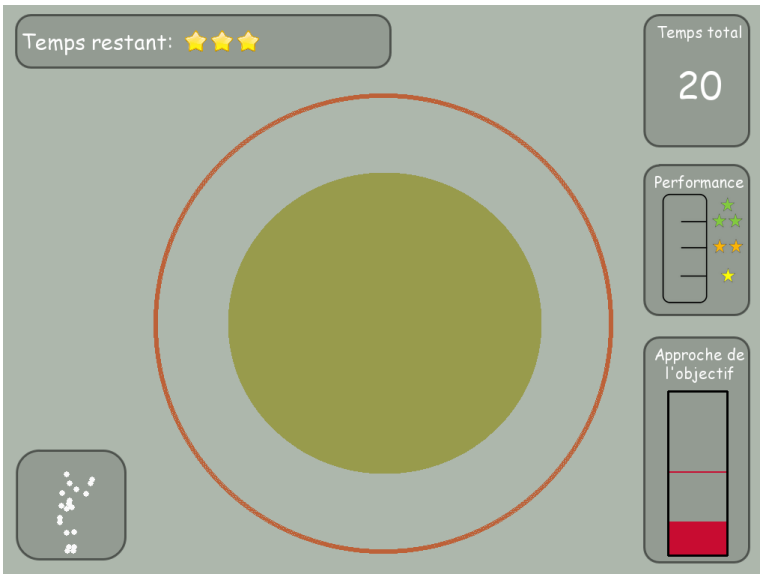


Figure 10. A screenshot representing the game interface as seen by the user.

In the context of the 3rd hand project 8.3.1.1 we created a framework for learning assembly tasks from demonstration. In this work we showed how a complex assembly task could be automatically decomposed in components allowing to learn constraints between different objects and their assembly plan. We created also a Graphical User Interface (GUI) allowing to present the learned data in a intuitive way, so that the user can be aware of what the computer has learned. This awareness is crucial for Human-Robot cooperation since the robot will base its decisions on the learned data. Making them clear to the user also allow to rely on him to find potential errors and correct the noise. Thus, the user can program the robot by combining demonstrations and manual corrections minimizing the overall programming phase. Our experimental setup consists in several sequencial phases:

1. **Demonstrations**: User provides several demonstrations of an assembly. All parts of the objects are individually tracked by an Optitrack tracking system
2. **Constraint extraction**: Trajectories are analysed to extract rigid constraints
3. **Segmentation**: Constraints on all demonstrations are segmented to find one constraint per object
4. **Plan computation**: We deduce relational MDP trajectories from raw data, creating one assembly step per constraint
5. **Presentation and correction**: The raw constraints and assembly plan are presented to the user in a friendly way through a 3D GUI so that he is able to visualize and correct them 12
6. **Execution**: The corrected informations are then sent to the robot for actual execution. The execution system only receives constraints and the plan, all motions are computed by a motion planner to reach the goals, but motions could also been extracted from the demonstrations using dynamic motor primitives (DMP). We used a simulated Baxter robot that we acquired during the year.

The framework is written in C++ (GUI) and Python (tracking system, data analysis and execution system), and is completely integrated into ROS. The main steps of the workflow are shown on figure 11 .

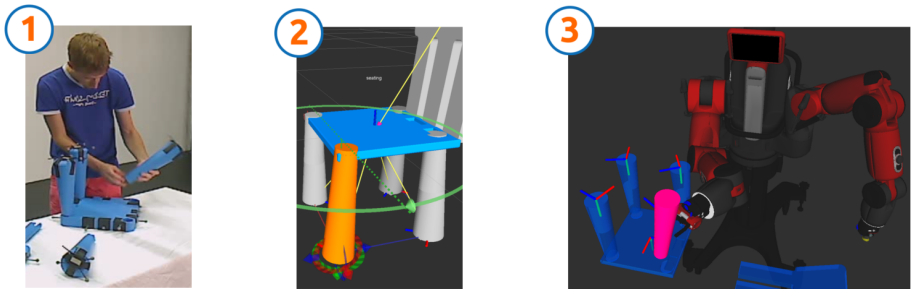


Figure 11. Demonstration, correction and execution of an assembly

The GUI itself 12 represents rigid constraints visually, and provides all the controls necessary to correct them using a graphical procedure. It shows the learned assembly plan as a list of sequential steps that the user can browse like any assembly manual. Also the GUI introduces degrees of freedom in the form of standard mechanical joints (rotational, prismatic, cylindrical joints ...) that the robot can use during execution to simplify the motions and decrease failures during motion planning. The GUI draw graphical cues to represent them and is also able to animate them to make them even clearer.

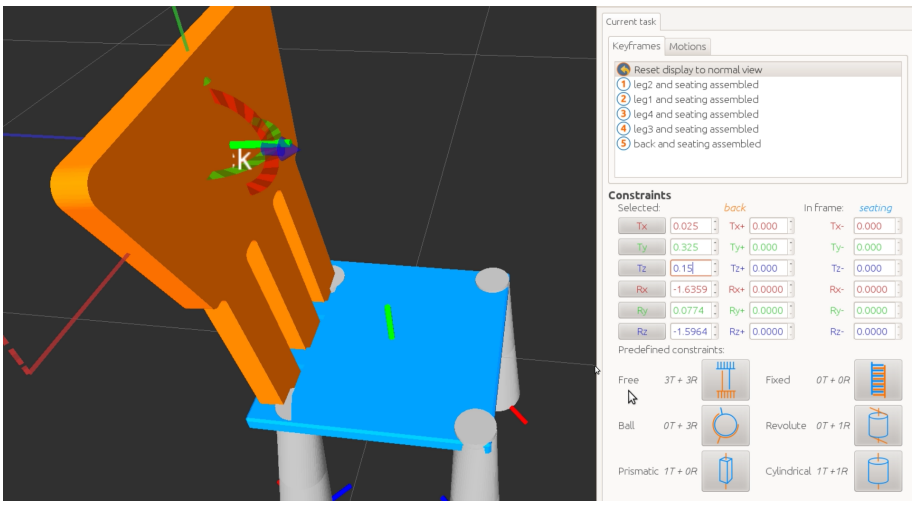


Figure 12. Detailed view of the GUI showing the learned constraints and assembly plan

5.6. Hardware

5.6.1. Poppy Platform

Participants: Matthieu Lapeyre [correspondant], Pierre Rouanet, Jonathan Grizou, Pierre-Yves Oudeyer [supervisor].

The Poppy Project [54], [53], [23] (see Figure 13 , http://www.matthieu-lapeyre.com/thesis.pdf) develops an open-source 3D printed humanoid platform based on robust, flexible, easy-to-use and reproduce hardware and software. In particular, the use of 3D printing and rapid prototyping technologies is a central aspect of this project, and makes it easy and fast not only to reproduce the platform, but also to explore morphological variants. Poppy targets three domains of use: science, education and art (see http://www.poppy-project.org).

Poppy was initially designed with a scientific objective, aiming to be a new experimental platform opening the possibility to systematically study the role of morphology in sensorimotor control, in human-robot interaction and in cognitive development. Indeed, a suitable design of a robot morphology can greatly simplify control problems, increase robustness, and open new modes of interaction with the physical and social world. Thus, being able to study the body as an experimental variable, something which can be systematically changed and experimented, is of paramount importance. Yet, until recently it was complicated because building a robot relied on heavy and costly manufacturing techniques. 3D printing has changed the landscape of what is possible: Poppy Project transposed it to humanoid robotics, and it is now possible to explore new body shapes in just a few days. It enables and simplifies the experimentation, the reproduction and the modification of the morphology in research laboratories. It also allows collaborative working, sharing and replication of the results on these issues between laboratories. The ambition is to become a reference platform for benchmarking and dissemination of scientific results.

Thanks to the fact that it integrates advanced and yet easily accessible techniques in an embodiment that motivates students and the wider public, this platform also meets a growing societal need: education and training in technologies combining computer science, electronics and mechanics, as well as a training tool to the emergent revolutionary 3D printing process. With its openness, its design and its rather low-cost, Poppy provides a unique context for experimentation and learning of these technologies in a Do-It-Yourself (DIY) approach. Several experiences with Poppy in secondary, high schools, science museums and Fablabs in France and abroad are underway and will be discussed in the incoming sections. Finally, the possibility to easily modify both the hardware and the software also makes Poppy a useful tool for artistic projects working with interactive computerized installations.

5.6.1.1. Open-Source Robotic Platform

Poppy is the first complete 3D printed open-source and open-hardware humanoid robot. Its 3D printed skeleton and its Arduino-based electronics are open-hardware (Creative Commons). Its software is open-source (GPL V3), and allows programming beginners as well as advanced roboticists to control the robot in Python thanks to the PyPot library (https://github.com/poppy-project/pypot). Its motors are common off-the-shell Robotis actuators (http://www.robotis.com/xe/dynamixel_en), and allow for compliant control and soft physical human-robot interaction. Poppy presents an original mechanical structure which permits to obtain a light structure with 3.5kg for 84cm height. Before the arrival of 3D printing techniques, this kind of complex structure was either impossible to produce or extremely expensive. Now, anyone can produce and modify such robot in their home using affordable personal 3D printers.

Several web tools support collaboration and sharing among members of the Poppy community: a portal web site (www.poppy-project.org), GitHub repositories for the hardware and software with associated wikis for documentation (www.github.com/poppy-project/), and a forum based on Discourse [0] technology (forum.poppy-project.org).

[0] www.discourse.org

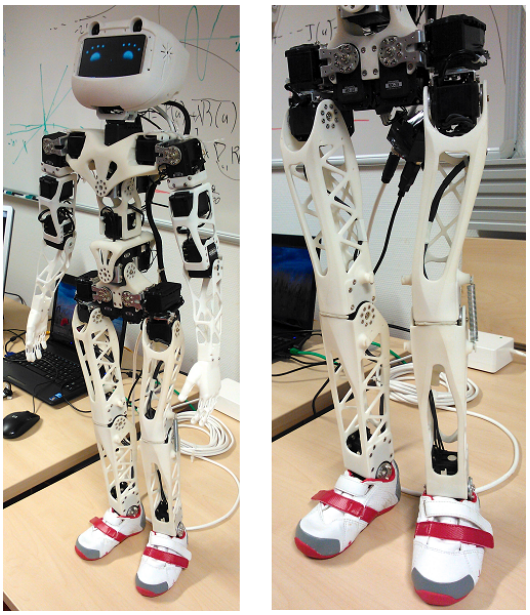


Figure 13. a. Global view of the Poppy platform. b. Zoom on legs design

HEPHAISTOS Team

5. New Software and Platforms

5.1. Introduction

Software development is an essential part of the research done by HEPHAISTOS since a large part of our methods can only be validated experimentally (both for our numerical experiments and in robotics). Software developments follow various directions:

1. interval arithmetic: although we do not plan to work in this very specialized area (we generally rely on existing packages) interval arithmetic is an important part of our interval analysis algorithms and we may have to modify the existing packages so as to deal, in particular, with multi-precision and arithmetic extensions
2. interval analysis libraries: we daily use the ALIAS library that has been designed in the project and is still under development. A long term work is to develop a generic programming framework that allows for modularity and flexibility, with the objectives of testing new functionalities easily and building specific solvers by a simple juxtaposition of existing modules
3. interface to interval analysis: in our opinion interval analysis software must be available within general purpose scientific software (such as `Maple`, `Mathematica`) and not only as a stand-alone tool. Indeed most end-users are reluctant to learn a new programming language just to solve problems that are only small elements of a more general problem. Furthermore interval analysis efficiency may benefit from the functionalities available in the general purpose scientific software.

5.2. Interval analysis libraries

5.2.1. ALIAS

Participants: Jean-Pierre Merlet [correspondant], Odile Pourtallier.

The `ALIAS` library (*Algorithms Library of Interval Analysis for Systems*), whose development started in 1998, is a collection of procedures based on interval analysis for systems solving and optimization.

`ALIAS` is made of two parts:

- `ALIAS-C++`: the C++ library (87 000 code lines) which is the core of the algorithms
- `ALIAS-Maple`: the `Maple` interface for `ALIAS-C++` (55 000 code lines). This interface allows one to specify a solving problem within `Maple` and get the results within the same `Maple` session. The role of this interface is not only to generate the C++ code automatically, but also to perform an analysis of the problem in order to improve the efficiency of the solver. Furthermore, a distributed implementation of the algorithms is available directly within the interface.

Although these libraries are intended to be used within the project-team they can be freely downloaded as a library file (but the user may introduce its own code in several part of the package) and has been used for example at LIRMM and IRCCyN.

5.3. Platforms

A large number of teams at Inria are developing hardware platforms whose development is quite different from pure software. In our case we have several of such platforms:

- *instrumented flat*: HEPHAISTOS benefits from its own experimental workplace with a simulated flat that includes all the basic home elements (kitchen, bedroom, toilets, relaxation and rehabilitation area) [0]

[0] see http://www-sop.inria.fr/hephaistos/prototypes/main.html

- *walking aids family* ANG: ANG-light (for walking analysis), ANG-II (a fully motorized rollator) and ANG-med (with adjustable friction brakes in the rear wheels).
- *cable-driven parallel robots family* MARIONET: MARIONET-ASSIST for transfer and manipulation, MARIONET-REHAB for rehabilitation purposes, MARIONET-VR for rehabilitation and training in an immersive room, MARIONET-SCHOOL for dissemination
- *miscellaneous robots and sensors*: mobile robots (Roomba, Wanny, PoBots), a motion base supporting up to 250 kg, a motion capture system with 12 cameras, force plates ...

LAGADIC Project-Team

5. New Software and Platforms

5.1. ViSP: a visual servoing and tracking software library

Participants: Fabien Spindler [correspondant], Aurélien Yol, Eric Marchand, François Chaumette.

Since 2005, we develop and release under the terms of the GPLv2 license, ViSP, an open source library available from http://team.inria.fr/lagadic/visp. It allows fast prototyping of visual tracking and visual servoing tasks. ViSP was designed to be independent with 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...), 3D model-based tracking of known objects or template tracking. Simulation capabilities are also available. ViSP and its full functionalities are presented in Fig. 1 and described in [5].

This year, we continued our efforts to improve the software by ensuring the compatibility with third-party libraries that evolves a lot like CMake 3.0.0 and OpenCV 3.0.0 and by enlarging the compatibility with exotic platforms like RaspberryPi. We also fixed some issues, allowed the model-based tracker to consider circles. We introduced new bar code and face detection but also tracking capabilities. Moreover, we completely re-factored the capabilities concerning keypoint detection and matching. We improved the documentation by providing new tutorials covering the main capabilities of the software. A new release was produced in February. The source code tarball was downloaded 1000 times. With the help of the community, this release was packaged for Debian and Ubuntu 14.04. A new release is in preparation.

Concerning ROS community, all the existing packages in "`vision_visp`" ROS stack (see http://wiki.ros.org/vision_visp) were updated and ported to indigo build system. To ease ViSP usage in the ROS framework, the last release was packaged for ROS.

ViSP is used in research labs in France, USA, Japan, Korea, India, China, Lebanon, Italy, Spain, Portugal, Hungary, Canada. For instance, it is used as a support in graduate courses at IFMA Clermont-Ferrand, University of Picardie in Amiens, Télécom Physique in Strasbourg and ESIR in Rennes.

5.2. DESlam software

Participant: Patrick Rives [correspondant].

The DESlam (Dense Egocentric Slam) software developed in collaboration with Andrew Comport from I3S in Sophia Antipolis was registered to the APP ("Agence de Protection des Programmes") (IDDN.FR.001.320001.000.S.P.2012.000.21000). 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.

5.3. HandiViz software

Participants: Marie Babel [correspondant], François Pasteau.

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.

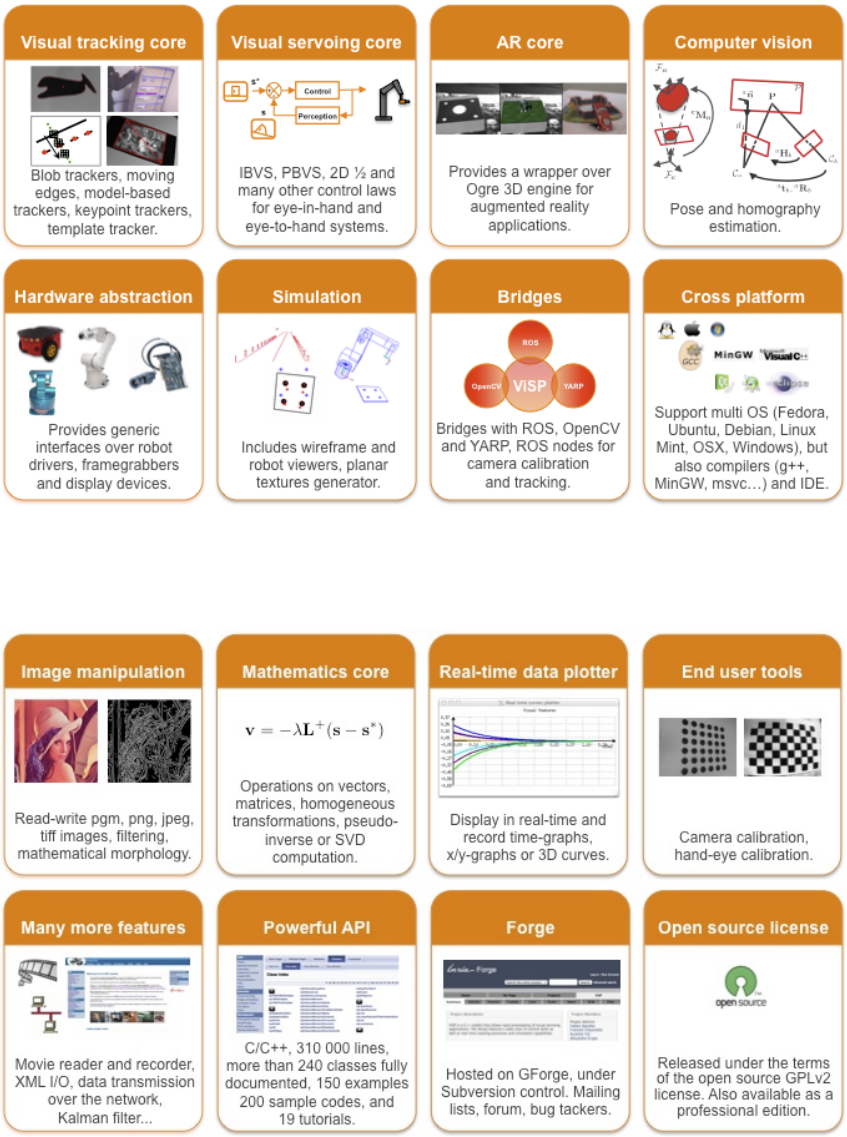


Figure 1. This figure highlights ViSP main capabilities for visual tracking, visual servoing, and augmented reality that may benefit from computer vision algorithms. ViSP allows controlling specific platforms through hardware abstraction or in simulation. ViSP provides also bridges over other frameworks 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 Inria's forge as an open source software under GPLv2 license.

5.4. Platforms

5.4.1. Robot vision platforms

Participant: Fabien Spindler [correspondant].

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 Gantry robot with six degrees of freedom, the other one is a cylindrical robot with four degrees of freedom (see Fig. 2). These robots are equipped with cameras. The Gantry robot allows also to embed grippers on its end-effector.

Seven papers published by Lagadic in 2014 enclose results validated on this platform [12], [18], [21], [24], [47], [51], [52].

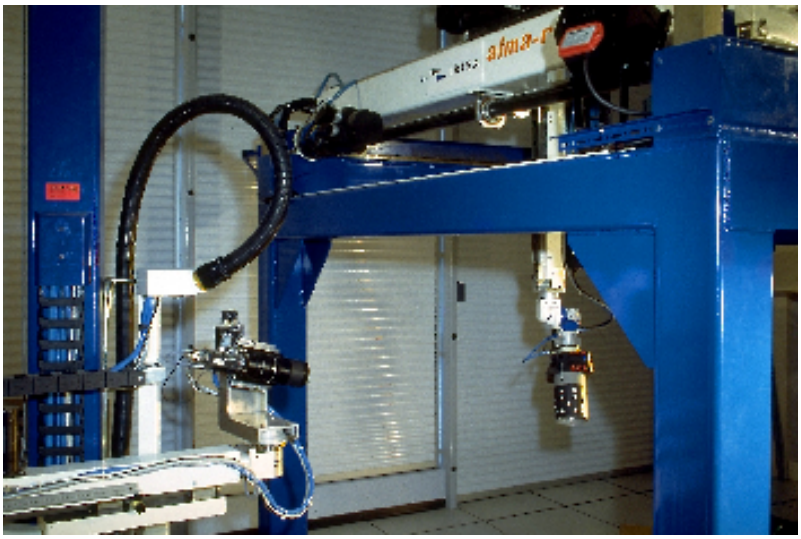


Figure 2. Lagadic robotics platforms for vision-based manipulation

5.4.2. Mobile robotics platforms

Participants: Fabien Spindler [correspondant], Erwan Demairy, Marie Babel, Patrick Rives.

5.4.2.1. 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 Robotino from Festo (see Fig. 3 .b) and Pioneer 3DX from Adept (see Fig. 3 .c). 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 6.2.1), we have in Rennes a six wheel electric wheelchair from Penny and Giles Drives Technology (see Fig. 3 .d) and a five wheel electric wheelchair from You-Q (see Fig. 3 .e). 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 eleven ultrasound sensors to perform the required servoing for assisting handicapped people.

Note that eleven papers exploiting the indoors mobile robots were published this year [16], [29], [30], [31], [33], [37], [43], [41], [42], [56], [58].

5.4.2.2. Outdoor mobile robots

The team exploits also Cycab urban electrical cars (see Figs. 3 .f and 3 .g). Two vehicles in Sophia Antipolis and one in Rennes are instrumented with cameras and range finders to validate researches in the domain of intelligent urban vehicle. Cycabs were used as experimental testbeds in several national projects.

Two papers published by Lagadic in 2014 enclose experimental results obtained with these outdoor mobile robots [11], [14].

5.4.2.3. Technological Development Action (ADT) P2N

The ADT P2N aims at sharing existing and in development codes between the Lagadic and E-Motion teams in the field of autonomous navigation of indoor robots. These codes are also used in the platforms involved in the large-scale initiative action PAL (Personnally Assisted Living, see Section 8.2.6).

This year, the most notable activities for this ADT have been to:

- make the Slam module developed by Lagadic usable by the E-Motion navigation module;
- port the code on the wheelchairs used in PAL;
- develop the core architecture running under ROS supporting the different sensors and platforms available in Sophia-Antipolis.
- demonstrate the social based navigation methods on the Hannibal platform (see Section 6.2.3)

5.4.3. Medical robotics platforms

Participants: Fabien Spindler [correspondant], Alexandre Krupa.

This testbed is of primary interest for researches and experiments concerning ultrasound visual servoing applied to probe positioning, soft tissue tracking or robotic needle insertion tasks described in Section 6.5 .

This platform is composed by two Adept Viper six degrees of freedom arms (see Fig. 4 .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.

We designed an experimental setup to test an autonomous robotic needle insertion method based on visual servoing 6.5.3 . The experimental setup is composed with a gelatin phantom simulating soft tissues, a flexible biopsy needle actuated by an Adept Viper arm and a 3D ultrasound probe held by the second Adept Viper arm (see Fig. 4 .b).

This year, six papers enclose experimental results obtained with this platform [13], [34], [35], [48], [49], [50].

5.4.4. Humanoid robot

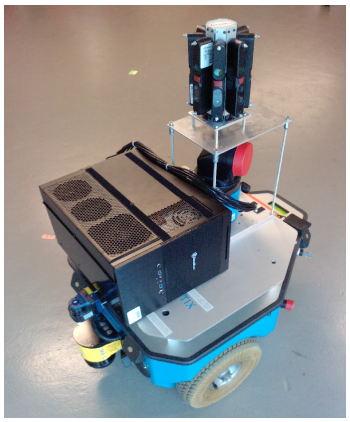
Participants: Giovanni Claudio, Fabien Spindler [correspondant].

Romeo is a humanoid robot from Aldebaran Robotics which is intended to be a genuine personal assistant and companion. In September, we were the first of the four European research laboratories that acquire a Romeo. For the moment only the upper part of the body (arms, head) is working. This research platform is now being used to validate our researches. We developed a first demonstration that make use of visual servoing and visual tracking approaches developed in the team to grasp a box and deliver it to a human (see Fig. 5).

5.4.5. Unmanned Aerial Vehicles (UAVs)

Participants: Fabrizio Schiano, Paolo Robuffo Giordano.

In 2014 the team also started some activities involving perception and control for single and multiple quadrotor UAVs, especially thanks to a grant from “Rennes Métropole” (see Section 8.1.4). To this end, we purchased two quadrotors from Mikrokopter Gmbh, Germany (Fig. 6 .a), and one quadrotor from 3DRobotics, USA (Fig. 6 .b). These quadrotors will be 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.



(a)

(b)

(c)

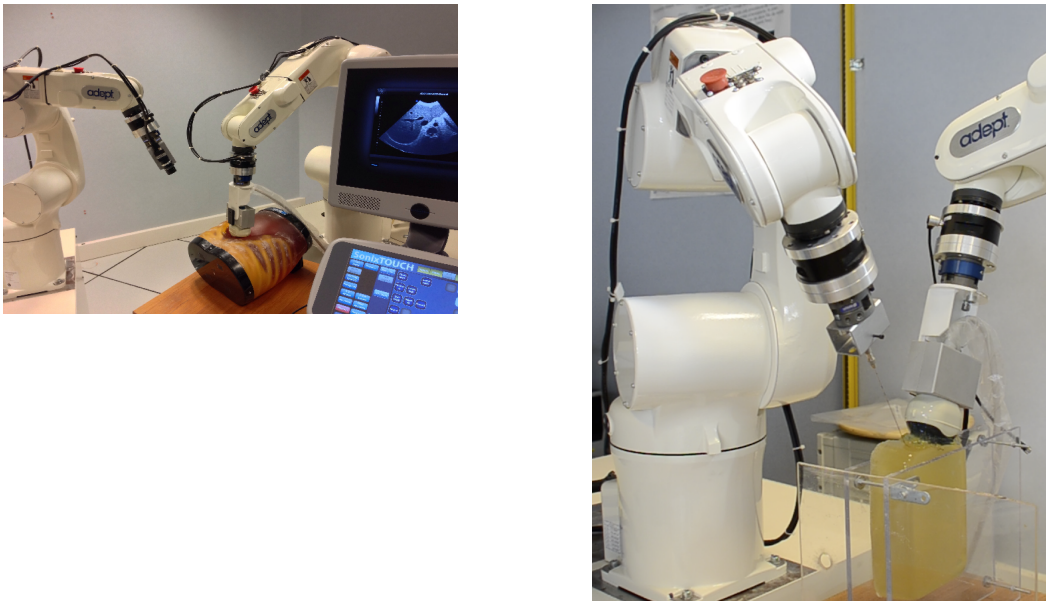
(d)

(e)

(f)

(g)

Figure 3. a) Hannibal platform, b) Robotino, c) Pioneer P3-DX robot, d) wheelchair from Penny and Giles Drives Technology, e) wheelchair from You-Q , f) Cycab available in Rennes, g) one of the Cycabs available in Sophia Antipolis.



(a) (b)

Figure 4. a) Lagadic medical robotics 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.

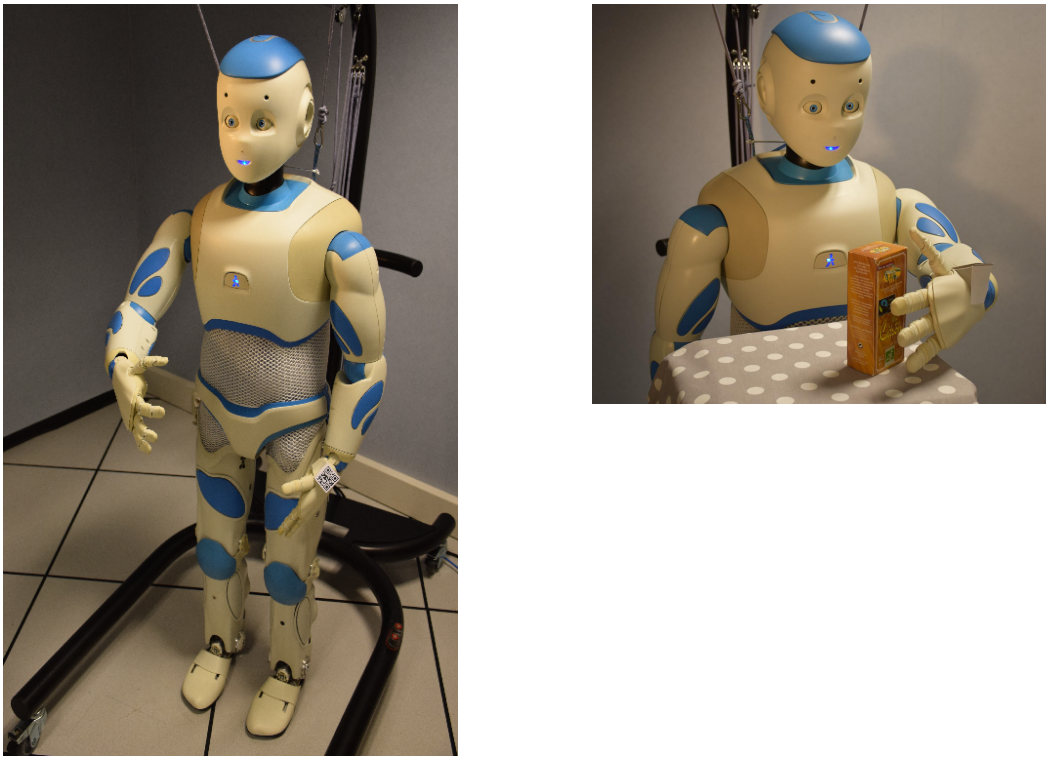


Figure 5. Romeo experimental platform.

(a) (b)

Figure 6. a) Quadrotor XL1 from Mikrokopter, b) Quadrotor Iris from 3DRobotics

RITS Team

5. New Software and Platforms

5.1. New Software

The following software items have been submitted very recently to the APP; some already have IDDN references. Some of these are under improvement and other have already been transferred to industrial partners.

- **SODA**: This software has been developed in the context of the French ABV [0] project. This package contains the functions that are necessary to automate the vehicle navigation in its secured lane. This software has been purchased by a private partner (Valeo Group) aiming at developing its own automated vehicle.
- **MELOSYM**: this is the latest laser based Hierarchical ML-SLAM algorithm developed by RITS. It contains all the functions needed to perform the vehicle localization and the mapping of the environment. Windows compatible, it was initially developed under the ^{RT}MAPS platform but the version includes a standalone version. This software has been evaluated by a private partner aiming at developing its own automated vehicle for indoor applications. It is currently evaluated by another private partner aiming at implementing our solution on its outdoor automated shuttles.
- **STEREOLOC**: this is the package performing stereovision based localization and mapping. It performs semi-dense mapping of outdoor large environments and provides real-time estimates of the vehicle position. The software was tested and validated using ^{RT}MAPS like databases as well as the KITTI benchmark.

5.1.1. DOLAR

This software performs real-time obstacle detection and tracking using laser data scanned with one or several laser sensors with different geometric configurations. Obstacle detection is based on laser data segmentation while obstacle tracking uses PHD-based filtering techniques. The software is currently evaluated by a private partner aiming at implementing our solution on its outdoor automated unmanned vehicles.

5.1.2. FEMOT

FEMOT (Fuzzy Embedded MOTor) is an experimental motor for implementing fuzzy logic controllers, including all the fuzzy stages (fuzzification, inference, and defuzzification). This library has been compiled in Microsoft Visual (MVS) Studio and RTMaps. The proposed library is modular and adaptable to different situations and scenarios, especially for autonomous driving applications. FEMOT allows the development of the fuzzy rules to be written as sentences in an almost natural language. It allows the user to define variables and their fuzzy rules and to join them with other variables in rules to yield crisp signals for the controllers. The APP deposit was delivered May 2014. The Properties defined in FEMOT shows the number of inputs, outputs and fuzzy rules that the controller needs.
This software is used for the arbitration and control for fully automated functions. The behaviour of a human driver can be emulated with this technique. First simulations are showing promising results, and the library allows an easy adaptation in decision marking situations.

5.1.3. V2Provue

It is a software developed for the Vehicle-to-Pedestrian (V2P) communications, risk calculation, and alarming pedestrians of collision risk [34]. This software is made of an Android application dedicated to pedestrians and RtMaps modules for the vehicles.

[0] Automatisation Basse Vitesse

On the pedestrian side, the application is relying on GPS data to localize the user and Wi-Fi communications are used to receive messages about close vehicles and send information about the pedestrian positioning. Besides, a service has been developed to evaluate the collision risk with the vehicles near the pedestrian and an HMI based on OpenStreetMap displays all the useful information such as pedestrian and vehicles localization and, collision risk.

On the vehicle side, RtMaps modules allowing V2X communications have been developed. These modules contain features such as TCP/UDP socket transmissions, broadcast, multicast, unicast communications, routing, forwarding algorithms, and application specific modules. In the V2ProVu software, a particular application module has been implemented to create data packets containing information about the vehicle state (position, speed, yaw rate,...) and the V2X communication stack is used to broadcast these packets towards pedestrians. Moreover, the V2proVu application can also receive data from pedestrians and create objects structures that can be shared with the vehicle perception tools.

AYIN Team (section vide)

LEAR Project-Team

5. New Software and Platforms

5.1. Yael library

Participants: Matthijs Douze [correspondant], Herve Jegou [TEXMEX Team Inria Rennes].

Yael [14] is a library with Matlab and Python bindings providing optimized (multi-threaded, Blas/Lapack, low level optimization) implementations of functions useful in vision and machine learning such as k-means, GMM, exact nearest neighbor search and Fisher vector computation.

In 2014, it was extended to include a generic inverted file implementation, that can accomodate any type of signature that refines the similarity computation between documents. The Fisher vector computation code was also optimized.

5.2. SPArse Modeling Software (SPAMS)

Participants: Julien Mairal [correspondant], Yuansi Chen, Zaid Harchaoui.

SPAMS v2.5 was released as open-source software in May 2014 (v1.0 was released in September 2009). It is an optimization toolbox implementing algorithms to address various machine learning and signal processing problems involving

- Dictionary learning and matrix factorization (NMF, sparse PCA, ...);
- Solving medium-scale sparse decomposition problems with LARS, coordinate descent, OMP, SOMP, proximal methods;
- Solving large-scale sparse estimation problems with stochastic optimization;
- Solving structured sparse decomposition problems (sparse group lasso, tree-structured regularization, structured sparsity with overlapping groups,...).

The software and its documentation are available at http://spams-devel.gforge.inria.fr/.

This year, we added new functionalities to the toolbox. The implementation of archetypal analysis corresponding to the paper [9] was added.

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

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

FlipFlop is an open-source software, implementing a fast method for de novo transcript discovery and abundance estimation from RNA-Seq data [4]. It differs from classical approaches such as Cufflinks by simultaneously performing the identification and quantitation tasks using a penalized maximum likelihood approach, which leads to improved precision/recall. Other software taking this approach have an exponential complexity in the number of exons of a gene. We use a novel algorithm based on network flow formalism, which gives us a polynomial runtime. In practice, FlipFlop was shown to outperform penalized maximum likelihood based softwares in terms of speed and to perform transcript discovery in less than 1/2 second for large genes.

FlipFlop 1.4.1 is a user friendly bioconductor R package, which was released in October 2014. It is freely available on the Bioconductor website under a GPL licence: http://bioconductor.org/packages/release/bioc/html/flipflop.html.

5.4. DeepFlow

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

We developed a package for the “deep flow” algorithm. “Deep flow” combines a standard variational framework with a our new matching algorithm “deep matching”. The code for “deep matching” is in python and the code for “deep flow” in C. Both of them are available on-line at http://lear.inrialpes.fr/src/deepmatching. Note that the run time is a few seconds per images pair, which is less than for most other methods. The latest release was published in March 2014.

5.5. Mixing Body-Part Sequences for Human Pose Estimation

Participants: Cherian Anoop, Mairal Julien, Alahari Karteek, Schmid Cordelia.

The code corresponding to the publication [11] has been released as an open-source MATLAB package along with a dataset for human pose estimation in videos called “Poses in the Wild”. It is available at http://lear.inrialpes.fr/research/posesinthewild/#dataset. This dataset has 30 video sequences generated from three Hollywood movies, namely “Forrest Gump”, “The Terminal”, and “Cast Away”. Each sequence has approximately 30 frames and is manually annotated for human upper-body keypoints, namely (i) neck, (ii) left and right shoulders, (iii) left and right elbows, (iv) left and right wrists, and (v) mid-torso. In comparison to earlier evaluation datasets publicly available for this problem, Poses in the Wild is significantly more representative of real-world scenarios with background clutter, body-part occlusions, and severe camera motion.

5.6. Image Transformation Pursuit

Participants: Mattis Paulin, Jerome Revaud, Zaid Harchaoui, Florent Perronnin [XRCE], Cordelia Schmid.

This is an open-source software package corresponding to the papers [19], [23], available here http://lear.inrialpes.fr/people/paulin/projects/ITP/. The code has three main purposes. Starting from input images, it can be used to generate transformed versions to use as "virtual examples". It implements the main algorithm of the article (ITP), performing an automatic selection of a small set of transformations in order to improve classification performance. Lastly, it provides a complete classification framework, allowing to train and test a classifier on an image dataset.

5.7. Convolutional Kernel Networks

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

This is an open-source software package corresponding to the paper [16], available at http://ckn.gforge.inria.fr/. In this software package, convolutional neural networks are learned in an unsupervised manner. We control what the non-linearities of the network are really doing: the network tries to approximate the kernel map of a reproducing kernel.

5.8. EpicFlow

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

We developed a package for the EpicFlow method [29]. EpicFlow computes a dense correspondence field by performing a sparse-to-dense interpolation from an initial sparse set of matches, leveraging contour cues using an edge-aware geodesic distance. The resulting dense correspondence field is fed as an initial optical flow estimate to a one-level variational energy minimization. The code is written in C/C++ and is available at http://lear.inrialpes.fr/src/epicflow.

LINKMEDIA Project-Team

5. New Software and Platforms

5.1. Software

5.1.1. News and updates

5.1.1.1. Peyote

Participants: Sébastien Campion, Hervé Jégou [correspondent].

Peyote is a framework for Video and Image description, indexation and nearest neighbor search. It can be used as-is by a video-search or image-search front-end with the implemented descriptors and search modules. It can also be used via scripting for large-scale experimentation. Finally, it is modular and as such can be used for scientific experimentation on new descriptors or indexation methods. Peyote is used in the AABOT software and was used for the Mediaeval Placing task and the Trecvid Instance Search task.

Peyote is used by Lamark, a start-up that is currently being incubating at Inria Rennes.

Last APP deposit: IDDN.FR.001.420008.001.S.A.2012.000.21000.

5.1.1.2. Yael

Participant: Hervé Jégou [correspondent].

This software is jointly maintained by Matthijs Douze, from Inria Grenoble.

Yael [30] is a C/python/Matlab library providing implementations of computationally demanding functions. In particular, the library provides very optimized functions for k-means clustering and exact nearest neighbor search. It is maintained and continuously improved. This year, we have in particular added a few tutorials implementing two simple image search systems, see http://yael.gforge.inria.fr/tutorial/tuto_imgindexing.html.

The current release (v401) was registered at APP under no IDDN.FR.001.220014.002.S.P.2010.000.10000 on July 2014.

5.2. The A||GO web services

Participants: Sébastien Campion [correspondent], Guillaume Gravier.

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. The engineer hired by SED in October 2013 developed several new features that enable software providers to deploy autonomously their algorithm. Dedicated hardware equipment was also purchased in 2014, composed by a main server with 1.3 TB of storage and 3 nodes for computing task and setup, and will be available in 2015. In addition to a strong involvement in the development of the platform, LINKMEDIA contributed several services.

5.3. Experimental platform

Participant: Sébastien Campion [correspondent].

Our experimental platform, consisting of dedicated equipments to experiment on very large collections of multimedia data, was upgraded in 2014. In order to replace old hardware, we acquired 380 TB of additional disk space. Divided in two categories, the first part (140 TB) must replace in 2015 our current network area storage where datasets are stored. The second part (240 TB) is dedicated to a distributed storage filesystem (CEPH), used to store our experimental results with high IO performances for use with the mesocluster IGRIDA.

MAGRIT Project-Team

5. New Software and Platforms

5.1. Ralib

Our research efforts are integrated in a library called RAlib which contains our research development on image processing, registration (2D and 3D) and visualization. This library is licensed by the APP (French agency for software protection). The library was extended over the period to integrate our new research code on tongue modeling and tracking. Several applications either used internally or to demonstrate our work have been designed with this library.

5.2. PoLAR

The visualization module in RAlib has now reached a level of maturity where we believe it could be proposed to a wider audience. In the context of the ADT PoLAR (which started on October, 1st), a software engineer, Pierre-Jean Petitprez, started working on a new library called PoLAR (Portable Library for Augmented Reality). So far, the code has been cleanly made independent from our other code in RAlib, and in the process of being ported to up-to-date versions of the supporting libraries: OpenSceneGraph 3.2 and Qt5.

5.3. Ltrack

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

MORPHEO Project-Team

5. New Software and Platforms

5.1. Software packages

5.1.1. Shape Tracking

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

5.1.2. LucyViewer

Lucy Viewer http://4drepository.inrialpes.fr/lucy_viewer/ is an interactive viewing software for 4D models, i.e, dynamic three-dimensional scenes that evolve over time. Each 4D model is a sequence of meshes with associated texture information, in terms of images captured from multiple cameras at each frame. Such data is available from various websites over the world including the 4D repository website hosted by Inria Grenoble http://4drepository.inrialpes.fr/. The software was developed in the context of the European project iGlance, it is available as an open source software under the GNU LGP Licence.

5.1.3. Ethomice

Ethomice http://morpheo.inrialpes.fr/people/reveret/ethomice/ is a motion analysis software to characterize motor behavior of small vertebrates such as mice or rats. From a multiple views video input, a biomechanical model of the skeleton is registered. Study on animal model is the first important step in Biology and Clinical research. In this context, the analysis of the neuro-motor behaviour is a frequent cue to test the effect of a gene or a drug. Ethomice is a platform for simulation and analysis of the small laboratory animal, such as rat or mouse. This platform links the internal skeletal structure with 3D measurements of the external appearance of the animal under study. From a stream of multiple views video, the platform aims at delivering a three dimensional analysis of the body posture and the behaviour of the animal. The software was developed by Lionel Reveret and Estelle Duveau. An official APP repository has been issued this year.

5.2. Databases

5.2.1. 4D repository (http://4drepository.inrialpes.fr/)

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

5.3. Platforms

5.3.1. Platform Grimage

The Grimage platform is an experimental multi-camera platform dedicated to spatio-temporal modeling including immersive and interactive applications. It hosts a multiple-camera system connected to a PC cluster, as well as visualization facilities including head mounted displays. This platform is shared by several research groups, most proeminently Moais, Morpheo and Perception. In particular, Grimage allows challenging real-time immersive applications based on computer vision and interactions between real and virtual objects, Figure 1 . Note that the Grimage platform, while still active in 2014, is now replaced by the Kinovis platform that exhibit a larger acquisition space and better acquisition facilities.

Figure 1. Platform: the Grimage acquisition.

5.3.2. Platform Kinovis

Kinovis (http://kinovis.inrialpes.fr/) is a new multi-camera acquisition project that was was selected within the call for proposals "Equipements d'Excellence" of the program "Investissement d'Avenir´´ funded by the French government. The project involves 2 institutes: the Inria Grenoble Rhône-Alpes, the université Joseph Fourier and 4 laboratories: the LJK(laboratoire Jean Kuntzmann - applied mathematics), the LIG (laboratoire d'informatique de Grenoble - Computer Science), the Gipsa lab (Signal, Speech and Image processing) and the LADAF (Grenoble Hospitals - Anatomy). The Kinovis environment will be composed of 2 complementary platforms. A first platform located at the Inria Grenoble will have a 10mx10m acquisition surface and will be equipped with 60 cameras. It is the evolution of the Grimage platform previously described towards the production of better models of more complex dynamic scenes. A second platforms located at Grenoble Hospitals, within the LADAF anatomy laboratory, will be equipped with both color and X-ray cameras to enable combined analysis of internal and external shape structures, typically skeleton and bodies of animals. Installation works of both platforms started in 2013 and are now finished. Members of Morpheo are highly involved in this project. Edmond Boyer is coordinating this project and Lionel Reveret is in charge of the LADAF platform. Thomas Pasquier and Julien Pansiot are managing the technical resources of both platforms.

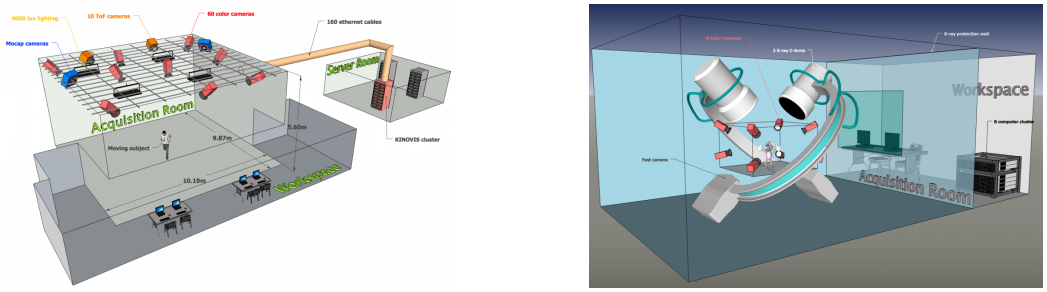


Figure 2. Kinovis platforms: on the left the Inria platform; on the right Grenoble Hospital platform.

5.3.3. Multicamera platform for video analysis of mice behavior

This project is a follow-up of the experimental set-up developed for a CNES project with Mathieu Beraneck from the CESeM laboratory (centre for the study of sensorimotor control, CNRS UMR 8194) at the Paris-

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

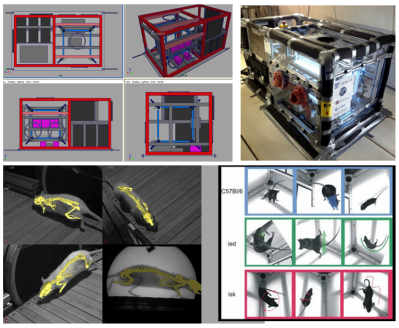


Figure 3. Ethomice: Experimental platform for video analysis of mice behavior.

PERCEPTION Project-Team

4. New Software and Platforms

4.1. The MIXCAM Hardware/Software Platform

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

Website: https://team.inria.fr/perception/mixcam-lab/

Figure 2. The MIXCAM laboratory is a multiple-camera multiple-PC hardware/software platform that combines high-resolution color (RGB) cameras with low-resolution time-of-flight (TOF) cameras. The cameras are arranged in "units", where each unit is composed of two RGB cameras and one TOF camera (left image). Currently the system is composed of four such units (right image), or a total of eight RGB and four TOF cameras. Over years, in collaboration with 4D View Solutions, we have developed and maintained software packages for camera, multiple-camera, and cross-modal calibration, 3D reconstruction, multiple-camera stereo, TOF-stereo fusion, and image-based rendering.

4.2. Audiovisual Robots and Heads

We have developed two audiovisual (AV) robot heads: the POPEYE head and the NAO stereo head. Both are equipped with a binocular vision system and with four microphones. The software modules comprise stereo matching and reconstruction, sound-source localization and audio-visual fusion. POPEYE has been developed within the European project POP (https://team.inria.fr/perception/pop/) in collaboration with the project-team MISTIS and with two other POP partners: the Speech and Hearing group of the University of Sheffield and the Institute for Systems and Robotics of the University of Coimbra. The NAO stereo head

was developed under the European project HUMAVIPS (http://humavips.inrialpes.fr) in collaboration with Aldebaran Robotics (which manufactures the humanoid robot NAO) and with the University of Bielefeld, the Czech Technical Institute, and IDIAP. The software modules that we develop are compatible with both these robot heads [33].

For more information on POPEYE and on NAO please visit https://team.inria.fr/perception/popeye/ and https://team.inria.fr/perception/nao/.

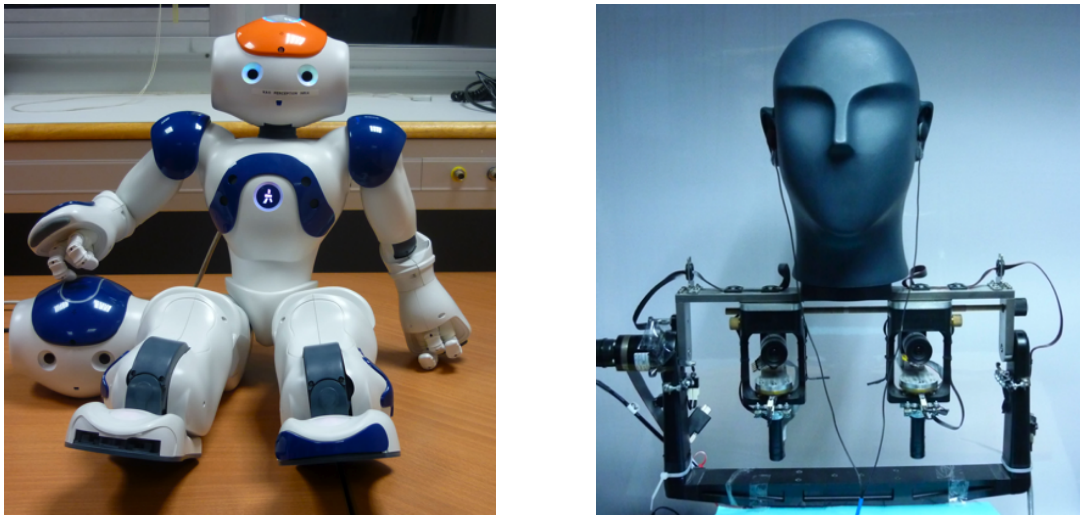


Figure 3. Left: The consumer humanoid robot NAO is equipped with a binocular-binaural head specially designed for human-humanoid interaction; Right: The binocular-binaural robot head POPEYE equipped with a four degrees of freedom stereo camera pair and with an acoustic dummy head.

PRIMA Project-Team

4. New Software and Platforms

4.1. OMiSCID Middleware for Distributed Multimodal Perception

Participants: Amaury Negre, Patrick Reignier, Dominique Vaufreydaz [correspondant].

Middleware, Distributed perceptual systems

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

OMiSCID has been designed to be easy to learn in order to stimulate software reuse in research teams and is revealing to have a high adoption rate. To maximize this adoption and have it usable in projects involving external partners, the OMiSCID middleware has been released under an open source licence. To maximize its target audience, OMiSCID is available from a wide variety of programming languages: C++, Java, Python and Matlab. A website containing information and documentations about OMiSCID has been set up to improve the visibility and promote the use of this middleware.

4.2. Pal Middleware

Participants: Amaury Negre, Dominique Vaufreydaz [correspondant].

Middleware, Distributed perceptual systems, Robotic Operating System (ROS), IPL PAL

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

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

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

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

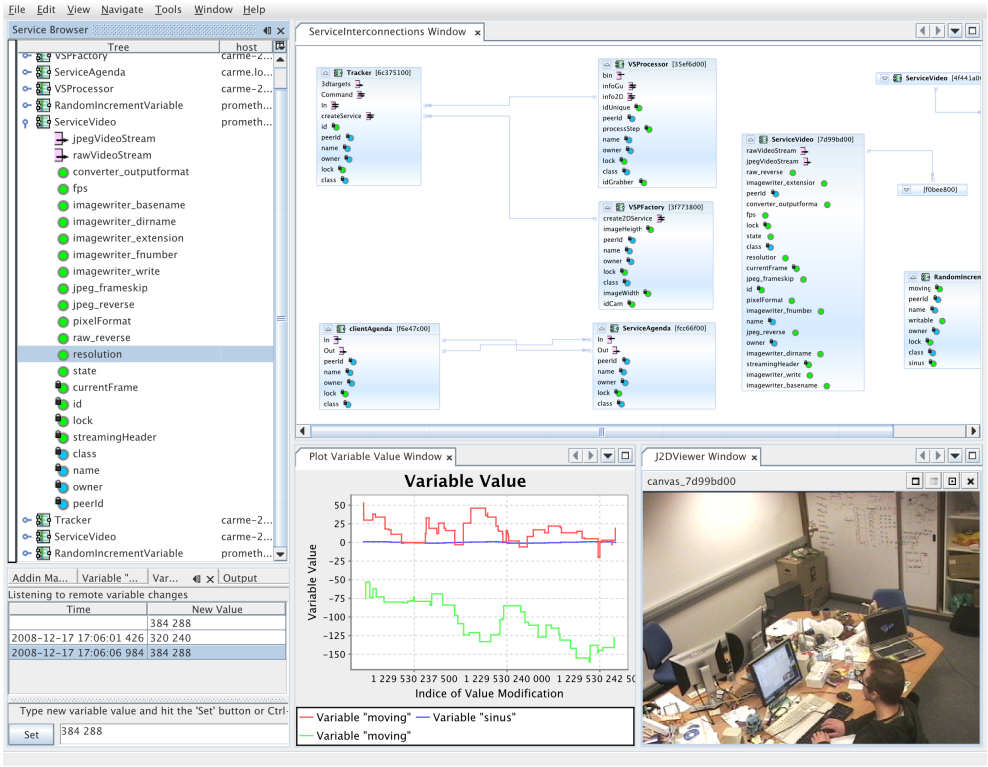


Figure 2. OMiSCID GUI showing a list of running services and some modules for service interconnections, variable plotting, live video stream display and variable control

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

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

4.3. EmoPRAMAD

Participant: Dominique Vaufreydaz [correspondant].

Affective computing,

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

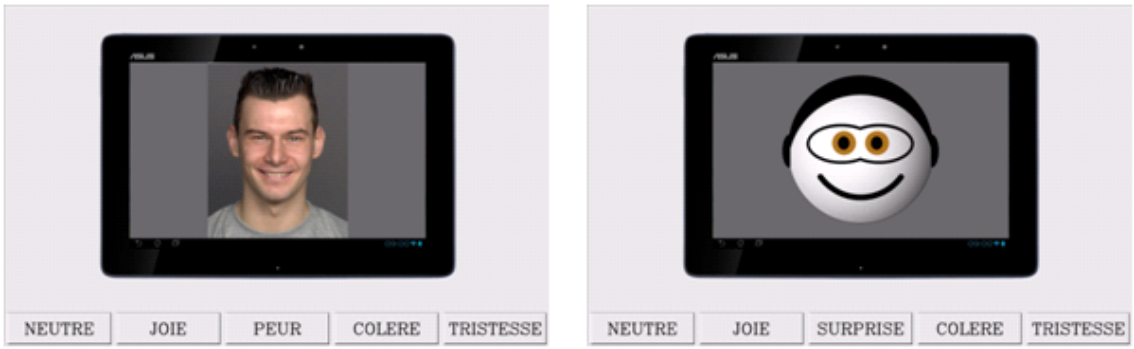


Figure 3. EmoPRAMAD interfaces with a human face and a 3D face from our virtual agent.

The evaluation conducted though EmoPRAMAD concerns both unimodal (facial only) and bimodal conditions (facial/sound). The emotions set is composed of 4 basic emotions (joy, fear, anger, sadness) and a neutral state. While experimenting, the software collects several parameters in order to evaluate more than correctness of the answers: time to respond, length of mouse moves, etc. Experimentation is still in progress at Inria in Grenoble, University Pierre and Marie Currie and Broca Hospital in Paris. A set of 235 participants from 14 to 88 years old was already recorded.

4.4. Detection and Tracking of Pedestrians in INRETS Intelligent Urban Spaces Platform

Participants: Claudine Combe, James Crowley [correspondant], Lukas Rummelhard.

Visual detection and tracking of pedestrians, Intelligent Urban Space

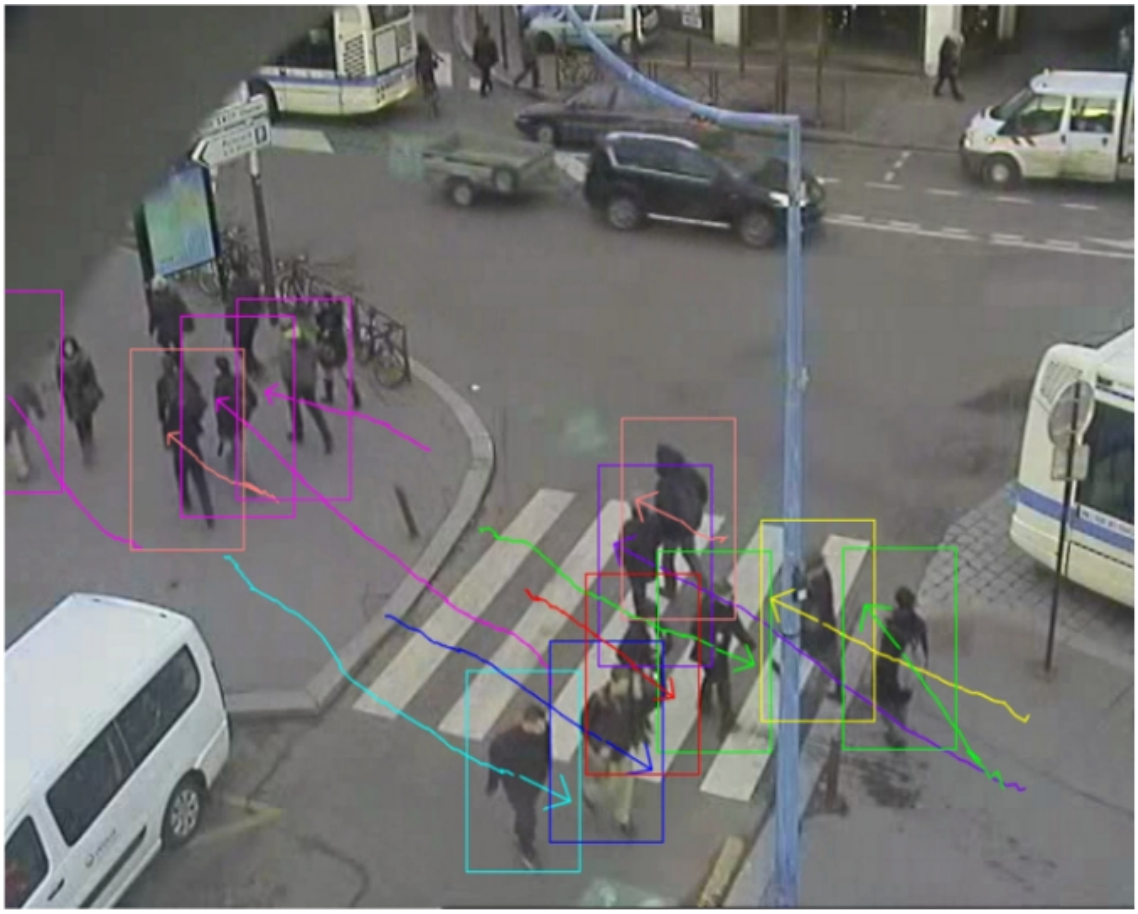


Figure 4. Cipebus: pedestrian tracking system.

The project ANR-07-TSFA-009-01 CIPEBUS ("Carrefour Intelligent - Pole d'Echange - Bus) has been proposed by INRETS-IFSTTAR, in collaboration with Inria, Citilog, Fareco, and the city of Versaille. The Objective of the CIPEBUS project is to develop an experimental platform for observing activity in a network of urban streets in order to experiment with techniques for optimizing circulation by context aware control of traffic lights.

Within CipeBus, Inria has developed a real time multi-camera computer vision system to detect and track people using a network of surveillance cameras. The CipeBus combines real time pedestrian detection with 2D and 3D Bayesian tracking to record the current position and trajectory of pedestrians in an urban environment under natural view conditions. The system extends the sliding window approach to use a half-octave Gaussian Pyramid to explore hypotheses of pedestrians at different positions and scales. A cascade classifier is used to determine the probability that a pedestrian can be found at a particular position and scale. Detected pedestrians are then tracked using a particle filter.

The resulting software system has been installed and tested at the INRETS CipeBus platform and is currently used for experiments in controlling the traffic lights to optimize the flow of pedertrians and public transportation while minimizing the delay imposed on private automobiles.

4.5. Multisensor observation of human activity for integrated energy and comfort management

Participants: Claudine Combe, James Crowley [correspondant], Lucas Nacsa, Amaury Negre, Lukas Rummelhard.

multimodal tracking of human activity

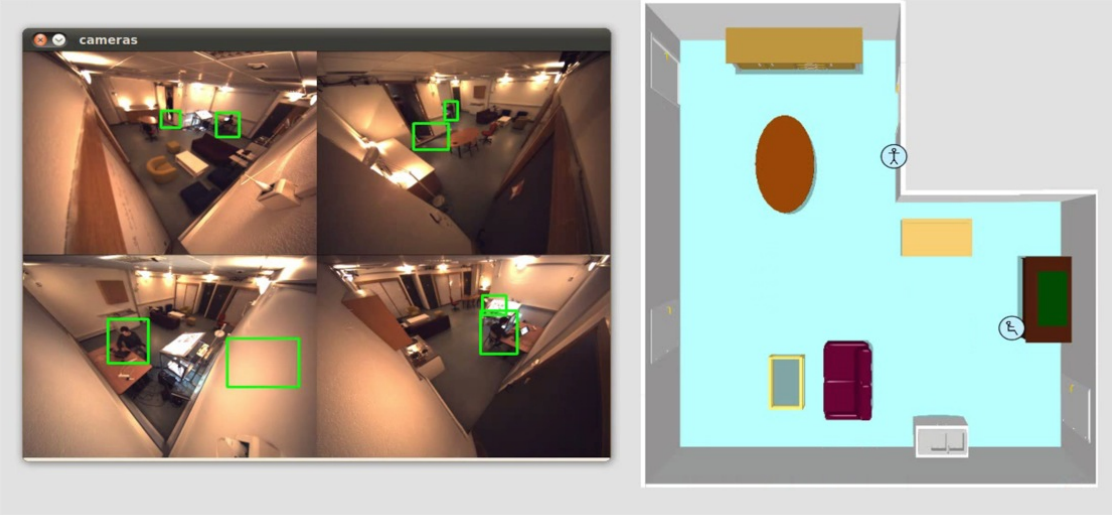


Figure 5. The 3D tracker integrates observations from multiple sensors

As part of Inria's contribution of ICTLabs Action TSES - Smart Energy Systems, we have constructed a system that integrates information from multiple environmental sensor to detect and track people in indoor environments. This system, constructed as part of activity 11831 Open SES Experience Labs for Prosumers and New Services, has been released to ICTLabs partners in June 2012. It has also been used for construction of a smart spaces testbed at Schneider Electric.

This software, named MultiSensor activity tracker, integrates information from multiple environmental sensors to keep track of the location and activity of people in a smart environment. This model is designed to be used by a home energy broker that would work in conjunction with a smart grid to manage the energy consumption of home appliances, balancing the needs of inhabitants with opportunities for savings offered by electricity rates. This database will also be used for by advisor services that will offer advice to inhabitants on the consequences to energy consumption and energy cost that could potentially result from changes to lifestyle or home energy use.

Work in this task draws from earlier result from a number of development projects at Inria. In the ANR Casper project Inria created Bayesian tracking system for human activity using a voxel based occupancy grid. Within the INRA ADT PAL project, Inria is creating methods for plug and play installation of visual and acoustic sensors for tracking human activity within indoor environments.

While a voxel based Bayesian tracker has served well for a number of applications, a number of limitations have been observed. For example, under certain circumstances, the sensor data can provide contradictory or ambiguous data about the location and activities of people. Resolving such cases required the Bayesian tracker to choose between a numbers of competing hypotheses, potentially resulting in errors. Several members of

our group have argued that an alternative integration approach based on the use of a Particle filter would solve these problems and provide a more reliable tracking system. This task has been undertaken to evaluate this hypothesis. The system configured and optimized for detecting and tracking people within rooms using multiple calibrated cameras. The system currently uses corner mounted cartesian cameras, ceiling mounted cameras with wide angle lenses and panoramic cameras placed on tables. Cameras may be connected and disconnected while the component is running, but they must be pre-calibrated to a common room reference frame. We are currently experimenting with techniques for Bayesian estimation of camera parameters for auto-calibration. Cameras may be connected dynamically.

The original system 3DBT has been declared with the APP "Agence pour la Protection des Programmes" under the Interdeposit Digital number IDDN.FR.001.490023.000.S.P.2006.000.10000. A revised declaration for the latest version of the system is currently being prepared.

4.6. Stereo Viewfinder

Participants: Frédéric Devernay [correspondant], Loic Lefort, Elise Mansilla, Sergi Pujades-Rocamora.

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

This software has been filed with the APP "Agence pour la Protection des Programmes" under the Interdeposit Digital number IDDN.FR.001.370083.000.S.P.2007.000.10000

4.7. Visual Emotion Recognition for Health and Well Being.

Participants: James Crowley [correspondant], Varun Jain, Sergi Pujades-Rocamora.

Visual Emotion Recognition

People express and feel emotions with their face. Because the face is the both externally visible and the seat of emotional expression, facial expression of emotion plays a central role in social interaction between humans. Thus visual recognition of emotions from facial expressions is a core enabling technology for any effort to adapt ICT to improve Health and Wellbeing.

Constructing a technology for automatic visual recognition of emotions requires solutions to a number of hard challenges. Emotions are expressed by coordinated temporal activations of 21 different facial muscles assisted by a number of additional muscles. Activations of these muscles are visible through subtle deformations in the surface structure of the face. Unfortunately, this facial structure can be masked by facial markings, makeup, facial hair, glasses and other obstructions. The exact facial geometry, as well as the coordinated expression of muscles is unique to each individual. In additions, these deformations must be observed and measured under a large variety of illumination conditions as well as a variety of observation angles. Thus the visual recognition of emotions from facial expression remains a challenging open problem in computer vision.

Despite the difficulty of this challenge, important progress has been made in the area of automatic recognition of emotions from face expressions. The systematic cataloging of facial muscle groups as facial action units by Ekman [38] has let a number of research groups to develop libraries of techniques for recognizing the elements of the FACS coding system [30]. Unfortunately, experiments with that system have revealed that the system is very sensitive to both illumination and viewing conditions, as well as the difficulty in interpreting the resulting activation levels as emotions. In particular, this approach requires a high-resolution image with a high signal-to-noise ratio obtained under strong ambient illumination. Such restrictions are not compatible with the mobile imaging system used on tablet computers and mobile phones that are the target of this effort.

As an alternative to detecting activation of facial action units by tracking individual face muscles, we propose to measure physiological parameters that underlie emotions with a global approach. Most human emotions can be expressed as trajectories in a three dimensional space whose features are the physiological parameters of Pleasure-Displeasure, Arousal-Passivity and Dominance-Submission. These three physiological parameters can be measured in a variety of manners including on-body accelerometers, prosody, heart-rate, head movement and global face expression.

The PRIMA Group at Inria has developed robust fast algorithms for detection and recognition of human faces suitable for use in embedded visual systems for mobile devices and telephones. The objective of the work described in this report is to employ these techniques to construct a software system for measuring the physiological parameters commonly associated with emotions that can be embedded in mobile computing devices such as cell phones and tablets.

A revised software package has recently been released to our ICTlab partners for face detection, face tracking, gender and age estimation, and orientation estimation, as part of ICTlabs Smart Spaces action line. This software has been declared with the APP "Agence pour la Protection des Programmes" under the Interdeposit Digital number IDDN.FR.001.370003.000.S.P.2007.000.21000.

A software library, named PrimaCV has been designed, debugged and tested, and released to ICTLabs partners for real time image acquisition, robust invariant multi-scale image description, highly optimized face detection, and face tracking. This software has been substantially modified so as to run on an mobile computing device using the Tegra 3 GPU.

4.8. AppsGate - Smart Home Application Gateway

Participants: Alexandre Demeure, James Crowley [correspondant], Emeric Grange, Cedric Gerard, Camille Lenoir, Kouzma Petoukhov.

Smart Home Applications Gateway

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

- Integration of sensors and actuators managed by a variety of protocols, and provision of a uniform abstraction for these devices as component-oriented-services,
- Integration of Web services made available on the cloud by a variety of web service providers, and provision of a uniform abstraction for these services as component-oriented-services,
- Communication between the HMI middleware and client applications - typically, user interfaces for controlling and programming the smart home, that run on high-end devices such as smartphones, tablets, and TVs.

As part of the Appsgate middleware, we have developed SPOK, an End User Development Environment, that enables inhabitants to control and program their smart Homes via a web interface. The current version of SPOK includes an editor for editing programs using a pseudo-natural language and an interpreter. A multi-syntax editor as well as additional services such as a debugger and a simulator are currently under development.

4.9. a SmartEnergy Serious Game

Participant: Patrick Reignier.

This ongoing serious game is the result of a collaboration with Ayesha Kashif (LIG), Stephane Ploix (G-Scop) and Julie Dugdale (LIG). It has been developped as part of the Grenoble INP SmartEnergy project.

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

SIROCCO Project-Team

5. New Software and Platforms

5.1. Visual Fixation Analysis

Participant: Olivier Le Meur [contact person].

From a set of fixation data and a picture, the software called Visual Fixation Analysis extracts from the input data a number of features (fixation duration, saccade length, orientation of saccade...) and computes a human saliency map. The software can also be used to assess the degree of similarity between a ground truth (eye fixation data) and a predicted saliency map. This software is dedicated to people working in cognitive science and computer vision. This software has been registered at the APP (Agence de Protection des Programmes).

5.2. Hierarchical super-resolution based inpainting

Participant: Olivier Le Meur [contact person].

From an input binary mask and a source picture, the software performs an examplar-based inpainting. The method is based on the combination of multiple inpainting applied on a low resolution of the input picture. Once the combination has been done, a single-image super-resolution method is applied to recover the details and the high frequency in the inpainted areas. The developments have been pursued in 2014, in particular by introducing a Poisson blending step in order to improve the visual quality of the inpainted video. This software is dedicated to people working in image processing and post production. This software is being registered at the APP (Agence de Protection des Programmes).

5.3. Salient object extraction

Participants: Zhi Liu, Olivier Le Meur [contact person].

This software detects salient object in an input picture in an automatic manner. The detection is based on super-pixel segmentation and contrast of histogram. This software is dedicated to people working in image processing and post production. This software is being registered at the APP (Agence de Protection des Programmes).

STARS Project-Team

5. New Software and Platforms

5.1. SUP

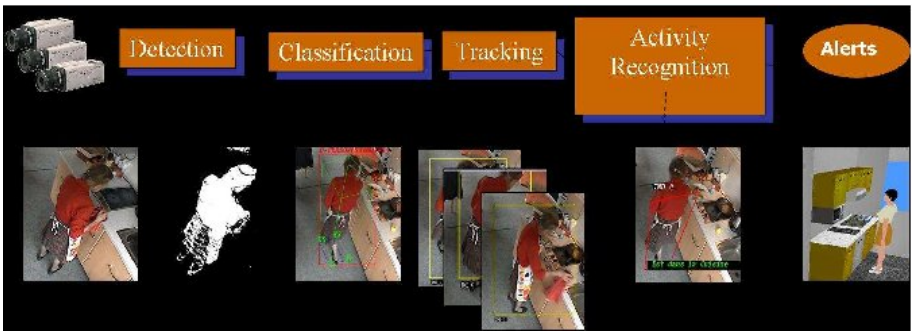


Figure 5. SUP workflow

5.1.1. Presentation

SUP is a Scene Understanding Software Platform (see Figure 5) written in C++ designed for analyzing video content . SUP is able to recognize events such as 'falling', 'walking' of a person. SUP divides the workflow of a video processing into several separated modules, such as acquisition, segmentation, up to activity recognition. Each module has a specific interface, and different plugins (corresponding to algorithms) can be implemented for a same module. We can easily build new analyzing systems thanks to this set of plugins. The order we can use those plugins and their parameters can be changed at run time and the result visualized on a dedicated GUI. This platform has many more advantages such as easy serialization to save and replay a scene, portability to Mac, Windows or Linux, and easy deployment to quickly setup an experimentation anywhere. SUP takes different kinds of input: RGB camera, depth sensor for online processing; or image/video files for offline processing.

This generic architecture is designed to facilitate:

1. integration of new algorithms into SUP;
2. iharing of the algorithms among the Stars team. Currently, 15 plugins are available, covering the whole processing chain. Some plugins use the OpenCV library.

Goals of SUP are twofold:

1. From a video understanding point of view, to allow the Stars researchers sharing the implementation of their algorithms through this platform.
2. From a software engineering point of view, to integrate the results of the dynamic management of vision applications when applying to video analytic.

The plugins cover the following research topics:

- algorithms : 2D/3D mobile object detection, camera calibration, reference image updating, 2D/3D mobile object classification, sensor fusion, 3D mobile object classification into physical objects (individual, group of individuals, crowd), posture detection, frame to frame tracking, long-term tracking of individuals, groups of people or crowd, global tacking, basic event detection (for example entering a zone, falling...), human behaviour recognition (for example vandalism, fighting,...) and event fusion; 2D & 3D visualisation of simulated temporal scenes and of real scene interpretation results; evaluation of object detection, tracking and event recognition; image acquisition (RGB and RGBD cameras) and storage; video processing supervision; data mining and knowledge discovery; image/video indexation and retrieval.
- languages : scenario description, empty 3D scene model description, video processing and understanding operator description;
- knowledge bases : scenario models and empty 3D scene models;
- learning techniques for event detection and human behaviour recognition;

5.1.2. Improvements

Currently, the OpenCV library is fully integrated with SUP. OpenCV provides standardized data types, a lot of video analysis algorithms and an easy access to OpenNI sensors such as the Kinect or the ASUS Xtion PRO LIVE.
In order to supervise the GIT update progress of SUP, an evaluation script is launched automatically everyday. This script updates the latest version of SUP then compiles SUP core and SUP plugins. It executes the full processing chain (from image acquisition to activity recognition) on selected data-set samples. The obtained performance is compared with the one corresponding to the last version (i.e. day before). This script has the following objectives:

- Check daily the status of SUP and detect the compilation bugs if any.
- Supervise daily the SUP performance to detect any bugs leading to the decrease of SUP performance and efficiency.

The software is already widely disseminated among researchers, universities, and companies:

- PAL Inria partners using ROS PAL Gate as middleware
- Nice University (Informatique Signaux et Systèmes de Sophia), University of Paris Est Créteil (UPEC - LISSI-EA 3956)
- EHPAD Valrose, Institut Claude Pompidou
- European partners: Lulea University of Technology, Dublin City University,...
- Industrial partners: Toyota, LinkCareServices, Digital Barriers

Updates and presentations of our framework can be found on our team website https://team.inria.fr/stars/software . Detailed tips for users are given on our Wiki website http://wiki.inria.fr/stars and sources are hosted thanks to the Inria software developer team SED.

5.2. ViSEvAl

ViSEval is a software dedicated to the evaluation and visualization of video processing algorithm outputs. The evaluation of video processing algorithm results is an important step in video analysis research. In video processing, we identify 4 different tasks to evaluate: detection, classification and tracking of physical objects of interest and event recognition.

The proposed evaluation tool (ViSEvAl, visualization and evaluation) respects three important properties:

- To be able to visualize the algorithm results.
- To be able to visualize the metrics and evaluation results.
- To allow users to easily modify or add new metrics.

The ViSEvAl tool is composed of two parts: a GUI to visualize results of the video processing algorithms and metrics results, and an evaluation program to evaluate automatically algorithm outputs on large amounts of data. An XML format is defined for the different input files (detected objects from one or several cameras, ground-truth and events). XSD files and associated classes are used to check, read and write automatically the different XML files. The design of the software is based on a system of interfaces-plugins. This architecture allows the user to develop specific treatments according to her/his application (e.g. metrics). There are 6 user interfaces:

1. The video interface defines the way to load the images in the interface. For instance the user can develop her/his plugin based on her/his own video format. The tool is delivered with a plugin to load JPEG image, and ASF video.
2. The object filter selects which objects (e.g. objects far from the camera) are processed for the evaluation. The tool is delivered with 3 filters.
3. The distance interface defines how the detected objects match the ground-truth objects based on their bounding box. The tool is delivered with 3 plugins comparing 2D bounding boxes and 3 plugins comparing 3D bounding boxes.
4. The frame metric interface implements metrics (e.g. detection metric, classification metric, ...) which can be computed on each frame of the video. The tool is delivered with 5 frame metrics.
5. The temporal metric interface implements metrics (e.g. tracking metric, ...) which are computed on the whole video sequence. The tool is delivered with 3 temporal metrics.
6. The event metric interface implements metrics to evaluate the recognized events. The tool provides 4 metrics.

The GUI is composed of 3 different parts:

1. The visualization of results windows dedicated to result visualization (see Figure 6):
   - Window 1: the video window displays the current image and information about the detected and ground-truth objects (bounding-boxes, identifier, type,...).
   - Window 2: the 3D virtual scene displays a 3D view of the scene (3D avatars for the detected and ground-truth objects, context, ...).
   - Window 3: the temporal information about the detected and ground truth objects, and about the recognized and ground-truth events.
   - Window 4: the description part gives detailed information about the objects and the events,
   - Window 5: the metric part shows the evaluation results of the frame metrics.
2. The object window enables the user to choose the object to be displayed (see Figure 7).
3. The multi-view window displays the different points of view of the scene (see Figure 8).

The evaluation program saves, in a text file, the evaluation results of all the metrics for each frame (whenever it is appropriate), globally for all video sequences or for each object of the ground truth.

The ViSEvAl software was tested and validated into the context of the Cofriend project through its partners (Akka, ...). The tool is also used by IMRA, Nice hospital, Institute for Infocomm Research (Singapore), ... The software version 1.0 was delivered to APP (French Program Protection Agency) on August 2010. ViSEvAl is under GNU Affero General Public License AGPL (http://www.gnu.org/licenses/) since July 2011. The tool is available on the web page : http://www-sop.inria.fr/teams/pulsar/EvaluationTool/ViSEvAl_Description.html

5.3. Clem

The *Clem Toolkit* [68](see Figure 9) is a set of tools devoted to design, simulate, verify and generate code for LE [18] [81] programs. LE is a synchronous language supporting a modular compilation. It also supports automata possibly designed with a dedicated graphical editor and implicit Mealy machine definition.

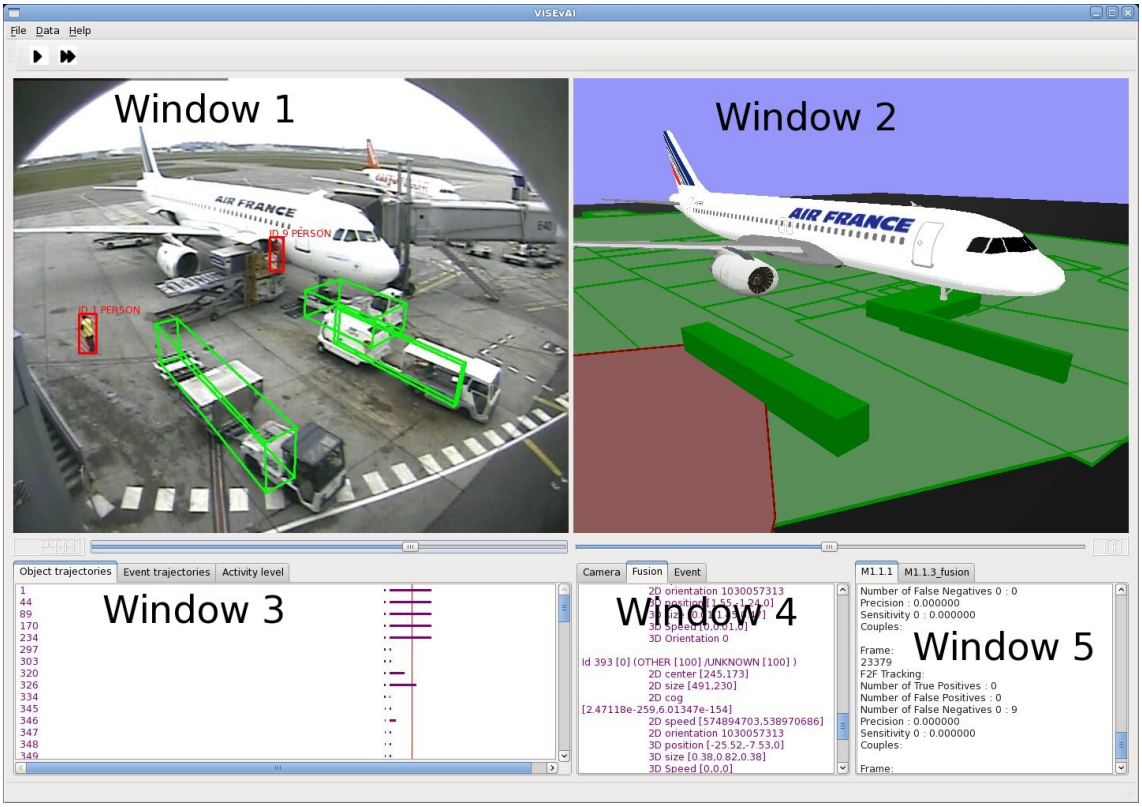


Figure 6. GUI of the ViSEvAl software

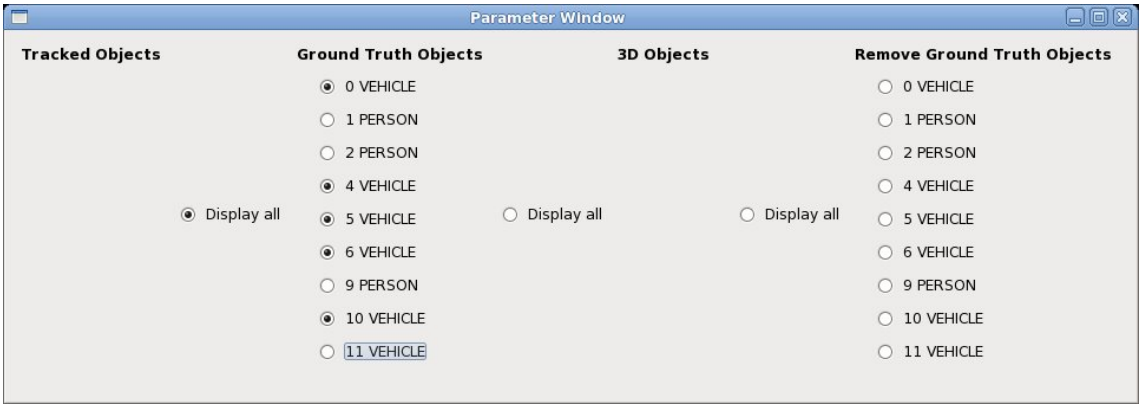


Figure 7. The object window enables users to choose the object to display

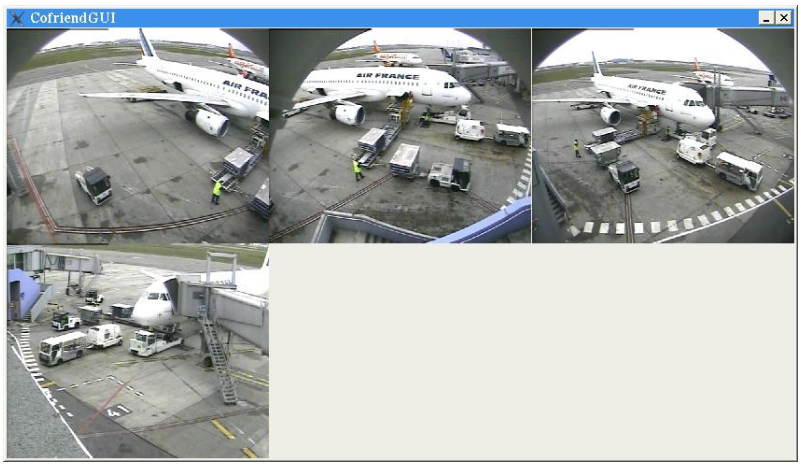


Figure 8. The multi-view window

Each LE program is compiled later into *lec* and *lea* files. Then when we want to generate code for different backends, depending on their nature, we can either expand the lec code of programs in order to resolve all abstracted variables and get a single *lec* file, or we can keep the set of lec files where all the variables of the main program are defined. Then, the *finalization* will simplify the final equations and code is generated for simulation, safety proofs, hardware description or software code. Hardware description (Vhdl) and software code (C) are supplied for LE programs as well as simulation. Moreover, we also generate files to feed the NuSMV model checker [65] in order to perform validation of program behaviors. In 2014, LE supports data value for automata and CLEM is used in 2 research axes of the team (SAM and SynComp). CLEM is registered at the APP since May 2014.

The work on CLEM was published in [68], [69], [18], [19].
Web page: http://www-sop.inria.fr/teams/pulsar/projects/Clem/

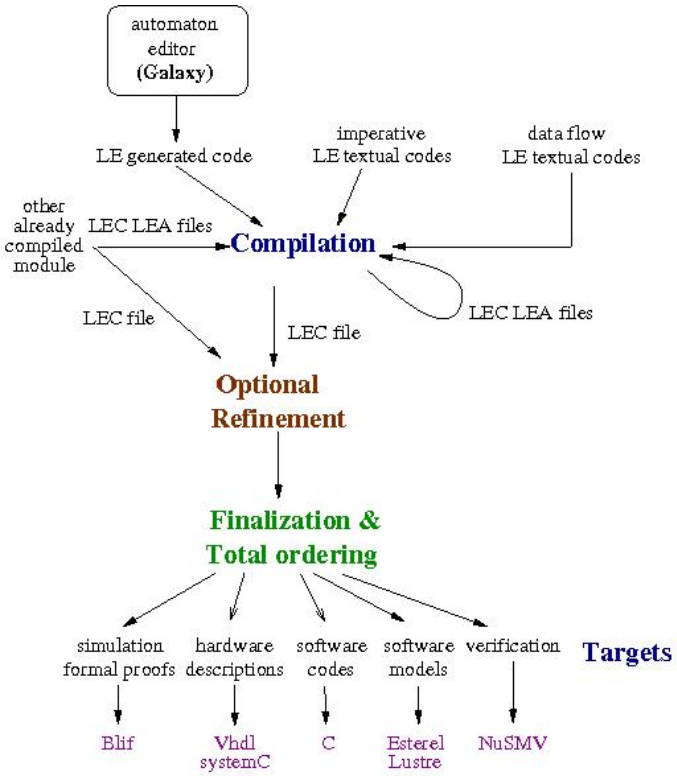


Figure 9. The Clem Toolkit

WILLOW Project-Team

5. New Software and Platforms

5.1. SPArse Modeling Software (SPAMS)

SPAMS v2.5 was released as open-source software in May 2014 (v1.0 was released in September 2009, v2.0 in November 2010). It is an optimization toolbox implementing algorithms to address various machine learning and signal processing problems involving

- Dictionary learning and matrix factorization (NMF, sparse PCA, ...)
- Solving sparse decomposition problems with LARS, coordinate descent, OMP, SOMP, proximal methods
- Solving structured sparse decomposition problems (ℓ_1/ℓ_2, ℓ_1/ℓ_∞, sparse group lasso, tree-structured regularization, structured sparsity with overlapping groups,...).

The software and its documentation are available at http://www.di.ens.fr/willow/SPAMS/.

5.2. Efficient video descriptors for action recognition

This package contains source code for highly-efficient extraction of local space-time video descriptors for action recognition. The accuracy of descriptors measured at standard benchmarks for action recognition is comparable to the state-of-the-art dense trajectory features, while being more than 100 times faster on standard CPU. The previous version of this code was evaluated in our recent work [12]. The package is available from http://www.di.ens.fr/~laptev/download/fastvideofeat-1.0.zip. Earlier version of our space-time video features is available at http://www.di.ens.fr/~laptev/download/stip-2.0-linux.zip.

5.3. Weakly Supervised Action Labeling in Videos Under Ordering Constraints

This is a package of Matlab code implementing weakly-supervised learning of actions from input videos and corresponding sequences of action labels. The code finds optimal alignment of action labels and video intervals during training. Along the optimization, the method trains corresponding action model. The package is available at http://www.di.ens.fr/willow/research/actionordering/. The method corresponding to this code package has been described and evaluated in Bojanowski *et al.* ECCV 2014 [10].

5.4. Visual Place Recognition with Repetitive Structures

Open-source release of the software package for visual localization in urban environments has been made publicly available in May 2014. The software package implements the method [A. Torii et al., CVPR 2013] for representing visual data containing repetitive structures (such as building facades or fences), which often occur in urban environments and present significant challenge for current image matching methods. This is an extended version that includes geometric verification. The original version was released in 2013. The software is available at http://www.di.ens.fr/willow/research/repttile/download/repttile_demo_ver03.zip.

5.5. Seeing 3D chairs: exemplar part-based 2D-3D alignment using a large dataset of CAD models

Open-source release of the software package for 2D-3D category-level alignment has been made publicly available. The software package implements newly developed method [9] for category-level recognition that not only outputs the bounding box of the object but predicts an approximate 3D model aligned with the input image. The software is available at http://www.di.ens.fr/willow/research/seeing3Dchairs/.

5.6. Painting-to-3D Model Alignment Via Discriminative Visual Elements

Open-source release of the software package for alignment of 3D models to historical and non-photographic depictions has been made publicly available. The software package implements the method of [9] for alignment of 3D models to input historical and non-photographic depictions such as paintings, drawings or engravings, where standard local feature-based method fail. The software is available at http://www.di.ens.fr/willow/research/painting_to_3d/.

5.7. Painting recognition from wearable cameras

Open-source release of the software package for painting recognition from wearable cameras has been made publicly available. The software implements a method described in [20] that recognizes 2D paintings on a wearable Google Glass device, for example, for a virtual museum guide application. The software runs directly on Google Glass without sending images to external servers for processing and recognizes a query painting in a database of 100 paintings in one second. The report and software are publicly available at http://www.di.ens.fr/willow/research/glasspainting/.

5.8. Learning and transferring mid-level image representations using convolutional neural networks

The first version of the open source software package for convolutional neural networks [13] has been released online. The software package is based on the cuda-convnet implementation of convolutional neural networks and includes a pre-trained convolutional neural network that can be applied to visual object classification as in the Pascal VOC 2012 set-up, where it achieves state-of-the-art single network results. The package also includes functions for visualization of object localization. The software is publicly available at http://www.di.ens.fr/willow/research/cnn/code/voc12-cvpr-reproduce.tar.