



RESEARCH CENTER

FIELD

Perception, Cognition and Interaction

Activity Report 2016

Section Software

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CEDAR Team

6. New Software and Platforms

6.1. New Software

6.1.1. *CliqueSquare*

CliqueSquare allows storing and querying very large volumes of RDF data in a massively parallel fashion in a Hadoop cluster. The system uses its own partitioning and storage model for the RDF triples in the cluster.

CliqueSquare evaluates queries expressed in a dialect of the SPARQL query language. It is particularly efficient when processing complex queries, because it is capable of translating them into MapReduce programs guaranteed to have the minimum number of successive jobs. Given the high overhead of a MapReduce job, this advantage is considerable.

6.1.2. *Compact*

Compact reformulates conjunctive queries in the setting of ontology-based query answering. It takes as input a conjunctive query and an ontology, and outputs a first-order rewriting of that query whenever it exists (without termination guarantee when it does not exist). To ease its use and dissemination, a novel version has been implemented by M. Thomazo based on the framework GRAAL, developed within the Inria Sophia-Antipolis team GraphIK by C. Sipieter, an engineer funded by an ADT. It will in particular ease the integration with Semantic Web standards, as well as the use of query optimization techniques developed within Cedar for RDFS and DL-Lite_R to more general ontology languages.

6.1.3. *RDF-Commons*

RDF-Commons is a set of modules providing the abilities to *i*) load and store RDF data in a DBMS *ii*) parse RDF conjunctive queries *iii*) encode URIs and literals into integers *iv*) encode RDF conjunctive queries *v*) build statistics on RDF data *vi*) estimate the cost of the evaluation of a conjunctive query *vii*) saturate the RDF data, with respect to an RDF Schema *viii*) reformulate a conjunctive query with respect to an RDF Schema (ix) propose algebraic plans.

The algebraic plan part has been developed by A. Solimando and D. Bursztyn. An ADT funding for two years has been granted to consolidate and extend the development of RDF-Commons. The hiring process is ongoing.

6.1.4. *RDFSummary*

RDF Summary is a standalone Java software capable of building summaries of RDF graphs. Summaries are compact graphs (typically several orders of magnitude smaller than the original graph), which can be used to get acquainted quickly with a given graph, they can also be used to perform static query analysis, infer certain things about the answer of a query on a graph, just by considering the query and the summary.

6.1.5. *Tatooine*

We developed lightweight data integration system called Tatooine, based on our discussions with our journalist partners in the ANR ContentCheck project from the team “Les Décodeurs”. Tatooine allows to exploit heterogeneous data sources of different data models, which we view as a mixed data instance, by querying them together; Tatooine combines data from various sources within an integrated engine complemented by information extraction and data visualization modules. Figure 1 illustrates the functioning of Tatooine through screen captures: a set of tweets (JSON documents stored in SOLR) obtained through a full-text search are combined with information about their authors (RDF metadata stored in Jena TDB) and the results are presented to the users highlighting the political affiliation of the tweet authors.

DAHU Project-Team (section vide)

EXMO Project-Team

5. New Software and Platforms

5.1. Alignment API

SCIENTIFIC DESCRIPTION

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

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

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

FUNCTIONAL DESCRIPTION

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

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

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

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

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

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

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

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- Contact: Jérôme Euzenat
- URL: <http://alignapi.gforge.inria.fr/>

5.2. OntoSim

SCIENTIFIC DESCRIPTION

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

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

FUNCTIONAL DESCRIPTION

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

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

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

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

GRAPHIK Project-Team

5. New Software and Platforms

5.1. SudoQual

Participants: Michel Leclère, Michel Chein, Alain Gutierrez, Clément Sipieter, Brett Choquet.

Contact: Michel Leclère

SudoQual is a software suite that allows discovering and evaluating coreference links between individual entities references. It has been developed during the ANR project Qualinca. This software suite comprises:

- a generic API allowing to implement (thanks to a graphical interface) applications computing “same-as” and “different-from” links in knowledge bases;
- a generic application (whose specific parameters are defined in a configuration file) evaluating the quality of a knowledge base; it is available either as a standalone client or as a web service;
- a library dedicated to the comparison of individual entities’ attributes;
- the specific configuration file dedicated to evaluating the quality of links in ABES’ Sudoc catalogue.

Main developments this year are:

- adapting the API’s architecture to the NetBeans IDE in order to benefit from its better edition functionalities;
- finalizing, testing and optimizing the linkage application;
- specifying and implementing the quality evaluation application;
- implementing this latter application as a web service.

5.2. GRAAL

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

Contact: Marie-Laure Mugnier (scientific contact), Clément Sipieter (technical contact)

Keywords: Data management - Ontologies - Query Answering

Web site: <https://graphik-team.github.io/graal/>

Scientific Description Graal is a generic platform for ontological query answering with existential rules. It implements various paradigms that fall into that framework. It is an open source software written in Java.

Functional Description See last year’s report for a description of GRAAL’s features <http://raweb.inria.fr/rapportsactivite/RA2015/graphik/uid49.html>.

New Features The main features developed in 2016 are:

- improvement of the semi-saturation algorithm with compilable rules;
- implementation of mappings allowing to query an existing database as it is, without prior loading it in GRAAL;
- design and implementation of classes that manage a knowledge base (i.e., the rules and the data). In particular, the results of the rule analyser Kiabora (that has been integrated within GRAAL) are used to automatically select the most appropriate algorithms for querying the knowledge base.

5.3. Cogui

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

Contact: Marie-Laure Mugnier (scientific contact), Alain Gutierrez (technical contact)

Keywords: Graphical knowledge bases - Ontology Editor - Conceptual Graphs

Web site: <http://www.lirmm.fr/cogui/>

Scientific Description Cogui is a tool for building and verifying graphical knowledge bases. It is a freeware written in Java.

Functional Description See last year's report for a description of CoGui's features <http://raweb.inria.fr/rappportsactivite/RA2015/graphik/uid41.html>.

New features Cogui is currently under heavy refactoring to benefit from NetBeans graphical libraries.

5.4. CoGui-Capex

CoGui-Capex is a decision support tool dedicated to food industry. Its knowledge base represents the causal links between food descriptors and actions which can be undertaken by operators to control food quality on the line. The new version of CoGui-Capex developed in 2016 in a Neatbeans environnement is coupled with the so-called "Knowledge book" developed by INRA I2M team in Bordeaux [49]. This collaboration will be extended in the CASDAR Docamex national project (funded by the French Ministry of Agriculture), which will begin in January 2017 for 4 years with several cheese makers.

5.5. @Web

An extension of the 5 stars/FAIRS scientific data annotation platform called @Web (<http://www6.inra.fr/cati-icat-atweb>), managed by INRA, has been developped by Leandro Lovisolo (UBA master student) co-supervised by Federico Ulliana and Patrice Buche using semantic web languages (OWL, SPARQL, RDF). This extension permits to represent negative constraints expressed on annotated data and will be used in data curation phase.

LACODAM Team

6. New Software and Platforms

6.1. EcoMata

FUNCTIONAL DESCRIPTION

The EcoMata tool-box provides means for qualitative modeling and ecosystem exploration and for assisting the design of environmental guidelines. We have proposed a new qualitative approach for ecosystem modeling based on timed automata (TA) formalism combined to a high-level query language for exploring scenarios.

- Participants: Marie-Odile Cordier, Yulong Zhao, Christine Largouët and Thomas Guyet
- Contact: Christine Largouët

6.2. PaturMata

KEYWORDS: Bioinformatics - Biology

SCIENTIFIC DESCRIPTION

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

FUNCTIONAL DESCRIPTION In the PaturMata software, users can create a pasture system description by entering herds and plots information. For each herd, the only parameter is the number of animals. For each plot, users should enter the surface, the density, the herb height, the distance to the milking shed, a herb growth profile and an accessibility degree.

Users then specify pasturing and fertilization strategies. Finally, users can launch a pasture execution. PaturMata displays the results and a detailed trace of pasture. Users can launch a batch of different strategies and compare the results in order to find the best pasture strategy.

PaturMata is developed in Java (Swing for the GUI) and the model-checker that is called for the timed properties verification is UPPAAL .

- Participants: Christine Largouët, Marie-Odile Cordier, Yulong Zhao
- Contact: Christine Largouët

6.3. QTempIntMiner

KEYWORDS: Data mining - Health - Medical - Physiology - Temporal information

SCIENTIFIC DESCRIPTION

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 intervals 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).

- Participants: Thomas Guyet and René Quiniou
- Partner: AGROCAMPUS
- Contact: Thomas Guyet
- URL: <http://people.irisa.fr/Thomas.Guyet/QTempIntMiner/>

LINKS Project-Team

6. New Software and Platforms

6.1. ShEx Validator

KEYWORDS: RDF Data management - RDF - Shape Expression

FUNCTIONAL DESCRIPTION

Shape Expression schemas is a formalism for defining constraints on RDF graphs. This software allows to check whether a graph satisfies a Shape Expressions schema.

- Participants: Iovka Boneva
- Contact: Iovka Boneva
- URL: <https://gforge.inria.fr/projects/shex-impl>

6.2. gMark

KEYWORDS: graph benchmark - Graph Database - Graph Query

FUNCTIONAL DESCRIPTION

gMark allow the generation of graph databases and an associated set of query from a schema of the graph. gMark is based on the following principles: great flexibility in the schema definition, ability to generate big size graphs, ability to generate recursive queries and queries with a desired selectivity .

- Participants: Aurélien Lemay
- Contact: Aurélien Lemay
- URL: <https://github.com/graphMark/gmark>

6.3. QuiXPath

KEYWORDS: XML Streams - XPath 3.0 Queries - Aggregation - Data Joins

FUNCTIONAL DESCRIPTION

QuiXPath is a streaming implementation that covers most of XPath 3.0. It was developed during the PhD thesis of T. Sebastian funded by our industrial transfer partner Innovimax.

- Participants: Tom Sebastian and Joachim Niehren
- Contact: Joachim Niehren
- URL: <https://project.inria.fr/quix-tool-suite>

6.4. X-FUN

KEYWORDS: XML - Transformation - Functional programming - Compilers - Programming language

FUNCTIONAL DESCRIPTION

X-FUN is a core language for implementing various XML, standards in a uniform manner. X-Fun is a higher-order functional programming language for transforming data trees based on node selection queries.

- Participants: Pavel Labath and Joachim Niehren
- Contact: Joachim Niehren

MAGNET Project-Team

6. New Software and Platforms

6.1. CoRTex

Python library for noun phrase COreference Resolution in natural language TEXTs

FUNCTIONAL DESCRIPTION

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.

- Participants: Pascal Denis and David Chatel
- Contact: Pascal Denis
- URL: <https://team.inria.fr/magnet/software/>

6.2. Magneto

Python toolbox for generating and evaluating vector space representations for Natural Language Processing

FUNCTIONAL DESCRIPTION

Version 1.0 of Magneto contains preprocessing methods for texts in french and english. It includes classical methods for generating vector space representations: count based models, dimensionality reduction based methods and predictive methods (word2vec and Glove). For version 1.0, vector space representations can be evaluated on dedicated evaluation tasks such as similarity and analogy.

- Participants: Pascal Denis, Rémi Gilleron, Mikaela Keller, François Noyer and Nathalie Vauquier
- Contact: Pascal Denis
- URL: <https://team.inria.fr/magnet/software/>

ORPAILLEUR Project-Team

6. New Software and Platforms

6.1. Symbolic KDD Systems

6.1.1. LatViz

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

FUNCTIONAL DESCRIPTION.

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

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

6.1.2. OrphaMine – Data mining platform for orphan diseases

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

FUNCTIONAL DESCRIPTION.

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

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

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

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

FUNCTIONAL DESCRIPTION.

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

6.1.4. Siren - Interactive and visual redescription mining

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

FUNCTIONAL DESCRIPTION.

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

6.2. Stochastic systems for knowledge discovery and simulation

6.2.1. The CarottAge and ARPEntAge Systems

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

FUNCTIONAL DESCRIPTION.

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

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

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

SMIS Project-Team

5. New Software and Platforms

5.1. PLUG-DB ENGINE

FUNCTIONAL DESCRIPTION: PlugDB is a complete platform dedicated to a secure and ubiquitous management of personal data. It aims at providing an alternative to a systematic centralization of personal data. The PlugDB engine is a personal database server capable of storing data (tuples and documents) in tables and BLOBs, indexing them, querying them in SQL, sharing them through assertional access control policies and enforcing transactional properties (atomicity, integrity, durability) [4]. The PlugDB engine is embedded in a tamper-resistant hardware device combining the security of smartcard with the storage capacity of NAND Flash. The personal database is hosted encrypted in NAND Flash and the PlugDB engine code runs in the microcontroller. Complementary modules allow to pre-compile SQL queries for the applications, communicate with the DBMS from a remote Java program, synchronize local data with remote servers (typically used for recovering the database in the case of a broken or lost devices) and participate in distributed computation (e.g., global queries). PlugDB runs both on secure devices provided by Gemalto and on specific secure devices designed by SMIS and assembled by electronic SMEs. Mastering the hardware platform opens up new research and experiment opportunities (e.g., we have recently integrated a Bluetooth module to communicate wirelessly with PlugDB and a fingerprint module to strongly authenticate users) and allows us to engage ourselves in an open-source/open hardware initiative. Open-SW/open-HW contributes to the trust the community of users can put in any privacy preserving solution and is key to enable a diversity of solutions, hence decreasing the risk of class attacks. PlugDB engine has been registered first at APP (Agence de Protection des Programmes) in 2009 - a new version being registered every two years and the hardware datasheets in 2015. PlugDB has been experimented in the field, notably in the healthcare domain. We also recently set up an educational platform on top of PlugDB, named SIPD (Système d'Information privacy-by-Design) and used at ENSIIE, INSA CVL and UVSQ through the Versailles Sciences Lab fablab, to raise students awareness of privacy protection problems and embedded programming. As a conclusion, PlugDB combines several research contributions from the team, at the crossroads of flash data management, embedded data processing and secure distributed computations. It then strongly federates all members of our team (permanent members, PhD students and engineers). It is also a vector of visibility, technological transfer and dissemination and gives us the opportunity to collaborate with researchers from other disciplines around a concrete privacy enhancing platform.

- Participants: Nicolas Anciaux, Luc Bouganim, Philippe Pucheral and Aydogan Ersoz
- Contact: Nicolas Anciaux
- URL: <https://project.inria.fr/plugdb/>

5.2. Privacy Preserving Mobile Laboratory

FUNCTIONAL DESCRIPTION: We have started to design a privacy preserving mobile laboratory used as an experimental platform for multidisciplinary research launched 'in vivo'. The goal is to conduct reliable surveys and avoid the privacy paradox (what users declare on their privacy behavior is far from what they effectively do). The platform, built on top of PlugDB, includes two android applications, a "server" which takes as input a questionnaire description and broadcast it on demand to the client applications. Users interact with the questionnaire on the client applications, storing the detailed answers in their PlugDB personal server. Then a secure distributed computation takes place (between users' PlugDB servers) and computes non-sensitive global statistics based on potentially sensitive raw answers. A beta-version of this platform was developed during the PhD of Athanasia Katsouraki and was used for a pre-experimentation targeting 140 students. While the experiment was successful, it showed the limitation and complexity of the initial setting (laptops, required Internet access, complexity in the questionnaire deployment). We designed and implement a second platform running on android tablets with a local router and automatic questionnaire deployment. The platform has been

demonstrated in several forums and very recently at the Sénat in Paris. This platform represents a backing for two PhD theses on privacy (the first one in economics, the second one in our team) funded in 2016 by the interdisciplinary doctoral program at UPSay (IDI 2016).

- Participants: Nicolas Anciaux, Luc Bouganim, Aydogan Ersoz, Athanasia Katsouraki, Riad Ladjel, Benjamin Nguyen, Remy Pasquion, Paul Tran Van
- Contact: Luc Bouganim
- URL: <https://project.inria.fr/plugdb/en/PPML>

TYREX Project-Team

5. New Software and Platforms

5.1. Benchmarks Attitude Smartphones

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

SCIENTIFIC DESCRIPTION

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

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

5.2. CSS Analyzer

FUNCTIONAL DESCRIPTION

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

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

5.3. RDFHive

KEYWORDS: Hadoop - RDF - SPARQL

SCIENTIFIC DESCRIPTION

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

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

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

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

5.4. Tree Reasoning Solver

SCIENTIFIC DESCRIPTION

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

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

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

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

5.5. XQuery Type-Checker

SCIENTIFIC DESCRIPTION

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

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

5.6. SPARQLGX

KEYWORDS: RDF - SPARQL - Distributed computing

SCIENTIFIC DESCRIPTION

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

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

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

WIMMICS Project-Team

6. New Software and Platforms

6.1. Corese

COncceptual REsource Search Engine

KEYWORDS: Semantic Web - Web of Data - Search Engine - RDF - SPARQL

FUNCTIONAL DESCRIPTION

Corese is a Semantic Web Factory that implements W3C RDF, RDFS, SPARQL 1.1 Query and Update. Furthermore, Corese query language integrates original features such as approximate search. It provides a SPARQL Template Transformation Language for RDF, a SPARQL based Inference Rule Language for RDF and a Linked Data Script Language. Corese also provides distributed federated query processing, a Semantic Web server and a SPARQL endpoint. Corese development is supported by an Inria grant (ADT).

- Participants: Olivier Corby, Erwan Demairy, Catherine Faron-Zucker, Fabien Gandon. Alumni: Virginie Bottollier, Olivier Savoie, and Fuqi Song.
- Partners: I3S - Mnemotix
- Contact: Olivier Corby
- URL: <http://wimmics.inria.fr/corese>, <http://corese.inria.fr>

6.2. DBpedia.fr

FUNCTIONAL DESCRIPTION

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 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. In addition, Wimmics extended the open source DBpedia platform with new capabilities and in particular DBpedia Historic to extract the entire edition history of a chapter as linked data.

- Participants: Fabien Gandon and Raphaël Boyer
- Contact: Fabien Gandon
- URL: <http://dbpedia.fr>

6.3. Discovery Hub

Discovery Hub Exploratory Search Engine

KEYWORD: Search Engine

FUNCTIONAL DESCRIPTION

Discovery Hub is an exploratory search engine built on top of linked data sources and, in particular, DBpedia. The exploratory search is a new way to search the web to find new topics the users were not aware of but which may be interesting for them. It allows users performing queries in an innovative way and helps them navigate rich results. As a hub, it proposes redirections to others platforms to let users benefit from their discoveries. It relies on an extension of spreading activation algorithms over linked data to recommend and explain results.

- Participants: Nicolas Marie, Fabien Gandon, Emilie Palagi and Alain Giboin
- Partner: Alcatel-Lucent
- Contact: Fabien Gandon
- URL: <http://discoveryhub.co/>

6.4. Licentia

License you Data

KEYWORDS: Licenses - Normative Reasoning - Semantic Web - RDF

FUNCTIONAL DESCRIPTION

Licentia is a web service application with the aim to support users in licensing data. Our goal is to provide a full suite of services to help in the process of choosing the most suitable license depending on the data to be licensed. The core technology used in our services is powered by the SPINdle Reasoner and the use of Defeasible Deontic Logic to reason over the licenses and conditions. The dataset of RDF licenses we use in Licentia is the RDF licenses dataset where the Creative Commons Vocabulary and Open Digital Rights Language (ODRL) Ontology are used to express the licenses.

- Participants: Serena Villata, Fabien Gandon. Alumni: Cristian Cardellino
- Partners: I3S
- Contact: Serena Villata
- URL: <http://licentia.inria.fr/>

6.5. Qakis

Question-Answering wiki framework based system

FUNCTIONAL DESCRIPTION

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.

- Participants: Elena Cabrio, Julien Cojan, Amine Hallili, Alessio Palmero Aprosio, Fabien Gandon and Serena Villata.
- Contact: Elena Cabrio
- URL: <http://www.qakis.org/>

6.6. KNEWS

Versatile Text-to-Knowledge Pipeline

KEYWORD: NLP

FUNCTIONAL DESCRIPTION

KNEWS is a versatile text-to-knowledge pipeline for machine reading, configurable to use different external modules for word sense disambiguation and entity linking. KNEWS works by running these components separately on a text, then it aligns the output of a semantic parser (Boxer) to the output of the other two modules, to produce complete semantic structures linked to DBpedia and Wordnet and represented as RDF graphs. KNEWS provides different kind of outputs: frame instances (based on the FrameBase scheme), word-aligned frames, and first-order logic formulas.

- Participants: Valerio Basile, Elena Cabrio and Fabien Gandon.
- Contact: Valerio Basile & Elena Cabrio
- URL: <https://github.com/valeribasile/learningbyreading>

ZENITH Project-Team

6. New Software and Platforms

6.1. Pl@ntNet

Participants: Antoine Affouard, Jean-Christophe Lombardo, Hervé Goëau, Alexis Joly [contact].

Pl@ntNet is an image sharing and retrieval application for the identification of plants. It is developed in the context of the Floris'tic project that involves Inria, CIRAD, INRA, IRD and Tela Botanica. 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. Since its first release in march 2013 on the apple store, the application has been downloaded by 3M users in more than 170 countries, with between 15,000 and 50,000 active users daily. 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 300K images covering more than 10K species in the world (and about 60% of the West European flora).

6.2. The Plant Game: crowdsourced plants identification

Participants: Maximilien Servajean, Alexis Joly [contact], Antoine Affouard.

URL: <http://theplantgame.com/>

The Plant Game is a participatory game whose purpose is the production of large masses of taxonomic data to improve our knowledge of biodiversity. The objective is to learn botany with fun and participate to a large citizen sciences project in biodiversity. The game relies on consistent research contributions in scalable crowdsourcing models and algorithms that can deal with thousands of complex classes such as plant species. One major contribution is the active training of the users based on innovative sub-task creation and assignment processes that are adaptive to the increasing skills of the user. The first public version of the game was released in july 2015. As of today, about 22K players are registered and produce hundreds of new validated plant observations per day. The accuracy of the produced taxonomic tags is about 94%, which is quite impressive considering the fact that a majority of users are beginners when they start playing.

6.3. Smart'Flore

Participants: Antoine Affouard [contact], Alexis Joly, Hervé Goëau.

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

Smart'Flore is an Android mobile application for the discovery of the surrounding vegetal biodiversity. It has three main features: (i) the geo-based exploration of the world's largest repository of biodiversity occurrences (GBIF, <http://www.gbif.org/>), (ii) the exploration of virtual botanical trails (created offline through a dedicated web application hosted by TelaBotanica NGO) and (iii) the access to a variety of information about the plants. Smart'Flore is the first mobile app in the world making use of the GBIF web services which makes it a remarkable and possibly highly visible realization. The first public version of the application was released in may 2016. Since then, it has been downloaded by more than 22K users and the daily number of sessions is about 250.

6.4. Snoop & SnoopIm

Participants: Alexis Joly, 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 vector hashing, approximate k-nearest neighbors search and Hamming embedding. Snoop is a refactoring of a previous library called PMH developed jointly with INA. SnoopIm is a content-based image search engine built on top of Snoop that allows retrieving small visual patterns or objects in large collections of pictures. The software is used as the visual search engine of the PI@ntNet applications and it is used in several other contexts, including a logo retrieval application in collaboration with INA, a whale's individuals matching application in collaboration with the CetaMada NGO, and a hieroglyph recognition application in collaboration with the Egyptology department of University Montpellier 3.

6.5. MultiSite-Rec

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

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.

6.6. Chiaroscuro

Participants: Tristan Allard, Florent Masegla, Esther Pacitti.

URL: <http://people.irisa.fr/Tristan.Allard/chiaroscuro/>

Chiaroscuro is a software developed in the context of a research contract with EDF. It aims at clustering time series with privacy preserving guarantees. It is a distributed system, working in a P2P environment. It is used by the team for experiments and by EDF as a proof-of-concept. Chiaroscuro is the first software for that purpose. It is written in Java. The distributed algorithm implemented in Chiaroscuro has been filed by EDF in a patent (with Inria and University of Montpellier)

6.7. LogMagnet

Participant: Florent Masegla.

URL: <https://team.inria.fr/zenith/software/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.

6.8. FP-Hadoop

Participants: Reza Akbarinia, Patrick Valduriez.

<https://gforge.inria.fr/plugins/mediawiki/wiki/fp-hadoop>

FP-Hadoop is an extension of Hadoop that efficiently deals with the problem of data skew in MapReduce jobs. In FP-Hadoop, there is a new phase, called intermediate reduce (IR), in which blocks of intermediate values, constructed dynamically, are processed by intermediate reduce workers in parallel, by using a scheduling strategy.

6.9. CloudMdsQL Compiler

Participants: Carlyna Bondiombouy, Boyan Kolev, Oleksandra Levchenko, Patrick Valduriez.

URL: <http://cloudmssql.gforge.inria.fr>

The CloudMdsQL (Cloud Multi-datastore Query Language) compiler transforms queries expressed in a common SQL-like query language into an optimized query execution plan to be executed over multiple cloud data stores (SQL, NoSQL, HDFS, etc.) through a query engine. The compiler/optimizer is implemented in C++ and uses the Boost.Spirit framework for parsing context-free grammars. CloudMdsQL has been validated on relational, document and graph data stores, as well as Spark/HDF in the context of the CoherentPaaS European project.

6.10. AgroLD

Participants: Pierre Larmande, Patrick Valduriez.

URL: <http://www.agrold.org>

Agronomic Linked Data (AgroLD) is a portal to help bioinformatics and domain experts exploiting the homogenized data models towards efficiently generating research hypotheses. AgroLD is an RDF knowledge base that is designed to integrate data from various publicly available plant centric data sources and ontologies, using Web Ontology Language (OWL) and the SPARQL Query Language (SPARQL).

6.11. SciFloware

Participants: Benjamin Billet, Didier Parigot.

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.

ALICE Project-Team

6. New Software and Platforms

6.1. GEOGRAM

GEOGRAM : A functions library for geometric programming

KEYWORD: 3D modeling

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

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

6.2. GLE

GraphiteLifeExplorer

KEYWORDS: 3D modeling - Biology

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

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

6.3. Graphite

Graphite: The Numerical Geometry Workbench

KEYWORDS: 3D modeling - Numerical Geometry - Texturing - Lighting - CAD - Visualization

Graphite is an experimental 3D modeler, built on top of the Geogram programming library. It has data structures and efficient OpenGL visualization for pointsets, surfacic meshes (triangles and polygons), volumetric meshes (tetrahedra and hybrid meshes). It has state-of-the-art mesh repair, remeshing, reconstruction algorithms. It also has an interface to the Tetgen tetrahedral mesh generator (by Hang Si). This year, Graphite3 was released. It is a major rewrite, based on Geogram, with increased software quality standards (zero warnings on all platforms, systematic documentation of all classes / all functions / all parameters, dramatically improved performances). It embeds Geogram (and optionally Vorpaline) with an easy-to-use Graphic User Interface.

Graphite is a dedicated software platform in numerical geometry that enables, among other things, 3D modelling and texture baking.

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

6.4. IceSL

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

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

6.5. LibSL

LibSL: Simple Library For Graphics

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

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

6.6. OpenNL

OpenNL: Open Numerical Library

KEYWORDS: 3D modeling - Numerical algorithm

SCIENTIFIC DESCRIPTION

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

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

6.7. VORPALINE

VORPALINE mesh generator

KEYWORDS: 3D modeling - Unstructured heterogeneous meshes

VORPALINE is a surfacic and volumetric mesh generator, for simplicial meshes (triangles and tetrahedra), for quad-dominant and hex-dominant meshes.

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

AVIZ Project-Team

6. New Software and Platforms

6.1. Zooids

Participants: Mathieu Le Goc [correspondant], Lawrence Kim, Ali Parsaei, Jean-Daniel Fekete, Pierre Dragicevic, Sean Follmer.

Zooids are autonomous robots that handle both display and interaction. We distribute them as an open-source open-hardware platform for developing tabletop swarm interfaces [24]. All information, related content and material can be found at <http://www.aviz.fr/swarmui>.



Figure 3. Zooids can be held as tokens, manipulated collectively or individually, behave as physical pixels, act as handles and controllers, and can move dynamically under machine control. They are building blocks for a new class of user interface we call swarm user interfaces.

6.2. Reorder.js

Participant: Jean-Daniel Fekete [correspondant].

Visualizing data tables and graph/network can be done using a matrix visualization. Jacques Bertin, the French cartographer and visualization pioneer explained in his book "Semiology of Graphics" that, to make sense of a matrix, it should first be correctly ordered. This is what the `Reorder.js` library is doing.

Ordering is also useful for other purposes. For example, if you want to visualize with Parallel Coordinates, you should provide an order for the dimension axes. `Reorder.js` can be used to find a suitable order. See also the poster paper [48].

The library also provide examples of visualizations using reordering; they are based on the `d3.js` library. For more information, see our survey of methods for matrix reordering [3].

6.3. NetworkCube

Participants: Jean-Daniel Fekete [correspondant], Nathalie Henry-Riche, Benjamin Bach.

Network visualizations support research in a range of scientific domains from biology to humanities. NetworkCube is a platform to bridge the gap between domain scientists and visualisation researchers; NetworkCube aims in being a fast way to deploy experimental visualizations from research to domain experts analyzing dynamic networks. In turn, InfoVis researchers benefit from studying how their visualizations are used in the wild [45].

NetworkCube is made of three parts: a core, the Vistorian which is specialized for visualizations for historians, and the Connectoscope which is specialized for Brain Researchers. NetworkCube provides multiple representations for dynamic networks, allowing complex explorations from Web clients.

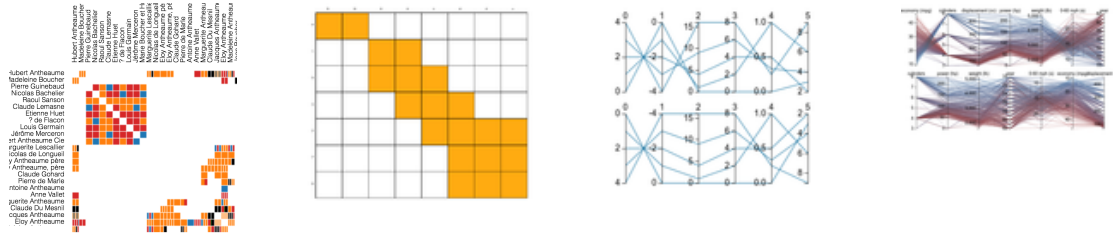


Figure 4. Correctly ordered matrices of a network (left), and parallel coordinate plots with dimensions ordered according to their correlation (right)

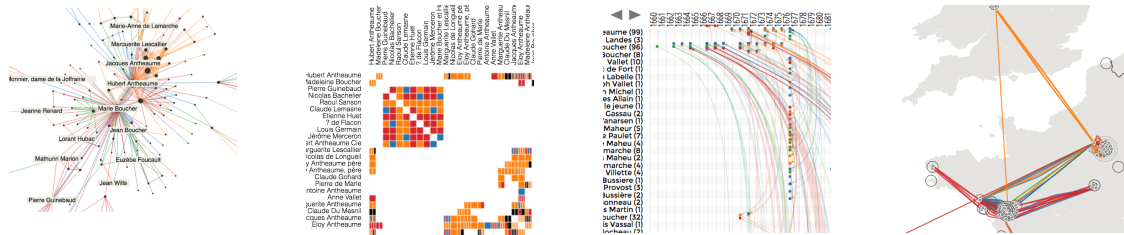


Figure 5. Four different visualization techniques to explore dynamic networks provided by NetworkCube

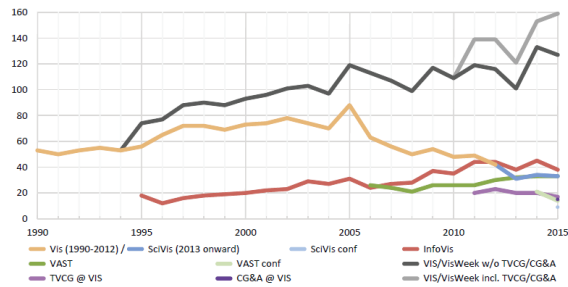


Figure 6. Overview of the files included in the dataset.

6.4. Vispubdata

Participants: Petra Isenberg [correspondant], Florian Heimerl, Steffen Koch, Tobias Isenberg, Panpan Xu, Charles Stolper, Michael Sedlmair, Torsten Möller, John Stasko.

We have created and made available to all a dataset with information about every paper that has appeared at the IEEE Visualization (VIS) set of conferences: InfoVis, SciVis, VAST, and Vis. The information about each paper includes its title, abstract, authors, and citations to other papers in the conference series, among many other attributes. This data is meant to be useful to the broad data visualization community to help understand the evolution of the field and as an example document collection for text data visualization research.

6.5. Time Curves

Participants: Benjamin Bach, Pierre Dragicevic [correspondant], Conglei Shi, Nicolas Heulot.

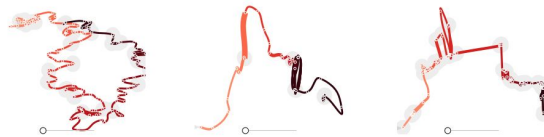


Figure 7. Wikipedia article on abortion illustrated with time curves.

We introduced *time curves* as a general approach for visualizing patterns of evolution in temporal data [2]. Examples of such patterns include slow and regular progressions, large sudden changes, and reversals to previous states. These patterns can be of interest in a range of domains, such as collaborative document editing, dynamic network analysis, and video analysis. Time curves employ the metaphor of folding a timeline visualization into itself so as to bring similar time points close to each other. This metaphor can be applied to any dataset where a similarity metric between temporal snapshots can be defined, thus it is largely datatype-agnostic. In our paper and on the online Website, we illustrate how time curves can visually reveal informative patterns in a range of different datasets.

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

6.6. CENDARI Note-Taking-Environment

SCIENTIFIC DESCRIPTION

CENDARI (<http://www.aviz.fr/Research/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 through the notes and documents.

FUNCTIONAL DESCRIPTION

Editors' Notes is an open-source, web-based tool for recording, organizing, preserving, and opening access to research notes, built with the needs of documentary editing projects, archives, and library special collections in mind.

- Participants: Evanthia Dimara, Nadia Boukhelifa Sari Ali and Jean-Daniel Fekete
- Contact: Jean-Daniel Fekete
- URL: <https://github.com/CENDARI/editorsnotes>

6.7. Hybrid Image Visualisation

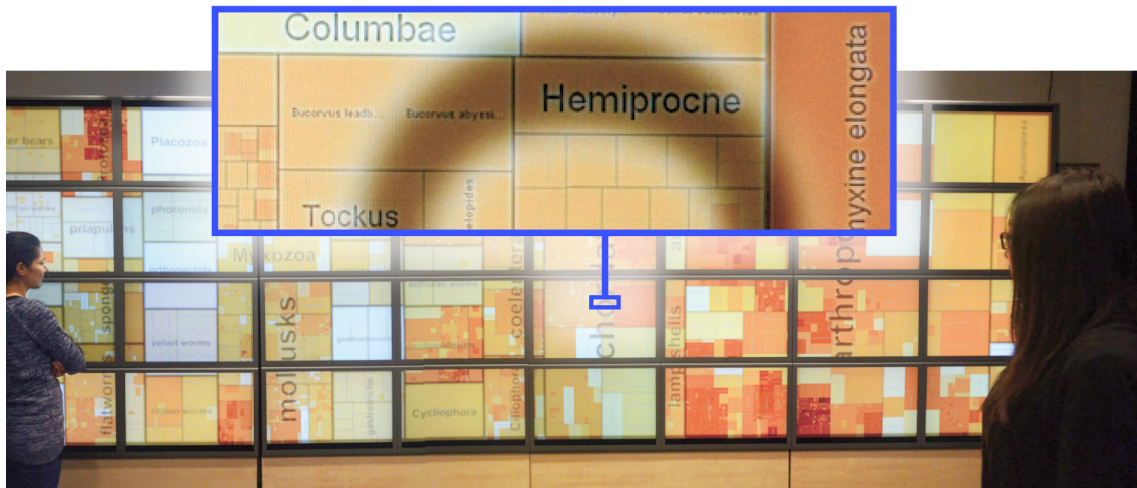


Figure 8. Hybrid image visualization software for the creation of visualizations for distant and close viewing on large displays.

Hybrid-image visualizations blend two different visual representations into a single static view, such that each representation can be perceived at a different viewing distance. Our work is motivated by data analysis scenarios that incorporate one or more displays with sufficiently large size and resolution to be comfortably viewed by different people from various distances. Hybrid-image visualizations can be used, in particular, to enhance overview tasks from a distance and detail-in-context tasks when standing close to the display. By taking advantage of humans' perceptual capabilities, hybrid-image visualizations do not require tracking of viewers in front of a display. Moreover, because hybrid-images use a perception-based blending approach, visualizations intended for different distances can each utilize the entire display. We contribute a design space, discuss the perceptual rationale for our work, provide examples and a set of techniques for hybrid-image visualizations, and describe tools for designing hybrid-image visualizations. An example can be found in Figure 8 .

KEYWORDS: Wall-Sized Displays, Perception, Hybrid Images

FUNCTIONAL DESCRIPTION

- Participants: Jean-Daniel Fekete, Petra Isenberg, Pierre Dragicevic, Wesley Willett, Romain Primet.
- Contact: Petra Isenberg
- URL: <http://aviz.fr/Research/HybridImageVisualizations>

6.8. Sparklificator

KEYWORDS: Information visualization - Data visualization - Visualization

SCIENTIFIC DESCRIPTION

Sparklificator is a general open-source jQuery library that eases the process of integrating word-scale visualizations into HTML documents.

FUNCTIONAL DESCRIPTION

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

- Participants: Pascal Goffin, Wesley Willett and Petra Isenberg
- Contact: Jean-Daniel Fekete
- URL: <http://inria.github.io/sparklificator/>

EX-SITU Team

6. New Software and Platforms

6.1. New Software

6.1.1. WildOS

Participant: Michel Beaudouin-Lafon [correspondant].

WildOS is middleware designed to support applications that run in an interactive room, such as our WILD and WILDER rooms, with various interaction resources, including a tiled wall display, a motion tracking system, interactive tabletops, tablets, smartphones and custom-made or 3d printed interactive devices. The conceptual model of WildOS is a *platform*, such as the WILD or WILDER room, that can be described as a set of devices 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 or 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 for remote control. Sample applications include a web browser, an image viewer, a window manager, and the BrainTwister application developed in collaboration with neuroanatomists at NeuroSpin.

WildOS is used for several research projects at ExSitu and by other partners of the Digiscope project. It was also deployed on several of Google's interactive rooms in Mountain View, Dublin and Paris. It is available under an Open Source licence at <https://bitbucket.org/mblinsitu/wildos>.

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

6.1.2. Unity Cluster

Participants: Cédric Fleury [correspondant], Olivier Gladin, Jean-Baptiste Louvet.

Unity Cluster is middleware to distribute any Unity 3D (<https://unity3d.com/>) application on a cluster of computers that run in interactive rooms, such as our WILD and WILDER rooms, or immersive CAVES (Computer-Augmented Virtual Environments). Users can interact with the application with various interaction resources.

Unity Cluster provides an easy solution for running existing Unity 3D applications on any display that requires a rendering cluster with several computers. *Unity Cluster* is based on a master-slave architecture: The master computer runs the main application and the physical simulation as well as manages the input; the slave computers receive updates from the master and render small parts of the 3D scene. *Unity Cluster* manages data distribution and synchronization among the computers to obtain a consistent image on the entire wall-sized display surface.

Unity Cluster can also deform the displayed images according to the user's position in order to match the viewing frustum defined by the user's head and the four corners of the screens. This respects the motion parallax of the 3D scene, giving users a better sense of depth.

Unity Cluster is composed of a set of C Sharp scripts that manage the network connection, data distribution, and the deformation of the viewing frustum. In order to distribute an existing application on the rendering cluster, all scripts must be embedded into a Unity package that is included in an existing Unity project.

- ACM: C.2.4 [Distributed Systems]: Distributed applications, I.3.7 [3D Graphics and Realism]: Virtual reality
- Software benefit: adapts existing Unity 3D application to a rendering cluster of an interactive room.
- OS/Middleware: Crossplatform
- Required library or software: Unity 3D
- Programming language: C Sharp

6.2. Platforms

6.2.1. WILDER

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

WILDER (Figure 1) is our second experimental ultra-high-resolution interactive environment, which follows the WILD platform developed in 2009 [2]. 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 that lets users interact with the wall, as well as the surrounding space, with various mobile devices. The display uses a multitouch frame (the largest of its kind in the world) to make the entire wall touch sensitive.

WILDER was inaugurated in June, 2015. It is one of the ten platforms 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, such as WildOS and Unity Cluster, that enable developers to run applications on these multi-device, cluster-based systems.

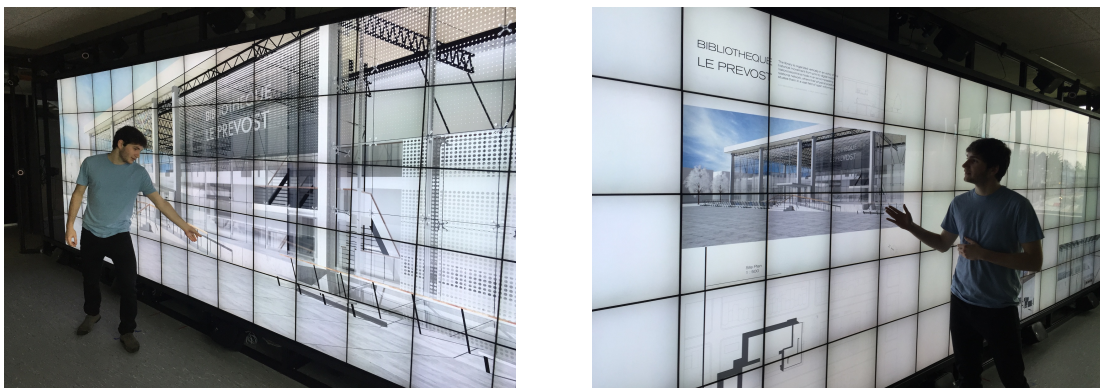


Figure 1. The WILDER platform.

GRAPHDECO Project-Team

5. New Software and Platforms

5.1. SWARPI-Unity

SWARPI-Unity (for Superpixel Warp for Image-based rendering for Unity)

This is a software module developed in collaboration with Testaluna in the context of the CR-PLAY EU project. It involves an implementation of the Image-Based rendering algorithms of the group in the Unity3D framework. The software was improved this year to support mobile Android devices and was used in the evaluation step of the CR-PLAY project and for multiple demos.

- Participants: Sebastien Bonopera, Jerome Esnault, George Drettakis and Gaurav Chaurasia
- Contact: George Drettakis

5.2. SIBR

SIBR (for Simple Image-Based Rendering)

This is a framework containing libraries and tools used internally for research projects based on Image-Base Rendering. It includes both preprocessing tools (computing data used for rendering) and rendering utilities. This new framework replaces the previously used IBR-COMMON tools.

- Participants: George Drettakis, Abdelaziz Djelouah, Rodrigo Ortiz Canyon, Theo Thonat, Sebastien Bonopera
- Contact: George Drettakis

5.3. MVIIR

MVIIR (for Multi-View Image Intrinsic Images and Relighting)

This package is the software implementation of the intrinsic image algorithm of Duchêne et al. It includes two libraries; one general-purpose that can be used to augment the functionalities of the previously mentioned SIBR framework, and another for specific logic concerning the relighting task. This package includes also programs to compute preprocess data required for the relighting of a dataset.

- Participants: George Drettakis, Sebastien Bonopera, Adrien Bousseau
- Contact: George Drettakis

5.4. SGTDP

SGTDP (for Synthetic Ground Truth Data Generation Platform)

We have started the development of a ground truth data generation platform based on complex and realistically rendered scenes built in 3D modelling packages such as 3DS Max. The platform includes an export module from 3DSMax with support for complex materials and shade trees such as those developed for the physically based rendering V-Ray platform. This module exports to the Mitsuba opensource renderer, and includes support for various operations using Mitsuba, as well as rendering on the Inria cluster. The platform is designed to generate ground truth data for learning as well as data for ground truth comparisons for image-based rendering projects in the group.

- Participants: George Drettakis, George Kopanas, Sai Bangaru
- Contact: George Drettakis

HYBRID Project-Team

6. New Software and Platforms

6.1. #FIVE

KEYWORDS: Virtual reality - Behaviour - 3D interaction

FUNCTIONAL DESCRIPTION

#FIVE (Framework for Interactive Virtual Environments) is a framework for the development of interactive and collaborative virtual environments. #FIVE was developed to answer the need for an easier and a faster design and development of virtual reality applications. #FIVE provides a toolkit that simplifies the declaration of possible actions and behaviours of objects in a VE. It also provides a toolkit that facilitates the setting and the management of collaborative interactions in a VE. It is compliant with a distribution of the VE on different setups. It also proposes guidelines to efficiently create a collaborative and interactive VE. The current implementation is in C# and comes with a Unity3D engine integration, compatible with MiddleVR framework. #FIVE contains software modules that can be interconnected and helps in building interactive and collaborative virtual environments. The user can focus on domain-specific aspects for his/her application thanks to #FIVE's modules. These modules can be used in a vast range of domains using virtual reality applications and requiring interactive environments and collaboration, such as in training for example.

- Participants: Bruno Arnaldi, Valerie Gouranton, Florian Nouviale, Guillaume Claude
- Contact: Valerie Gouranton and Florian Nouviale
- URL: <https://bil.inria.fr/fr/software/view/2527/tab>

6.2. #SEVEN

KEYWORDS: Virtual reality - Scenario - Training - Petri Net - 3D interaction

FUNCTIONAL DESCRIPTION

#SEVEN (Sensor Effector Based Scenarios Model for Driving Collaborative Virtual Environments) is a sensor effector based scenario engine that enables the execution of complex scenarios for driving Virtual Reality applications. #SEVEN's scenarios are based on an enhanced Petri net model which is able to describe and solve intricate event sequences. #SEVEN comes with an editor for creating, editing and remotely controlling and running scenarios. #SEVEN is implemented in C# and can be used as a stand-alone application or as a library. An integration to the Unity3D engine, compatible with MiddleVR, also exists.

- Participants: Bruno Arnaldi, Valerie Gouranton, Florian Nouviale, Guillaume Claude
- Contact: Valerie Gouranton and Florian Nouviale
- URL: <https://bil.inria.fr/fr/software/view/2528/tab>

6.3. OpenViBE

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

FUNCTIONAL DESCRIPTION

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

- Participants: Anatole Lécuyer, Jussi Tapio Lindgren, Jerome Chabrol, Charles Garraud, and Marsel Mano
- Partners: Inria teams POTIOC, ATHENA and NEUROSYS
- Contact: Anatole Lécuyer
- URL: <http://openvibe.inria.fr>
- URL: <https://bil.inria.fr/fr/software/view/1194/tab>

6.4. Platform: Immerstar

- Participants : Florian Nouviale, Ronan Gaugne

With the two platforms of virtual reality, Immersia and Immermove, grouped under the name Immerstar, the team has access to high level scientific facilities. This equipment benefits the research teams of the center and has allowed them to extend their local, national and international collaborations. The Immerstar platform is granted by a Inria CPER funding for 2015-2019 that enables important evolutions of the equipment. In 2016, the first technical evolutions have been decided, with, for Immermove, the addition of a third face to the immersive space, and the extension of the Vicon tracking system, and for Immersia, the installation of WQXGA laser projectors and of a new tracking system.

ILDA Project-Team

6. New Software and Platforms

6.1. Smarties

FUNCTIONAL DESCRIPTION

The Smarties system 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.

- Contact: Olivier Chapuis
- URL: <http://smarties.lri.fr/>

Smarties was used in the projects that led to the following publications this year: [7], [8], [22].

6.2. ZVTM

Zoomable Visual Transformation Machine

KEYWORDS: Information visualization - Data visualization - Visualization - Big data - Graph visualization

FUNCTIONAL DESCRIPTION

ZVTM is a toolkit enabling the implementation of multi-scale interfaces for interactively navigating in large datasets displayed as 2D graphics.

ZVTM is used for browsing large databases in multiple domains: geographical information systems, control rooms of complex facilities, astronomy, power distribution systems.

The toolkit also enables the development of applications running on ultra-high-resolution wall-sized displays.

- Participants: Caroline Appert, Maria Jesus Lobo Gunther, Arnaud Prouzeau, Hande Ozaygen, Can Liu and Olivier Chapuis
- Contact: Emmanuel Pietriga
- URL: <http://zvtm.sf.net>

Smarties was used in the projects that led to the following publications this year: [7], [8], [22], [19], [21].

6.3. Platforms

6.3.1. Platform: WILDER

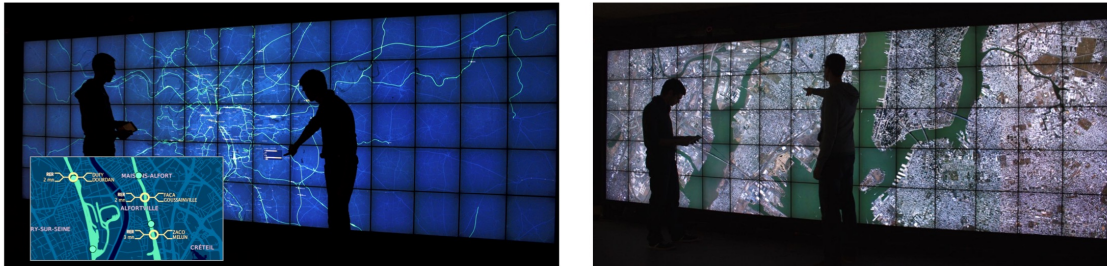


Figure 2. Geovisualization applications running on the WILDER platform. Real-time monitoring of railroad traffic in France (left), large-scale high-resolution orthoimagery visualization (right).

Ultra-high-resolution wall-sized displays [33] feature a very high pixel density over a large physical surface. Such platforms have properties that make them well-suited to the visualization of very large datasets. They can represent the data with a high level of detail while at the same time retaining context: users can transition from an overview of the data to a detailed view simply by physically moving in front of the wall display. Wall displays also offer good support for collaborative work, enabling multiple users to simultaneously visualize and interact with the displayed data. To make them interactive, wall-sized displays are increasingly coupled with input devices such as touch frames, motion-tracking systems and wireless multitouch devices, in order to enable multi-device and multi-user interaction with the displayed data. Application areas for such visualization platforms range from the monitoring of complex infrastructures and crisis management situations to tools for the exploratory visualization of scientific data.

WILDER is the latest ultra-high-resolution wall-sized display set up at Inria Saclay, and is one of the nodes of the Digiscope EquipEx. We use this platform for multiple projects, both fundamental HCI research, and research and development activities for specific application areas such as geographical informations systems (Figure 2) and astronomy (see Figure 3).

WILDER was used in the projects that led to the following publications this year: [7], [8], [22], [19], [23].

6.3.2. Platform: ANDES

ANDES is a platform similar to WILDER, set up at Inria in Santiago de Chile, that we use both as a research platform and as a showroom of our research and development activities. ANDES is the main platform used for our collaborative research project with the Millenium Institute of Astrophysics on the visualization of large FITS images (see Figure 3).

ANDES was used in the projects that led to the following publications this year: [7].

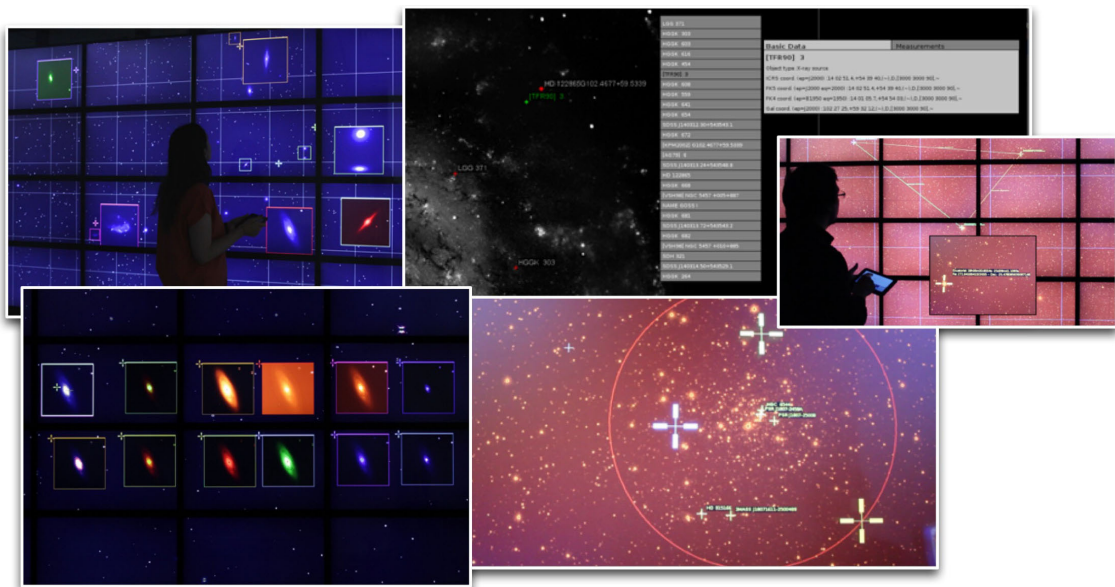


Figure 3. Visualization of high-dynamic-range FITS images and associated data catalogs in the domain of Astronomy on ANDES (collaboration with Inria Chile, Millenium Institute of Astrophysics, and Institut d'Astrophysique Spatiale).

IMAGINE Project-Team

5. New Software and Platforms

5.1. Expressive

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

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

5.2. MyCF



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

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

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

5.3. SOFA

Simulation Open Framework Architecture

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

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

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

5.4. Natron

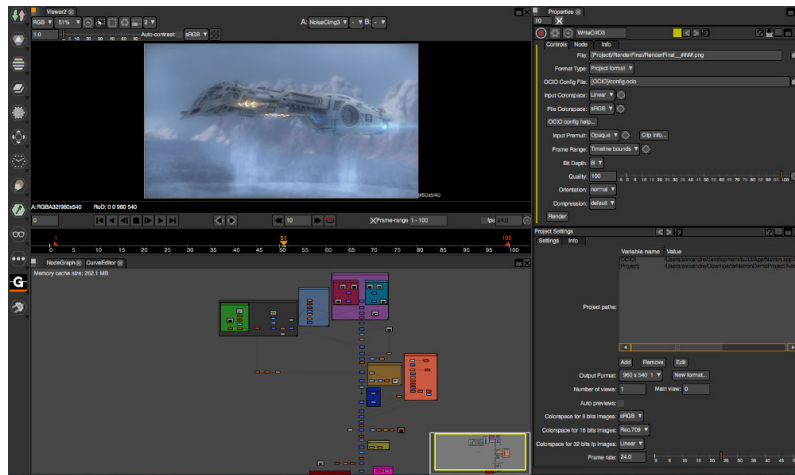


Figure 2. Video compositing using the Natron interface.

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

Typical examples of compositing are, for example:

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

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

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

MANAO Project-Team

6. New Software and Platforms

6.1. ALTA Lib

The ALTA Library

KEYWORDS: Statistic analysis - Fitting - Measures

FUNCTIONAL DESCRIPTION

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, tools to understand models and data.

- Participants: Laurent Belcour, Romain Pacanowski, Xavier Granier and Pascal Barla
- Partner: LP2N (CNRS - UMR 5298)
- Contact: Romain Pacanowski
- URL: <http://alta.gforge.inria.fr/>

6.2. Elasticity Skinning

SCIENTIFIC DESCRIPTION

Geometric skinning techniques are very popular in the industry for their high performances, but fail to mimic realistic deformations. With elastic implicit skinning the skin stretches automatically (without skinning weights) and the vertices distribution is more pleasing. Our approach is more robust, for instance the angle's range of joints is larger than implicit skinning.

This software has been ported as a plugin for the Modo software (The Foundry) in collaboration with *Toulouse Tech Transfer*. This plugin has been bought by The Foundry, which maintains and sells it.

- Participants: Rodolphe Vaillant, Loïc Barthe, Florian Canezin, Gaël Guennebaud, Marie-Paule Cani, Damien Rohmer, Brian Wyvill, Olivier Gourmel and Mathias Paulin
- Partners: Université de Bordeaux - CNRS - INP Bordeaux - Université de Toulouse - Institut Polytechnique de Grenoble - Ecole Supérieure de Chimie Physique Electronique de Lyon
- Contact: Gaël Guennebaud
- URL: <http://rodolphe-vaillant.fr/?e=59>

6.3. Eigen

FUNCTIONAL DESCRIPTION

Eigen is an 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, AVX, FMA, AVX512, Altivec, VSX 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.

In 2016, we released three revisions of the 3.2 branch, as well as the new 3.3 version that leverages numerous major novel features and improvements. Those include, a novel evaluation mechanism of expressions, support for AVX, FMA, AVX512, VSX and ZVector vector instructions, unaligned vectorization, nvcc/CUDA, more OpenMP parallelism, a fast divide and conquer SVD algorithm, a CompleteOrthogonalDecomposition class for fast minimal norm solving, a LS-CG solver, a fast reciprocal condition number estimators in LU and Cholesky factorizations, LU::transpose()/adjoint() API, support for inplace decompositions, support for matrix-free iterative solvers, new array functions, support for any BLAS/LAPACK libraries as backend, improved support for mixing scalar types, eigenvectors in GeneralizedEigenSolver, a complete rewrite of LinSpaced, a non officially supported but massively used Tensor module with CUDA and OpenCL support, and **more**.

- Participant: Gaël Guennebaud
- Contact: Gaël Guennebaud
- URL: <http://eigen.tuxfamily.org/>

6.4. HDRSee

KEYWORDS: OpenGL-GLSL HDR/LDR Viewer **FUNCTIONAL DESCRIPTION** HDRSee is a OpenGL/GLSL software that displays High Dynamic Range (HDR) and Low Dynamic Range (LDR) images. It is based on several libraries (e.g., glut, see below for full dependencies). To display HDR images, HDRSee implements a few tone-mapping operators. Moreover, it is designed with a plugin mechanism that let developers add, as easily as possible, their own tone-mapping operator. All tone-mapping operations are done using Graphics Hardware through pixel shader operations. The GUI currently used is nvWidgets.

- Participants: Romain Pacanowski, Xavier Granier.
- Partner: LP2N (CNRS - UMR 5298)
- Contact: Romain Pacanowski
- URL: <http://mhdrviewer.gforge.inria.fr/>

6.5. Patate Lib

KEYWORDS: Expressive rendering - Multi-scale analysis - Material appearance - Vector graphics - 2D animation

FUNCTIONAL DESCRIPTION

Patate is a header only C++/CUDA library for graphics applications. 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.

The library is still in its infancy and we are actively working on it to include the latest of our published research techniques. Modules will be dealing with graphics domains as varied as multi-scale analysis, material appearance, vector graphics, expressive rendering and 2D animation.

- Participants: Gaël Guennebaud, Pascal Barla, Simon Boyé, Gautier Ciaudo and Nicolas Mellado
- Contact: Gaël Guennebaud
- URL: <http://patate.gforge.inria.fr/html/>

MAVERICK Project-Team

6. New Software and Platforms

6.1. Diffusion curves

KEYWORDS: Vector-based drawing - Shading

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

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

6.2. GRATIN

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

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

6.3. GigaVoxels

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

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

6.4. HQR

High Quality Renderer

KEYWORDS: Lighting simulation

FUNCTIONAL DESCRIPTION

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

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

6.5. MobiNet

KEYWORDS: Co-simulation - Education - Programmation

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

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

6.6. PROLAND

PROcedural LANDscape

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

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

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

6.7. ShwarpIt

KEYWORD: Warping

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

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

6.8. VRender

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

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

6.9. X3D TOOLKIT

X3D Development platform

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

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

6.10. libylm

LibYLM

KEYWORD: Spherical harmonics

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

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

MIMETIC Project-Team

6. New Software and Platforms

6.1. AsymGait

Asymmetry index for clinical gait analysis based on depth images

KEYWORDS: Motion analysis - Kinect - Clinical analysis

SCIENTIFIC DESCRIPTION

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

FUNCTIONAL DESCRIPTION

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

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

6.2. Cinematic Viewpoint Generator

KEYWORDS: Virtual Cinematography - Intelligent Gallery

FUNCTIONAL DESCRIPTION

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

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

6.3. Directors Lens Motion Builder

KEYWORDS: Previsualization - Virtual cinematography - 3D animation

FUNCTIONAL DESCRIPTION

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

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

6.4. Kimea

Kinect IMprovement for Egronomics Assessment

KEYWORDS: Biomechanics - Motion analysis - Kinect

SCIENTIFIC DESCRIPTION

Kimea consists in correcting skeleton data delivered by a Microsoft Kinect for ergonomics purposes. Kimea is able to manage most of the occultations that can occur on workstations (real working situations). To this end, Kimea relies on a database of examples/poses organized as a graph, in order to replace unreliable body segment reconstructions by poses that have already been measured on real subjects. The potential pose candidates are used in an optimization framework.

FUNCTIONAL DESCRIPTION

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

- Participants: Franck Multon, Pierre Plantard and Hubert Shum
- Partner: Faurecia
- Contact: Franck Multon

6.5. Populate

KEYWORDS: Behavioral animation - Virtual cities

SCIENTIFIC DESCRIPTION

Populate is a toolkit dedicated to task scheduling under time and space constraints in the field of behavioral animation. It is currently used to populate virtual cities with pedestrians performing different kind of activities implying travels between different locations. However the generic aspect of the algorithm and underlying representations enables 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 fulfilment are identified and locations where tasks should be performed are automatically selected.

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

FUNCTIONAL DESCRIPTION

The software provides the following functionalities:

- A high level XML dialect that is dedicated to the description of agents activities in terms of tasks and sub activities that can be combined with different kind of operators: sequential, without order, interlaced. This dialect also enables the description of time and location constraints associated to tasks.
- An XML dialect that enables the description of agent's personal characteristics.
- An informed graph describes the topology of the environment as well as the locations where tasks can be performed. A bridge between TopoPlan and Populate has also been designed. It provides an automatic analysis of an informed 3D environment that is used to generate an informed graph compatible with Populate.
- The generation of a valid task schedule based on the previously mentioned descriptions.
- Participants: Fabrice Lamarche and Carl-Johan Jorgensen
- Contact: Fabrice Lamarche

6.6. The Theater

KEYWORDS: Interactive Scenarios - 3D animation - Storytelling

SCIENTIFIC DESCRIPTION

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

FUNCTIONAL DESCRIPTION

The Theater is Unity 3D application. XML descriptions are used to specify characters behaviors.

- Contact: Marc Christie

6.7. Immerstar Platform

Participants: Georges Dumont [contact], Ronan Gaugne, Anthony Sorel, Franck Multon.

With the two platforms of virtual reality, Immersia and Immermove, grouped under the name Immerstar, the team has access to high level scientific facilities. This equipment benefits the research teams of the center and has allowed them to extend their local, national and international collaborations. The Immerstar platform is granted by a Inria CPER funding for 2015-2019 that enables important evolutions of the equipment. In 2016, the first technical evolutions have been decided, with, for Immermove, the addition of a third face to the immersive space, and the extension of the Vicon tracking system, and for Immersia, the installation of WQXGA laser projectors and of a new tracking system.

MINT Project-Team

5. New Software and Platforms

5.1. ControllAR

FUNCTIONAL DESCRIPTION

ControllAR is a novel system that facilitates the appropriation of rich visual feedback on control surfaces through remixing of graphical user interfaces and augmented reality display.

- Contact: Florent Berthaut
- URL: <http://forge.lifl.fr/ControllAR>

5.2. GINA

- Participants: Nicolas Bremard and Laurent Grisoni
- Contact: Laurent Grisoni

5.3. Revil

FUNCTIONAL DESCRIPTION

Revil is an application for building and manipulating 3D SceneGraphs for Mixed-Reality Artistic Performances. It is based on OpenGL/GLSL(glfw, glm), OpenNI2, FLTK and is entirely controllable via OpenSoundControl messages. It relies on the approach of revealing virtual content in the physical space by intersecting it with performers and spectator's bodies and props.

- Contact: Florent Berthaut
- URL: <http://forge.lifl.fr/Revil>

5.4. TaxtelOSC

FUNCTIONAL DESCRIPTION

TaxtelOSC is a software which uses the concept of taxtel to reproduce rich and dense tactile feedback on

- Contact: Laurent Grisoni
- URL: <http://forge.lifl.fr/ControllAR>

Mjolnir Team

6. New Software and Platforms

6.1. Introduction

Each software listed below is characterized according to the *criteria for software self-assessment* proposed by **Inria's Evaluation Committee**. Note that the only software mentioned here are those that were created or significantly modified during the year.

6.2. Libpointing

Participants: Géry Casiez [correspondent], Nicolas Roussel, Izzatbek Mukhanov, Sébastien Poulmane.

Libpointing is a software toolkit that provides direct access to HID pointing devices and supports the design and evaluation of pointing transfer functions [3]. 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, Java and Node.js bindings available (about 49,000 lines of code in total). It is publicly available under the GPLv2 license.

The library has been thoroughly improved in 2016. Notable changes concern the migration of code on GitHub, the set up of continuous integration and the automated release of buildings for Windows, Linux and MacOS. libpointing can be easily installed using apt-get command on Linux and Homebrew and Macport package installers on MacOS. New features like the estimation of the input frequency have been added and different demos have been developed. Code has been re-factored and various bugs fixed.

Web site: <http://libpointing.org/>

Software characterization: [A-3] [SO-3] [SM-2] [EM-2↑] [SDL-5]

6.3. Liblag

Participants: Géry Casiez [correspondent], Nicolas Roussel, Sébastien Poulmane.

Liblag is a software toolkit designed to support the comparison of latency compensation techniques. The toolkit notably includes a playground application that allows to compare different trajectory prediction algorithms on desktop (OS X, Ubuntu and Windows) and mobile (iOS and Android) systems. The source code for this toolkit (about 8,500 lines of code) is only available to TurboTouch partners for now.

Sébastien Poulmane was recruited in May as an engineer on the TurboTouch project. He has been contributing to refactor the code, integrate new input devices and new prediction techniques and also develop associated demos and experiments.

Software characterization: [A-1] [SO-4] [SM-1] [EM-2] [SDL-1]

6.4. Mouse-based lagmeter

Participants: Géry Casiez [correspondent], Stéphane Huot, Nicolas Roussel.

As part of the work reported in [46], we implemented our mouse-based method for measuring end-to-end latency using Java/Swing, C++/GLUT, C++/Qt and JavaScript/HTML5. We also wrote Python scripts to parse the logs generated by these implementations in order to compare them. This software (about 2,500 lines of code) was made available in 2016 on a public git repository. The online interactive demo has been improved to collect anonymous latency measurement data from users and integrate libpointing in order to get information about the input and output devices connected. A native Android version has also been developed.

Web site: <http://mjolnir.lille.inria.fr/turbotouch/lagmeter/>

Software characterization: [A-1] [SO-4] [SM-1] [EM-2] [SDL-1]

6.5. TAN

Participants: Fanny Chevalier [correspondent], Nicolas Roussel, Stéphane Huot.

TAN stands for *Transitions animées*, i.e. *Animated transitions*. This web site illustrates some of our past research on this topic. It combines videos and live demonstrations of Histomages, an image editing tool that associates pixel and color space; Diffamation, an animation tool to follow and understand the modifications made to a document over time; and Glimpse, a markup language editor (e.g. HTML, LaTeX, Wiki) to instantly switch from source code to the document it produces and vice versa. The source code for the three demonstrators (about 87,000 lines of Java and JavaScript) is not distributed for the moment.

Web site: <http://tan.lille.inria.fr/>

Software characterization: [A-4] [SO-2] [SM-3] [EM-2] [SDL-4]

6.6. InspectorWidget

Participants: Christian Frisson [correspondent], Sylvain Malacria.

InspectorWidget [26] is an HTML5/nodejs/C++ software suite that can be used by an experimenter to track and analyze users' behaviors in closed interactive software. The suite has a *recording* module that records users' display and captures low-level events while she carries her task, and an *annotation* module that combines OCR and low-level inputs analysis so the experimenter post-annotate users' activity afterwards. InspectorWidget is cross-platform, open-source and publicly available under the GPLv3 license. New features, notably recording and exploiting accessibility API, are currently under development in order to be tested and added to the software suite.

Web site: <https://github.com/InspectorWidget/InspectorWidget/>

Software characterization: [A-2[↑]] [SO-3] [SM-3[↑]] [EM-3] [SDL-4]

POTIOC Project-Team

6. New Software and Platforms

6.1. PapARt

PapARt is a software development kit (SDK) that enables the creation of interactive projection mapping (See <https://project.inria.fr/papart>). This year, we focused on making this toolkit widely available. We created a set of examples and created tutorials. The PapARt code is now Open Source, our objective being to favor a wide appropriation by artists, teachers, or students.

Participants: Jeremy Laviolle, Martin Hachet

URL: <https://github.com/poqudrof/Papart-examples/wiki>

6.2. Helios

Helios is a software tool (Unity3D) we have developed in collaboration with Stéphanie Fleck from Université de Lorraine. It is dedicated to the learning of astronomy at school. It bases on augmented reality and tangible interaction. See Section 7.4 .

Participants: Robin Gourdel, Jérémy Laviolle, Benoit Coulais, Martin Hachet.

Partners: Université de Lorraine - SATT Nancy Grand-Est.

6.3. Aïana

We have developped Aïana, a MOOC player, with the support of the Inria MOOC Lab. Aïana offers original interaction features in order to enable a wide spectrum of users including persons with disabilities. The first version of Aïana has been used by the 3700 participants of the Digital Accessibility MOOC we have produced on the national MOOC platform FUN. See Section 7.9 .

Participants: Pierre-Antoine Cinquin, Pascal Guitton

Partners: LearningLab Inria

6.4. HOBIT

Along with the project HOBIT (see Section 7.1), we continue enhancing the platform that is dedicated to the simulation and augmentation of optics experiments. In particular, this year, we did a major evolution that consists in making the system reconfigurable. Various optical components be plugged in, and the simulation and augmentations are updated accordingly.

Participants: Benoit Coulais, David Furio, Martin Hachet.

Partners: Université de Bordeaux - IUT de Bordeaux, LaBRI, IMS, CELIA

<https://project.inria.fr/hobit>

TITANE Project-Team

6. New Software and Platforms

6.1. CGAL Barycentric_coordinates_2

This CGAL software component offers an efficient and robust implementation of two-dimensional closed-form generalized barycentric coordinates defined for simple two-dimensional polygons.

- Participants: Pierre Alliez
- Contact: Pierre Alliez
- URL: http://doc.cgal.org/latest/Barycentric_coordinates_2/index.html#Chapter_2D_Generalized_Barycentric_Coordinates

6.2. MeshMantics

This software component implements an approach that reconstructs 3D urban scenes in the form of levels of detail (LODs). Starting from raw data sets such as surface meshes generated by multi-view stereo systems, the algorithm proceeds in three main steps: classification, abstraction and reconstruction. From geometric attributes and a set of semantic rules combined with a Markov random field, we classify the scene into four meaningful classes. The abstraction step detects and regularizes planar structures on buildings, fits icons on trees, roofs and facades, and performs filtering and simplification for LOD generation. The abstracted data are then provided as input to the reconstruction step which generates watertight buildings through a min-cut formulation on a set of 3D arrangements.

- Participants: Florent Lafarge and Pierre Alliez
- Contact: Pierre Alliez
- URL: <https://bil.inria.fr>

6.3. Module CGAL : Point Set Processing

This CGAL component implements methods to analyze and process unorganized point sets. The input is an unorganized point set, possibly with normal attributes (unoriented or oriented). The point set can be analyzed to measure its average spacing, and processed through functions devoted to the simplification, outlier removal, smoothing, normal estimation, normal orientation and feature edges estimation.

- Participants: Pierre Alliez and Clément Jamin
- Contact: Pierre Alliez
- URL: http://doc.cgal.org/latest/Point_set_processing_3/index.html#Chapter_Point_Set_Processing

6.4. Module CGAL : Scale space surface reconstruction

This method allows to reconstruct a surface that interpolates a set of 3D points. This method provides an efficient alternative to the Poisson surface reconstruction method. The main difference in output is that this method reconstructs a surface that interpolates the point set (as opposed to approximating the point set). How the surface connects the points depends on a scale variable, which can be estimated semi-automatically.

- Participants: Pierre Alliez
- Contact: Pierre Alliez
- URL: http://doc.cgal.org/latest/Scale_space_reconstruction_3/index.html#Chapter_Scale_space_reconstruction

6.5. Skeleton-Blockers

Skeleton-Blockers is a compact, efficient and generic data-structure that can represent any simplicial complex. The implementation is in C++11.

- Participant: David Salinas
- Contact: David Salinas
- URL: <https://project.inria.fr/gudhi/software/>

6.6. APP Deposits

WALLEMME is a software for classifying large-scale urban areas from dense textured 3D meshes in a supervised manner.

- Participants: Mohammad Rouhani, Florent Lafarge and Pierre Alliez.

DIMUVIC is a software for reconstructing in 3D a polyline-sketch using contextual knowledge contained in multiview stereo images.

- Participants: Jean-Dominique Favreau, Florent Lafarge and Adrien Bousseau.

ROOFEXTRACTOR is a software for reconstructing roofs from dense defect-laden meshes as compact piecewise-planar surface representations.

- Participants: Sven Oesau and Florent Lafarge.

ALPAGE Project-Team

5. New Software and Platforms

5.1. Alexina

Atelier pour les LEXiques INformatiques et leur Acquisition

FUNCTIONAL DESCRIPTION

Alexina is Alpage's 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 Lefff, a morphological and syntactic lexicon for French.

- Participants: Benoît Sagot and Laurence Danlos
- Contact: Benoît Sagot
- URL: <http://gforge.inria.fr/projects/alexina/>

5.2. Bonsai

FUNCTIONAL DESCRIPTION

Alpage has developed a statistical parser for French, named Bonsai, trained on the French Treebank. This parser provides both a phrase structure and a projective dependency structure 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.

- Participants: Marie-Hélène Candito, Djame Seddah and Benoît Crabbe
- Contact: Marie-Hélène Candito
- URL: http://alpage.inria.fr/statgram/frdep/fr_stat_dep_parsing.html

5.3. Crapbank

French Social Media Bank

FUNCTIONAL DESCRIPTION

The French Social Media Bank is a treebank of French sentences coming from various social media sources (Twitter(c), Facebook(c)) and web forums (JeuxVidéos.com(c), Doctissimo.fr(c)). It contains different kind of linguistic annotations: part-of-speech tags, surface syntactic representations (phrase-based representations), as well as normalized form whenever necessary.

- Contact: Djame Seddah

5.4. DyALog

FUNCTIONAL DESCRIPTION

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.

- Participant: Eric Villemonte De La Clergerie
- Contact: Eric Villemonte De La Clergerie
- URL: <http://dyalog.gforge.inria.fr/>

5.5. FDTB1

- Contact: Laurence Danlos

5.6. FQB

French QuestionBank
FUNCTIONAL DESCRIPTION

The French QuestionBanks is a corpus of around 2000 questions coming from various domains (TREC data set, French governmental organisation, NGOs, etc..) it contains different kind of annotations - morpho-syntactic ones (POS, lemmas) - surface syntaxe (phrase based and dependency structures) with long-distance dependency annotations.

The TREC part is aligned with the English QuestionBank (Judge et al, 2006).

- Contact: Djame Seddah

5.7. FRMG

- Participant: Eric Villemonte De La Clergerie
- Contact: Éric De La Clergerie
- URL: <http://mgkit.gforge.inria.fr/>

5.8. Extreme UGC corpus

FUNCTIONAL DESCRIPTION

The Extreme UGC corpus is French three-domain data set focusing on user-generated content, made up of noisy question headlines from a cooking forum, live game chat logs and associated forums from two popular online games (MINECRAFT and LEAGUE OF LEGENDS). Building such an out of domain corpus, allowed us to consider the limits of our current normalization approaches. Currently annotated with part-of-speech, we plan to add other annotations layers.

- Contact: Djame Seddah

5.9. LexConn

- Contact: Laurence Danlos

5.10. LexViz

FUNCTIONAL DESCRIPTION

In the context of the industrial collaboration of ALPAGE with the company Lingua & Machina, we have extended their WEB platform 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).

- Participants: Eric Villemonte De La Clergerie and Mickaël Morardo
- Contact: Eric Villemonte De La Clergerie

5.11. MElt

Maximum-Entropy lexicon-aware tagger

KEYWORD: Part-of-speech tagger

FUNCTIONAL DESCRIPTION

MElt is a freely available (LGPL) state-of-the-art sequence labeller that is meant to be trained on both an annotated corpus and an external lexicon. It was developed by Pascal Denis and Benoît Sagot within the Alpage team, a joint Inria and Université Paris-Diderot team in Paris, France. MElt allows for using multiclass Maximum-Entropy Markov models (MEMMs) or multiclass perceptrons (multitrons) as underlying statistical devices. Its output is in the Brown format (one sentence per line, each sentence being a space-separated sequence of annotated words in the word/tag format).

MElt has been trained on various annotated corpora, using Alexina lexicons as source of lexical information. As a result, models for French, English, Spanish and Italian are included in the MElt package.

MElt also includes a normalization wrapper aimed at helping processing noisy text, such as user-generated data retrieved on the web. This wrapper is only available for French and English. It was used for parsing web data for both English and French, respectively during the SANCL shared task (Google Web Bank) and for developing the French Social Media Bank (Facebook, twitter and blog data).

- Contact: Benoît Sagot
- URL: <https://www.rocq.inria.fr/alpage-wiki/tiki-index.php?page=MElt>

5.12. Mgwiki

FUNCTIONAL DESCRIPTION

Mgwiki is a linguistic wiki that may be 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.

- Participants: Eric Villemonte De La Clergerie and Paul Bui-Quang
- Contact: Eric Villemonte De La Clergerie
- URL: <http://alpage.inria.fr/frmgwiki/>

5.13. OGRE

Optimized Graph Rewriting Engine

FUNCTIONAL DESCRIPTION

OGRE is a graph rewriting system specifically designed for manipulating linguistic trees and graphs. It relies on a rule specification language for expressing graph rewriting patterns. The transformation is performed in two steps:

First, the system performs simple transformations following the rewriting patterns,

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 designed for the analysis and manipulation of attributed oriented and multi-relational graphs. It is currently being used to convert existing universal dependencies for French to the upcoming 2.0 scheme to be used for the next “big” CoNLL parsing Shared Task of 2017.

- Participants: Corentin Ribeyre, Djame Seddah, Eric Villemonte De La Clergerie and Marie-Hélène Candito
- Contact: Corentin Ribeyre
- URL: <http://www.corentinribeyre.fr/projects/view/OGRE>

5.14. SYNTAX

FUNCTIONAL DESCRIPTION

Syntax system 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 Sx Pipe 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).

- Participants: Pierre Boullier, Philippe Deschamps and Benoît Sagot
- Contact: Pierre Boullier
- URL: <http://syntax.gforge.inria.fr/>

5.15. Sequoia corpus

FUNCTIONAL DESCRIPTION

The Sequoia corpus contains French sentences, annotated with various linguistic information:

- parts-of-speech
- surface syntactic representations (both constituency trees and dependency trees)
- deep syntactic representations (which are deep syntactic dependency graphs)
- Contact: Djame Seddah

5.16. SxPipe

SCIENTIFIC DESCRIPTION

Developed for French and for other languages, Sx Pipe 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.

FUNCTIONAL DESCRIPTION

SxPipe 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) and for surface processing (named entities recognition, text normalization, unknown word extraction and processing...).

- Participants: Pierre Boullier, Benoît Sagot, Eric Villemonte De La Clergerie and Djame Seddah
- Contact: Benoît Sagot
- URL: <http://lingwb.gforge.inria.fr/>

5.17. Verb \ni net

- Contact: Laurence Danlos

5.18. dyalog-sr

KEYWORD: Parsing

FUNCTIONAL DESCRIPTION

DyALog-SR is a transition-based dependency parser, built on top of DyALog system. Parsing relies on dynamic programming techniques to handle beams. Supervised learning exploit a perceptron and aggressive early updates. DyALog-SR can handle word lattice and produce dependency graphs (instead of basic trees). It was tested during several shared tasks (SPMRL'2013 and SEMEVAL'2014). It achieves very good accuracy on French TreeBank, alone or by coupling with FRMG parser.

- Contact: Éric De La Clergerie

5.19. hyparse

Alpage Hybrid Parser

KEYWORDS: Parsing - NLP

FUNCTIONAL DESCRIPTION

Multilingual Phrase Structure Parser

- Contact: Benoît Crabbe
- URL: <http://hyparse.gforge.inria.fr>

5.20. vera

- Participants: Benoît Sagot and Dimitri Tcherniak
- Partner: Verbatim Analysis
- Contact: Benoît Sagot

MULTISPEECH Project-Team

6. New Software and Platforms

6.1. ASTALI

Automatic Speech-Text Alignment Software

KEYWORD: Speech-text alignment

FUNCTIONAL DESCRIPTION

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

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

6.2. dnnsep

Multichannel audio source separation with deep neural networks

KEYWORDS: Audio - Source Separation - Deep learning

SCIENTIFIC DESCRIPTION

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

FUNCTIONAL DESCRIPTION

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

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

6.3. JSnoori

FUNCTIONAL DESCRIPTION

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

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

6.4. KATS

Kaldi-based Automatic Transcription System

KEYWORD: Speech recognition

FUNCTIONAL DESCRIPTION

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

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

6.5. PLAVIS

Software for audio-visual and multimodal data acquisition and processing

FUNCTIONAL DESCRIPTION

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

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

6.6. SOJA

Speech Synthesis platform in JAVa

FUNCTIONAL DESCRIPTION

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

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

6.7. VisArtico

Visualization of EMA Articulatory data

FUNCTIONAL DESCRIPTION

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

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

6.8. Xarticulators

KEYWORD: Medical imaging

FUNCTIONAL DESCRIPTION

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

During 2016, we developed a new version of the articulatory model which incorporates a more realistic model of the epiglottis and lips.

- Contact: Yves Laprie

6.9. Platforms

6.9.1. Platform MultiMod : Multimodal Acquisition Data Platform

FUNCTIONAL DESCRIPTION

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

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

PANAMA Project-Team

6. New Software and Platforms

6.1. Audio Activity Detector

KEYWORD: Audio activity estimation

- Authors: Frédéric Bimbot, Ewen Camberlein, Romain Lebarbenchon and Vincent Soupe
- Contact: Frédéric Bimbot

6.2. Audio Breath Rhythm Estimator

KEYWORD: Breath rhythm estimation

- Authors: Frédéric Bimbot, Ewen Camberlein and Romain Lebarbenchon
- Contact: Frédéric Bimbot

6.3. Audio GMM Classifier

- Authors: Frédéric Bimbot, Vincent Soupe, Jérémy Paret, Ewen Camberlein and Romain Lebarbenchon
- Contact: Frédéric Bimbot

6.4. CSCbox

Compressive Spectral Clustering Toolbox

KEYWORD: Clustering

SCIENTIFIC DESCRIPTION

The Compressive Spectral Clustering Toolbox is a Matlab toolbox implementing routines to reproduce experiments from the paper "Compressive Spectral Clustering", by N. Tremblay, G. Puy, P. Vandergheynst and R. Gribonval.

FUNCTIONAL DESCRIPTION

Matlab toolbox implementing routines to reproduce experiments from the paper "Compressive Spectral Clustering"

- Authors: Nicolas Tremblay, Gilles Puy, Pierre Vandergheynst and Rémi Gribonval
- Partner: EPFL - Ecole Polytechnique Fédérale de Lausanne
- Contact: Rémi Gribonval
- URL: <http://www.irisa.fr/panama/software>

6.5. FASST2

Flexible Audio Source Separation Toolbox

KEYWORDS: Audio - Source Separation

SCIENTIFIC DESCRIPTION

Only source separation software publicly available allowing to use both spacial and spectral source properties with a generalised EM algorithm (expectation - maximisation). Fast specification of each use case by the choice of suitable constraints in constraint libraries.

FUNCTIONAL DESCRIPTION

Toolbox for the fast design of audio source separation adapted to any use case.

- Participants: Emmanuel Vincent and Yann Salaun
- Contact: Emmanuel Vincent
- URL: <http://fasst.gforge.inria.fr>

6.6. FAuST

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

FUNCTIONAL DESCRIPTION

C++ toolbox, designed to decompose a given dense matrix into a product of sparse matrices in order to reduce its computational complexity (both for storage and manipulation).

- Authors: Luc Le Magoarou, Rémi Gribonval, Adrien Leman, Nicolas Bellot and Thomas Gautrais
- Contact: Rémi Gribonval
- URL: <http://faust.gforge.inria.fr/>

6.7. Multi-channel BSS Locate Basic

KEYWORDS: Audio - Localization - Signal processing - Multichannel signal

SCIENTIFIC DESCRIPTION

Multi-Channel BSS Locate is a Matlab toolbox to estimate Direction Of Arrival (expressed both in azimuth and elevation) of multiple sources in a multi-channel audio signal recorded by an array of microphones. This toolbox implements the previous 8 angular spectrum methods presented in BSS Locate (GCC-PHAT, GCC-NONLIN, MUSIC and several SNR-based spectra).

- Authors: Emmanuel Vincent, Charles Blandin, Alexey Ozerov, Ewen Camberlein, Romain Lebarbenchon, Frédéric Bimbot and Nancy Bertin
- Contact: Emmanuel Vincent
- URL: http://bass-db.gforge.inria.fr/bss_locate/

6.8. SPADE

Sparse Audio Declipper

KEYWORDS: Audio - Sparse regularization - Declipping

SCIENTIFIC DESCRIPTION

Matlab routines to reproduce audio declipping experiments from the paper: - Srdan Kitic, Nancy Bertin, Remi Gribonval. Audio Declipping by Cosparsity Hard Thresholding. iTwist - 2nd international - Traveling Workshop on Interactions between Sparse models and Technology, Aug 2014, Namur, Belgium. <hal-00922497v3> - Srdan Kitic, Nancy Bertin, Remi Gribonval. Sparsity and cosparsity for audio declipping: a flexible non-convex approach. LVA/ICA 2015 - The 12th International Conference on Latent Variable Analysis and Signal Separation, Aug 2015, Liberec, Czech Republic. pp.8. <hal-01159700v2>

- Participants: Srdan Kitic, Nancy Bertin and Rémi Gribonval
- Contact: Rémi Gribonval
- URL: <http://xspaad.gforge.inria.fr/>

6.9. SPOD Audio

KEYWORDS: Audio source classification - Speaker verification - Breath rhythm estimation - Audio activity estimation

- Authors: Frédéric Bimbot, Vincent Soupe, Ewen Camberlein and Romain Lebarbenchon
- Contact: Frédéric Bimbot
- URL: <http://www.kerlink.fr/en/>

6.10. SPOD Model Generation

KEYWORDS: Machine learning - Audio source classification - Statistical modeling - Speaker verification

- Authors: Frédéric Bimbot, Vincent Soupe, Jérémy Paret, Ewen Camberlein and Romain Lebarbenchon
- Contact: Frédéric Bimbot

6.11. SRP-PHAT

KEYWORD: Source localization

- Authors: Frédéric Bimbot, Nancy Bertin, Ewen Camberlein, Romain Lebarbenchon, Emmanuel Vincent, Charles Blandin and Alexey Ozerov
- Contact: Frédéric Bimbot

6.12. SketchMLBox

KEYWORD: Clustering

SCIENTIFIC DESCRIPTION

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

FUNCTIONAL DESCRIPTION

Matlab toolbox for fitting mixture models to large collections of feature vectors using sketching techniques.

- Authors: Nicolas Keriven, Rémi Gribonval and Nicolas Tremblay
- Partner: Université de Rennes 1
- Contact: Rémi Gribonval
- URL: <http://sketchml.gforge.inria.fr>

6.13. VoiceHome Corpus

KEYWORDS: Audio - Source Separation

FUNCTIONAL DESCRIPTION

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

- Contact: Nancy Bertin
- URL: http://voice-home.gforge.inria.fr/voiceHome_corpus.html

6.14. graphsamplingbox

- Authors: Nicolas Tremblay, Gilles Puy, Pierre Vandergheynst and Rémi Gribonval
- Partner: EPFL - Ecole Polytechnique Fédérale de Lausanne
- Contact: Rémi Gribonval
- URL: <http://www.irisa.fr/panama/software>

SEMAGRAMME Project-Team

5. New Software and Platforms

5.1. ACGtk

Abstract Categorical Grammar Development Toolkit

KEYWORDS: Natural language processing - NLP - Syntactic analysis - Semantics

FUNCTIONAL DESCRIPTION

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

- Contact: Sylvain Pogodalla
- URL: <http://www.loria.fr/equipements/calligramme/acg/>

5.2. Grew

Graph Rewriting

FUNCTIONAL DESCRIPTION

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

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

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

5.3. ZombiLingo

FUNCTIONAL DESCRIPTION

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

During 2016, the main evolutions of the application were:

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

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

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

5.4. SLAMtk

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

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

CHROMA Team

6. New Software and Platforms

6.1. CUDA-HSBOF

FUNCTIONAL DESCRIPTION

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

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

6.2. DATMO (Detection and Tracking of Moving Objects)

FUNCTIONAL DESCRIPTION

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

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

6.3. E.R.C.I.

Estimation of collision risks at road intersections

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

6.4. Embedded Perception

FUNCTIONAL DESCRIPTION

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

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

6.5. GPU BOF

Bayesian Occupancy Filter on GPU

FUNCTIONAL DESCRIPTION

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

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

6.6. GPU Stro Occupancy Grid

GPU Stereo Occupancy Grid

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

6.7. VI-SFM

FUNCTIONAL DESCRIPTION

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

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

6.8. kinetics

FUNCTIONAL DESCRIPTION

Software computing decision support strategies and decision-making

- Contact: Jilles Dibangoye

DEFROST Team

6. New Software and Platforms

6.1. SOFA

Simulation Open Framework Architecture

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

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

Since 2016, SOFA development and maintenance is now coordinated by the SOFA Consortium.

DEFROST is an active member of the consortium steering committee; beside his mission of Inria continuous integration support team coordinator, Bruno Carrez is in charge of the continuous integration setup of the SOFA consortium.

- Participants: Christian Duriez, Jeremie Dequidt, Bruno Carrez, Damien Marchal, Eulalie Coevoet, Frederick Largilliere
- Partner: Sofa consortium, projet-team Mimesis, projet-team Imagine, projet-team Asclepios, In-Simo, Anatoscope
- Contact: Hugo Talbot
- URL: <http://www.sofa-framework.org>

6.2. Soft-robot plugin for Sofa

Soft-robot plugin for Sofa

KEYWORDS: Simulation - Soft-Robot - Inverse models - Finite Element Method - Quadratic Programmings

FUNCTIONAL DESCRIPTION The soft-robot plugin consists in a new framework to simulate and control soft robots. This framework is based on a mechanical modeling of the robot elements in Sofa combined with fast real-time direct/inverse FEM solvers.

The keypoint of the approach implemented is that the same modeling is used for interactive simulation of its behavior and interactive control of the fabricated robots. This plugin was developed during the ADT project SORBET that ended in 09/2016.

- Participants: Eulalie Coevoet, Olivier Goury, Frederick Largilliere, Bruno Carrez, Damien Marchal, Jérémie Dequidt and Christian Duriez
- Contact: Eulalie Coevoet and Christian Duriez
- URL: <https://project.inria.fr/softrobot/>

FLOWERS Project-Team

6. New Software and Platforms

6.1. Poppy project

6.1.1. HiPi Board

FUNCTIONAL DESCRIPTION

HiPi is a board to control robots on Raspberry Pi. It is an extension of the Pixl board with the following features:

- A DC/DC power converter from 12V (motor) to 5V (Raspberry Pi) at 3A.
- A stereo audio amplifier 3W.
- A MPU9250 central motion unit .
- A RS232 and a RS485 bus connected to the Raspberry Pi by SPI for driving MX and RX Dynamixel motor series.

This board will be integrated soon in the new head of the Poppy Humanoid and Poppy Torso.

Using the Raspberry Pi for every Poppy robots will simplify the hardware complexity (we maintain 4 types of embedded boards, with different Linux kernel and configurations) and improve the usage and installation of new robots.

- Contact: Theo Segonds
- URL: <https://forum.poppy-project.org/t/poppy-1-1-hipi/2137>

6.1.2. IKPy

Inverse Kinematics Python Library

FUNCTIONAL DESCRIPTION

IKPy is a Python Inverse Kinematics library, designed to be simple to use and extend. It provides Forward and Inverse kinematics functionality, bundled with helper tools such as 3D plotting of the kinematics chains. Being written entirely in Python, IKPy is lightweight and is based on numpy and scipy for fast optimization. IKPy is compatible with many robots, by automatically parsing URDF files. It also supports other (such as DH-parameters) and custom representations. Moreover, it provides a framework to easily implement new Inverse Kinematics strategies. Originally developed for the Poppy project, it can also be used as a standalone library.

- Contact: Pierre Manceron
- URL: <https://github.com/Phylliade/ikpy>

6.1.3. Pixl Board

FUNCTIONAL DESCRIPTION

Pixl is a tiny board used to create low cost robots based on Raspberry Pi board and Dynamixel XL-320 motors. This board has 2 main features:

- The power part, allowing the user to plug a 7.5V AC/DC converter or a battery directly into the Pixl. This power is distributed to all XL320 motors and is converted to 5V for the Raspberry Pi board.
- The communication part, which converts full duplex to half duplex and vice-versa. The half duplex part switch between RX and TX automatically. Another connector allows the user to connect his XL320 network.

The board is used in the Poppy Ergo Jr robot.

- Contact: Theo Segonds
- URL: <https://github.com/poppy-project/pixl>

6.1.4. Poppy

FUNCTIONAL DESCRIPTION

The Poppy Project team develops open-source 3D printed robots platforms 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.

In the Poppy project we are working on the Poppy System which is a new modular and open-source robotic architecture. It is designed to help people create and build custom robots. It permits, in a similar approach as Lego, building robots or smart objects using standardized elements.

Poppy System is a unified system in which essential robotic components (actuators, sensors...) are independent modules connected with other modules through standardized interfaces:

- Unified mechanical interfaces, simplifying the assembly process and the design of 3D printable parts.
- Unified communication between elements using the same connector and bus for each module.
- Unified software, making it easy to program each module independently.

Our ambition is to create an ecosystem around this system so communities can develop custom modules, following the Poppy System standards, which can be compatible with all other Poppy robots.

- Participants: Pierre Rouanet, Matthieu Lapeyre, Jonathan Grizou and Pierre-Yves Oudeyer
- Contact: Pierre-Yves Oudeyer
- URL: <https://www.poppy-project.org/>

6.1.5. Poppy Ergo Jr

FUNCTIONAL DESCRIPTION

Poppy Ergo Jr is an open hardware robot developed by the Poppy Project to explore the use of robots in classrooms for learning robotic and computer science.

It is available as a 6 or 4 degrees of freedom arm designed to be both expressive and low-cost. This is achieved by the use of FDM 3D printing and low cost Robotis XL-320 actuators. A Raspberry Pi camera is attached to the robot so it can detect object, faces or QR codes.

The Ergo Jr is controlled by the Pypot library and runs on a Raspberry pi 2 or 3 board. Communication between the Raspberry Pi and the actuators is made possible by the Pixl board we have designed.

The Poppy Ergo Jr robot has several 3D printed tools extending its capabilities. There are currently the lampshade, the gripper and a pen holder.

With the release of a new Raspberry Pi board early 2016, the Poppy Ergo Jr disk image was updated to support Raspberry Pi 2 and 3 boards. The disk image can be used seamlessly with a board or the other.

- Contact: Theo Segonds
- URL: <https://github.com/poppy-project/poppy-ergo-jr>

6.1.6. Poppy Ergo Jr Installer

FUNCTIONAL DESCRIPTION

An alternative way to install the Ergo Jr robot software is made available using containers.

Users can own their own operating system installation, then add the Ergo Jr required software in a sandboxed environment. This results in a non-intrusive installation on the host system.

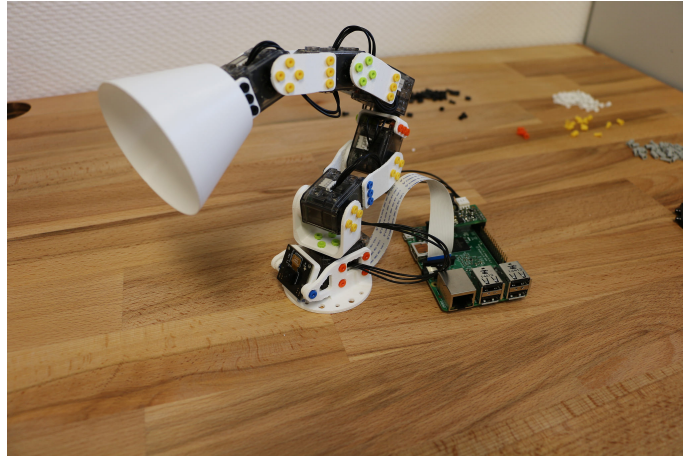


Figure 1. Poppy Ergo Jr, 6-DoFs arm robot for education

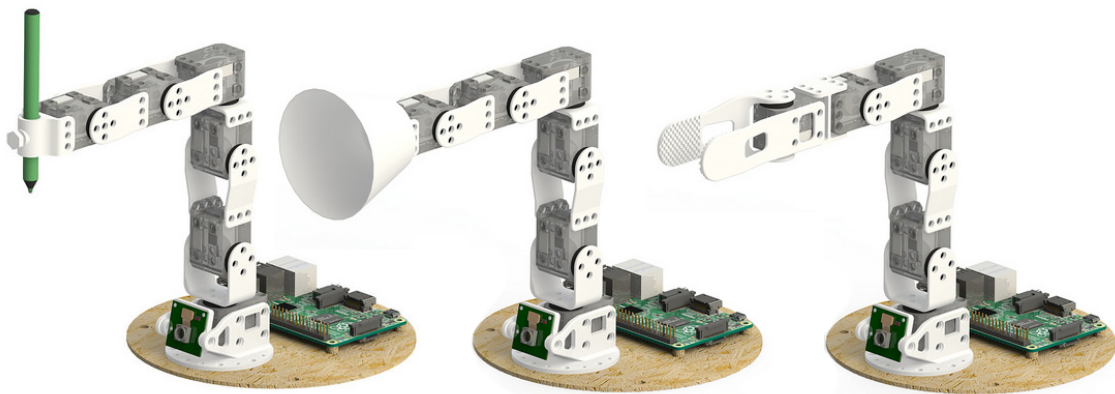


Figure 2. The available Ergo Jr tools: a pen holder, a lampshade and a gripper

Docker containers implementation were used, and image is hosted at Docker Hub.

- Contact: Damien Caselli
- URL: <https://hub.docker.com/r/poppycommunity/ergo-jr/>

6.1.7. Poppy Ergo Jr Simulator

FUNCTIONAL DESCRIPTION

Poppy Project, through Poppy Education, wants users to get used to robotics, even without owning a physical robot.

For that purpose, Poppy Project team created a dummy robot in Pypot that is meant to be used in conjunction with a consumer application. We choose to develop a web hosted application using a 3D engine (Threejs) to render the robot.

Our ambition is to have a completely standalone simulated robot with physics. Some prototypes were created to benchmark possible solutions.

- Contact: Damien Caselli
- URL: <https://github.com/poppy-project/poppy-simu>

6.1.8. PyPot

SCIENTIFIC DESCRIPTION

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. Pypot can be used to:

- control Robotis motors through a USB2serial device,
- define the structure of a custom robot and control it through high-level commands,
- define primitives and easily combine them to create complex behavior.

Pypot is part of the Poppy project. It is the core library used by the Poppy robots. This abstraction layer allows to seamlessly switch from a given Poppy robot to another. It also provides a common set of tools, such as forward and inverse kinematics, simple computer vision, recording and replaying moves, or easy access to the autonomous exploration library Explauto.

To extend pypot application domains and connection to outside world, it also provides an HTTP API. On top of providing an easy way to connect to smart sensors or connected devices, it is notably used to connect to Snap!, a variant of the well-known Scratch visual programming language.

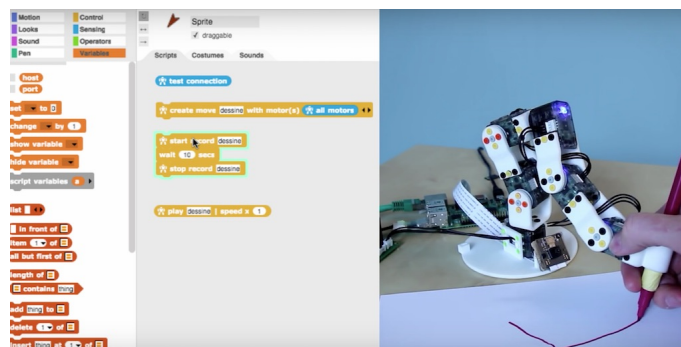


Figure 3. Example of using pypot to program a robot to reproduce a drawn shape

FUNCTIONAL DESCRIPTION

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

Pypot is also compatible with the V-REP simulator. This allows the transparent switch from a real robot to its simulated equivalent with a single code base.

Finally, it has been developed to be easily and quickly extended for other types of motors and sensors.

It works with Python 2.7 or Python 3.3 or later, and has also been adapted to the Raspberry Pi board.

Pypot has been connected to Snap!, a variant of the famous Scratch visual language, developed to teach computer science to children. It is based on a drag-and-drop blocks interface to write scripts by assembling those blocks.

Thanks to the Snap! HTTP block, a connection can be made to pypot allowing users to directly control robots through their visual interfaces. A set of dedicated Snap! blocks have been designed, such as **set motor position** or **get motor temperature**. Thanks to the Snap! HTTP block, users can control robots through this visual interfaces connecting to Pypot. A set of dedicated Snap! blocks has been designed, such as **set motor position** or **get motor temperature**.



Figure 4. Using Snap! to program a robot by demonstration and create complex choreographies

Snap! is also used as a tool to program the robot by demonstration. Using the **record** and **play** blocks, users can easily trigger kinesthetic recording of the whole robot or only a specific subpart, such as an arm. These records can then be played or "mixed" - either played in sequence or simultaneously - with other recordings to compose complex choreographies. The moves are encoded as a model of mixture of gaussians (GMM) which allows the definition of clean mathematical operators for combining them.

This recording tool has been developed and used in collaboration with artists who show interest in the concept of robotic moves.

- Participants: Pierre Rouanet, Matthieu Lapeyre, Steve Nguyen, Damien Caselli and Theo Segonds
- Contact: Theo Segonds
- URL: <https://github.com/poppy-project/pypot>

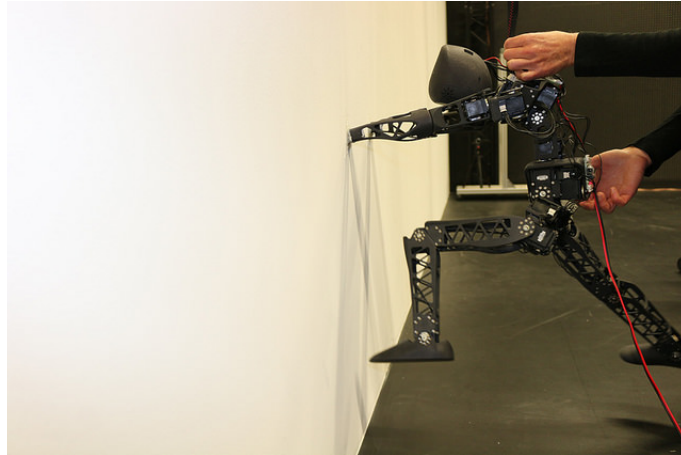


Figure 5. Artistic project exploring the concept of robotic move.

6.1.9. PyQMC

Python library for Quasi-Metric Control
FUNCTIONAL DESCRIPTION

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 independent 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.

- Participant: Steve Nguyen
- Contact: Steve Nguyen
- URL: <https://github.com/SteveNguyen/pyqmc>

6.2. Explauto

an autonomous exploration library
SCIENTIFIC DESCRIPTION

An important challenge in developmental robotics is how robots can be intrinsically motivated to learn efficiently parametrized policies to solve parametrized multi-task reinforcement learning problems, i.e. learn the mappings between the actions and the problem they solve, or sensory effects they produce. This can be a robot learning how arm movements make physical objects move, or how movements of a virtual vocal tract modulates vocalization sounds. The way the robot will collect its own sensorimotor experience have a strong impact on learning efficiency because for most robotic systems the involved spaces are high dimensional, the mapping between them is non-linear and redundant, and there is limited time allowed for learning. If robots explore the world in an unorganized manner, e.g. randomly, learning algorithms will be often ineffective because very sparse data points will be collected. Data are precious due to the high dimensionality and the limited time, whereas data are not equally useful due to non-linearity and redundancy. This is why learning has to be guided using efficient exploration strategies, allowing the robot to actively drive its own interaction with the environment in order to gather maximally informative data to optimize the parametrized policies. In the recent year, work in developmental learning has explored various families of algorithmic principles which allow the efficient guiding of learning and exploration.

Explauto is a framework developed to study, model and simulate curiosity-driven learning and exploration in real and simulated robotic agents. Explauto's scientific roots trace back from Intelligent Adaptive Curiosity algorithmic architecture [152], which has been extended to a more general family of autonomous exploration architectures by [3] and recently expressed as a compact and unified formalism [38]. The library is detailed in [39]. In Explauto, interest models are implementing the strategies of active selection of particular problems / goals in a parametrized multi-task reinforcement learning setup to efficiently learn parametrized policies. The agent can have different available strategies, parametrized problems, models, sources of information, or learning mechanisms (for instance imitate by mimicking vs by emulation, or asking help to one teacher or to another), and chooses between them in order to optimize learning (a process called strategic learning [45]). Given a set of parametrized problems, a particular exploration strategy is to randomly draw goals/ RL problems to solve in the motor or problem space. More efficient strategies are based on the active choice of learning experiments that maximize learning progress using bandit algorithms, e.g. maximizing improvement of predictions or of competences to solve RL problems [152]. This automatically drives the system to explore and learn first easy skills, and then explore skills of progressively increasing complexity. Both random and learning progress strategies can act either on the motor or on the problem space, resulting in motor babbling or goal babbling strategies.

- Motor babbling consists in sampling commands in the motor space according to a given strategy (random or learning progress), predicting the expected effect, executing the command through the environment and observing the actual effect. Both the parametrized policies and interest models are finally updated according to this experience.
- Goal babbling consists in sampling goals in the problem space and to use the current policies to infer a motor action supposed to solve the problem (inverse prediction). The robot/agent then executes the command through the environment and observes the actual effect. Both the parametrized policies and interest models are finally updated according to this experience. It has been shown that this second strategy allows a progressive solving of problems much more uniformly in the problem space than with a motor babbling strategy, where the agent samples directly in the motor space [3].

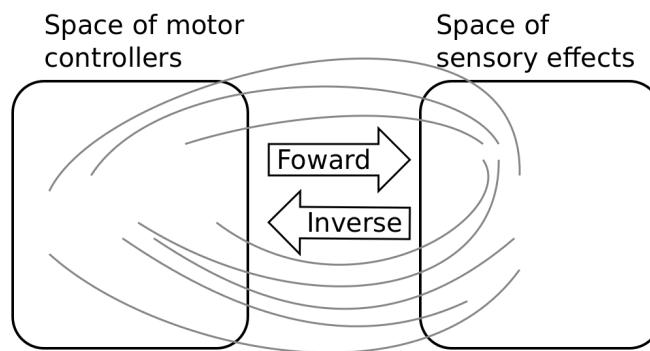


Figure 6. Complex parametrized policies involve high dimensional action and effect spaces. For the sake of visualization, the motor M and sensory S spaces are only 2D each in this example. The relationship between M and S is non-linear, dividing the sensorimotor space into regions of unequal stability: small regions of S can be reached very precisely by large regions of M , or large regions in S can be very sensitive to variations in M : s as well as a non-linear and redundant relationship. This non-linearity can imply redundancy, where the same sensory effect can be attained using distinct regions in M .

FUNCTIONAL DESCRIPTION

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

- Real and simulated robotic setups (Environment level),
- Incremental learning of parametrized policies (Sensorimotor level),
- Active selection of parametrized RL problems (Interest level).

The library comes with several built-in environments. Two of them corresponds to simulated environments: a multi-DoF arm acting on a 2D plan, and an under-actuated torque-controlled pendulum. The third one allows to control real robots based on Dynamixel actuators using the Pypot library. Learning parametrized policies involves machine learning algorithms, which are typically regression algorithms to learn forward models, from motor controllers to sensory effects, and optimization algorithms to learn inverse models, from sensory effects, or problems, to the motor programs allowing to reach them. We call these sensorimotor learning algorithms sensorimotor models. The library comes with several built-in sensorimotor models: simple nearest-neighbor look-up, non-parametric models combining classical regressions and optimization algorithms, online mixtures of Gaussians, and discrete Lidstone distributions. Explauto sensorimotor models are online learning algorithms, i.e. they are trained iteratively during the interaction of the robot in the environment in which it evolves. Explauto provides also a unified interface to define exploration strategies using the InterestModel class. The library comes with two built-in interest models: random sampling as well as sampling maximizing the learning progress in forward or inverse predictions.

Explauto environments now handle actions depending on a current context, as for instance in an environment where a robotic arm is trying to catch a ball: the arm trajectories will depend on the current position of the ball (context). Also, if the dynamic of the environment is changing over time, a new sensorimotor model (Non-Stationary Nearest Neighbor) is able to cope with those changes by taking more into account recent experiences. Those new features are explained in Jupyter notebooks.

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),
- acoustic model of a vocal tract.

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

- Contact: Sébastien Forestier
- URL: <https://github.com/flowersteam/explauto>

6.3. Tools for robot learning, control and perception

6.3.1. CARROMAN

FUNCTIONAL DESCRIPTION

This software implements a control architecture for the Meka humanoid robot. It integrates the Stanford Whole Body Control in the M3 architecture provided with the Meka robot, and provides clear and easy to use interfaces through the URBI scripting language. This software provides a modular library of control modes and basic skills for manipulating objects, detecting objects and humans which other research projects can reuse, extend and enhance. An example would be to locate a cylindrical object on a table using stereo vision, and grasping it using position and force control.

- Contact: David Filliat

6.3.2. Aversive++

FUNCTIONAL DESCRIPTION

Aversive++ is a C++ library that eases micro-controller programming. Its aim is to provide an interface simple enough to be able to create complex applications, and optimized enough to enable small micro-controllers to execute these applications. The other aspect of this library is to be multiplatform. Indeed, it is designed to provide the same API for a simulator (named SASIAE) and for AVR-based and ARM-based micro-controllers.

- Contact: Loïc Dauphin
- URL: <http://aversiveplusplus.com/>

6.3.3. DMP-BBO

Black-Box Optimization for Dynamic Movement Primitives

KEYWORD: -

FUNCTIONAL DESCRIPTION

The DMP-BBO 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 PIBB algorithm for direct policy search. The dmp-bbo C++ library has been extended to include the “unified model for regression”. The implementation of several of the function approximators have been made real-time compatible.

- Participant: Freek Stulp
- Partner: ENSTA
- Contact: Freek Stulp
- URL: <https://github.com/stulp/dmpbbo>

6.3.4. KERAS-QR

KERAS with Quick Reset

KEYWORDS: Library - Deep learning

- Participant: Florian Golemo
- Contact: Florian Golemo
- URL: <https://github.com/fgolemo/keras>

6.3.5. Multimodal

FUNCTIONAL DESCRIPTION

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 is primarily intended for reproduction of the multimodal 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.

- Participant: Olivier Mangin
- Contact: Olivier Mangin
- URL: <https://github.com/omangin/multimodal>

6.3.6. Of 3-D point cloud

FUNCTIONAL DESCRIPTION

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.

- Participants: David Filliat, Alexander Geppert and Louis-Charles Caron
- Contact: Alexander Geppert

6.3.7. PEDDETECT

FUNCTIONAL DESCRIPTION

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 multiple 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.

- Participant: Alexander Gepperth
- Contact: Alexander Gepperth

6.3.8. ThifloNet

KEYWORDS: Deep learning - Policy Learning

SCIENTIFIC DESCRIPTION

We created a software architecture that combines a state-of-the-art computer vision system with a policy learning framework. This system is able to perceive a visual scene, given by a still image, extract facts ("predicates"), and propose an optimal action to achieve a given goal. Both systems are chained into a pipeline that is trained by presenting images and demonstrating an optimal action. By providing this information, both the predicate recognition model and the policy learning model are updated.

Our architecture is based on the recent works of Lerer, A., Gross, S., & Fergus, R., 2016 ("Learning Physical Intuition of Block Towers by Example"). They created a large network able to identify physical properties of stacked blocks. Analogously our vision system utilizes the same network layout (without the image prediction auxiliary output), with an added output layer for predicates, based on the expected number and arity of predicates. The vision subsystem is not trained with a common cross-entropy or MSE loss function, but instead receives its loss from the policy learning subsystem. The policy learning module calculates the loss as optimal combination of predicates for the given expert action.

By using this combination of systems, the architecture as a whole requires significantly fewer data samples than other systems (which exclusively utilize neural networks). This makes the approach more feasible to real-life application with actual live demonstration.

FUNCTIONAL DESCRIPTION

The neural network consists of ResNet-50 (the currently best-performing computer vision system), with 50 layers, 2 layers for converting the output of ResNet to predicates and a varying amount of output neurons, corresponding to the estimated number of n-arity predicates. The network was pretrained on the ImageNet dataset. The policy learning module incorporates the ACE tree learning tool and a wrapper in Prolog.

Our example domain consists of 2-4 cubes colored in red, blue, green, and yellow and randomly stacked on top of each other in a virtual 3D environment. The dataset used for training and testing contains a total of 30000 elements, each with an image of the scene, the correct predicates, a list of blocks that are present and the corresponding expert action, that would lead to stacking the blocks to a tower.

- Participants: Florian Golemo, Thibaut Munzer and Manuel Lopes
- Contact: Florian Golemo

6.4. Tools for education

6.4.1. KidLearn

KEYWORD: Automatic Learning

FUNCTIONAL DESCRIPTION

KidLearn is a software which adaptively personalizes sequences of learning activities to the particularities of each individual student. It aims at proposing to the student the right activity at the right time, maximizing concurrently his learning progress and its motivation. The library regrouping the different developed technologies is available on [github](#).

- Participants: Benjamin Clement, Pierre Yves Oudeyer, Didier Roy and Manuel Lopes
- Contact: Manuel Lopes
- URL: <https://flowers.inria.fr/research/kidlearn/>, <https://github.com/flowersteam/kidlearn>

6.4.2. KidBreath

FUNCTIONAL DESCRIPTION

KidBreath is a web responsive application composed by several interactive contents linked to asthma and displayed to different forms: learning activities with quiz, short games and videos. There are profil creation and personalization, and a part which describes historic and scoring of learning activities, to see evolution of Kidreath use. To test Kidlearn algorithm, it is adapted and integrated on this platform. Development in PHP, HTML-5, CSS, MySQL, JQuery, Javascript. Hosting in APACHE, LINUX, PHP 5.5, MySQL, OVH.

- Partner: ItWell SAS
- Contact: Alexandra Delmas
- URL: <http://www.kidbreath.fr>

6.4.3. Kidlearn: money game application

FUNCTIONAL DESCRIPTION

The game is instantiated in a browser environment where students are proposed exercises in the form of money/token games (see Figure 7). For an exercise type, one object is presented with a given tagged price and the learner has to choose which combination of bank notes, coins or abstract tokens need to be taken from the wallet to buy the object, with various constraints depending on exercises parameters. The games have been developed using web technologies, HTML5, javascript and Django.

- Contact: Benjamin Clement
- URL: <https://flowers.inria.fr/research/kidlearn/>

6.4.4. Kidlearn: script for Kidbreath use

FUNCTIONAL DESCRIPTION

A new way to test Kidlearn algorithms is to use them on Kidbreath Platform. The Kidbreath Platform use apache/PHP server, so to facilitate the integration of our algorithm, a python script have been made to allow PHP code to use easily the python library already made which include our algorithms.

Github link to explanation about it : https://github.com/flowersteam/kidlearn/tree/feature/kidbreath/module_php.

- Contact: Benjamin Clement
- URL: https://github.com/flowersteam/kidlearn/tree/feature/kidbreath/module_php

6.5. 3rdHand Project

6.5.1. 3rdHand Infrastructure

KEYWORDS: Interaction - Robotics - Infrastructure software - Framework - Robot Operating System (ROS)

FUNCTIONAL DESCRIPTION

The infrastructure is predicate-based to handle relational actions and covers perception (scene description generation, human actions recognition), decision making (teleoperated, scripted or learning from demonstrations), interaction with end users (GUI, voice, gestures) and parallel executions of robotic actions (hold, pick, grasp, bring, ...).

- Contact: Yoan Mollard
- https://github.com/3rdHand-project/thr_infrastructure

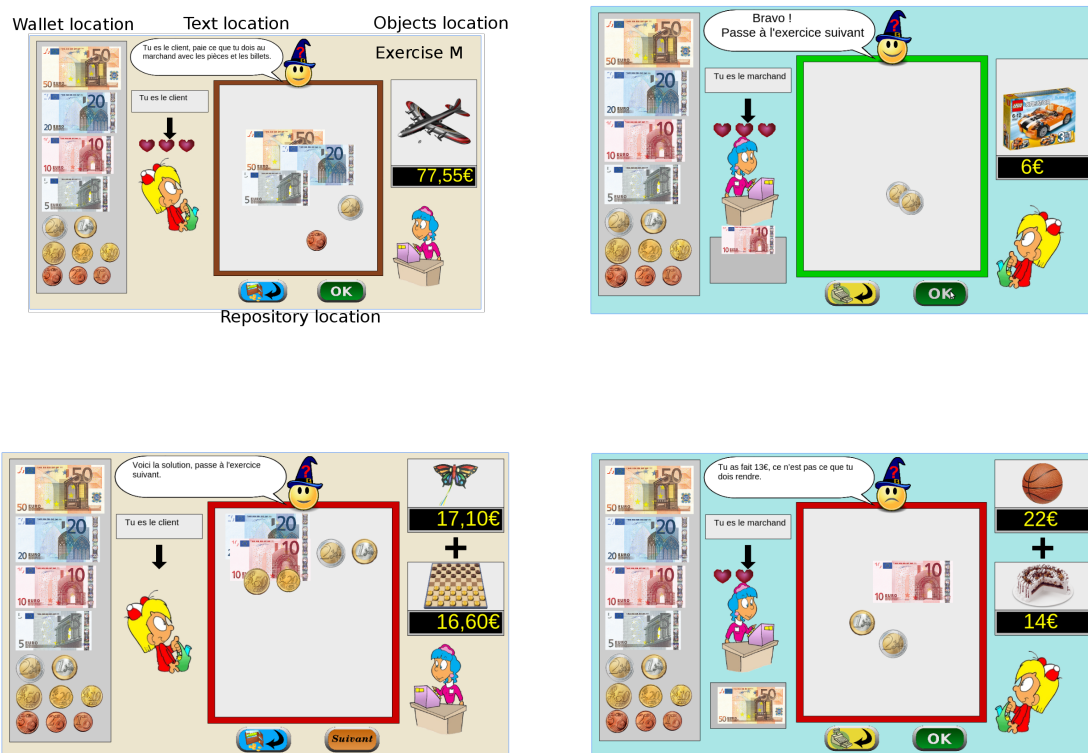


Figure 7. Four principal regions are defined in the graphical interface. The first is the wallet location where users can pick and drag the money items and drop them on the repository location to compose the correct price. The object and the price are present in the object location. Four different types of exercises exist: M : customer/one object, R : merchant/one object, MM : customer/two objects, RM : merchant/two objects.

6.5.2. Kinect 2 Server

Kinect 2 server

KEYWORDS: Depth Perception - Speech recognition - Gesture recognition - Kinect

FUNCTIONAL DESCRIPTION

The server written in C# uses the Kinect SDK v2 to get the RGBD raw image, skeleton tracking information, recognized speech. It also uses the text-to-speech from Microsoft. Then it streams JSON data over the network using the Publisher/Subscriber pattern from the ZeroMQ network library. A Linux client has been written in Python but it can be written in any other language that is compatible with ZeroMQ. Features are controllable through a Graphical User Interface on Windows, or through the code from any Linux/Windows client. The clients can for instance enable features (speech recognition on, skeleton tracking off, ...) and parameters (set new speech to recognize, change language, ...) from remote.

- Contact: Yoan Mollard
- URL: https://github.com/baxter-flowers/kinect_2_server/

6.5.3. ProMP

Probabilistic Movement Primitives

KEYWORDS: Interaction - Robotics - Probability - Motion model - Robot Operating System (ROS)

FUNCTIONAL DESCRIPTION

Joint-space primitives with a task-space constraint: The primitives are stored in joint-space but demonstrations are provided both in joint space and task space, context. Thanks to this context, task-space goals can be requested to these joint-space primitives. The benefit is that requesting a new task-space goal does not require to call an IK method which would return demonstrations-agnostic joint configurations.

Vocal interactive learning and clustering: This work includes an interactive learning aspect which allows to automatically cluster motor primitives based on the standard deviation of their demonstrations. A new primitive is created automatically if the provided demonstration is out of 2 standard deviation of the existing primitives, otherwise the demonstration is distributed to an existing one.

- Contact: Yoan Mollard
- URL: <https://github.com/baxter-flowers/promplib>

6.5.4. ROS Optitrack Publisher

KEYWORDS: Target tracking - Robot Operating System (ROS)

FUNCTIONAL DESCRIPTION

This package allows to publish optitrack markers declared as rigid bodies as TF transforms. Data is gathered through the embedded VRPN server of Motive/Arena. Only rigid bodies are requested to the server, thus single points in 2D/3D are ignored. VRPN server can be enable in View > Data streaming in Motive.

- Contact: Yoan Mollard
- URL: https://github.com/baxter-flowers/optitrack_publisher

HEPHAISTOS Project-Team

6. New Software and Platforms

6.1. ALIAS

Algorithms Library of Interval Analysis for Systems

FUNCTIONAL DESCRIPTION

The ALIAS library 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.

- Participants: Odile Pourtallier and Jean-Pierre Merlet
- Contact: Jean-Pierre Merlet
- URL: <http://www-sop.inria.fr/hephaistos/developpements/main.html>

6.2. Platforms

We describe here only the new platforms that have been developed in 2016 while we maintain a very large number of platforms (e.g. the cable-driven parallel robots of the MARIONET family, the ANG family of walking aids or our experimental flat).

6.2.1. GMSIVE ADT: virtual reality and rehabilitation

Inria has agreed to fund us for developing the platform GMSIVE whose purpose is to introduce end-user motion and their analysis in a virtual reality environment in order to make rehabilitation exercises more attractive and more appropriate for the rehabilitation process. For example we have developed an active treadmill whose slope will change according to the user place in the virtual world while the lateral inclination may be changed in order to regulate the load between the left and right leg. Such a system may be used in rehabilitation to simulate a walk in the mountain while increasing on-demand the load on an injured leg (that is usually avoided by the user) for a shorter rehabilitation time. At the same time the walking pattern is analyzed in order to assess the efficiency of the rehabilitation exercise.

The motion system is composed of two vertical columns whose height may be adjusted (they are used for actuating the treadmill), a 6 d.o.f motion base and a cable-driven parallel robot which may lift the user (in the walking experiment this robot may be used to support partly the user while he is walking allowing frail people to start the rehabilitation earlier). We intend to develop sailing and ski simulators as additional rehabilitation environment. Currently the columns and motion base are effective while the robot has been installed but not tested yet and we have started to study the coupling between the motion generators and the 3D visualization.

6.2.2. Activities detection platform

For non intrusive activities detection we use low cost distance and motion sensors that are incorporated in a 3D printed box (figure 1) and constitute a detection station. Several such station are implemented at appropriate place in the location that has to be monitored (e.g. the Valrose EHPAD where 15 such stations has been deployed at the end of 2016 while 17 stations will be deployed at Institut Claude Pompidou at the very beginning of 2017). Although the information provided by each station is relatively poor an appropriate network of such station allow us to provide the information requested by the medical community.

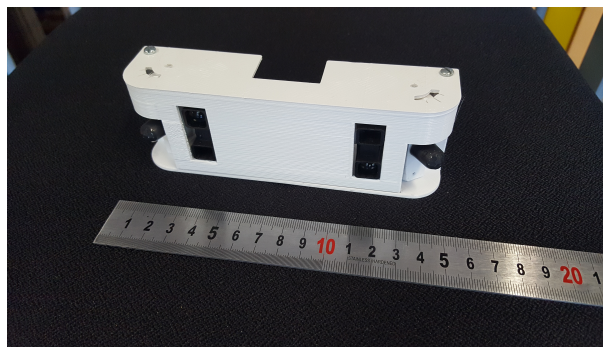


Figure 1. A station for activities detection. The 4 sensors allow to determine the presence of the subject in a given zone, his/her direction of motion and speed even at night

LAGADIC Project-Team

6. New Software and Platforms

6.1. DESlam

Dense Egocentric SLAM

KEYWORDS: Depth Perception - Robotics - Localization

FUNCTIONAL DESCRIPTION

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

- Participants: Maxime Meilland, Andrew Ian Comport and Patrick Rives
- Contact: Patrick Rives
- URL: <http://team.inria.fr/lagadic>

6.2. HandiViz

KEYWORDS: Health - Persons attendant - Handicap

FUNCTIONAL DESCRIPTION

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

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

- Participants: Francois Pasteau and Marie Babel
- Contact: Marie Babel
- URL: <https://team.inria.fr/lagadic/>

6.3. Perception360

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

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

FUNCTIONAL DESCRIPTION

This software is a collection of libraries and applications for robot vision and 3D mapping with omnidirectional RGB-D sensors or standard perspective cameras. It provides the functionalities to do image acquisition, semantic annotation, dense registration, localization and 3D mapping. The omnidirectional RGB-D sensors used within this software have been developed at Inria Sophia Antipolis.

- Participants: Eduardo Fernandez Moral, Renato José Martins and Patrick Rives
- Contact: Patrick Rives
- URL: <https://team.inria.fr/lagadic>

6.4. Sinatrack

KEYWORDS: Computer vision - Robotics

FUNCTIONAL DESCRIPTION

Sinatrack is a tracking software that performs the 3D localization (translation and rotation) of an object with respect to a monocular camera. It allows considering objects with complex shape. The underlying approach is a model-based tracking technique. It has been developed for satellite localization and on-orbit service applications but is also suitable for augmented reality purpose.

- Participants: Antoine Petit, Eric Marchand and Francois Chaumette
- Contact: Eric Marchand
- URL: <http://team.inria.fr/lagadic>

6.5. UsTk

Ultrasound Toolkit

KEYWORDS: Echographic imagery - Image reconstruction - Active contours - Medical robotics

FUNCTIONAL DESCRIPTION

UsTk, standing for Ultrasound Toolkit, is a cross-platform library for two- and three-dimensional ultrasound image processing and visual servoing based on ultrasound images. Written in C++, UsTk provides tools for ultrasound image acquisition, processing, and display, as well as control of ultrasound probe motion by ultrasound visual servoing. This year we started the development of a new version. The objective is first to consolidate existing developments, to improve the quality of the software, to add new state-of-the-art algorithms, and then to disseminate them within the community as an open-source software.

- Participants: Marc Pouliquen, Alexandre Krupa, Pierre Chatelain and Fabien Spindler
- Contact: Alexandre Krupa
- URL: <https://team.inria.fr/lagadic/>

6.6. ViSP

KEYWORDS: Computer vision - Robotics - Augmented reality - Visual servoing

SCIENTIFIC DESCRIPTION

Since 2005, we have been developing and releasing ViSP [5], an open source library available from <http://visp.inria.fr>. ViSP standing for Visual Servoing Platform allows prototyping and developing applications using visual tracking and visual servoing techniques at the heart of the Lagadic research. ViSP was designed to be independent from the hardware, to be simple to use, expandable and cross-platform. ViSP allows to design vision-based tasks for eye-in-hand and eye-to-hand visual servoing that contains the most classical visual features that are used in practice. It involves a large set of elementary positioning tasks with respect to various visual features (points, segments, straight lines, circles, spheres, cylinders, image moments, pose...) that can be combined together, and image processing algorithms that allow tracking of visual cues (dots, segments, ellipses...) or 3D model-based tracking of known objects or template tracking. Simulation capabilities are also available.

FUNCTIONAL DESCRIPTION

ViSP provides simple ways to integrate and validate new algorithms with already existing tools. It follows a module-based software engineering design where data types, algorithms, sensors, viewers and user interaction are made available. Written in C++, ViSP is based on open-source cross-platform libraries (such as OpenCV) and builds with CMake. Several platforms are supported, including OSX, Windows and Linux. ViSP online documentation allows to ease learning. More than 250 fully documented classes organized in 16 different modules, with more than 200 examples and 35 tutorials are proposed to the user. ViSP is released under a dual licensing model. It is open-source with a GNU GPLv2 license. A professional edition license that replaces GNU GPLv2 is also available.

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

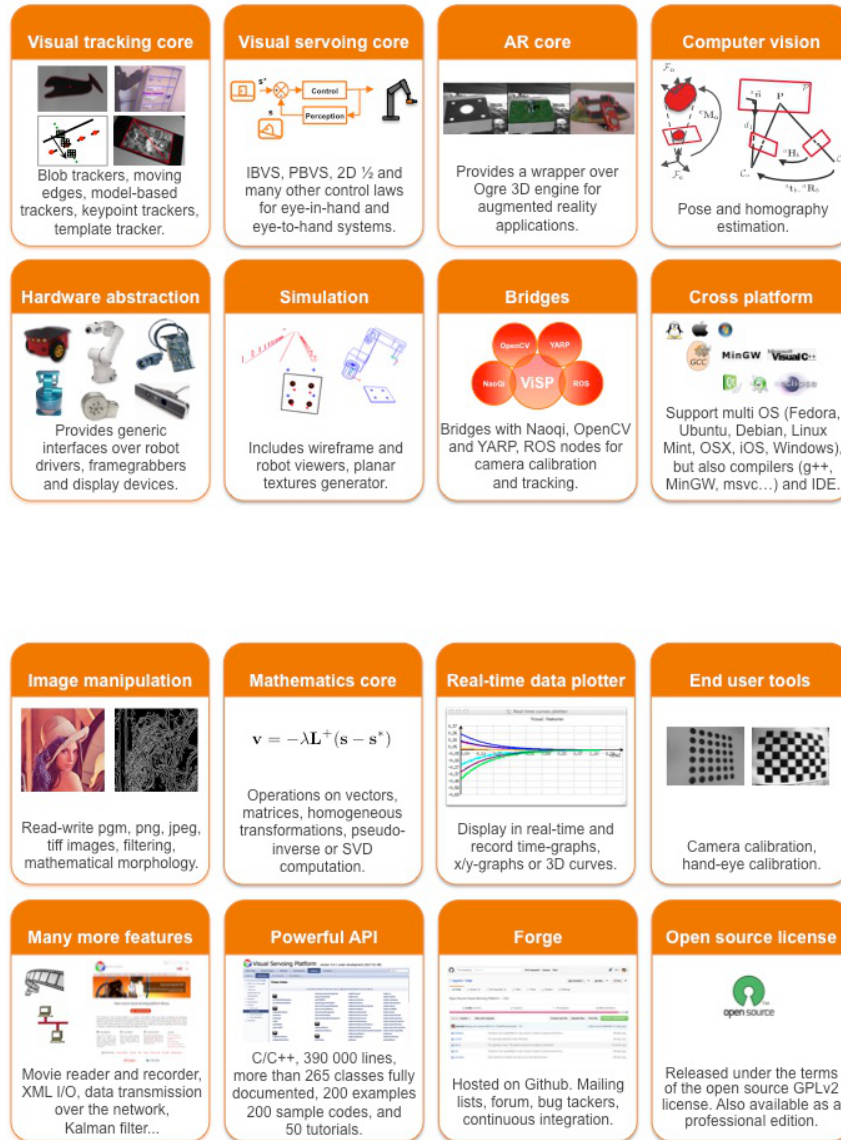


Figure 1. This figure highlights ViSP main capabilities for visual tracking, visual servoing, and augmented reality that may benefit from computer vision algorithms. ViSP allows controlling specific platforms through hardware abstraction or in simulation. ViSP provides also bridges over other frameworks such as OpenCV and ROS. All these capabilities are cross-platform. Moreover, for easing the prototyping of applications, ViSP provides tools for image manipulation, mathematics, data plotting, camera calibration, and many other features. ViSP powerful API is fully documented and available on Github as an open source software under GPLv2 license.

In December 2015, ViSP 3.0.0 new modular architecture was released. The corresponding source code tarball was downloaded 2138 times, much more than the previous 2.10.0 release that was downloaded 1412 times. This confirms that ViSP popularity is increasing and motivates the efforts we are doing since more than 10 years to improve the software. ViSP 3.0.0 last release was packaged for Debian, Ubuntu 16.04 LTS, Arch Linux, OSX and ROS. ViSP 3.0.1 next release is in preparation and should be released at the beginning of 2017. This release will be also packaged for iOS devices. In this new version we introduced new wrapper for USB-3 or GigE PointGrey cameras, Haption haptic device, ATI force/torque sensors, Intel RealSense RGB-D devices. We also make an effort to optimize some critical code sections using SSE and make possible cross-compilation for Raspberry PI and iOS targets, and also Nao, Romeo and Pepper robots from SoftBank Robotics. We also introduce a new version of the 3D model-based tracker dedicated to stereo tracking, fixed some issues, improved the documentation by providing new tutorials and by updating the existing ones.

Concerning ROS community, all the existing packages in “`vision_visp`” ROS stack (see http://wiki.ros.org/vision_visp) were updated and ported to kinetic build system. To ease ViSP usage in the ROS framework, the releases of the year were packaged for ROS.

ViSP is used in research labs in France, USA, Canada, Japan, Korea, India, China, Italy, Spain, Portugal, etc. 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. Last August, during the Intel Developer Forum opening keynote, Intel CEO Brian Krzanich introduced the Intel Joule compute module. Using an Intel Joule with glasses from French company PivotHead, Intel demonstrated an augmented reality application that was using ViSP (<https://www.youtube.com/watch?v=QRBofzL4MDY>).

6.7. WarpDriver

KEYWORDS: Crowd Simulation - Pedestrian Simulation - Collision Avoidance - Reactive Navigation

FUNCTIONAL DESCRIPTION

WarpDriver is a microscopic crowd simulation software, which simulates the collision-free locomotion of many individual agents among the obstacles of a given environment. The originality of the algorithm relies on motion prediction mechanism which allows each agent to predict the probability of colliding other agents with respect to their current motion, their past motion, and the presence of obstacles forcing agents to follow some paths in the environment. Agents then move to their goal whilst they minimize their probability of colliding obstacles.

- Participants: David Wolinski and Julien Pettré
- Contact: Julien Pettré
- URL: <http://team.inria.fr/lagadic>

6.8. bib2html

FUNCTIONAL DESCRIPTION

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

- Contact: Eric Marchand
- URL: <http://www.irisa.fr/lagadic/soft/bib2html/bib2html.html>

6.9. Platforms

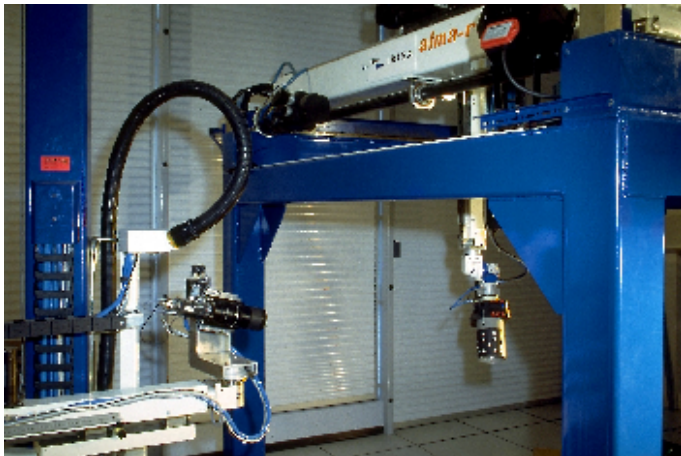
6.9.1. Robot vision platform

Participant: Fabien Spindler [contact].

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

This year we completed the platform with a haptic Virtuose 6D device from Haption company (see Fig. 2 .b). This device is used for visual-based shared control (see Section 9.3.1.3).

Note that 3 papers published by Lagadic in 2016 enclose results validated on this platform [21][48][46].



(a)



(b)

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

6.9.2. Mobile robots

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

6.9.2.1. Indoor mobile robots

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

Moreover, to validate the researches in personally assisted living topic (see Section 7.4.5), we have three electric wheelchairs in Rennes, one from Permobil, one from Sunrise and the last from YouQ (see Fig. 3 .c). The control of the wheelchair is performed using a plug and play system between the joystick and the low level control of the wheelchair. Such a system lets us acquire the user intention through the joystick position and control the wheelchair by applying corrections to its motion. The wheelchairs have been fitted with cameras and ultrasound sensors to perform the required servoing for assisting handicapped people.

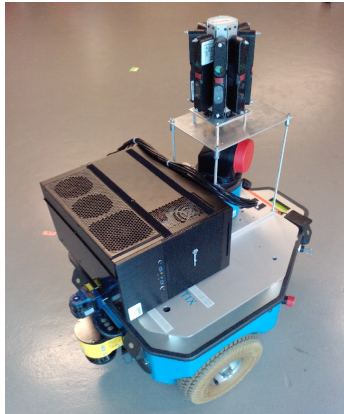
Note that 11 papers exploiting the indoors mobile robots were published this year [67][26][61][37][62][30][55][38][71][64][66].

6.9.2.2. Outdoor vehicles

A camera rig has been developed in Sophia Antipolis. It can be fixed to a standard car (see Fig. 4), which is driven at a variable speed depending on the road/traffic conditions, with an average of 30 km/h and a maximum

speed of 80 km/h. The sequences are recorded at a frame rate of 20 Hz, where the six global shutter cameras of the stereo system are synchronized, producing spherical images with a resolution of 2048x665 (see Fig. 4). Such sequences are fused offline to obtain maps that can be used later for localization or for scene rendering (in a similar fashion to Google Street View) as shown in the video <http://www-sop.inria.fr/members/Renato-Jose.Martins/iros15.html>.

Paper [68] contains experimental results obtained with this camera rig.



(a)



(b)



(c)

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

6.9.3. Medical robots

Participants: Fabien Spindler [contact], 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 (see Section 7.3).



Figure 4. Globeye stereo sensor and acquisition system.

This platform is composed by two Adept Viper six degrees of freedom arms (see Fig. 5 .a). Ultrasound probes connected either to a SonoSite 180 Plus or an Ultrasonix SonixTouch imaging system can be mounted on a force torque sensor attached to each robot end-effector.

This year we replaced the F/T sensor attached to one of the Viper robot in order to use a DAQ acquisition board able to provide measures at a higher frame rate (up to 1 kHz). This feature is especially useful for flexible needle steering by ultrasound visual servoing (see Fig. 5 .b).

Notice that 10 papers published this year include experimental results obtained with this platform [40][31][34][58][57][70][52][59] [50][51].

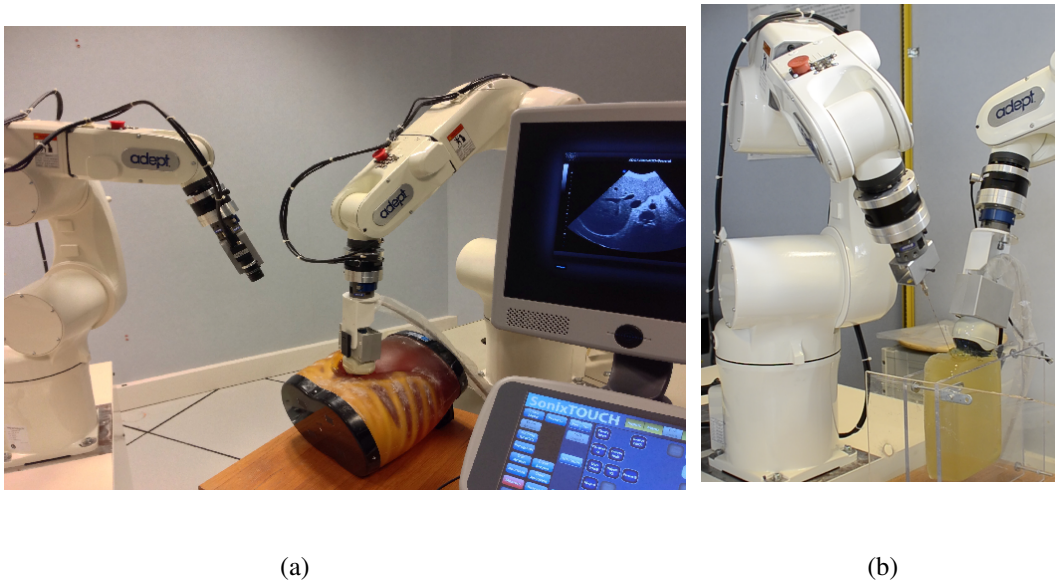


Figure 5. a) Lagadic medical robotics platforms. On the right Viper S850 robot arm equipped with a SonixTouch 3D ultrasound probe. On the left Viper S650 equipped with a tool changer that allows to attach a classical camera or biopsy needles. b) Robotic setup for autonomous needle insertion by visual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

6.9.4. Humanoid robots

Participants: Giovanni Claudio, Fabien Spindler [contact].

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

In July, this platform was extended with Pepper, another human-shaped robot designed by SoftBank Robotics to be a genuine day-to-day companion (see Fig. 6 .b). It has 17 degrees of freedom mounted on a wheeled holonomic base and a set of sensors (cameras, laser, ultrasound, inertial) that makes this platform interesting for researches in vision-based manipulation and navigation. Our first developments were devoted to visual servoing for controlling the gaze of the robot exploiting the redundancy of the head and mobile base and adding the capability to follow a person.

Note that 4 papers published this year include experimental results obtained with these platforms [53][81][65][20].

6.9.5. Unmanned Aerial Vehicles (UAVs)

Participants: Thomas Bellavoire, Paolo Robuffo Giordano [contact].

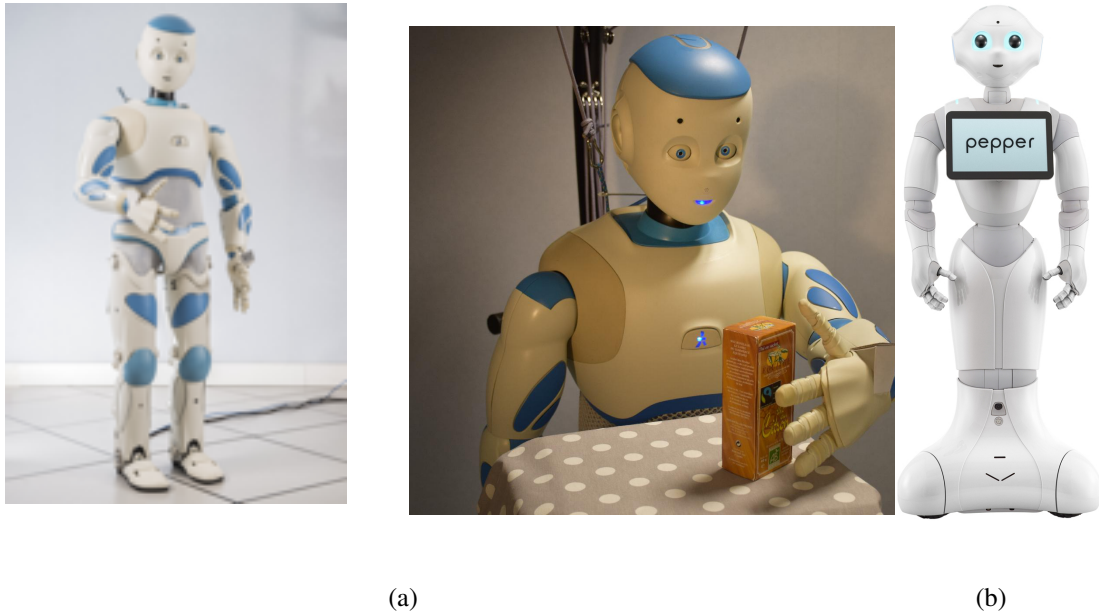


Figure 6. a) Romeo experimental platform, b) Pepper human-shaped robot

From 2014, Lagadic also started some activities involving perception and control for single and multiple quadrotor UAVs, especially thanks to a grant from “Rennes Métropole” (see Section 9.1.5) and the ANR project “SenseFly” (see Section 9.2.5). To this end, we purchased four quadrotors from Mikrokopter GmbH, Germany (see Fig. 7 .a), and one quadrotor from 3DRobotics, USA (see Fig. 7 .b). The Mikrokopter quadrotors have been heavily customized by: (i) reprogramming from scratch the low-level attitude controller onboard the microcontroller of the quadrotors, (ii) equipping each quadrotor with an Odroid XU4 board (see Fig. 7 .d) running Linux Ubuntu and the TeleKyb software (the middleware used for managing the experiment flows and the communication among the UAVs and the base station), and (iii) purchasing the Flea Color USB3 cameras together with the gimbal needed to mount them on the UAVs (see Fig. 7 .c). The quadrotor group is used as robotic platforms for testing a number of single and multiple flight control schemes with a special attention on the use of onboard vision as main sensory modality.

Two papers published this year enclose experimental results obtained with this platform [72][64].



(a)



(b)



(c)



(d)

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

LARSEN Team

6. New Software and Platforms

6.1. Limbo

Library for Model-based Bayesian Optimization

KEYWORDS: Black-box optimization - C++ - Global optimization - Machine learning - Policy Learning - Bayesian optimization

FUNCTIONAL DESCRIPTION

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

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

6.2. sferes2

A lightweight generic C++ framework for evolutionary computation

FUNCTIONAL DESCRIPTION

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

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

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

6.3. xsensdriver

`xsens_driver`

FUNCTIONAL DESCRIPTION

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

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

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

6.4. Platforms

6.4.1. *iCub*

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

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

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

<https://github.com/inria-larsen>

6.4.2. *Pepper*

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

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

PERSASIVE INTERACTION Team

5. New Software and Platforms

5.1. DomiCube

- Participant: Rémi Pincent
- Contact: Rémi Pincent

5.2. EmoPRAMAD

KEYWORDS: Health - Home care

FUNCTIONAL DESCRIPTION

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

The evaluation conducted 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.

- Contact: Dominique Vaufreydaz

5.3. Online Movie Director

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

5.4. SmartEnergy

FUNCTIONAL DESCRIPTION

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

- Participant: Patrick Reignier
- Contact: Patrick Reignier

5.5. SmartServoFramework

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

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

5.6. MobileRGBD

KEYWORDS: Benchmark corpus - Health - Home Care

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

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

5.7. Unix Interface for InfraRed Sensor

- Author: Pierre Baret
- Contact: James Crowley

5.8. Virtual Reality rehabilitation platform for Complex Regional Pain Syndrome

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

5.9. EquipEx AmiQual4Home - Ambient Intelligence for Quality of Life

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

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

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

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

RITS Project-Team

5. New Software and Platforms

5.1. DOLAR

FUNCTIONAL DESCRIPTION

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.

- Authors: Raoul de Charette, Fawzi Nashashibi and Evangeline Pollard
- Contact: Fawzi Nashashibi

5.2. FEMOT

Fuzzy Embedded MOTor

FUNCTIONAL DESCRIPTION

FEMOT 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.

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.

- Participants: Joshue Perez Rastelli and Vicente Milanés
- Contact: Fawzi Nashashibi

5.3. MELOSYM

FUNCTIONAL DESCRIPTION

MELOSYM 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 RTMAPS platform but the version includes a standalone version.

- Participants: Fawzi Nashashibi, Benjamin Lefaudeux, Jianping Xie and Paulo Lopes Resende
- Contact: Fawzi Nashashibi

5.4. PML-SLAM

- Participants: Zayed Alsayed and Fawzi Nashashibi
- Contact: Fawzi Nashashibi

5.5. Platools

KEYWORD: Telecommunications

- Participant: Marios Makassikis
- Contact: Thierry Ernst

5.6. SODA

Softwares for Driving Automation

KEYWORD: Environment perception

FUNCTIONAL DESCRIPTION

This software has been developed in the context of the French ABV (Automatisation Basse Vitesse) project. This package contains the functions that are necessary to automate the vehicle navigation in its secured lane.

- Participants: Paulo Lopes Resende and Fawzi Nashashibi
- Contact: Fawzi Nashashibi

5.7. STEREOLOC-3D

FUNCTIONAL DESCRIPTION

STEREOLOC 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.

- Participants: Benjamin Lefaudeux and Fawzi Nashashibi
- Contact: Fawzi Nashashibi

5.8. Taxi-col

KEYWORD: Mobile Computing, Transportation

- Participant: Eugenie Lioris
- Contact: Fawzi Nashashibi

5.9. V2Provuc

Vehicle-to-Pedestrian

FUNCTIONAL DESCRIPTION

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

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.

- Contact: Fawzi Nashashibi

5.10. SimConVA

Participants: Pierre Merdrignac, Oyunchimeg Shagdar, Jean-Marc Lasgouttes.

This software was developed during the SINETIC FUI project. It aims at interfacing the network simulator ns-3 and the prototyping software RTMaps.

The source code of this software is a library to generate an RTMaps component that triggers and controls ns-3. The component handles emission and reception of data packets between RTMaps and ns-3 for every vehicle. It can also deal with the mobility of vehicles in ns-3 based on the localization known in ns-3.

This software was used with the communication stack developed in RITS. It has been shown during the SINETIC project how this it can be used for simulating and emulating cooperative driver assistance systems. Particularly, the software has been tested on cooperative platoons. The tests were conducted on both simulation and real platforms to prove how the such software can be used during the development phase and that it is fully compatible with the architecture already present in the experimental vehicles.

- Contact: Fawzi Nashashibi

AYIN Team

5. New Software and Platforms

5.1. Consulting for Industry

Josiane Zerubia is a scientific consultant for the Galderma company (<http://www.galderma.com/AboutGalderma/Worldwide-presence/R-D-Locations>)

LINKMEDIA Project-Team

6. New Software and Platforms

6.1. AllGO multimedia web services

Participants: Guillaume Gravier [correspondent], Gabriel Sargent.

Available at <http://allgo.irisa.fr>, the AllGO platform allows for the easy deployment of the technology developed in the team as web services. Based on the AllGO infrastructure, LINKMEDIA has continued making available a number of web services related to multimedia content analysis. In 2016, we revamped the multimedia-related web service offer, making all services interoperable and broadening the scope of services made available (silence detection, face detection, text-based fragmentation). We also made available **short videos that demonstrate the usefulness of our web services**.

MAGRIT Project-Team

5. New Software and Platforms

5.1. Ltrack

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

- Contact: Marie-Odile Berger, Gilles Simon.

5.2. PoLAR

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

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

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

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

5.3. Fast>VP

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

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

5.4. The GridMethod Toolbox

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

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

MORPHEO Project-Team

6. New Software and Platforms

6.1. Kinovis: 4D repository

FUNCTIONAL DESCRIPTION

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

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

6.2. Lucy Viewer

KEYWORDS: Data visualization - 4D - Multi-Cameras

FUNCTIONAL DESCRIPTION

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

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

6.3. QuickCSG

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

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

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

6.4. Shape Tracking

FUNCTIONAL DESCRIPTION

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

- Contact: Edmond Boyer

6.5. 3DtLaplace

KEYWORDS: Laplace operator - Mesh sequence

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

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

6.6. CVTGenerator

KEYWORDS: Mesh - Centroidal Voronoi tessellation - Implicit surface

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

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

6.7. Platforms

6.7.1. Platform Kinovis

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

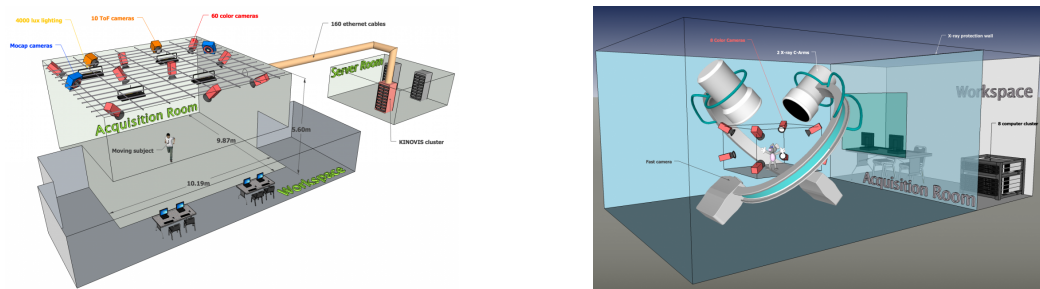


Figure 1. Kinovis platforms: on the left the Inria platform; on the right Grenoble Hospital platform.

PERCEPTION Project-Team

5. New Software and Platforms

5.1. ECMPR

Expectation Conditional Maximization for the Joint Registration of Multiple Point Sets

FUNCTIONAL DESCRIPTION

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

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

5.2. Mixcam

Reconstruction using a mixed camera system

KEYWORDS: Computer vision - 3D reconstruction

FUNCTIONAL DESCRIPTION

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

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

5.3. NaoLab

Distributed middleware architecture for interacting with NAO

FUNCTIONAL DESCRIPTION

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

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

5.4. Stereo matching and recognition library

KEYWORD: Computer vision

FUNCTIONAL DESCRIPTION

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

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

5.5. Platforms

5.5.1. Audio-Visual Head Popeye+

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

Website:

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

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

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

5.5.2. NAO Robots

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



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

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

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

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

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

Websites:

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

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

SIROCCO Project-Team

6. New Software and Platforms

6.1. Salient object extraction

FUNCTIONAL DESCRIPTION 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.

- Participants: Zhi Liu and Olivier Le Meur
- Contact: Olivier Le Meur

6.2. VideoInpainting

KEYWORDS: Video Inpainting - Motion informations - Loss concealment - BMFI (Bilinear Motion Field Interpolation)

SCIENTIFIC DESCRIPTION From an input binary mask and a source picture, the software performs an exemplar-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.

- Participants: Ronan Le Boulch and Olivier Le Meur
- Contact: Olivier Le Meur

6.3. Visual Fixation Analysis

SCIENTIFIC DESCRIPTION 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.

- Participants: Olivier Le Meur and Thierry Baccino
- Partner: Université de Rennes 1
- Contact: Olivier Le Meur

6.4. Saccadic model

SCIENTIFIC DESCRIPTION The software called Scanpath Prediction aims at predicting the visual scanpath of an observer. The visual scanpath is a set of fixation points. The computational model is based on bottom-up saliency maps, viewing tendencies (that have been learned from eye tracking datasets) and inhibition-of-return. A presentation of this model is available on the following link: <http://fr.slideshare.net/OlivierLeMeur/saccadic-model-of-eye-movements-for-freeviewing-condition>. This software is dedicated to people working in computer science, computer vision and cognitive science. This software is being registered at the APP (Agence de Protection des Programmes) under the number IDDN.FR.001.240029.000.S.P.2016.000.10000.

- Participants: Olivier Le Meur
- Partner: Université de Rennes 1
- Contact: Olivier Le Meur

6.5. ADT-ATep

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

A project founded by Inriahub has recently started in the SIROCCO team. Called ATeP for “Acquisition, Traitement et Partage” (Acquisition, Processing and Sharing), it targets the acquisition of such dataset. Another interesting aspect of this project is that the acquisition system relies on omnidirectional cameras. The dataset will thus interest all the industries and scientists currently working on the development of efficient processing and coding tools for 360 videos.

- Participants: Cédric Le Cam, Thomas Maugey
- Partner: Inria
- Contact: Thomas Maugey

STARS Project-Team

5. New Software and Platforms

5.1. CLEM

FUNCTIONAL DESCRIPTION

The Clem Toolkit is a set of tools devoted to design, simulate, verify and generate code for LE 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.

- Participants: Daniel Gaffe and Annie Ressouche
- Contact: Annie Ressouche
- URL: <http://www-sop.inria.fr/teams/pulsar/projects/Clem/>

5.2. EGMM-BGS

FUNCTIONAL DESCRIPTION

This software implements a generic background subtraction algorithm for video and RGB-D cameras, which can take feedback from people detection and tracking processes. Embedded in a people detection framework, it does not classify foreground / background at pixel level but provides useful information for the framework to remove noise. Noise is only removed when the framework has all the information from background subtraction, classification and object tracking. In our experiment, our background subtraction algorithm outperforms GMM, a popular background subtraction algorithm, in detecting people and removing noise.

- Participants: Anh Tuan Nghiem, Francois Bremond and Vasanth Bathrinarayanan
- Contact: Francois Bremond

5.3. MTS

FUNCTIONAL DESCRIPTION

This software consists of a retrieval tool for a human operator to select a person of interest in a network of cameras. The multi-camera system can re-identify the person of interest, wherever and whenever (s)he has been observed in the camera network. This task is particularly hard due to camera variations, different lighting conditions, different color responses and different camera viewpoints. Moreover, we focus on non-rigid objects (i.e. humans) that change their pose and orientation contributing to the complexity of the problem. In this work we design two methods for appearance matching across non-overlapping cameras. One particular aspect is the choice of the image descriptor. A good descriptor should capture the most distinguishing characteristics of an appearance, while being invariant to camera changes. We chose to describe the object appearance by using the covariance descriptor as its performance is found to be superior to other methods. By averaging descriptors on a Riemannian manifold, we incorporate information from multiple images. This produces mean Riemannian covariance that yields a compact and robust representation. This new software has made digital video surveillance systems a product highly asked by security operators, especially the ones monitoring large critical infrastructures, such as public transportation (subways, airports, and harbours), industrials (gas plants), and supermarkets.

- Participants: Slawomir Bak and Francois Bremond
- Contact: Francois Bremond

5.4. Person Manual Tracking in a Static Camera Network (PMT-SCN)

FUNCTIONAL DESCRIPTION

This software allows tracking a person in a heterogeneous camera network. The tracking is done manually. The advantage of this software is to give the opportunity to operators in video-surveillance to focus on tracking the activity of a person without knowing the positions of the cameras in a considered area. When the tracked person leaves the field-of-view (FOV) of a first camera, and enters the FOV of a second one, the second camera is automatically showed to the operator. This software was developed conjointly by Inria and Neosensys.

- Participants: Bernard Boulay, Anais Ducoffe, Sofia Zaidenberg, Annunziato Polimeni and Julien Gueytat
- Partner: Neosensys
- Contact: Anais Ducoffe

5.5. PrintFoot Tracker

FUNCTIONAL DESCRIPTION

This software implements a new algorithm for tracking multiple persons in a single camera. This algorithm computes many different appearance-based descriptors to characterize the visual appearance of an object and to track it over time. Object tracking quality usually depends on video scene conditions (e.g. illumination, density of objects, object occlusion level). In order to overcome this limitation, this algorithm presents a new control approach to adapt the object tracking process to the scene condition variations. More precisely, this approach learns how to tune the tracker parameters to cope with the tracking context variations. The tracking context, or video context, of a video sequence is defined as a set of six features: density of mobile objects, their occlusion level, their contrast with regard to the surrounding background, their contrast variance, their 2D area and their 2D area variance. The software has been experimented with three different tracking algorithms and on long, complex video datasets.

- Participants: Duc Phu Chau and Francois Bremond
- Contact: Francois Bremond

5.6. Proof Of Concept Néosensys (Poc-NS)

FUNCTIONAL DESCRIPTION

This is a demonstration software which gathers different technologies from Inria and Neosensys: PMT-SCN, re-identification and auto-side switch. This software is used to approach potential clients of Neosensys.

- Participants: Bernard Boulay, Sofia Zaidenberg, Julien Gueytat, Slawomir Bak, Francois Bremond, Annunziato Polimeni and Yves Pichon
- Partner: Neosensys
- Contact: Francois Bremond

5.7. SUP

Scene Understanding Platform

KEYWORDS: Activity recognition - 3D - Dynamic scene

FUNCTIONAL DESCRIPTION

SUP is a software platform for perceiving, analyzing and interpreting a 3D dynamic scene observed through a network of sensors. It encompasses algorithms allowing for the modeling of interesting activities for users to enable their recognition in real-world applications requiring high-throughput.

- Participants: François Brémond, Carlos Fernando Crispim Junior and Etienne Corvée
- Partners: CEA - CHU Nice - I2R - Université de Hamburg - USC Californie
- Contact: Francois Bremond
- URL: <https://team.inria.fr/stars/software>

5.8. VISEVAL

FUNCTIONAL DESCRIPTION

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.

- Participants: Bernard Boulay and Francois Bremond
- Contact: Francois Bremond
- URL: http://www-sop.inria.fr/teams/pulsar/EvaluationTool/ViSEvAl_Description.html

5.9. py_ad

py action detection

FUNCTIONAL DESCRIPTION

Action Detection framework Allows user to detect action in video stream. It uses model trained in py_ar.

- Participants: Michal Koperski and Francois Bremond
- Contact: Michal Koperski

5.10. py_ar

py action recognition

FUNCTIONAL DESCRIPTION

Action Recognition training/evaluation framework. It allows user do define action recognition experiment (on clipped videos). Train, test model, save the results and print the statistics.

- Participants: Michal Koperski and Francois Bremond
- Contact: Michal Koperski

5.11. py_sup_reader

FUNCTIONAL DESCRIPTION

This is a library which allows to read video saved in SUP format in Python.

- Participant: Michal Koperski
- Contact: Michal Koperski

5.12. py_tra3d

py trajectories 3d

SCIENTIFIC DESCRIPTION

New video descriptor which fuse trajectory information with 3D information from depth sensor.

FUNCTIONAL DESCRIPTION

3D Trajectories descriptor Compute 3D trajectories descriptor proposed in (<http://hal.inria.fr/docs/01/05/49/49/PDF/koperski-icip.pdf>)

- Participants: Michal Koperski and Francois Bremond
- Contact: Michal Koperski

5.13. sup_ad

sup action detection

SCIENTIFIC DESCRIPTION

This software introduces the framework for online/real-time action recognition using state-of-the-art features and sliding window technique.

FUNCTIONAL DESCRIPTION

SUP Action Detection Plugin Plugin for SUP platform which performs action detection using sliding window and Bag of Words. It uses an input data model trained in py_ar project.

- Participants: Michal Koperski and Francois Bremond
- Contact: Michal Koperski

THOTH Project-Team

6. New Software and Platforms

6.1. CoNFab: CoNvolutional Neural FABric

Participants: Shreyas Saxena, Jakob Verbeek.

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

6.2. Modl

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

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

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

Participants: Pavel Tokmakov, Cordelia Schmid, Karteek Alahari.

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

6.4. DALY: Daily Action Localization in Youtube

Participants: Philippe Weinzapfel, Xavier Martin, Cordelia Schmid.

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

6.5. GUN-71

Participant: Gregory Rogez.

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

6.6. Synthetic human 3D pose dataset

Participants: Gregory Rogez, Cordelia Schmid.

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

WILLOW Project-Team

6. New Software and Platforms

6.1. NetVLAD: CNN architecture for weakly supervised place recognition

Open source release of the software package for our paper "NetVLAD: CNN architecture for weakly supervised place recognition" [9]. It provides a full implementation of the method, including code for weakly supervised training of the CNN representation, testing on standard datasets, as well as trained models. Links to all of these are available at our project page <http://www.di.ens.fr/willow/research/netvlad/>.

6.2. Unsupervised learning from narrated instruction videos

Open source release of the software package for our paper "Unsupervised learning from narrated instruction videos" . It provides a full implementation of the method, including code for weakly supervised training from instruction video, as well as trained models. Links to all of these are available at our project page <http://www.di.ens.fr/willow/research/instructionvideos/>.

6.3. ContextLocNet: Context-aware deep network models for weakly supervised localization

Open source release of code reproducing the results in our "ContextLocNet: Context-aware deep network models for weakly supervised localization" [11]. It provides code for training models, testing on standard datasets and trained models. It can be found online at <https://github.com/vadimkantorov/contextlocnet>.

6.4. Long-term Temporal Convolutions for Action Recognition

Open source release of the software package for our paper "Long-term Temporal Convolutions for Action Recognition" [20]. It provides code for training models, testing on standard datasets and trained models. Links are available at our project page <http://www.di.ens.fr/willow/research/ltc/>.