Activity Report 2015

Section Software

VISION, PERCEPTION AND MULTIMEDIA INTERPRETATION

DAHU Project-Team (section vide)

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

6. New Software and Platforms

6.1. Platforms

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

6.1.1. Platform: Environmental decision-support systems

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

6.1.1.1. SACADEAU

Système d'Acquisition des Connaissances pour l'Aide à la Décision sur la qualité de l'EAU
FUNCTIONAL DESCRIPTION

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

- Contact: Véronique Masson
- URL: http://www.irisa.fr/dream/SACADEAU/

6.1.1.2. EcoMata

FUNCTIONAL DESCRIPTION

The EcoMata tool-box provides means for qualitative modeling and exploring ecosystems and for aiding to design environmental guidelines.We have proposed a new qualitative approach for ecosystem modeling 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
- URL: https://team.inria.fr/dream/fr/ecomata/

6.1.1.3. PaturMata

KEYWORDS: Bioinformatics - Biology
SCIENTIFIC 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 .
FUNCTIONAL 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.

- Contact: Christine Largouët

6.1.2. Platform: Pattern Mining

Participants: Thomas Guyet, René Quiniou.

6.1.2.1. QTempIntMiner

Temporal pattern mining in sequences
SCIENTIFIC DESCRIPTION

The QTempIntMiner data mining software implements several algorithms (QTIAPRIORI and QTIPREFIXS-PAN). The software is mainly implemented in Matlab. It uses the Mixmod toolbox to compute multi-dimensional Gaussian distributions. The main features of QTEMPINTMINER are:

- a tool for generating synthetic noisy sequences of temporal events,

- an implementation of the QTEMPINTMINER, QTIAPRIORI and QTIPREFIXSPAN algorithms,

- a graphical interface that enables the user to generate or import data set and to define the parameters of the algorithm and that displays the extracted temporal patterns.

- a sequence transformer to process long sequences of temporal events. Long sequences are transformed into a database of short temporal sequences that are used as input instances for the available algorithms.

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

This year, an APP deposit of the early version (in Matlab) of this framework has been done. In parallel, we started the developement of a C++ version of the framework.

- Participants: Thomas Guyet and René Quiniou

- Partner: AGROCAMPUS

- Contact: Thomas Guyet

- URL: http://www.irisa.fr/dream/QTempIntMiner/

6.1.3. Platform: Diagnostic and Monitoring Systems

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

6.1.3.1. ManageYourself

FUNCTIONAL DESCRIPTION

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

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

- Contact: Laurence Rozé

6.1.3.2. Odisseptale

KEYWORDS: Biology - Health
FUNCTIONAL DESCRIPTION

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

- Contact: René Quiniou

6.2. TraceSquiz

FUNCTIONAL DESCRIPTION

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

- Participants: Alexandre Termier, Serge Vladimir Emteu Tchagou, René Quiniou
- Contact: Serge Vladimir Emteu Tchagou

EXMO Project-Team

6. New Software and Platforms

6.1. Alignment API

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

We have designed a format for expressing alignments in a uniform way [2]. The goal of this format is to share available alignments on the web. It should help systems using alignments, e.g., mediators, translators, to take advantage of any matching algorithm and it will help matching algorithms to be used in many different tasks. This format is expressed in RDF, so it is freely extensible.

The API itself [2] is a JAVA description of tools for accessing the common format. It defines five main interfaces (OntologyNetwork, Alignment, Cell, Relation and Evaluator).

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

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

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

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

We have developed, on top of the Alignment API, an Alignment server that can be used by remote clients for matching ontologies and for storing and sharing alignments. It is developed as an extensible platform which allows to plug-in new interfaces. The Alignment server can be accessed through HTML, web service (SOAP and REST) and agent communication interfaces. It has been used this year in the Ready4SmartCities project (§9.2.1.1) [14], [20].

The Alignment API is used in the Ontology Alignment Evaluation Initiative data and result processing (§7.1.1). It is also used by more than 50 other teams worldwide.

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

6.2. The OntoSim library

Participants: Jérôme David [Correspondent], Jérôme Euzenat.

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

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

In 2015, OntoSim only supported a maintenance upgrade.

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

<p align="center" style="color:red">GRAPHIK Project-Team</p>

6. New Software and Platforms

6.1. DLGP 2.0

- Participants: Jean-François Baget, Michel Chein, Alain Gutierrez, Michel Leclère, Marie-Laure Mugnier, Swan Rocher and Clément Sipieter
- URL: http://graphik-team.github.io/graal/

DLGP (for Datalog+) is our textual format for the existential rules framework. This year, we extended it to ensure compatibility with Semantic Web languages. This required to include web notions such as IRIs and literals. A new parser was implemented, and is used in both Cogui (6.2) and Graal (6.3).

6.2. Cogui

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

- Participants: Alain Gutierrez, Michel Leclère, Michel Chein, Marie-Laure Mugnier and Madalina Croitoru
- Contact: Michel Leclère (scientific contact) and Alain Gutierrez (technical contact)
- URL: http://www.lirmm.fr/cogui/

Objectives: Cogui is a visual tool for building conceptual graph knowledge bases (KB). It allows to create a KB, to edit its structure and content, and to control it. The KB can be serialized in the XML. Imports and exports from and to RDFS are also provided, as well as from and to the *Datalog+ (DLGP)* format that we defined for existential rules. Wizards allow to analyze and check facts with respect to some constraints, as well as to query them while taking into account inferences enabled by the ontology.

Users community:*Research:* MIMOS (National R&D center in information and communication technology, Malaysia http://www.mimos.my/), Defence R&D Canada, our partners in INRA, CIRAD, as well as a new collaboration with the Inria team Imagine. *Education:* Used in knowledge engineering in universities of Nice, Strasbourg, Montpellier, Sheffield, as well as in the engineering school of Tarbes.

Impact: internal use in several EU or National projects. We expect a broader audience by using Cogui as a graphical ontology modeling tool for our other software Graal, the communication being done through our DLGP format http://www.lirmm.fr/~mugnier/graphik/kiabora/downloads/datalog-plus_en.pdf.

State of the art: To the best of our knowledge, Cogui is the only ontology editing tool able to do reasoning with conceptual graph rules (equivalent to existential rules). Many tools exist for DLs and Semantic Web languages (e.g. Protégé http://protege.stanford.edu mainly designed for description logics and TopBraid Composer http://www.topquadrant.com/ designed for RDF and SPIN rules, which are rules without existential variables).

Misc.: Cogui is written in Java and has been part time developed since 2005 by Alain Gutierrez (approx. 50 man months). First developed as an interface communicating with the conceptual graph reasoner Cogitant http://cogitant.sourceforge.net/, it has become a standalone tool, integrating more and more reasoning features.

New features: This year, we mainly focused on improving the compatibility with the semantic web languages. The main improvements are the following:

- integration of the parser using our new textual format DLGP 2.0 (6.1).
- a new repository is available to store the projects. It facilitates collaborative work combined with a version control software (a feature developed for Qualinca combined with GIT).
- ergonomics: rule engine and query assistants have been redesigned, several graphical editor behaviors have been improved.
- A backward chaining rule evaluation algorithm, with lazy computation of rule bodies, has been developed for the kind of Datalog rules used in the system SudoQual.

6.3. GRAAL

In its current state, Graal allows storage of data via a generic interface in different storage paradigms and systems. Currently, the relational database management systems MySQL, PostgreSQL, Sqlite, and InMemory graph and LinkedList structures are implemented. The triple store Jena TDB and the graph database system Sparksee are coming soon. Graal also allows us to query this database taking into account an ontology represented by a set of existential rules. It provides forward chaining and query rewriting algorithms (building up on Mélanie König's PhD thesis) and a tool for the analysis of the properties of a set of rules which is an integration of Swan Rocher's tool Kiabora. The input and output of this software can be expressed in our Datalog-inspired format DLGP 2.0 (6.1), and can be translated from the semantic web language OWL2 or to RuleML. This software is designed in a modular way, hence it is possible to use only a subpart of Graal without embedding it all or to easily replace an implementation of a module by another.

FUNCTIONAL DESCRIPTION

Graal is intended to be a generic platform for ontology-based query answering with existential rules.

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

- Partner: LIRMM

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

- URL: http://graphik-team.github.io/graal/

Objectives: Graal is a generic platform for query answering under existential rules. It will integrate all algorithms designed in the team, and our ambition is to make it a reference platform in the research community, allowing for the integration of algorithms designed by other teams.

Users community: Graal is intended for use in research and education.

Impact: Due to the recent release of the first stable version, Graal has only been used for now in our projects. A related paper received the RuleML 2015 challenge award http://2015.ruleml.org/.

State of the art: To the best of our knowledge, the only other tool for reasoning with existential rules is Nyaya [0], a joint development from teams in Rome, Oxford, and Milan. It has been renamed IRIS+/- https://bitbucket.org/giorsi/nyaya.

Misc.: Graal is written in Java (around 30k lines of code, 30 man/months effort). It is mainly developed by Clément Sipieter (2 years Inria ADT funding) under the CeCILL licence (GPL compatible, see http://www.cecill.info/licences.fr.html). The development started 1.5 years ago from a prototype realized during Bruno Paiva's PhD thesis, and integrates work carried out by other PhD students (Mélanie König and Swan Rocher). Graal has been first presented at RuleML 2015 [23], [33], where it received a best paper award.

New features: Main features integrated in 2015 are query rewriting algorithms, projection algorithms, and translations to and from other languages (OWL2, RuleML).

Note that we do not detail here other software developments internal to our current projects and not publicly available.

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[0]De Virgilio, R.; Orsi, G.; Tanca, L.; Torlone, R., "NYAYA: A System Supporting the Uniform Management of Large Sets of Semantic Data," in Data Engineering (ICDE), 2012 IEEE 28th International Conference on , vol., no., pp.1309-1312, 1-5 April 2012

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

6. New Software and Platforms

6.1. QuiX Tool suite

KEYWORDS: XML - JSon - Xproc - XSLT - Schematron - Xquery - NoSQL
SCIENTIFIC DESCRIPTION

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

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

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

QuiX Tool suite reads and processes large XML files without loading the entire file in main memory. Instead of building a tree representation of the XML document, QuiXProc manages data as streams (sequence of opening and closing tags).

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

6.2. SmartHal

FUNCTIONAL DESCRIPTION

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

- Participants: Guillaume Bagan and Joachim Nierhen
- Contact: Joachim Niehren
- URL: http://smarthal.lille.inria.fr/

6.3. 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 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 preprocessing, 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://gforge.inria.fr/projects/cortex/

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

6. New Software and Platforms

6.1. Amada

<small>FUNCTIONAL DESCRIPTION</small>

AMADA is a platform for storing Web data (in particular, XML documents and RDF graphs) based on the Amazon Web Services (AWS) cloud infrastructure. AMADA operates in a Software as a Service (SaaS) approach, allowing users to upload, index, store, and query large volumes of Web data.

- Participants: Jesùs Camacho-Rodriguez, Manolescu Ioana, Dario Colazzo and François Goasdoué
- Contact: Ioana Manolescu
- URL: https://team.inria.fr/oak/projects/amada/

6.2. Clique Square

RDF data management platform based on Hadoop architecture
<small>KEYWORDS: Map-Reduce - Hadoop - RDF - Big data</small>
<small>SCIENTIFIC DESCRIPTION</small>

CliqueSquare is a system for storing and querying large RDF graphs relying on Hadoop's distributed file system (HDFS) and Hadoop's MapReduce open-source implementation. CliqueSquare is equipped with a unique optimization algorithm capable of generating highly parallelizable flat query plans relying on n-ary equality joins. In addition, it provides a novel partitioning and storage scheme that permits first-level joins to be evaluated locally using efficient map-only joins.
<small>FUNCTIONAL DESCRIPTION</small>

RDF (Ressource Description Framework) is the data format for the semantic web. CliqueSquare allows storing and querying very large volumes of RDF data in a massively parralel 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.

- Participants: Ioana Manolescu, Benjamin Djahandideh, Stamatios Zampetakis, Zoi Kaoudi, François Goasdoué and Jorge Arnulfo Quiane Ruiz
- Partners: Université de Rennes 1 - Qatar Computing Research Institute
- Contact: Ioana Manolescu
- URL: https://team.inria.fr/oak/projects/cliquesquare/

6.3. FactMinder

<small>KEYWORDS: Web - Fact-checking - Data Journalism - Open data</small>
<small>FUNCTIONAL DESCRIPTION</small>

FactMinder is a browser extension targeted at online fact checkers and data journalists. It enables users to analyze web pages with entity extractors and create, in a separate panel, views to cross these annotations with background knowledge from trusted XML or RDF sources such as data sets from the Linked Open Data or governmental agencies.

FactMinder is the basis of the ANR project ContentCheck and was awarded a Google Computational Journalism Research Award in June 2015.

- Participants: Ioana Manolescu, Stamatios Zampetakis and François Goasdoué
- Partner: Université Paris-Sud
- Contact: Ioana Manolescu
- URL: https://team.inria.fr/oak/projects/xr-an-xml-rdf-hybrid-model-for-annotated-documents/

6.4. PAXQuery

FUNCTIONAL DESCRIPTION

The PAXQuery engine seamlessly parallelizes the execution of XQuery queries. By applying on-the-fly translation and optimization procedures, PAXQuery runs user queries over massive collections of XML documents in a distributed fashion. PAXQuery runs on top of Apache Flink, a distributed execution platform that relies on the PACT model.

- Participants: Jesùs Camacho-Rodriguez, Ioana Manolescu, Dario Colazzo and Juan Alvaro Munoz Naranjo
- Contact: Ioana Manolescu
- URL: https://team.inria.fr/oak/projects/paxquery/

6.5. RDFSummary

RDF Summary
FUNCTIONAL DESCRIPTION

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.

- Contact: Sejla Cebiric
- URL: https://team.inria.fr/oak/projects/rdfsummary/

6.6. WaRG

Warehousing RDF Graphs
KEYWORDS: Data mining - Semantic Web - Data management - Decision - Big data
SCIENTIFIC DESCRIPTION

WaRG is a warehouse-style analytics platform on RDF graphs. The tool stores data in kdb+ with a Java frontend based on the Prefuse Visualization toolkit. The novelty of WaRG is to redesign the full stack of Data Warehouse abstractions and tools for heterogeneous, semantics-rich RDF data, this enables a WaRG RDF DW to be an RDF graph itself, heterogeneous and semantics-rich in its turn. Thus, WaRG benefits both from powerful analytics and the rich interoperability and semantic features of Semantic Web databases.
FUNCTIONAL DESCRIPTION

WaRG (Warehousing RDF graph) is an analytical platform specially designed for the analysis of RDF data.

WaRG allows defining RDF analytical schemas, comprising classes and properties interesting for the analysis. The analytical schema can then be materialized, leading to an instance (RDF graph) refined for the needs of the analysis.

The analytical schema can also be automatically built from the input RDF instance. Finally, RDF analytical queries can be specified and lead to RDF analysis cubes.

- Participants: Roatis Alexandra, Ioana Manolescu, Sejla Cebiric and François Goasdoué
- Partners: Université de Rennes 1 - Université Paris-Sud
- Contact: Ioana Manolescu
- URL: https://team.inria.fr/oak/projects/warg/

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

6. New Software and Platforms

6.1. Symbolic KDD Systems

6.1.1. The Coron Platform

- Contact: Amedeo Napoli
- URL: http://coron.loria.fr/site/index.php
- KEYWORDS: Data mining, Closed itemset, Frequent itemset, Generator, Association rule, Rare itemset

FUNCTIONAL DESCRIPTION.

The Coron platform [102], [96] is a KDD toolkit organized around three main components: (1) Coron-base, (2) AssRuleX, and (3) pre- and post-processing modules. The software was registered at the "Agence pour la Protection des Programmes" (APP) and is freely available (see http://coron.loria.fr).

The Coron-base component includes a complete collection of data mining algorithms for extracting itemsets such as frequent itemsets, closed itemsets, generators and rare itemsets. In this collection we can find APriori, Close, Pascal, Eclat, Charm, and, as well, original algorithms such as ZART, Snow, Touch, and Talky-G [103]. AssRuleX generates different sets of association rules (from itemsets), such as minimal non-redundant association rules, generic basis, and informative basis. In addition, the Coron system supports the whole life-cycle of a data mining task and proposes modules for cleaning the input dataset, and for reducing its size if necessary.

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

6.1.2. Orion: Skycube Computation Software

- Contact: Chedy Raissi
- URL: https://github.com/leander256/Orion
- KEYWORDS: Skyline, skycube.

FUNCTIONAL DESCRIPTION.

This program implements the algorithms described in a research paper published at VLDB 2010 [100]. The software provides a list of four algorithms discussed in the paper in order to compute skycubes. This is the most efficient –in term of space usage and runtime– implementation for skycube computation.

6.1.3. OrphaMine – Data mining platform for orphan diseases

- Partners: INSERM - MoDYCo CNRS - Délégation régionale Ile-de-France, secteur ouest et nord - Greyc Université de Caen - Basse-Normandie
- Contact: Chedy Raissi
- URL: http://webloria.loria.fr/~mosmuk/orphamine/
- 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 to build 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.

6.1.4. PoQeMON Analytics: Platform for Quality Evaluation of Mobile Netwoks

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

FUNCTIONAL DESCRIPTION.

PoQEMoN is a quality evaluation platform for mobile phone networks. The quality measures 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.

6.2. Stochastic systems for knowledge discovery and simulation

6.2.1. The CarottAge System

- Contact: Jean-François Mari
- URL: http://www.loria.fr/~jfmari/App/index_in_english.html
- 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 and a synthetic representation of temporal and spatial data [97]. CarottAge is currently used by INRA researchers interested in mining the changes in territories related to the loss of biodiversity (projects ANR BiodivAgrim and ACI Ecoger) and/or water contamination. CarottAge is also used for mining hydromorphological data proved to give very interesting results for that purpose.

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

6.2.2. The ARPEnTAge System

- Contact: Jean-François Mari
- URL: http://www.loria.fr/~jfmari/App/index_in_english.html
- KEYWORDS: Stochastic process, Hidden Markov Models.

FUNCTIONAL DESCRIPTION.

ARPEnTAge, for "*Analyse de Régularités dans les Paysages : Environnement, Territoires, Agronomie*" (http://www.loria.fr/~jfmari/App/) is a software based on stochastic models (HMM2 and Markov Field) for analyzing spatio-temporal data-bases [98]. ARPEnTAge is built on top of the CarottAge system to fully take into account the spatial dimension of input sequences. It takes as input an array of discrete data in which the columns contain the annual land-uses and the rows are regularly spaced locations of the studied landscape. It performs a Time-Space clustering of a landscape based on its time dynamic Land Uses (LUS). Displaying tools and the generation of Time-dominant shape files have also been defined.

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

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

6.2.3. *The GenExp System*

- Contact: Florence Le Ber
- URL: http://orpailleur.loria.fr/index.php/GenExp-LandSiTes:_KDD_and_simulation
- KEYWORDS: Simulation, Hidden Markov Models.

FUNCTIONAL DESCRIPTION.

In the framework of the project "Impact des OGM" initiated by the French Ministry of Research, we have developed a software called GenExp-LandSiTes for simulating bidimensional random landscapes, and then studying the dissemination of vegetable transgenes. The GenExp-LandSiTes system is linked to the CarottAge system, and is based on computational geometry and spatial statistics. The simulated landscapes are given as input for programs such as "Mapod-Maïs" or "GeneSys-Colza" for studying the transgene diffusion. Other landscape models based on tessellation methods are under studies. The last version of GenExp allows an interaction with R and deals with several geographical data formats.

6.3. KDD systems in Biology

6.3.1. *IntelliGO Online*

- Contact: Malika Smaïl-Tabbone
- URL: http://plateforme-mbi.loria.fr/intelligo/
- KEYWORDS: Bioinformatics, genomics.

FUNCTIONAL DESCRIPTION.

The IntelliGO measure computes semantic similarity between terms from a structured vocabulary (Gene Ontology: GO) and uses these values for computing functional similarity between genes annotated by sets of GO terms [82]. The IntelliGO measure is available on line (http://plateforme-mbi.loria.fr/intelligo/) to be used for evaluation purposes. It is possible to compute the functional similarity between two genes, the intra-set similarity value in a given set of genes, and the inter-set similarity value for two given sets of genes.

6.3.2. *WAFOBI: KNIME Nodes for Relational Mining of Biological Data*

- Contact: Malika Smaïl-Tabbone
- KEYWORDS: Bioinformatics, genomics.

FUNCTIONAL DESCRIPTION.

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

6.3.3. MODIM: MOdel-driven Data Integration for Mining

- Contact: Malika Smaïl-Tabbone
- URL: https://gforge.inria.fr/projects/modim/
- KEYWORDS: Data integration, workflow, data modeling.

FUNCTIONAL DESCRIPTION.

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

Although MODIM is domain independent, it was used so far for biological data integration in various internal research studies and for organizing data about non ribosomal peptide syntheses.

6.4. Knowledge Systems in Health and Cooking

6.4.1. The Kasimir System for Decision Knowledge Management

- Contact: Jean Lieber
- KEYWORDS: Classification-based reasoning, case-based reasoning, decision knowledge management, knowledge edition, knowledge base maintenance, semantic portal

FUNCTIONAL DESCRIPTION.

The objective of the Kasimir system is decision support and knowledge management for the treatment of cancer. A number of modules have been developed within the Kasimir system for editing treatment protocols, visualization, and maintenance. Kasimir is developed within a semantic portal, based on OWL. KatexOWL (Kasimir Toolkit for Exploiting OWL Ontologies, http://katexowl.loria.fr) was developed in a generic way and is applied to Kasimir. In particular, the user interface EdHibou of KatexOWL is used for querying the protocols represented within the Kasimir system. In [86], this research is presented, together with an extension of Kasimir for multi-viewpoint case-based reasoning.

CabamakA (case base mining for adaptation knowledge acquisition) is a module of the Kasimir system. This system performs case base mining for adaptation knowledge acquisition and provides information units to be used for building adaptation rules. Actually, the mining process in CabamakA is based on a frequent close itemset extraction module from the Coron platform (see §6.1.1).

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

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

- Contact: Emmanuel Nauer
- URL: http://intoweb.loria.fr/taaable3ccc/
- KEYWORDS: Knowledge acquisition, ontology engineering, semantic annotation, case-based reasoning, hierarchical classification, text mining.

FUNCTIONAL DESCRIPTION.

The objectives of the Taaable system are to retrieve textual cooking recipes and to adapt these retrieved recipes whenever needed [84]. Suppose that someone is looking for a "leek pie" but has only an "onion pie" recipe: how can the onion pie recipe be adapted?

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

The Taaable system is available on line since 2008 at http://intoweb.loria.fr/taaable3ccc/, and is constantly evolving. Since 2014, Taaable is based on Tuuurbine, a generic ontology guided CBR engine over RDFS, and Revisor, an adaptation engine implementing various revision operators. This year, new features have been added to the Taaable system in order to address the new challenges of the 8th Computer Cooking Contest at ICCBR 2015. Firstly, FCA was used to improve the ingredient substitution, by taking into account ingredient combinations in a large set of recipes. Secondly, an approach based on mixed linear optimization has been used to adapt ingredient quantities, in order to be more realistic with a real cooking setting.

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

- Contact: Emmanuel Nauer
- URL: http://tuuurbine.loria.fr/
- KEYWORDS: case-based reasoning, inference engine, knowledge representation, ontology engineering, semantic web

FUNCTIONAL DESCRIPTION.

The experience acquired since 5 years with the Taaable system conducted to the creation of a generic cased-based reasoning system, whose reasoning procedure is based on a domain ontology [91]. This new system, called Tuuurbine (http://tuuurbine.loria.fr/), takes into account the retrieval step, the case base organization, and also an adaptation procedure which is not addressed by other generic case-based reasoning tools. Moreover, Tuuurbine is built over semantic web standards that will ensure facilities for being plugged over data available on the web. The domain knowledge is represented in an RDF store, which can be interfaced with a semantic wiki, for collaborative edition and management of the knowledge involved in the reasoning system (cases, ontology, adaptation rules). The development of Tuuurbine was supported by an Inria ADT funding until October 2013.

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

- Contact: Emmanuel Nauer
- URL: https://github.com/kolflow/begoood
- KEYWORDS: Tests, non-regression, knowledge evolution.

FUNCTIONAL DESCRIPTION.

BeGoood is a system allowing to define test plans, independent of any application domain, and usable for testing any system answering queries by providing results in the form of sets of strings. BeGoood provides all the features usually found in test systems, such as tests, associated queries, assertions, and expected result sets, test plans (sets of tests) and test reports. The system is able to evaluate the impact of a system modification by running again test plans and by evaluating the assertions which define whether a test fails or succeeds. BeGoood is used by the Taaable system for managing the evolution of the knowledge base used by the CBR system.

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

- Contact: Jean Lieber
- URL: http://revisor.loria.fr/
- KEYWORDS: Belief revision, adaptation, revision-based adaptation, case-based reasoning, inference engines, knowledge representation.

FUNCTIONAL DESCRIPTION.

Revisor is a library of inference engines dedicated to belief revision and to revision-based adaptation for case-based reasoning. It is open source, under a GPL license and available on the web (http://revisor.loria.fr/). It gathers several engines developed during the previous years for various knowledge representation formalisms (propositional logic, with or without the use of adaptation knowledge, conjunction of linear constraints, and qualitative algebras [89]). Some of these engines are already used in the Taaable system. Current developments on Revisor aim at defining new engines in other formalisms. In particular, a study on a revision operator in the propositional closure of linear constraints (with integer and real number variables) has been carried out [70]: definition, properties and algorithm.

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

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). 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 - and we recently set up an educational platform 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, Shaoyi Yin, Yanli Guo, Kevin Jacquemin, Aydogan Ersoz and Quentin Lefebvre
- Contact: Nicolas Anciaux
- URL: https://project.inria.fr/plugdb/

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

5. New Software and Platforms

5.1. CSS Analyzer

CSS Analyzer
FUNCTIONAL DESCRIPTION

This software now consists in two distinct prototypes: two static analyzers (with a different purpose) that share a common compiler for CSS. The first prototype is used for bug detection and verification of a cascading style sheet (CSS) file. It involves a compiler for CSS rules (and in particular selectors) into logical formulas, adapted for the semantics of CSS (see the initial WWW'12 paper). The second prototype performs automated refactoring for size reduction of CSS style sheets. It reuses the first compiler and the logical solver for detecting which rules can be refactored and how. It implements various optimisation techniques (like early pruning), for the purpose of dealing with large-size real CSS files. This prototype reduces the size of CSS files found in the most popular websites (such as CNN, facebook, Google Sites, Apple, etc.) by up to 30% while preserving their semantics [18].

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

5.2. Interactive eXtensible Engine (IXE)

Interactive eXtensible Engine
FUNCTIONAL DESCRIPTION

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

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

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

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

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

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

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

5.3. XML Reasoning Solver

XML Reasoning Solver
FUNCTIONAL DESCRIPTION

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

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

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

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

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

5.4. XQuery type-checker

XQuery type-checker
FUNCTIONAL DESCRIPTION

This prototype implements a sound static type-system for XQuery, which, as of december 2014, is the most precise type system known for XQuery. It supports the static typing of backward axes that no other does nor is supported in the XQuery recommendation. It also includes precise typing for conditional statements which is challenging as such statement are usually sensitive to the program context. Our type checker successfully verifies complex programs for which existing type-checkers (either known from the literature or those developed in commercial software) fail by reporting false alarms. One major benefit is to allow the cost of validation to be deferred from runtime to compile-time (once only). This prototype is implemented in Scala and interacts with the solver by issuing externals calls for deciding complex subtyping relations. This prototype is described in preprint [20].

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

5.5. claireCourseMaker

Claire CourseMaker Library
FUNCTIONAL DESCRIPTION

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

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

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

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

WIMMICS Project-Team

6. New Software and Platforms

6.1. CORESE

KEYWORDS: Semantic Web - Web of Data - RDF - SPARQL
FUNCTIONAL DESCRIPTION

Corese is a Semantic Web Factory, it implements W3C recommandations such as RDF, RDFS, SPARQL 1.1 Query and Update. It provides an Inference Rule language, a Transformation Language for RDF graphs and a function language on top of SPARQL. Furthermore, Corese integrates original features such as approximate search and extended Property Path. It also provides distributed federated query processing (cooperation with Johan Montagnat, I3S).

- Participants: Olivier Corby, Erwan Demairy, Fuqi Song.
- Partners: I3S, Mnemotix
- Contact: Olivier Corby
- URL: http://wimmics.inria.fr/corese

6.2. DBpedia

KEYWORDS: French chapter of DBpedia
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 then allow anyone to solve sophisticated queries against Wikipedia extracted data, and to link the different data sets on these data. The French chapter of DBpedia was created and deployed by Wimmics and is now an online running platform providing data to several projects such as: QAKIS, Izipedia, zone47, Sépage, HdA Lab., JocondeLab, etc.

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

6.3. Discovery Hub

KEYWORD: Search Engine
FUNCTIONAL DESCRIPTION

Discovery Hub is an Exploratory Search Engine on top of DBpedia.

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

6.4. QAKiS

KEYWORD: Natural Language Question Answering
FUNCTIONAL DESCRIPTION Question-Answening wiki framework based system

The QAKiS system 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, Amine Hallili (SynchroNext), Alessio Palmero Aprosio (FBK Italy), Fabien Gandon and Serena Villata
- Contact: Elena Cabrio
- URL: http://www.qakis.org/

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

6. New Software and Platforms

6.1. Hadoop_g5k

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

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

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

6.2. LogMagnet

Participants: Julien Diener, Florent Masseglia.

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.

6.3. MultiSite-Rec

Participants: Mohamed Reda Bouadjenek, Florent Masseglia, 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.

6.4. ThePlantGame: crowdsourced plants identification

Participants: Maximilien Servajean [contact], Alexis Joly, Julien Champ.

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 interest of the game is twofold: (i) train and progress in botany while having fun, and (ii) participate to a large citizen sciences project in biodiversity. The game relies on consistent scientific contributions compared to classical crowdsourcing models and algorithms that are not scalable to classification problems with thousands of complex classes such as plant species. The most remarkable one 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. Nowadays, about 1000 players are registered and produce on average about 35 new validated plant observations per day. The accuracy of the produced taxonnomic tags is about 94%, which is quite impressive considering the fact that a majority of users are beginners when they start playing.

6.5. Pl@ntNet

Participants: Julien Champ, Hervé Goëau, Alexis Joly.

URL: http://goo.gl/CpSrr3

Pl@ntNet is an image sharing and retrieval application for the identification of plants. It is developed in the context of the Floris'tic project that involves four French research organisations (Inria, Cirad, INRA, IRD) and Tela Botanica social network. The key feature of the iOS and Android front ends is to help identifying plant species from photographs, through a server-side visual search engine based on several results of ZENITH team on content-based information retrieval. Since its first release in March 2013 on the apple store, the application was downloaded by around 1M users in more than 170 countries (between 2,500 and 10,000 active users daily with peaks occurring during the week-ends). The collaborative training set that allows the content-based identification is continuously enriched by the users of the application and the members of Tela Botanica social network. At the time of writing, it includes about 200K images covering more than 5000 French plant species about 4/5 of the whole French flora (this is actually the widest identification tool built anytime).

6.6. 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 vectors hashing, approximate k-nearest neighbors search and Hamming embedding. Snoop is a refactoring of a previous library called PMH developed jointly with the French National Institute of Audiovisual. It is based on the joined research work of Alexis Joly and Olivier Buisson. SnoopIm is a content-based image search engine built on top of Snoop and allowing to retrieve small visual patterns or objects in large collections of pictures. The software is being experimented/used in several contexts including a logo retrieval application set up in collaboration with INA (DigInPix: http://diginpix.ina.fr), a whale's individuals matching application set up in collaboration with CetaMada NGO (IdentyWhale, to be publicly released soon), a hieroglyphs recognition application currently under development in collaboration with the Egyptology department of Montpellier University Paul-Valéry.

6.7. SciFloware

Participants: Dimitri Dupuis, 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.

6.8. CloudMdsQL Compiler

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

URL: http://cloudmdsql.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 is being validated on relational, document and graph data stores in the context of the CoherentPaaS European project.

6.9. Chiaroscuro

Participants: Tristan Allard, Florent Masseglia, 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)

6.10. FP-Hadoop

Participants: Reza Akbarinia, Miguel Liroz, 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.

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

6. New Software and Platforms

6.1. Vorpaline

Participants: Dobrina Boltcheva, Bruno Lévy.

Vorpaline is a commercial software / programming library. The Vorpaline software takes a new approach to 3D mesh generation, based on the theory of numerical optimization. The optimal mesh generation algorithm, developed as part of the European Research Council GOODSHAPE project, globally and automatically optimizes the mesh elements with respect to geometric constraints. It is the subject of two patents. The mathematical foundations of this algorithm, *i.e.*, the minimization of a smooth energy function, result in practice in a faster algorithm, and–more importantly–in a higher flexibility. For instance, it will allow automatic generation of the aforementioned "hex-dominant" meshes. Vorpaline is based on Geogram (see below). It adds some specialized components targeted to specific industrial usage, such as 3D gridding for the oil and gas industry. It includes our latest research results in automatic meshing. Vorpaline is licensed under a proprietary license.

6.2. IceSL

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

IceSL exploits parallel algorithms running on the GPU to afford for interactive modeling of objects described by a Constructive Solid Geometry [0] scripting language. This also enables direct slicing for additive manufacturing by considering the printer bed as a screen onto which each object slice has to be drawn as quickly as possible. During display and slicing the CSG model is converted on the fly into an intermediate representation enabling fast processing on the GPU. Slices can be quickly extracted, and the tool path is prepared through image erosion. The interactive preview of the final geometry uses the exact same code path as the slicer, providing an immediate, accurate visual feedback.

IceSL allows practitioners to design and combine complex objects with unprecedented ease. Our latest version can combine meshes as well as analytical primitives (*i.e.*, shapes described by an equation), and outputs printer instructions for filament printers as well as stereolithography printers and laser cutters.

We also augmented IceSL with a modern UI that allows users to immediately visualize changes made to the script, as well as expose a set of parameters to non-expert users who are interested in customizing a model created with IceSL. https://youtu.be/I2y_yZ4VEgk.

IceSL is the recipient software for our ERC research project "ShapeForge", led by Sylvain Lefebvre and includes several research results from the project.

6.3. Graphite

Participants: Dobrina Boltcheva, Samuel Hornus, Bruno Lévy, Nicolas Ray.

Graphite is an experimental 3D modeler, built in 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 licensed under the GPLv3.

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[0] Boolean operations between solids: difference, union, intersection.

6.4. GraphiteLifeExplorer

Participant: Samuel Hornus.

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

The development of GLE is currently on hold, but it is still downloaded (freely) regularly. We plan to add some functionalities in 2016.

6.5. OpenNL - Open Numerical Library

Participants: Bruno Lévy, Nicolas Ray, Rhaleb Zayer.

OpenNL is a standalone library for numerical optimization, especially well-suited to mesh processing. The API is inspired by the graphics API OpenGL, this makes the learning curve easy for computer graphics practitioners. The included demo program implements our LSCM [36] mesh unwrapping method. It was integrated in Blender by Brecht Van Lommel and others to create automatic texture mapping methods. OpenNL is extended with two specialized modules :

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

6.6. Geogram

Participant: Bruno Lévy.

Stemming from project GOODSHAPE (ERC Starting Grant) and project VORPALINE (ERC Proof of Concept) Geogram is a programming library of geometric algorithms. It includes a simple yet efficient mesh data structure (for surface and volumetric meshes), exact computer arithmetics (a-la Shewchuck, implemented in GEO::expansion), a predicate code generator (PCK: Predicate Construction Kit), standard geometric predicates (orient/insphere), Delaunay triangulation, Voronoi diagram, spatial search data structures, spatial sorting, and less standard ones (more general geometric predicates, intersection between a Voronoi diagram and a triangular or tetrahedral mesh embedded in n dimensions). The latter is used by FWD/WarpDrive, the first algorithm that computes semi-discrete optimal transport in 3D that scales up to 1 million Dirac masses (see compute_OTM in the example programs). Geogram is licensed under the three-clauses BSD license.

Geogram Pluggable Software Modules: Some users are interested in small subsets of Geogram. Following the principle that Geogram should be as easy to use/compile as possible, some subsets of functionalities are alternatively available as a standalone pair of (header,implementation) files, automatically extracted/assembled from Geogram sourcetree. This makes the functionality usable with 0 dependency: client code that uses a PSM just need to insert the header and the implementation file into the project (rather than linking with the entire Geogram library). The Pluggable Software Modules are licensed under the three-clause BSD license. These Pluggable Software Modules include:

- OpenNL: a library of easy-to-use numerical solvers for sparse matrices,
- MultiPrecision: a number-type that can be used for computations in arbitrary precision, based on Shewchuk's arithmetic expansion [43]. It is shipped with wrapper classes to use it as a number type for CGAL,
- Predicates: implementation of exact and symbolically perturbed predicates with arithmetic filters (based on a combination of Meyer and Pion's arithmetic filter generator [38] and our MultiPrecision library).

6.7. LibSL

Participant: Sylvain Lefebvre.

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

AVIZ Project-Team

6. New Software and Platforms
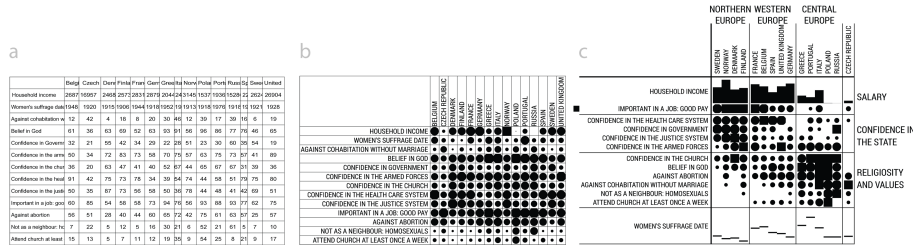
6.1. Bertifier

Figure 3. Image of Bertifier, a web application for creating tabular visualizations from spreadsheets.

FUNCTIONAL DESCRIPTION

Bertifier is a web application for rapidly creating tabular visualizations from spreadsheets (see Figure 3). Bertifier draws from Jacques Bertin's matrix analysis method, whose goal was to "simplify without destroying" by encoding cell values visually and grouping similar rows and columns. Although there were several attempts to bring this method to computers, no implementation exists today that is both exhaustive and accessible to a large audience. Bertifier remains faithful to Bertin's method while leveraging the power of today's interactive computers. Tables are formatted and manipulated through crossets, a new interaction technique for rapidly applying operations on rows and columns. Bertifier also introduces visual reordering, a semi-interactive reordering approach that lets users apply and tune automatic reordering algorithms in a WYSIWYG manner. We showed in an evaluation that Bertifier has the potential to bring Bertin's method to a wider audience of both technical and non-technical users, and empower them with data analysis and communication tools that were so far only accessible to a handful of specialists.

- Participants: Jean-Daniel Fekete, Charles Perin and Pierre Dragicevic
- Partner: Université Paris-Sud
- Contact: Jean-Daniel Fekete
- URL: http://www.bertifier.com

6.2. 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 throught the notes and documents.

FUNCTIONAL DESCRIPTION

The Note-Taking-Environment [24] 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, Emmanouil Giannisakis, and Jean-Daniel Fekete
- Contact: Jean-Daniel Fekete
- URL: https://github.com/CENDARI/editorsnotes

6.3. GraphCoiffure

SCIENTIFIC DESCRIPTION

Node-link infographics are visually very rich and can communicate messages effectively, but can be very difficult to create, often involving a painstaking and artisanal process. We have investigated node-link visualizations for communication, and have explored how to better support their creation. We have developed a set of techniques aimed at improving their creation workflow by bringing more flexibility and power to users, letting them manipulate all aspects of a node-link diagram (layout, visual attributes, etc.) while taking into account the context in which it will appear. We then implemented these techniques in a proof-of-concept prototype called GraphCoiffure, which we designed as an intermediary step between graph drawing/editing software and image authoring applications.

FUNCTIONAL DESCRIPTION

GraphCoiffure [21] is a proof-of-concept prototype designed to bridge the gap between graph editors and image authoring software by supporting graph beautification, i. e., the touching up of a node-link diagram to enhance its communicative power, or to make it conform to a desired aesthetics. GraphCoiffure is not meant to replace graph editors and graph drawing software, but rather to extend them by letting users import and beautify diagrams that have been created in these programs. GraphCoiffure does not itself enhance these diagrams, but it empowers users to do so. Its features include tools for interactive graph manipulation, a CSS-like stylesheet system, and a possibility of using page layout schemas to tailor a diagram for a specific context of use. Unlike graphics editors, it preserves visual mappings and makes it easier for users to make modifications based on the semantics of the graphs and their context of use.

- Participants: Andre Suslik Spritzer, Jeremy Boy, Pierre Dragicevic, Jean-Daniel Fekete, and Carla Maria dal Sasso Freitas
- Contact: Andre Suslik Spritzer

6.4. Hybrid Image Visualisation

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 4 .

KEYWORDS: Wall-Sized Displays, Perception, Hybrid Images

FUNCTIONAL DESCRIPTION

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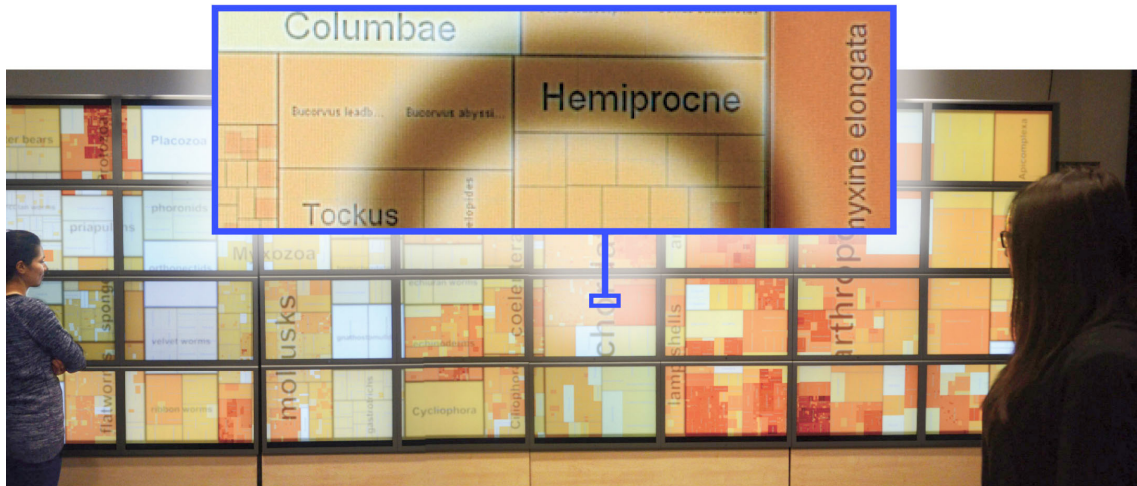- Contact: Petra Isenberg
- URL: http://aviz.fr/Research/HybridImageVisualizations

Figure 4. Hybrid image visualization software for the creation of visualizations for distant and close viewing on large displays.
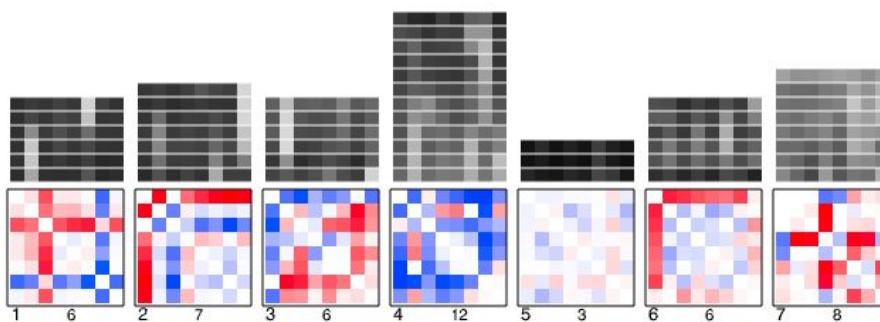

Figure 5. Small Multipiles is software for visualizing temporal networks such as for brain connectivity analysis.

6.5. Small Multipiles

SCIENTIFIC DESCRIPTION

MultiPiles [11] is a visualization to explore time-series of dense, weighted networks (see Figure 5). The interface is based on the physical analogy of piling adjacency matrices, each one representing a single temporal snapshot. Common interfaces for visualizing dynamic networks use techniques such as: flipping/animation; small multiples; or summary views in isolation. Our proposed 'piling' metaphor presents a hybrid of these techniques, leveraging each one's advantages, as well as offering the ability to scale to networks with hundreds of temporal snapshots. While MultiPiles is applicable to many domains, our prototype was initially designed to help neuroscientists investigate changes in brain connectivity networks over several hundred snapshots. The piling metaphor and associated interaction and visual encodings allowed neuroscientists to explore their data, prior to a statistical analysis. They detected high-level temporal patterns in individual networks and this helped them to formulate and reject several hypotheses.

FUNCTIONAL DESCRIPTION

MultiPiles is a visualization interface for the exploration of dense dynamic networks with changing edge weights. Dynamic networks are networks which change topology over time and/or edge weights change over time.

- Participants: Benjamin Bach, Nathalie Henry-Riche, Tim Dwyer, Tara Madhyastha, Jean-Daniel Fekete, Thomas Grabowski
- Contact: Benjamin Bach
- URL: http://visualizingbrainconnectivity.org/multipiles

6.6. Network Cube

SCIENTIFIC DESCRIPTION

Network visualizations support research in a range of scientific domains from biology to humanities. We created a platform to bridge the gap between domain scientists and visualisation researchers; NetworkCube [42] 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.

FUNCTIONAL DESCRIPTION

NetworkCube is implemented in Java and JavaScript and will be available shortly online.

- Participants: Benjamin Bach, Nathalie Henry Riche, Roland Fernandez, Emmanoulis Giannisakis, Bongshin Lee, Jean-Daniel Fekete
- Contact: Benjamin Bach

6.7. Time Curves

SCIENTIFIC DESCRIPTION

Time curves [12], as seen in Figure 6 , are a general approach for visualizing patterns of evolution in temporal data. 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. We illustrate how time curves can visually reveal informative patterns in a range of different datasets.
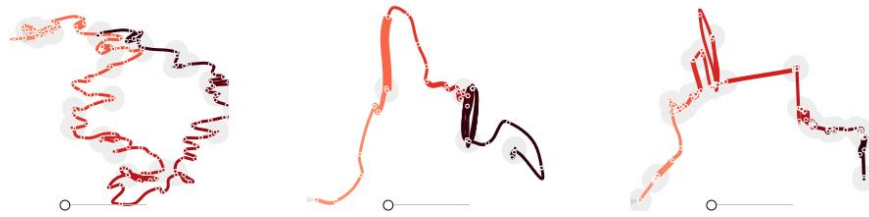
FUNCTIONAL DESCRIPTION

Figure 6. Time Curves is software for visualizing the evolution of patterns in temporal data.

Time Curves are implemented in Java and JavaScript.

- Participants: Benjamin Bach, Conglei Shi, Nicolas Heulot, Tara Madhyastha, Tom Grabowski, Pierre Dragicevic
- Contact: Benjamin Bach
- URL: http://www.aviz.fr/~bbach/timecurves/

6.8. SmartTokens

Figure 7. SmartTokens are small-sized tokens supporting touch and motion sensing, and wireless communication with a coordinator.

SCIENTIFIC DESCRIPTION

SmartTokens are small-sized tangible tokens that can sense multiple types of motion, multiple types of touch/grip, and send input events wirelessly as state-machine transitions. By providing an open platform for embedding basic sensing capabilities within small form-factors, SmartTokens extend the design space of tangible user interfaces. We describe the design and implementation of SmartTokens and illustrate how they can be used in practice by introducing a novel TUI design for event notification and personal task management.

FUNCTIONAL DESCRIPTION

SmartTokens are simple and cost-effective, but smart enough to be used as handles for digital information. SmartTokens allow to make generic, scalable and affordable user interfaces. They embed custom electronics, including touch and motion sensors as well as wireless communication functionalities.

- Participants: Mathieu Le Goc, Pierre Dragicevic, Samuel Huron, Jeremy Boy, Jean-Daniel Fekete
- Contact: Mathieu Le Goc
- URL: http://www.aviz.fr/smarttokens

6.9. Sparklificator

FUNCTIONAL DESCRIPTION

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

- 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 on 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], 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 the 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.
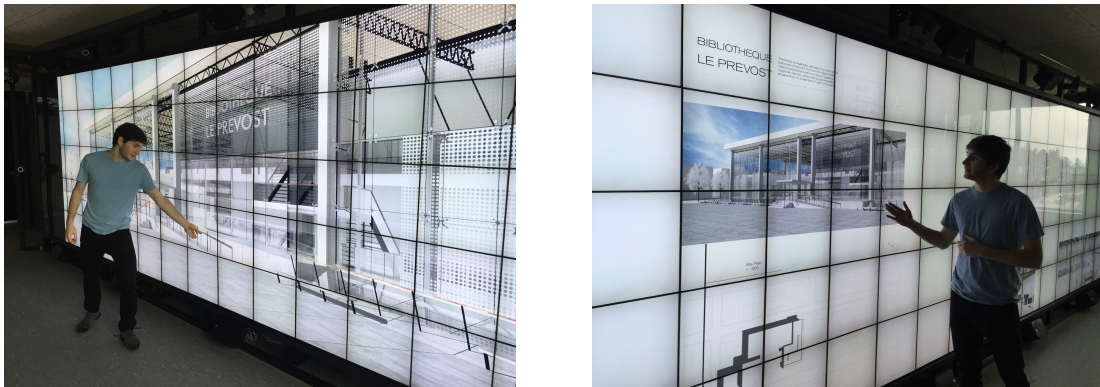

Figure 1. The WILDER platform.

GRAPHDECO Project-Team

6. New Software and Platforms

6.1. SWARPI

SWARPI (for Superpixel Warp for Image-based rendering)
FUNCTIONAL DESCRIPTION

This software package is the implementation of the publication and it was developed previously at REVES and now maintained by GRAPHDECO with public funding. The LINUX main software consists of two components: the depth synthesis step and the image-based runtime rendering step : a. depth synthesis step reads 3D points coming from the automated 3D reconstruction pipeline, together with images and calibrated cameras, and produces the superpixel decomposition and the depth synthesis algorithm. This package is provided as a set of C++ sources (for superpixel and depth) and matlab sources for depthSynth. b. The runtime rendering step is a C++ program (sources provided) which takes the result of the first step as input to allow interactive 3D navigation from pictures. The code uses multi-pass deferred shading with pixel and fragment shaders to perform the rendering.

- Participants: George Drettakis, Gaurav Chaurasia, Sylvain François Duchene and Olga Sorkine-Hornung
- Contact: George Drettakis

6.2. SWARPI-Unity

SWARPI-Unity (for Superpixel Warp for Image-based rendering for Unity)
This software package is the Unity port of the SWARPI used in the context of the CR-PLAY project.

- Participants: Jérôme Esnault, George Drettakis and Gaurav Chaurasia
- Contact: George Drettakis

6.3. SWARPI2-IBR-COMMON

SWARPI2-IBR-COMMON (for Superpixel Warp for Image-based rendering and common Image Based Rendering features)
This is the second version of SWARPI which is used internally for the research projects developed for Image-Based Rendering ([15]).

- Participants: George Drettakis, Gaurav Chaurasia, Jérôme Esnault and Sylvain François Duchene
- Contact: George Drettakis

6.4. CrossShade

CrossShade is an algorithm to estimate surface normals over a design sketch composed of vector curves representing silhouettes, boundaries and cross-sections. This algorithm has been developed in collaboration with U. of Toronto (Karan Singh) and U. British Columbia (A. Sheffer). We filed a patent on this technology and we have contacts with several companies about a potential transfer.

- Participants: Adrien Bousseau
- Contact: Adrien Bousseau

6.5. True2Form

True2Form is a sketch-based modeling system that reconstructs 3D curves from typical design sketches. This algorithm has been developed in collaboration with U. of Toronto (Karan Singh) and U. British Columbia (A. Sheffer). We filed a patent on this technology and we have contacts with several companies about a potential transfer.

- Participants: Adrien Bousseau
- Contact: Adrien Bousseau

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

6. New Software and Platforms

6.1. OpenViBE

KEYWORDS: Brain-Computer Interface, EEG, Neuroscience, Interaction, Health, Neurofeedback
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, Jérôme Chabrol, Charles Garraud, and Marsel Mano
- Partners: Inria teams POTIOC, ATHENA and NEUROSYS
- Contact: Anatole Lécuyer
- URL: http://openvibe.inria.fr

6.2. Statefinder

KEYWORDS: Brain-Computer Interface, EEG, Neuroscience, Interaction, Health, Neurofeedback, Welfare
FUNCTIONAL DESCRIPTION Statefinder is a software for determining the mental state of a user based on EEG signals analysis. It notably enables to classify between different different mental states on-line, using a preliminary training phase during which the EEG signals corresponding to these different mental states were recorded. This software was designed and used during the PhD of Mr. Laurent George, in Hybrid team. It has been transferred to Mensia Technologies startup company.

- Participants: Anatole Lécuyer
- Contact: Anatole Lécuyer

6.3. Pseudohaptik

KEYWORDS: User Interfaces, 3D web, Pseudo-Haptic, Deph Perception
FUNCTIONAL DESCRIPTION

PSEUDOHAPTIK is a software which enables to simulate pseudo-haptic effects notably for web applications. Pseudo-haptic feedback enables to simulate haptic properties such as feeling the texture or relief of an image using visual effects synchronized with the motion of the user. This software has been notably transferred to MBA Multimédia and Polymorph companies.

- Participants: Anatole Lécuyer, Ferran Argelaguet Sanz and Maud Marchal
- Contact: Anatole Lécuyer
- URL: https://team.inria.fr/hybrid/w3d-project/

6.4. Elastic_Images

KEYWORDS: User Interfaces, Depth Perception, 3D web, Pseudo-Haptic
FUNCTIONAL DESCRIPTION

Elastic_Images is a software which enables to simulate pseudo-haptic effects related to the elasticity or stiffness of 2D images, notably for web application purpose. This software has been transferred to MBA Multimédia and Polymorph companies.

- Participants: Anatole Lécuyer, Ferran Argelaguet Sanz and Maud Marchal
- Contact: Anatole Lécuyer
- URL: https://team.inria.fr/hybrid/w3d-project/

6.5. #FIVE

KEYWORDS: Virtual Reality, Collaboration, 3D Interaction
FUNCTIONAL DESCRIPTION

#FIVE is a set of software modules for the design of interactive and collaborative virtual environments. The user can focus on domain-specific aspects of his/her application (e.g., industry, medicine, etc). The #FIVE modules can then be used in a vast range of domains based on virtual reality and requiring interactive environments and collaboration - such as in training simulators for example when connected to the #SEVEN engine (see section 6.6).

- Participants: Thomas Boggini, Valérie Gouranton, Bruno Arnaldi, Florian Nouviale
- Contact: Florian Nouviale
- URL: https://hal.archives-ouvertes.fr/IRISA/hal-01147734v1

6.6. #SEVEN

KEYWORDS: Virtual Reality, Training, Scenario, Petri Net
FUNCTIONAL DESCRIPTION

#SEVEN is a scenario engines that enables the execution of complex scenarios for driving Virtual Reality training applications. #SEVEN's scenarios are based on an enhanced Petri net model that can describe and solve intricate event sequence. #SEVEN comes with an editor capable of creating, editing and remotely controlling and running such scenarios. #SEVEN is implemented in C# and can be used as a standalone application or as a library. An integration with the Unity3D engine, compatible with MiddleVR, also exists.

- Participants: Guillaume Claude, Valérie Gouranton, Bruno Arnaldi, Florian Nouviale
- Contact: Florian Nouviale
- URL: https://hal.archives-ouvertes.fr/hal-01086237

ILDA 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 developper can decide the types of widgets associated to pucks from the wall application side.

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

6.2. ZVTM

Zoomable Visual Transformation Machine
KEYWORDS: Information visualization - Data visualization - Geovisualization - 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, Olivier Chapuis, Bruno Fruchard, Maria Jesus Lobo Gunther, Arnaud Prouzeau, Hande Ozaygen and Can Liu
- Contact: Emmanuel Pietriga
- URL: http://zvtm.sf.net

6.3. Platforms

6.3.1. Platform: WILDER

Ultra-high-resolution wall-sized displays [27] 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.
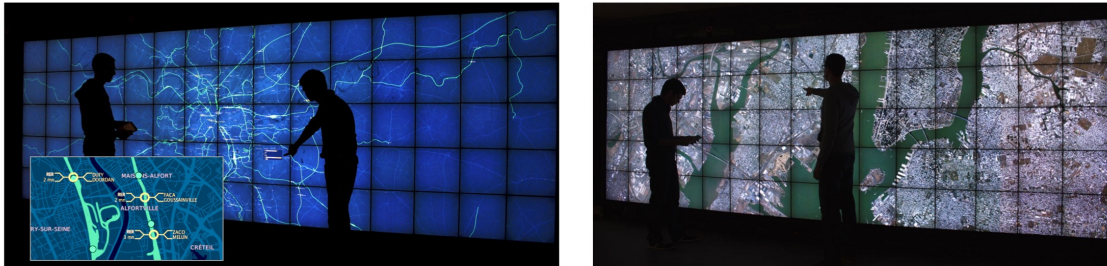
Figure 2. Geovisualization applications running on the WILDER platform. Real-time monitoring of railroad trafic in France (left), large-scale high-resolution orthoimagery visualization (right).

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).
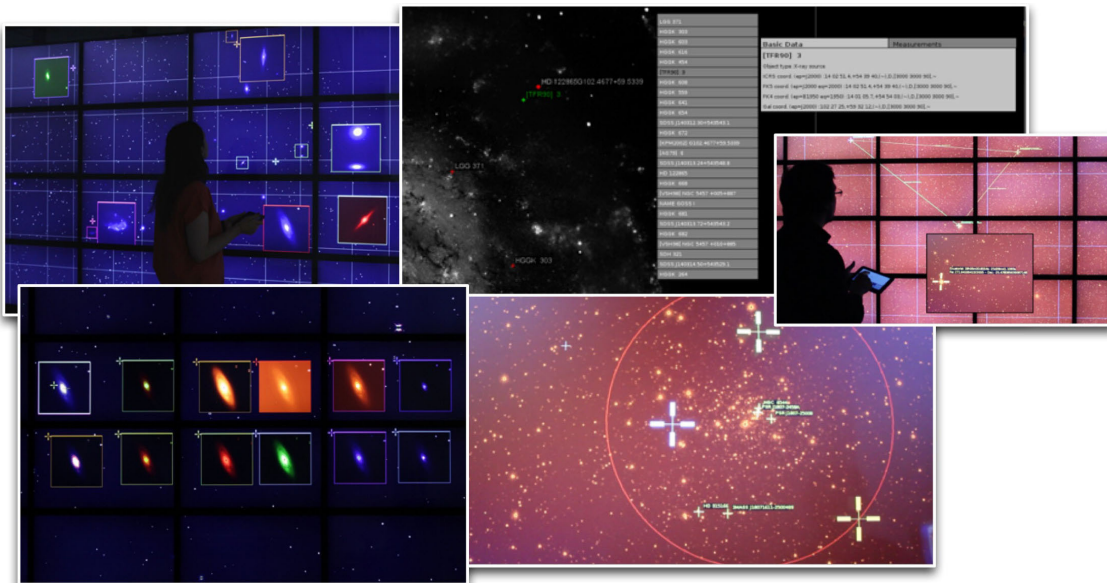
6.3.2. Platform: ANDES

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).

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).

IMAGINE Project-Team

5. New Software and Platforms

5.1. Expressive

FUNCTIONAL DESCRIPTION

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

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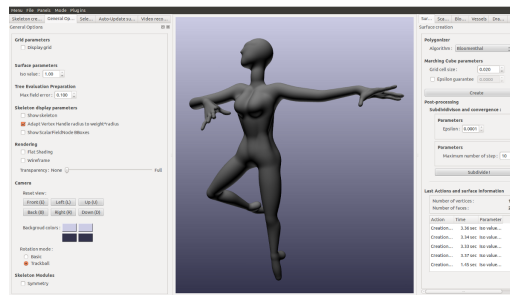- Contact: Marie-Paule Cani

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

5.2. MyCF

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

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

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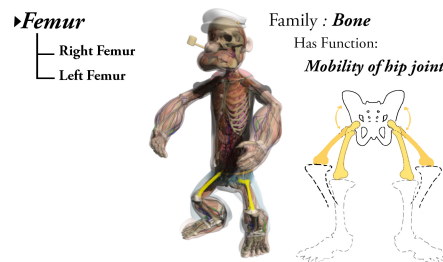- Contact: Olivier Palombi
- URL: http://www.mycorporisfabrica.org

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

5.3. SOFA

Simulation Open Framework Architecture

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

FUNCTIONAL DESCRIPTION

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

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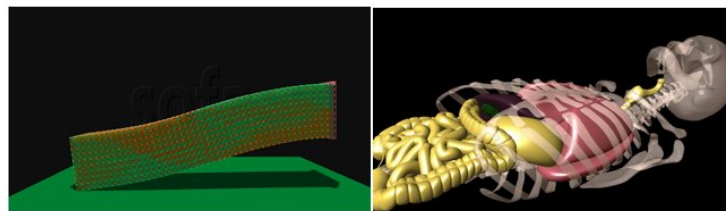- Contact: François Faure
- URL: http://www.sofa-framework.org

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

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 Bidirectional Reflection Distribution Functions (BRDFs). It provides a set of command line software to fit measured data to analytical forms, tools to understand models and data.
In 2015, we continued the development of ALTA and added different unit and integration tests to reach a new milestone with our first Beta version.

- 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, AltiVec and ARM NEON instruction sets, with graceful fallback to non-vectorized code. Expression templates allow to perform global expression optimizations, and to remove unnecessary temporary objects.

In 2015, we released four revisions of the 3.2 branch, and the beta-1 of the next 3.3 version.

- 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. PFSTools

KEYWORD: HDR Merging, radiometric calibration, HDR tonemapping
FUNCTIONAL DESCRIPTION

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

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

- Participants: Rafal Mantiuk, Ivo Ihrke
- Contact: Ivo Ihrke
- URL: http://pfstools.sourceforge.net/

6.6. Shiver

KEYWORD: HDR Viewer
FUNCTIONAL DESCRIPTION

Shiver is a Scientific HDR Image Viewer with a convenient GUI. It features fast display / zoom OpenGL capabilities, the comparison of several images in different tabs, LDR, HDR, and raw-support through a plugin architecture, and more.

In addition, Shiver is an image processing program providing the ability to execute algorithms that are programmed as plugins on one or more images. Different frontends like the command line or a QT-based graphical user interface are available. Depending on the frontend different work flows are possible.

The console frontend can be used, if no X11 server is available or a large number of images have to be processed. The QT Gui allows for intuitive work and a test of processing plugins. It allows for example pixel picking and a comfortable way to compare different processed images.

Available Shiver plugins implement, e.g., the CalTag system for automatically detecting checkerboard corners in camera calibration images.

- Participants: Ivo Ihrke
- Contact: Ivo Ihrke
- URL: http://sourceforge.net/projects/shiverfork/

6.7. Maori

KEYWORD: Matlab optical raytracing toolbox
FUNCTIONAL DESCRIPTION

The purpose of the Maori project is to provide a simple, extensible, optical raytracing library in Matlab that incorporates some modern concepts from computer graphics. In particular it features scene graph integration, a shader model, CSG objects and uses non-sequential raytracing as default. The goal is to provide a simple-to-use 3D system. In contrast to most commercial systems, 2D rotationally symmetric systems are treated as special cases of the 3D setting.

- Participants: Ivo Ihrke
- Contact: Ivo Ihrke

6.8. 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/

6.9. Radiance Scaling for MeshLab

FUNCTIONAL DESCRIPTION The Radiance Scaling technique has received some interest in the Archaeology community, for enhancing details in carved stones in particular. For this reason, we have made it available as a plugin for the Open Source software Meshlab.

- Participants: Romain Vergne, Olivier Dumas and Pascal Barla
- Contact: Pascal Barla
- URL: http://manao.inria.fr/category/software/

MAVERICK Project-Team

5. New Software and Platforms

5.1. Diffusion curves

KEYWORDS: Vector-based drawing - Shading
FUNCTIONAL DESCRIPTION

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

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

5.2. Freestyle

FUNCTIONAL DESCRIPTION

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

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

5.3. GRATIN

FUNCTIONAL DESCRIPTION

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

- Participants: Pascal Barla, Gautier Ciaudo and Romain Vergne
- Partner: UJF
- Contact: Romain Vergne
- URL: http://gratin.gforge.inria.fr

5.4. GigaVoxels

FUNCTIONAL DESCRIPTION

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

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

5.5. HQR: High Quality Renderer

KEYWORDS: Lighting simulation - Materials - Plug-in
FUNCTIONAL DESCRIPTION

HQR is a global lighting simulation platform. HQR software is based on the photon mapping method which is capable of solving the light balance equation and of giving a high quality solution. Through a graphical user interface, it reads X3D scenes using the X3DToolKit package developed at Maverick, it allows the user to tune several parameters, computes photon maps, and reconstructs information to obtain a high quality solution. HQR also accepts plugins which considerably eases the development of new algorithms for global illumination, those benefiting from the existing algorithms for handling materials, geometry and light sources.

- Participant: Cyril Soler
- Contact: Cyril Soler
- URL: http://artis.imag.fr/~Cyril.Soler/HQR
- URL: https://launchpad.net/~csoler-users/+archive/ubuntu/hqr

5.6. Spherical harmonic library

KEYWORDS: Lighting simulation - Materials - Plug-in
FUNCTIONAL DESCRIPTION

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

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

5.7. MobiNet

KEYWORD: Simulation

FUNCTIONAL DESCRIPTION

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

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

5.8. PLANTRAD

KEYWORDS: Bioinformatics - Biology
FUNCTIONAL DESCRIPTION

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

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

5.9. PROLAND

PROcedural LANDscape
KEYWORDS: Real time - 3D - Realistic rendering - Masses of data - Atmosphere - Ocean
FUNCTIONAL DESCRIPTION

The goal of this platform is the real-time quality rendering and editing of large landscapes. All features can work with planet-sized terrains, for all viewpoints from ground to space.

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

5.10. Vrender

FUNCTIONAL DESCRIPTION

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

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

VRender is also responsible for the vectorial snapshot feature of the QGLViewer library.

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

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

6. New Software and Platforms

6.1. AsymGait

Asymmetry index for clinical gait analysis based on depth images
KEYWORDS: Motion analysis - Kinect - Clinical analysis
SCIENTIFIC DESCRIPTION

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

FUNCTIONAL DESCRIPTION

AsymGait is a software package that works with Microsoft Kinect data, especially depth images, in order to carry-out clinical gait analysis. First is 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 of di-symmetric). The viewpoints allow to cover the range of possible framings for the specified entities. The computation of such viewpoints relies on a database of framings that are dynamically adapted to the 3D scene by using a manifold parametric representation and guarantee the visibility of the specified entities. The set of viewpoints is also automatically annotated with cinematographic tags such as shot scales, angles, compositions, relative placement of entities, line of interest.

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

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

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

6.5. Populate

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

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.

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

6.6. The Theater

SCIENTIFIC DESCRIPTION

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

FUNCTIONAL DESCRIPTION

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

- Contact: Marc Christie

MINT Project-Team

5. New Software and Platforms

5.1. Revil

SCIENTIFIC DESCRIPTION

Revil is an application for building and manipulating 3D SceneGraphs for Mixed-Reality Artistic Performances.It relies on the approach of revealing virtual content in the physical space by intersecting it with performers and spectator's bodies and props.

FUNCTIONAL DESCRIPTION

It provides a GUI for setting up the projectors, depth cameras and scene objects. It is based on OpenScene-Graph, OpenNI2 and is entirely controllable via OpenSoundControl messages so that it can be connected to Digital Musical Instruments and other interactive systems.

- Participants: Florent Berthaut, Cagan Arslan
- Contact: Florent Berthaut
- URL: http://forge.lifl.fr/Revil

5.2. libgina

FUNCTIONAL DESCRIPTION

LibGINA is a library for fast prototyping of gestural interaction.
In 2015, new features were added in the context of Nicolas Bremard's thesis. The software was used in various projects.

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

5.3. SmartInteraction

FUNCTIONAL DESCRIPTION

SmartInteraction is a library, result from the FUI SmartStore project. It allows mobile services to be activated easily through automatic connection to interaction public spots, without specific user action.

- Participants: Samuel Degrande, Laurent Grisoni
- Contact: Samuel Degrande

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

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 2015. Notable changes concern the management of pointing devices and displays, the standardization of URIs on all platforms, HID reports parsing on Linux and OS X, the integration of floating pixel coordinates and subpixel interaction [34], the improvement of existing bindings and the addition of Node.js ones, and support for Web browser integration.

Web site: http://libpointing.org/

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

6.3. Liblag

Participants: Géry Casiez [correspondent], Matthieu Falce, Nicolas Roussel.

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 and Ubuntu) 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.

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

6.4. Mouse-based lagmeter

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

As part of the work reported in [18], 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) should be made available in 2016.

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

POTIOC Project-Team

6. New Software and Platforms

6.1. OpenVIBE

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

OpenViBE is a software platform for real-time neurosciences (that is, for real-time processing of brain signals). It can be used to acquire, filter, process, classify and visualize brain signals in real time from various signal sources. OpenViBE is free and open source software. It works on Windows and Linux operating systems.

- Participants: Yann Renard, Anatole Lécuyer, Fabien Lotte, Bruno Renier, Vincent Delannoy, Laurent Bonnet, Baptiste Payan, Jozef Legény, Jussi Tapio Lindgren, Alison Cellard, Loïc Mahé, Guillaume Serriere, Marsel Mano, Maureen Clerc Gallagher, Théodore Papadopoulo, Laurent Bougrain, Jérémy Frey, Nathanael Foy
- Partners: INSERM - CEA-List - GIPSA-Lab
- Contact: Anatole Lécuyer
- URL: http://openvibe.inria.fr

In 2015, the first stable version of the OpenViBE software, OpenViBE version 1.0.0, was released. OpenViBE 1.0.0 features lots of fixes for stability and usability. There has been a significant effort in cleanup and removal of unused components and dead code. This version introduces more tools for communicating with other software, added support for some new, emerging acquisition systems, such as OpenBCI and new signal processing algorithms such as Wavelet decomposition and artifact removal boxes. Link: http://openvibe.inria.fr/openvibe-1-0-0-has-been-released/

6.2. Platforms

6.2.1. AMI

Augmented Michelson Interferometer
SCIENTIFIC DESCRIPTION

We have developed a hybrid plateform that merges physical and virtual elements for teaching optics. This work is described in more details in Section 7.6

- Participants: David Furio, Martin Hachet, Patrick Reuter and Bruno Bousquet
- Partners: Université de Bordeaux - LaBRI
- Contact: Martin Hachet
- URL: https://team.inria.fr/potioc/fr/2015/06/30/hobit-hybrid-optical-bench-for-innovative-teaching

TITANE Project-Team

6. New Software and Platforms

6.1. CGAL Barycentric coordinates 2D

SCIENTIFIC DESCRIPTION

The package 2D Generalized Barycentric Coordinates offers an efficient and robust implementation of two-dimensional closed-form generalized barycentric coordinates defined for simple two-dimensional polygons. If coordinates with respect to multivariate scattered points instead of a polygon are required, please refer to natural neighbour coordinates from the package 2D and Surface Function Interpolation. The package includes an implementation of Wachspress, mean value, and discrete harmonic coordinates and provides some extra functions to compute barycentric coordinates with respect to segments (segment coordinates) and triangles (triangle coordinates).

- Participants: Pierre Alliez and Dmitry Anisimov
- Contact: Pierre Alliez

6.2. Module CGAL: Point Set Processing

SCIENTIFIC DESCRIPTION

This 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, Laurent Saboret and Clément Jamin
- Contact: Pierre Alliez
- URL: http://doc.cgal.org/latest/Point_set_processing_3/index.html

6.3. Module CGAL: Scale-space surface reconstruction

KEYWORD: Geometric algorithms
SCIENTIFIC DESCRIPTION

This package implements a surface reconstruction method which takes as input an unordered point set and computes a triangulated surface mesh interpolating the point set. We assume that the input points were sampled from the surface of an object. The method can also process point sets sampled from the interior of the object, although we cannot provide guarantees on the output. This method can handle a decent amount of noise and outliers. The point set may greatly undersample the object in occluded regions, although no surface will be reconstructed to fill these regions.

See http://doc.cgal.org/latest/Scale_space_reconstruction_3/index.html
FUNCTIONAL DESCRIPTION

This method reconstructs 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 and Thijs Van Lankveld
- Contact: Pierre Alliez
- URL: http://doc.cgal.org/latest/Scale_space_reconstruction_3/index.html

6.4. Skeleton-Blockers

Skeleton-Blockers data-structure
KEYWORDS: C++ - Mesh - Triangulation - Topology - 3D
FUNCTIONAL DESCRIPTION

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/

6.5. Structure-preserving Decimation

KEYWORDS: Mesh - 3D - Multi-View reconstruction
FUNCTIONAL DESCRIPTION

Structure-preserving decimation is a software that can simplify 3D meshes while preserving some of their structure. Simplification is performed through either a command line or a graphical user interface that can combine several operations including several simplification methods.

- Participants: David Salinas, Pierre Alliez and Florent Lafarge

- Contact: David Salinas

ALPAGE Project-Team

6. New Software and Platforms

6.1. Alexina

Atelier pour les LEXiques INformatiques et leur Acquisition
FUNCTIONAL DESCRIPTION

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

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

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

- Participants: Marie-Hélène Candito, Djamé Seddah and Benoit Crabbé
- Contact: Marie-Hélène Candito
- URL: http://alpage.inria.fr/statgram/frdep/fr_stat_dep_parsing.html

6.3. 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: Djamé Seddah

6.4. 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: Éric Villemonte de La Clergerie
- Contact: Éric Villemonte de La Clergerie
- URL: http://dyalog.gforge.inria.fr/

6.5. FDTB1

- Contact: Laurence Danlos

6.6. 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: Djamé Seddah

6.7. FRMG

- Participant: Éric Villemonte de La Clergerie
- Contact: Éric de La Clergerie
- URL: http://mgkit.gforge.inria.fr/

6.8. French Question Bank

- Contact: Djamé Seddah

6.9. LexConn

- Contact: Laurence Danlos

6.10. LexViz

FUNCTIONAL DESCRIPTION

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

- Participants: Éric Villemonte de La Clergerie and Mickael Morardo
- Contact: Éric Villemonte de La Clergerie

6.11. 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

6.12. Mgwiki

FUNCTIONAL DESCRIPTION

Mgwiki is a linguistic wiki that may used to discuss linguistic phenomena with the possibility to add annotated illustrative sentences. The work is essentially devoted to the construction of an instance for documenting and discussing FRMG, with the annotations of the sentences automatically provided by parsing them with FRMG. This instance also offers the possibility to parse small corpora with FRMG and an interface of visualization of the results. Large parsed corpora (like French Wikipedia or Wikisource) are also available. The parsed corpora can also be queried through the use of the DPath language.

- Participants: Éric Villemonte de La Clergerie and Paul Bui–quang
- Contact: Éric Villemonte de La Clergerie
- URL: http://alpage.inria.fr/frmgwiki/

6.13. 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 designd for the analysis and manipulation of attributed oriented and multi-relational graphs.

- Participants: Corentin Ribeyre, Djamé Seddah, Éric Villemonte de La Clergerie and Marie-Hélène Candito
- Contact: Corentin Ribeyre
- URL: http://www.corentinribeyre.fr/projects/view/OGRE

6.14. 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/

6.15. 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: Djamé Seddah

6.16. 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, Kata Gábor, Marion Baranes, Pierre Magistry, Éric Villemonte de La Clergerie and Djamé Seddah
- Contact: Benoît Sagot
- URL: http://lingwb.gforge.inria.fr/

6.17. VerbeNet

- Contact: Laurence Danlos

6.18. hyparse

Alpage Hybrid Parser
KEYWORDS: Parsing - NLP
FUNCTIONAL DESCRIPTION

Multilingual Phrase Structure Parser

- Contact: Benoit Crabbé
- URL: http://hyparse.gforge.inria.fr

6.19. DyALog-sr

DYALOG-sr
KEYWORDS: Parsing - NLP
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

MULTISPEECH Project-Team

6. New Software and Platforms

6.1. ANTS - Automatic News Transcription System

FUNCTIONAL DESCRIPTION: ANTS is a multipass system for transcribing audio data, and in particular radio or TV shows. The audio stream is first split into homogeneous segments that are decoded using the most adequate acoustic model with a large vocabulary continuous speech recognition engine (Julius, Sphinx or Kaldi). Further processing passes are run in order to apply unsupervised adaptation processes on the features and/or on the model parameters, or to use Speaker Adaptive Training based models. Latest version include DNN (Deep Neural Network) acoustic modeling.

- Participants: Dominique Fohr, Odile Mella, Irina Illina and Denis Jouvet
- Contact: Dominique Fohr

6.2. ASTALI - Automatic 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 potential 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. The web application makes the service easy to use, without requiring any software downloading. Also, the software is currently under integration in the EQUIPEX ORTOLANG platform.

- Participants: Dominique Fohr, Odile Mella, Antoine Chemardin and Denis Jouvet
- Contact: Dominique Fohr
- URL: http://astali.loria.fr/

6.3. JCorpusRecorder

FUNCTIONAL DESCRIPTION: JCorpusRecorder is a software for the recording of audio corpora. It provides an easy tool to record with a microphone. The audio input gain is controlled during the recording. From a list of sentences, the output is a set of wav files automatically renamed according to textual information given in input (nationality, speaker language, gender, ...). An easy to use tagging allows for displaying a textual/visual/audio context for guiding the speaker, along with the text of the sentence to pronounce. Several text encodings are enabled (allowing for instance Chinese texts). The sentences can be presented in a random order. The last version can record up to 8 synchronous channels (8 channels under Linux and 2 channels under Windows). The software is developed in Java, and is currently used for the recording of sentences in several projects.

- Contact: Vincent Colotte

6.4. 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. Thus JSnoori currently focuses the calculation of F0, the forced alignment of non native English uttered by French speakers and the correction of prosody parameters (F0, rhythm and energy). Several tools have been incorporated to segment and annotate speech. A complete phonetic keyboard is available, several levels of annotation can be used (phonemes, syllables and words) and forced alignment can exploit pronunciation variants. In addition, JSnoori offers real time F0 calculation which can be useful from a pedagogical point of view. Besides the traditional graphic interface, JSnoori can now be used via scripts written in Jython.

- Participants: Yves Laprie, Slim Ouni, Julie Busset, Aghilas Sini and Ilef Ben Farhat
- Contact: Yves Laprie
- URL: http://www.loria.fr/~laprie/WinSnoori/

6.5. 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 coils 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. The last version of VisArtico can handle multimodal data, not articulatory data only. In fact, it is possible to visualize motion capture data from Vicon or kinect-like systems (PrimeSense and RealSense). It is possible to generate video from the visualized trajectories. A derived version from VisArtico is also used in the ADT Plavis as a tool to visualize and process the audiovisual data. The software is used by more than 170 researchers around the world.

- Participants: Slim Ouni, Loïc Mangeonjean and Ilef Ben Farhat
- Contact: Slim Ouni
- URL: http://visartico.loria.fr

6.6. 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. 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 constructing a velum model and incorporating it into the area functions.

- Contact: Yves Laprie

6.7. Platform EMA - Electromagnetic Articulography Acquisition

FUNCTIONAL DESCRIPTION: Since the purchase of the articulograph AG500 in 2007, we have built a strong experience with respect to the acquisition technique and we have developed an acquisition protocol. The platform has been improved by acquiring the latest articulograph AG501 funded by the EQUIPEX ORTOLANG project. The AG501 allows tracking the movement of 24 sensors at reasonable high frequency (250Hz) up to a very high frequency (1250Hz). In addition, we have continued improving VisArtico (cf. 6.5), a powerful tool to visualize articulatory data acquired using an articulograph. This year we have used the system to acquire articulatory data for the tongue, jaw and lips to study stuttering speech disorder (informal collaboration with F. Hirsch, Praxiling (UMR 5267)). We have also used the EMA platform to acquire motion capture data for the lips, to be used in the context of audiovisual speech synthesis [82].

- Contact: Slim Ouni

6.8. Platform MRI - Magnetic Resonance Imaging

KEYWORDS: Health - Medical imaging
FUNCTIONAL DESCRIPTION: Magnetic Resonance Imaging (MRI) takes an increasing place in the investigation of speech production because it provides a complete geometrical information of the vocal tract. We thus initiated a cooperation with the IADI laboratory (Imagerie Adaptive Diagnostique et Interventionnelle) at Nancy Hospital, which studies in particular magnetic resonance imaging. This year the work focused on the development of compressed sensing algorithms and the reconstruction of good quality images to acquire cineMRI at a sampling rate between 25 and 60 Hz. The algorithms were implemented on the 3T GE research MRI machine of the Nancy Hospital.

- Contact: Yves Laprie

PANAMA Project-Team

6. New Software and Platforms

6.1. FASST2

Flexible Audio Source Separation Toolbox
KEYWORDS: Audio - Source Separation
SCIENTIFIC DESCRIPTION

Only source separation software publicly availble 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

6.2. 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/

6.3. SPADE

Sparse Audio Declipper
KEYWORDS: Audio - Sparse regularization - Declipping
FUNCTIONAL DESCRIPTION

Matlab routines to reproduce audio declipping experiments from the papers:

- Srdan Kitic, Nancy Bertin, Remi Gribonval. Audio Declipping by Cosparse Hard Thresholding. iTwist - 2nd international - Traveling Workshop on Interactions between Sparse models and Technology, Aug 2014, Namur, Belgium. [95]
- 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. [31]
- Participants: Srdan Kitic, Nancy Bertin and Rémi Gribonval
- Contact: Rémi Gribonval
- URL: http://xspaad.gforge.inria.fr/

SEMAGRAMME Project-Team

5. New Software and Platforms

5.1. Abstract Categorial Grammar Development Toolkit (ACGtk)

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

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

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

The software is implemented in OCaml and is available as OPAM [0] package. Version 1.3.0 was released on November 30th.

- Contact: Sylvain Pogodalla
- URL: http://www.loria.fr/equipes/calligramme/acg/

5.2. Grew

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).

A online version of Grew for graph matching was presented as a demo in the TALN conference [19].

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

5.3. ZombiLingo

Crowdsourcing is nowadays a way of constructing linguistic resources which is more and more used. In the crowdsourcing area, one of the way to motivate a large amount of people to contribute to a project is to present it as a game. Games used in this particular way are called GWAPs (Game With A Purpose). ZombiLingo is a GWAP where gamers have to give linguistic information about the syntax of French natural language sentence.

At the end of 2015, 460 players are registered on the game website and they have produce 63,000 annotations.

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[0] https://opam.ocaml.org/

In 2015, an Inria ADT started based on the prototype built in 2014. The engineer (Nicolas Lefebvre) worked on this project since October 2015. The main improvement were: migration towards a new framework (Laravel) and code refactoring, integration of new designs into the game and internationalization of the interface to prepare the game for application to other natural Languages.

- Participants: Bruno Guillaume, Karën Fort (Université Paris Sorbonne) and Nicolas Lefebvre
- Contact: Bruno Guillaume
- URL: http://zombilingo.org/

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 (disfluencies) and MElt (POS and lemma) and propose different analyses of repartition, mainly during the Théophane De Logivière internship.

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

5.5. Dep2pict

Dep2pict is a program for drawing graphical representation of dependency structures of natural language sentences.

- Contact: Bruno Guillaume
- URL: http://dep2pict.loria.fr

5.6. LEOPAR

Leopar is a parser for natural languages which is based on the formalism of Interaction Grammars. The main features of the current version of the software are: automatic parsing of a sentence or a set of sentences, dependency and parse-tree representation of sentences, interactive parsing (the user chooses the couple of nodes to merge) and visualization of grammars produced by XMG-2 or of sets of description trees associated to some word in the linguistic resources.

- Participants: Guillaume Bonfante, Bruno Guillaume and Guy Perrier
- Contact: Bruno Guillaume
- URL: http://leopar.loria.fr

Chroma Team

6. New Software and Platforms

6.1. CUDA-HSBOF

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

6.2. DATMO (Detection and Tracking of Moving Objects)

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

6.3. E.R.C.I.

Estimation du risque de collision aux intersections

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

6.4. Embedded Perception

FUNCTIONAL DESCRIPTION

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

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

6.5. GPU BOF

Bayesian Occupancy Filter on GPU

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

6.6. GPU Stro Occupancy Grid

GPU Stereo Occupancy Grid

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

6.7. VI-SFM

FUNCTIONAL DESCRIPTION

Experimentaly the closed Form Solution for usual-initial data fusion agains real and simulated fusion

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

6.8. kinetics

- Contact: Jilles Dibangoye

DEFROST Team

6. New Software and Platforms

6.1. SOFA

Simulation Open Framework Architecture
KEYWORDS: Physical simulation - Health - Biomechanics - GPU - Computer-assisted surgery
FUNCTIONAL DESCRIPTION

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

- Participants: Stéphane Cotin and Hervé Delingette
- Partner: IGG
- Contact: Stéphane Cotin
- URL: http://www.sofa-framework.org

6.2. Soft robot plugin for sofa

Our contribution consists in a new framework to simulate and control soft robots. This framework is based on a mechanical modeling of the robot elements combined with fast real-time direct/inverse FEM solvers. The keypoint of our approach is that the same modeling is used for interactive simulation of its behavior and interactive control of the fabricated robots. This plugin is being developped in the ADT project SORBET.

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

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

6.3. Neurosurgery simulation

Vascular neurosurgery simulation based on SOFA Framework
KEYWORDS: Simulation - Health - Computer-assisted surgery

- Participants: Christian Duriez, Eulalie Coevoet, Laurent Thines and Jérémie Dequidt
- Partners: Université de Lille - CHRU Lille
- Contact: Christian Duriez

<p align="center" style="color:red">FLOWERS Project-Team</p>

6. New Software and Platforms

6.1. Poppy project

6.1.1. Introduction

- Participants: Matthieu Lapeyre, Pierre Rouanet, Nicolas Rabault, Theo Segonds, Jonathan Grizou and Pierre-Yves Oudeyer
- Contact: Pierre-Yves Oudeyer
- URL: https://www.poppy-project.org/

The Poppy Project develops open-sources 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.

6.1.2. Poppy Ergo Jr (hardware)

Poppy Ergo Jr is a new open hardware robot developed by the Poppy Project to explore the use of robots in classroom for learning robotic and computer science. It is a 6-Dofs arm designed to be both expressiv and low-cost. This is achieved by the use of FDM 3D printing, low cost Robotis XL-320 actuators. In addition we have added a Pi camera so the robot can detect object, faces or QR codes.

The Ergo Jr is controlled by the pypot software running on a Raspberry pi 2. The communication between the Raspberry pi and the actuators is made possible by the Pixl board we have designed.
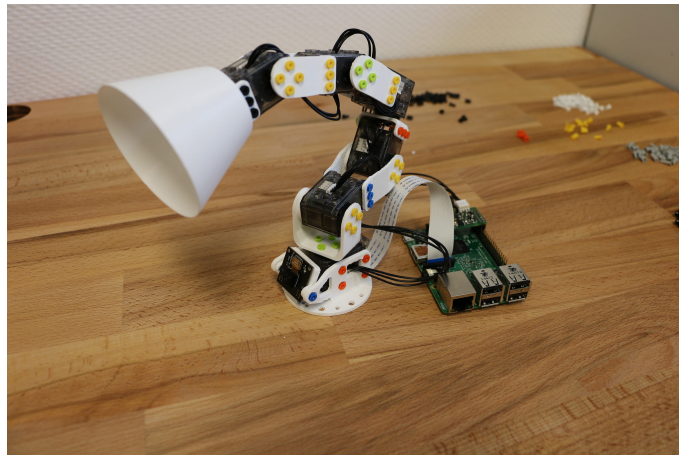

Figure 1. The new open hardware Poppy Ergo Jr, 6-DoFs arm robot for education

The sources are availables on the following web platforms:

- Github repository: https://github.com/poppy-project/poppy-ergo-jr
- CAD files: https://cad.onshape.com/documents/10951c2120eb4209abfff972/w/2b2ed99178db4a72aa4ebcc9
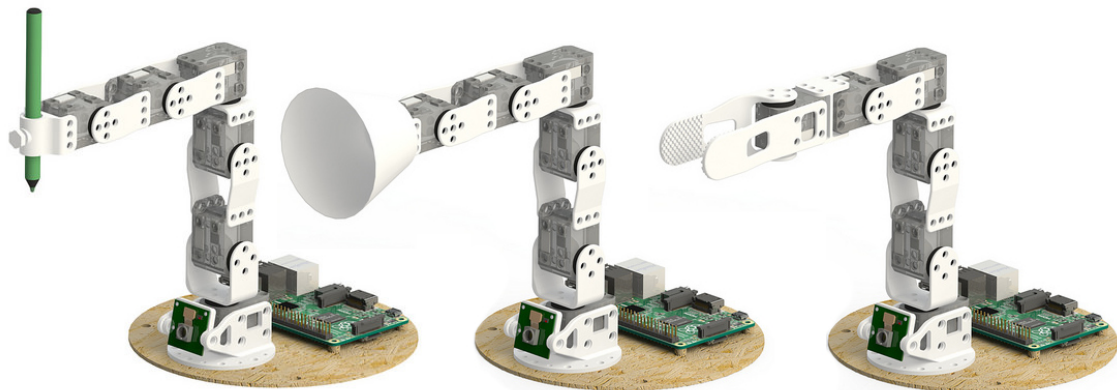
Figure 2. The Ergo Jr has 3 tools, a pen holder, a lampshade and a gripper

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

6.1.3. Pixl (Electronics)

Pixl is a tiny board used to create low cost robots based on raspbery pi and XL320 motors. This board have bean created by the Poppy project team. Pixl have 2 main features, the power part, and the communication part :

- The power part allow the user to plug an 7V AC/DC converter directly into the Pixl. This power will be distributed to all XL320 motors and will be converted to 5V for the raspberry pi.
- The communication part convert full duplex to half duplex and vice versa. The half duplex part switch between RX and TX automatically. Another connector allow the user to connect his XL320 network.

6.1.4. Poppy Com

FUNCTIONAL DESCRIPTION

Poppy-com is a low level library who manage the new poppy system communication protocol. This work in progress library, writen in C/C++, is completely open-source and available on github. Atctually poppy-com work with Atmel ATMEGA series microcontroler and a test version can be run on X86 architectures. His main objectiv is to give access to the user at the lowest level of code. Each poppy system module run this code to be detected into the robt network and to comunicate with others modules. Users can write theire owns code and write it in any module. With this new level the user can create basic behavior directly into a poppy system module.

- Bootloader : The bootloader have to manage robot network discovery, auto-addressing, module specific firmware update validation, and user code update.
- User : The user side have a small part of code dedicated to the module management like motor management routines, sensors synchronizations, numerical treatment of signals... The empty memory of each modules can be used by the user and he can add his own code to manage his robot.

This library will be compatible with the Arduino univers, that allow non expert people to use it anyway. To simplify the robot functionality developpement and function execution localization we want to try to create a way to write a code for all a robot modules on only one code. Each function of this code could be redirected in a specific module, the execution can be completely distributed.

- Participants: Pierre Rouanet, Matthieu Lapeyre, Nicolas Rabault and Pierre-Yves Oudeyer
- Contact: Pierre-Yves Oudeyer
- URL: https://www.poppy-project.org/
- Contact: Nicolas Rabault
- URL: https://github.com/poppy-project/poppy-com

6.1.5. *Poppy System*

FUNCTIONAL DESCRIPTION

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 an unified system where each essential robotic components (actuators, sensors, ...) is an independant module, connected with other through standardized interfaces:

- Unified mechanical interfaces which simplifies 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 makes it easy to program each module independantly.

The current Poppy robots (Humanoid, Torso, Ergo) will be updated using this novel architecture.

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.

6.1.6. *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. More precisely, you can use pypot to:

- directly control robotis motors through a USB2serial device,
- define the structure of your particular 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 different Poppy robots. This abstraction layer allows to seamlessly switch from one of the 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 REST 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.

FUNCTIONAL DESCRIPTION

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

Pypot is also compatible with the V-REP simulator. This allows the transparent switch from a real robot to its simulated equivalent without having to modify the code.

Finally, it has been developed to permit an easy and fast extension to other types of motors and sensors.
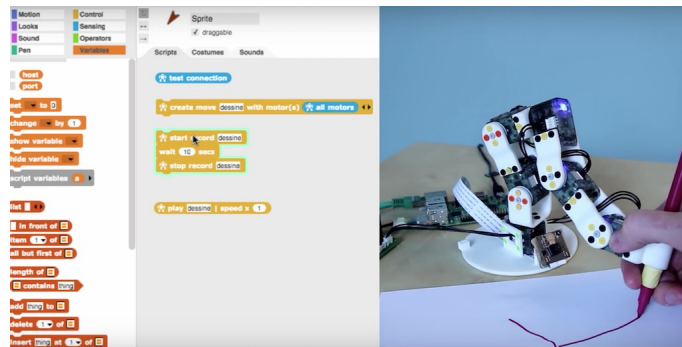
Figure 3. Example of using pypot to program a robot to reproduce a drawn shape

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

CONNECTION WITH THE VISUAL PROGRAMMING LANGUAGE SNAP!

Pypot has been connected to Snap!, a variant of the famous Scratch visual language, developed for teaching computer science to children. It is based on blocks that can be dragged-and-drop, and assembled to write scripts.

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*.

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

Snap! is also used as a tool for programming the robot by demonstration. Thanks to *record* and *play* blocks, users can easily trigger kinesthetic recording of the robots (or only subpart such as one arm). They can then be played or "mixed" - either played in sequence or in parallel - 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 tool has been developed and used in collaboration with artists who investigate the concept of robotic moves.

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

DISSEMINATION AND CONTRIBUTION

The pypot source file are released under the GPLv3 license and can be accessed on Github. They have been downloaded about 50k times (source Python Package Index) and forked about 50 times (source Github).

18 contributors have participated to its development.

Pypot are also largely based on jupyter notebooks to provide examples, tutorials or scientific experiments.

- Participants: Pierre Rouanet, Theo Segonds, Matthieu Lapeyre
- Contact: Pierre Rouanet
- URL: https://github.com/poppy-project/pypot

6.1.7. *Inverse kinematics library*

FUNCTIONAL DESCRIPTION

IKPy is a Python Inverse Kinematics library, designed to be simple to use and extend. It provides Forward and Inverse kinematics functionalities, 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. IKPy is open-source, and can be found at: https://github.com/Phylliade/ikpy

- Participants: Pierre Manceron, Pierre Rouanet, Pierre-Yves Oudeyer
- Contact: Pierre Rouanet
- URL: https://github.com/Phylliade/ikpy

6.2. Tools for robot learning, control and perception

6.2.1. 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

6.2.2. DMP-BBO

Black-Box Optimization for Dynamic Movement Primitives
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 (https://github.com/stulp/dmpbbo) has been extended to include the "unified model for regression", see Section 7.2.3 . The implementation of several of the function approximators have been made real-time compatible.

- Participant: Freek Stulp
- Contact: Freek Stulp
- URL: https://github.com/stulp/dmpbbo

6.2.3. DyNAMoS

FUNCTIONAL DESCRIPTION

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

- Participants: Alexander Gepperth and Mathieu Lefort
- Contact: Mathieu Lefort

6.2.4. *Multimodal Concept Learning with Non-negative Matrix Factorization*

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 mulimodal learning experiment mentioned above. It has already been reused in several experimentations by other member of the team and is expected to play an important role in further collaborations. It is also expected that the public availability of the code encourages further experimentation by other scientists with data coming from other domains, thus increasing both the impact of the aforementioned publication and the knowledge on the algorithm behaviors.

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

6.2.5. *Explorers*

FUNCTIONAL DESCRIPTION

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

- Participants: Pierre-Yves Oudeyer and Fabien Benureau

- Contact: Pierre-Yves Oudeyer

- URL: https://github.com/humm/explorers

6.2.6. 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 Gepperth and Louis-Charles Caron

- Contact: Alexander Gepperth

6.2.7. OptiTrack

FUNCTIONAL DESCRIPTION

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

- Participant: Pierre Rouanet

- Contact: Pierre Rouanet

6.2.8. 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 mulitple persons in 800x600 color images at frame rates of >15Hz, depending on available GPU power. In addition, it also classifies the pose of detected persons in one of the four categories "seen from the front", "seen from the back", "facing left" and "facing right". The software makes use of advanced feature computation and nonlinear SVM techniques which are accelerated using the CUDA interface to GPU programming to achieve high frame rates. It was developed in the context of an ongoing collaboration with Honda Research Institute USA, Inc.

- Participant: Alexander Gepperth

- Contact: Alexander Gepperth

6.2.9. pyStreamPlayer

FUNCTIONAL DESCRIPTION

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

major databases in this field (CalTech Pedestrian database, HRI RoadTraffic traffic objects database, CVC person database, KITTI traffic objects database) have been converted to the pyStreamPlaer format and now serve as a source of training and test data for learning algorithms.

- Participant: Alexander Gepperth
- Contact: Alexander Gepperth

6.2.10. Aversive++

SMALLCAPS FUNCTIONAL DESCRIPTION

Aversive++ is a C++ library that eases microcontroller programming. Its aim is to provide an interface simple enough to be able to create complex applications, and optimized enough to enable small microcontrollers 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 microcontrollers.

- Participants: Loïc Dauphin
- Contact: Loïc Dauphin
- Website: http://aversiveplusplus.com/

6.3. Explauto: Autonomous Exploration and Learning Benchmarking

An autonomous exploration library

SCIENTIFIC DESCRIPTION

An important challenge in Developmental Robotics is how robots can efficiently learn sensorimotor mappings by experience, i.e. the mappings between the motor actions they make and the 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 collects 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 feed the sensorimotor model.

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 virtual and robotic agents. Explauto's scientific roots trace back from Intelligent Adaptive Curiosity algorithmic architecture [120], which has been extended to a more general family of autonomous exploration architecture by [73] and recently expressed as a compact and unified formalism [114]. The library is detailed in [115].

In Explauto, the strategies to explore sensorimotor models are called interest models. They implements the active exploration process, where sensorimotor experiments are chosen to improve the forward or inverse prediction of the sensorimotor model. The simplest strategy is to randomly draw goals tin the motor or sensory space. More efficient strategies are based on the active choice of learning experiments that maximize learning progress, for e.g. improvement of predictions or of competences to reach goals [120]. 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 models can act either on the motor or on the sensory 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 sensory consequence, executing the command through the environment and observing the actual sensory effect. Both sensorimotor and interest models are finally updated according to this experience.

- Goal babbling consists in sampling goals in the sensory effect space and to use the current state of the sensorimotor model to infer a motor action supposed to reach the goals (inverse prediction). The robot/agent then executes the command through the environment and observes the actual sensory effect. Both sensorimotor and interest models are finally updated according to this experience.

It has been shown that this second strategy allows a progressive covering of the reachable sensory space much more uniformly than in a motor babbling strategy, where the agent samples directly in the motor space [73].
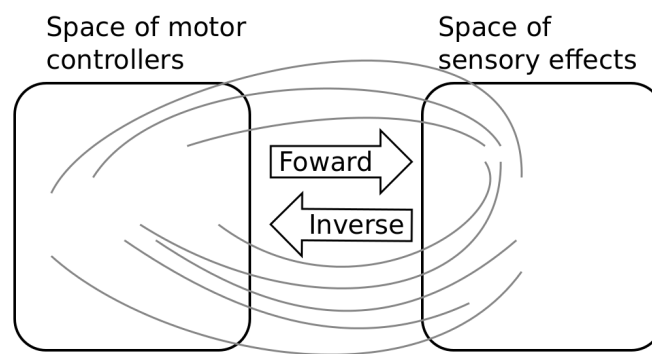

Figure 6. Complex sensorimotor mappings involve a high dimensional sensorimotor spaces. For the sake of visualization, the motor M and sensory S spaces are only 2D each in this example. The relationship between M and S is non-linear, dividing the sensorimotor space into regions of unequal stability: 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:

- Virtual and robotics setups (Environment level),
- Sensorimotor learning iterative models (Sensorimotor level),
- Active choice of sensorimotor experiments (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 sensorimotor mappings 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 goals, 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.

This library has been used in many experiments including:

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

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

- Participants: Pierre Rouanet, Clément Moulin-Frier, Sébastien Forestier, Pierre-Yves Oudeyer
- Contact: Pierre Rouanet
- URL: https://github.com/flowersteam/explauto

6.4. KidLearn: active teaching in Intelligent Tutoring Systems

KEYWORD: Automatic Learning
FUNCTIONAL DESCRIPTION

KidLearn is a software which adaptively personalize 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.

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

6.5. Self-calibration BCI

KEYWORDS: Neurosciences - Health - Brain-Computer Interface
FUNCTIONAL DESCRIPTION

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

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

- Participants: Manuel Lopes, Jonathan Grizou and Pierre-Yves Oudeyer
- Contact: Jonathan Grizou
- URL: https://github.com/flowersteam/self_calibration_BCI_plosOne_2015/

6.6. Platforms

6.6.1. Platform: Collaborative assemblies with Baxter

- Participant: Yoan Mollard, Baptiste Busch, Thibaut Munzer
- Contact: Yoan Mollard

FUNCTIONAL DESCRIPTION This platform is a set of software components and hardware robotic components designed as an experimental setup for performing scientific experiments with the Baxter robot illustrating human-robot collaboration. It comes with a set of capabilities (pick objects, handover, hold objects in place, ...) and physical objects (screwdriver, landmarks, camera mounts, ...) created on purpose or hacked to serve these capabilities. The initial capabilities focus on industrial activities and allow the robot to provide assistance to workers in manufacturing factories for their daily tasks (pieces fetching, screwing, assembly, ...). We simulated an industrial environment with a trolley acting as a feeder where all spare parts are initially located, a workspace for the worker and 7 spare parts composing a wooden toolbox that users and robot will handle for their collaborative tasks. This industrial environment is the one of the 3rd hand project, but the platform and its capabilities will progessively be improved and enriched to be used for other projects. The picture 7 illustrates the experimental setup.
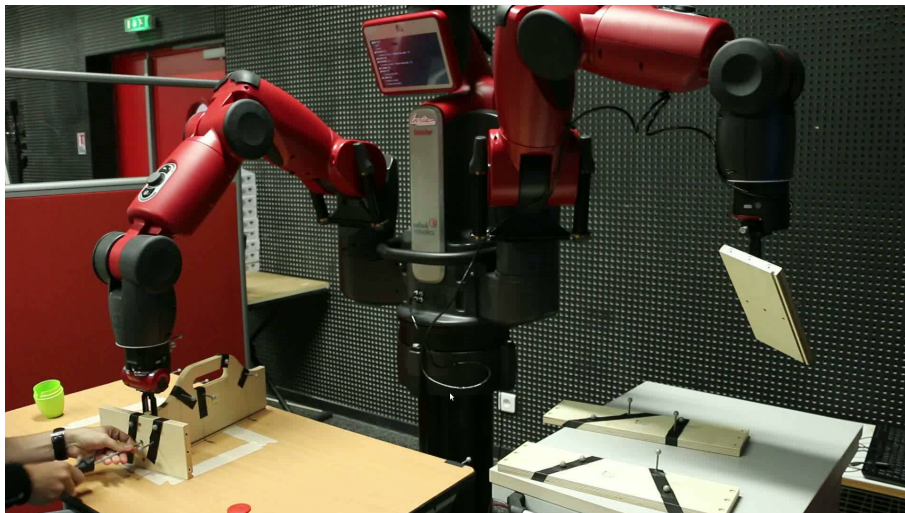

Figure 7. Experimental setup for human-robot collaborative assemblies of a wooden toolbox

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

LAGADIC Project-Team

6. New Software and Platforms

6.1. DESlam

Dense Egocentric SLAM
KEYWORDS: Deph Perception - Robotics - Localisation
FUNCTIONAL DESCRIPTION

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

- Participants: 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: François 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. This project provides the functionality to do image acquisition, semantic annotation, dense registration, localization and 3D mapping. The omnidirectional RGB-D sensors used within this project have been developed in Inria Sophia-Antipolis by the team LAGADIC.

- Contact: Patrick Rives
- URL: https://team.inria.fr/lagadic/software-eng.html

6.4. Sinatrack

KEYWORDS: Computer vision - Robotics
FUNCTIONAL DESCRIPTION

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

- Participants: Antoine Guillaume Petit, Éric Marchand and François Chaumette
- Contact: Éric Marchand
- 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. Written in C++, UsTk provides tools for ultrasound image acquisition, processing and display of these images. Combined with the UsSimulator software that simulates a virtual ultrasound probe interacting with a 3D ultrasound volume and the UsGraphCut library that allows real-time segmentation of ultrasound images, it can serve as an useful framework for developing and testing new visual servoing approaches based on ultrasound images.

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

6.6. ViSP

KEYWORDS: Augmented reality - Computer vision - Robotics - Visual servoing (VS)

SCIENTIFIC DESCRIPTION

Since 2005, we develop and release 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, Éric Marchand, Fabien Spindler, Aurélien Yol and Souriya Trinh
- Partners: Université de Rennes 1 - CNRS
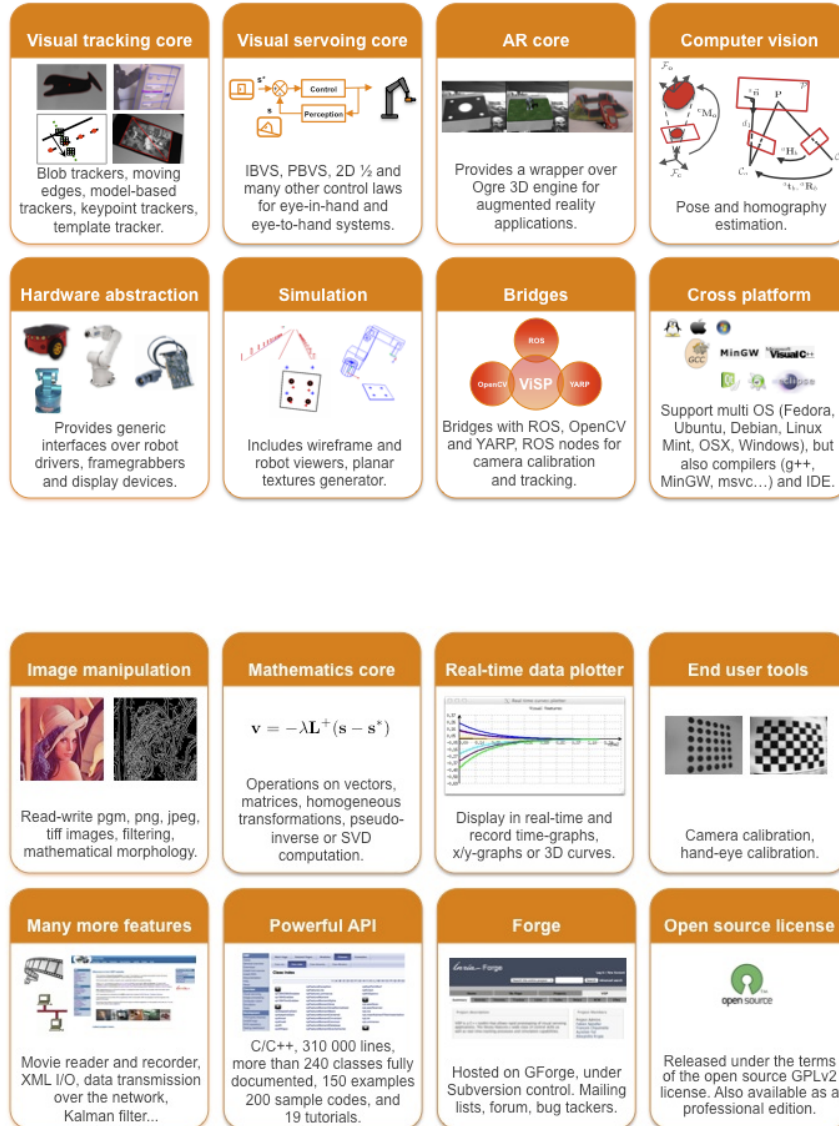- Contact: Fabien Spindler
- URL: http://visp.inria.fr

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 Inria's forge as an open source software under GPLv2 license.

This year, a new ViSP 2.10 release was produced in February. The corresponding source code tarball was downloaded 1290 times. With the help of the community, this release was packaged for Debian and Ubuntu 14.04. We also designed a new modular software architecture where ViSP capabilities are grouped in several modules (core, io, gui, vision...). As a result, the user will find several shared or static libraries, one for each module. In the mean time we continued our efforts to improve the software by ensuring the compatibility with third-party libraries that continue also to evolve like CMake and OpenCV. We also fixed some issues, allowed the markerless 3D model-based hybrid tracker to consider cylinders and introduce a new algorithm to determine face visibility. Moreover, we improve the object detection algorithm based on keypoints that is able to return the pose of a learned object. We improved the documentation by providing new tutorials and by updating the existing ones. ViSP 3.0.0 will be released these days.

Concerning ROS community, all the existing packages in "`vision_visp`" ROS stack (see http://wiki.ros.org/vision_visp) were updated and ported to jade 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, Japan, Korea, India, China, Lebanon, Italy, Spain, Portugal, Hungary, Canada. For instance, it is used as a support in graduate courses at IFMA Clermont-Ferrand, University of Picardie in Amiens, Télécom Physique in Strasbourg and ESIR in Rennes.

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

6.8. Robot vision platform

Participant: Fabien Spindler [correspondant].

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

Five papers published by Lagadic in 2015 enclose results validated on this platform [30][53][29][31][50].

6.9. Mobile robotics platforms

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

6.9.1. *Indoor mobile robots*

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

Moreover, to validate the researches in personally assisted living topic (see 7.3.3), we have in Rennes a six wheel electric wheelchair from Penny and Giles Drives Technology (see Fig. 3 .d) and a five wheel electric wheelchair from You-Q (see Fig. 3 .e). The control of the wheelchair is performed using a plug and play system between the joystick and the low level control of the wheelchair. Such a system lets us acquire the user intention through the joystick position and control the wheelchair by applying corrections to its motion. The wheelchairs have been fitted with cameras and eleven ultrasound sensors to perform the required servoing for assisting handicapped people.
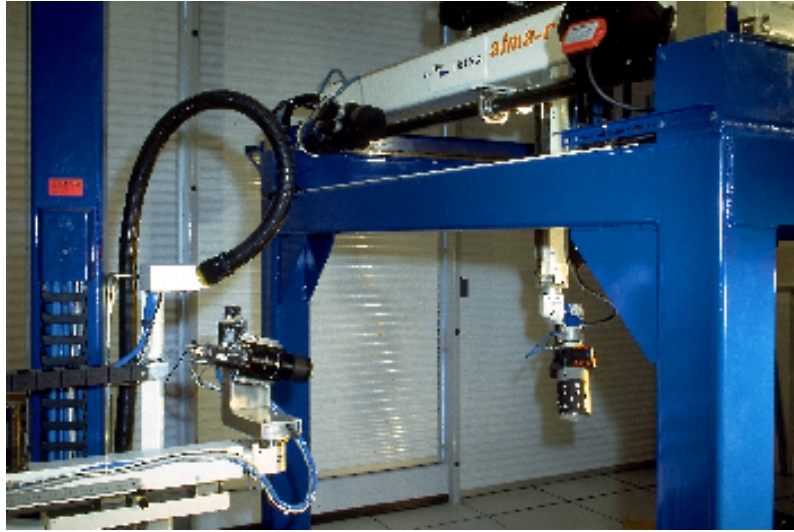
Figure 2. Lagadic robotics platform for vision-based manipulation

Note that 5 papers exploiting the indoors mobile robots were published this year [14][22][28][56][27].

6.9.2. *Outdoor vehicles*

The team exploits also Cycab urban electrical cars (see Figs. 3 .f and 3 .g). Two vehicles in Sophia Antipolis and one in Rennes are instrumented with cameras and range finders to validate researches in the domain of intelligent urban vehicle. Cycabs were used as experimental testbeds in several national projects in the past. This year we decided to donate the Cycab in Rennes to the INSA engineer school were it started a second live.

The camera rig can also 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 we show in the accompanying video [0].

Four papers published by Lagadic in 2015 enclose experimental results obtained with these outdoor vehicles [20][37][10][42].

6.10. Medical robotics platform

Participants: Fabien Spindler [correspondant], Alexandre Krupa.

This testbed is of primary interest for researches and experiments concerning ultrasound visual servoing applied to probe positioning, soft tissue tracking or robotic needle insertion tasks described in Section 7.6 .

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.

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[0]video url:(www-sop.inria.fr/members/Renato-Jose.Martins/iros15.html)
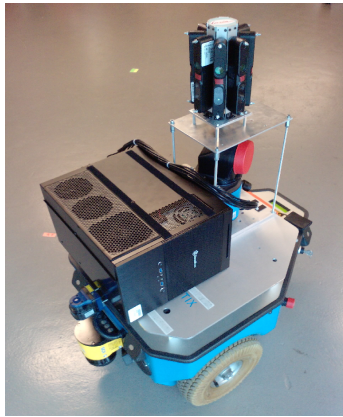
(a)

(b)

(c)

(d)

(e)

(f)

(g)

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

Figure 4. Globeye stereo sensor and acquisition system.

We designed an experimental setup to test an autonomous robotic needle insertion method based on visual servoing 7.6.2 . The experimental setup is composed with a gelatin phantom simulating soft tissues, a flexible biopsy needle actuated by an Adept Viper arm and a 3D ultrasound probe held by the second Adept Viper arm (see Fig. 5 .b).

This year, 5 papers enclose experimental results obtained with this platform [49][48][47][33][32].
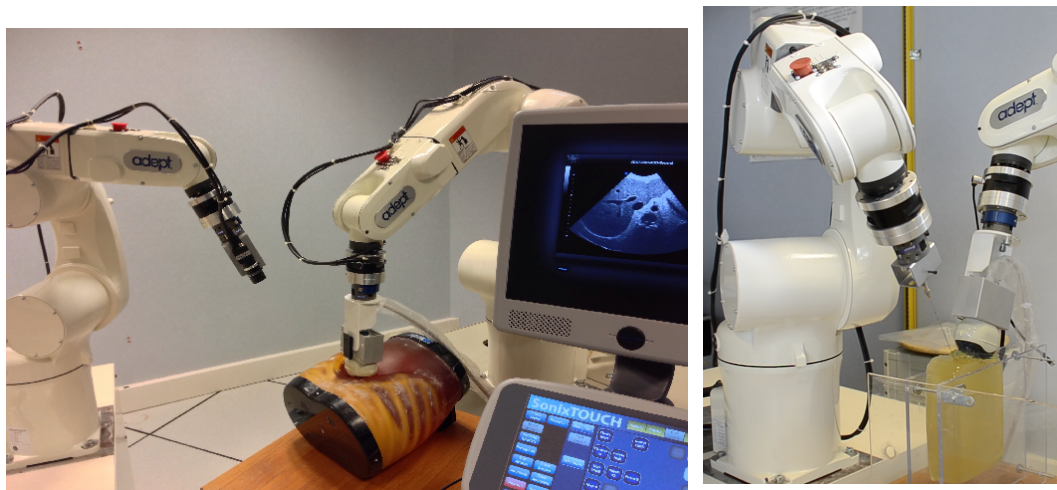
(a)   (b)

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.

6.11. Humanoid robot platform

Participants: Giovanni Claudio, Fabien Spindler [correspondant].

Romeo is a humanoid robot from Aldebaran Robotics which is intended to be a genuine personal assistant and companion. 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. We continue to improve the work initiated last year to grasp a box and deliver it to a human introducing especially joint limits avoidance (see Fig. 6). We started also to work on a visual servoing framework able to control both arms to manipulate an object using only vision.

This year one paper encloses experimental results obtained with this platform [54].

6.12. Unmanned Aerial Vehicles (UAVs) platform

Participants: Thomas Bellavoir, Paolo Robuffo Giordano [correspondant].

From 2014, the team also started some activities involving perception and control for single and multiple quadrotor UAVs, especially thanks to a grant from "Rennes Métropole" (see Section 9.1.5) and the ANR project "SenseFly" (see Section 9.2.4). To this end, we purchased four quadrotors from Mikrokopter Gmbh, Germany (Fig. 7 .a), and one quadrotor from 3DRobotics, USA (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 (Fig. 7 .d)
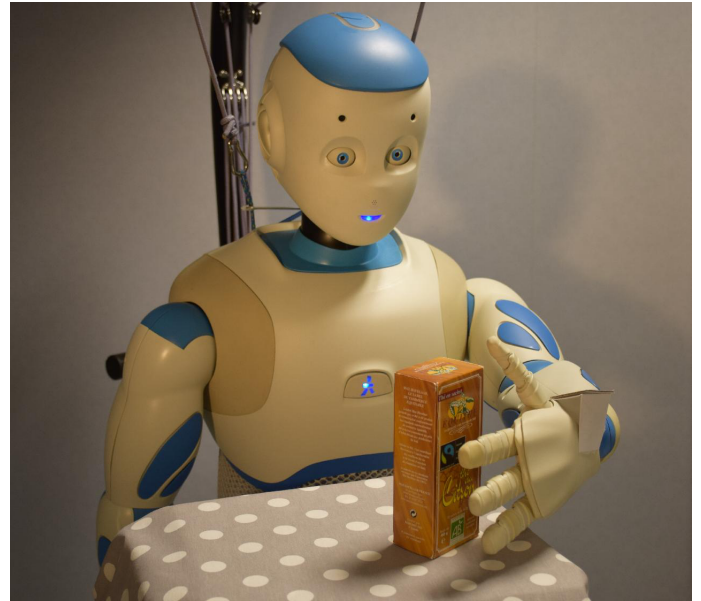
Figure 6. Romeo experimental platform.

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 (Fig. 7 .c). The quadrotor group will be used as robotic platforms for testing a number of single and multiple flight control schemes with a special attention on the use of onboard vision as main sensory modality.

(a)

(b)

(c)

(d)

Figure 7. a) Quadrotor XL1 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. New Platforms

6.1.1. Experimental Room for Robotics

We collaborate on this experimental platform with Olivier Rochel (SED Inria Nancy - Grand Est).

Figure 2. Overview of the new experimental room.

A new room has been installed for the experiments of the ResiBots ERC project and of the Codyco FP7 project (Figure 2). This 100 m^2 room contains a 5.5 × 6 m experimental "arena" made with aluminium trusses.

It is equipped with:

- a 6D motion capture system (Optitrack), with 8 gibagit cameras (Prime 13);
- 4 high-power, studio lights;
- 3 mobile 19" racks (on wheels), which host the power supplies and the computers to control the robots;
- a 6-legged robot, used by the ResiBots project;
- an omnidirectional wheeled robot (Kuka Youbot), used by the ResiBots project;
- a hybrid, wheel-legged robot, used by the ResiBots project (loan by the Pierre and Marie Curie University);
- a Kinova robotic arm, used by the Codyco project.

The trusses support the motion capture system and the lights, and hold all the cables (network, power, etc.).

This room will also host the iCub humanoid robot that should be received in March 2016.

RITS Project-Team

6. New Software and Platforms

6.1. 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.

- Contact: Fawzi Nashashibi

6.2. 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: Benjamin Lefaudeux

6.3. PML-SLAM

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

6.4. 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

6.5. 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

6.6. AutoPathPlan

Automatic Path Planning Generation
FUNCTIONAL DESCRIPTION

Automatic method for a real time path planning generation path for automated vehicles.

- Participants: David Gonzalez Bautista, Joshué Pérez Rastelli and Vicente Milanés Montero
- Contact: Fawzi Nashashibi

6.7. 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: Joshué Pérez Rastelli and Vicente Milanés Montero
- Contact: Fawzi Nashashibi

6.8. Platools

KEYWORD: Telecommunications

- Participant: Marios Makassikis
- Contact: Thierry Ernst

6.9. V2Provue

Vehicle-to-Pedestrian
KEYWORD: vehicle-to-pedestrian communications
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

6.10. Taxi-col

KEYWORD: Mobile Computing, Transportation

- Participant: Eugenie Lioris
- Contact: Fawzi Nashashibi

<div align="center">

AYIN Team

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6. New Software and Platforms

6.1. SAAD

- Participants: Zhao Liu and Josiane Zerubia
- Contact: Josiane Zerubia

The code SAAD (Semi-Automatic Acne Detection) V1.0, related to a new acne detection approach using a Markov random field model and chromophore descriptors extracted by bilateral decomposition, developed by Zhao Liu and Josiane Zerubia and deposited at APP (Agence de Protection des Programmes) in December 2013, has been transferred to L'OREAL company for research tests in February 2015.

6.2. ED

- Participants: Paula Craciun and Josiane Zerubia
- Contact: Josiane Zerubia

The code ED (Ellipses Detection) V1.0, related to a new elliptic object detection approach using Marked Point Process (MPP), developed by Paula Craciun and Josiane Zerubia, has been deposited to APP in December.

6.3. ET

- Participants: Paula Craciun and Josiane Zerubia
- Contact: Josiane Zerubia

The code ET (Ellipses Tracking) V1.0, related to a new elliptic object tracking approach using MPP, developed by Paula Craciun and Josiane Zerubia, has been deposited to APP in December. This code is available in a sequential or in a parallel (multi-core) version and can be applied to image sequences in biology or remote sensing (between 2 and 30 frames/second)

6.4. ETK

- Participants: Paula Craciun and Josiane Zerubia
- Contact: Josiane Zerubia

The code ETK (Ellipses Tracking Kalman) V1.0, which is a variant of of the ET V1.0 code (without the parallel implementation) using a Kalman filter, developed by Paula Craciun and Josiane Zerubia, has been deposited to BNF (Bibliothèque Nationale de France) in December.

6.5. CLESTO

- Participants: Seong-Gyun Jeong, Yuliya Taralka and Josiane Zerubia
- Contact: Josiane Zerubia

The code CLESTO (CurviLinear structure Extraction with STOchastic process) V1.0, related to a new method for the extraction of curvilinear structures based on MPP, developed by Seong-Gyun Jeong, Yuliya Taralka and Josiane Zerubia, has been deposited to BNF in December.

6.6. CLERANK

- Participants: Seong-Gyun Jeong, Yuliya Taralka and Josiane Zerubia
- Contact: Josiane Zerubia

The code CLERANK (CurviLinear structure Extraction with RANKing) V1.0, related to a new method for the extraction of curvilinear structures using ranking, developed by Seong-Gyun Jeong, Yuliya Taralka and Josiane Zerubia, has been deposited to BNF in December.

6.7. Consulting for Industry

Josiane Zerubia is a scientific consultant for the Galderma company [http://www.galderma.com/About-Galderma/Worldwide-presence/R-D-Locations]

LEAR Project-Team

6. New Software and Platforms

6.1. Video descriptors

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

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

6.2. Patch CKN

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

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

6.3. Convolutional Kernel Networks

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

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

6.4. DeepFlow

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

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

6.5. EpicFlow

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

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

6.6. Motion Boundaries Detection

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

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

6.7. Pose estimation and segmentation of multiple people

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

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

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

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

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

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

LINKMEDIA Project-Team

5. New Software and Platforms

5.1. TermEx

Participant: Vincent Claveau [correspondent].

TermEx is a domain-independent terminology extraction system based on natural language processing and information retrieval concepts. This year, a new version (2.0) has been implemented that corresponds to a major rewriting in Python3 with support for English (in addition to French) and faster processing of documents in batch.

In 2015, TermEx has been licensed to a large company as a key component of the archiving process.

5.2. Experimental platform

Participant: Laurent Amsaleg [correspondent].

The experimental multimedia indexing platform (PIM) consists of dedicated equipments to experiment on very large collections of multimedia data. In 2015, no major evolution of PIM occurred and activities on the platform mainly consisted on maintenance. Due to the departure of Sébastien Campion, our former PIM manager, we have also initiated a reorganization of the responsibilities, in collaboration with SED.

5.3. A‖GO multimedia web services

Participant: Guillaume Gravier [correspondent].

Available at http://allgo.irisa.fr, the A‖GO platform allows for the easy deployment of the technology developed in the team as web services. The engineer hired by SED in October 2013 developed several new features that enable software providers to deploy autonomously their algorithm. In 2015, the team hired a development engineer to revamp the web service offer, making services interoperable and broadening the scope of services made available.

MAGRIT Project-Team

5. New Software and Platforms

5.1. Ltrack

The Inria development action LTrack aims at developing an Android platform in order to facilitate the transfer of some of our algorithms onto mobile devices. This year we finished developing an application that performs tracking by synthesis using the camera and the sensors of a mobile phone. User tests will start in January 2016 and we expect to submit the application to the Android Market in the middle of 2016.

- 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.

After the code was made independent from our other research codes (RAlib), the library was ported to up-to-date versions of the supporting libraries: OpenSceneGraph 3.2 and Qt5.4. Heavy code refactoring was also carried out to set the core functionalities in conformity with the standards of the supporting libraries.

PoLAR was made available to the public in October 2015, and can be used under Linux or Windows at the moment.

Also this year, a research branch was developed to add the management of physics engines in PoLAR: so far, Bullet and Vega deformation engines were considered, the former being well integrated and the latter still being a work in progress.

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

5.3. RAlib

RAlib is a library which contains the team's research development on image processing, registration (2D and 3D) and visualization. The library was extended over the period to integrate the Java code developed by Maxime Malgras during his Master's internship. Several applications either used internally or to demonstrate the team's work have been designed with this library.

- Contact: Erwan Kerrien, Gilles Simon

5.4. Reproducible research

Matlab software implementing the algorithms described in published articles is publicly available: NESIF (noise estimation by stacking images affected by illumination flickering) [15], ARPENOS (automated removal of quasi-periodic noise using frequency domain statistics) [14], and AC-ARPENOS (a-contrario automated removal of quasi periodic noise using frequency domain statistics) [22].

MORPHEO Project-Team

6. New Software and Platforms

6.1. 4D repository

FUNCTIONAL DESCRIPTION

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

- Contact: Bruno Raffin
- URL: http://4drepository.inrialpes.fr/

6.2. ETHOMICE

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

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

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

6.3. Lucy Viewer

FUNCTIONAL DESCRIPTION

Lucy Viewer is an interactive viewing software for 4D models, i.e, dynamic three-dimensional scenes that evolve over time. Each 4D model is a sequence of meshes with associated texture information, in terms of images captured from multiple cameras at each frame.

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

6.4. QuickCSG

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

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

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

6.5. Shape Tracking

FUNCTIONAL DESCRIPTION

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

- Contact: Edmond Boyer

6.6. Platforms

6.6.1. Platform Kinovis

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

6.6.2. Multicamera platform for video analysis of mice behavior

This project is a follow-up of the experimental set-up developed for a CNES project with Mathieu Beraneck from the CESeM laboratory (centre for the study of sensorimotor control, CNRS UMR 8194) at the Paris-Descartes University. The goal of this project was to analyze the 3D body postures of mice with various vestibular deficiencies in low gravity condition (3D posturography) during a parabolic flight campaign. The set-up has been now adapted for new experiments on motor-control disorders for other mice models. This experimental platform is currently under development for a broader deployment for high throughput phenotyping with the technology transfer project ETHOMICE. This project involves a close relationship with the CESeM laboratory and the European Mouse Clinical Institute in Strasbourg (Institut Clinique de la Souris, ICS).
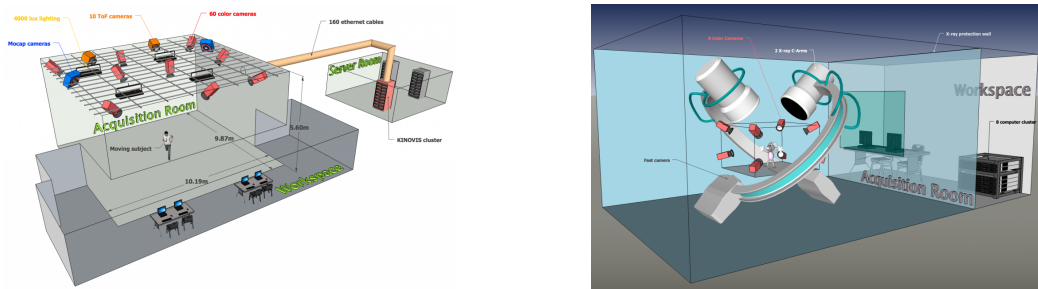
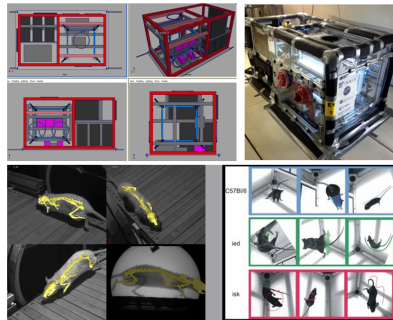*Figure 1. Kinovis platforms: on the left the Inria platform; on the right Grenoble Hospital platform.*

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

5. New Software and Platforms

5.1. Associations of Audio Cues with 3D Locations Library

FUNCTIONAL DESCRIPTION

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

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

The software provides also a multimodal fusion library.

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

5.2. Supervised Binaural Mapping Software
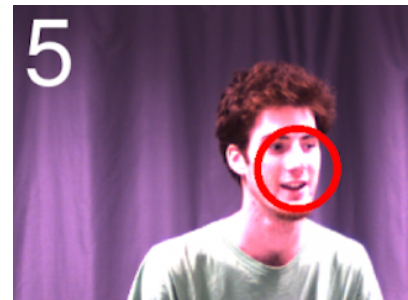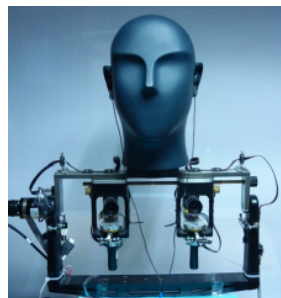
FUNCTIONAL DESCRIPTION

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

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

- Participants: Antoine Deleforge, Soraya Arias and Radu Horaud
- Contact: Radu Horaud
- URL: https://team.inria.fr/perception/supervised-binaural-mapping/
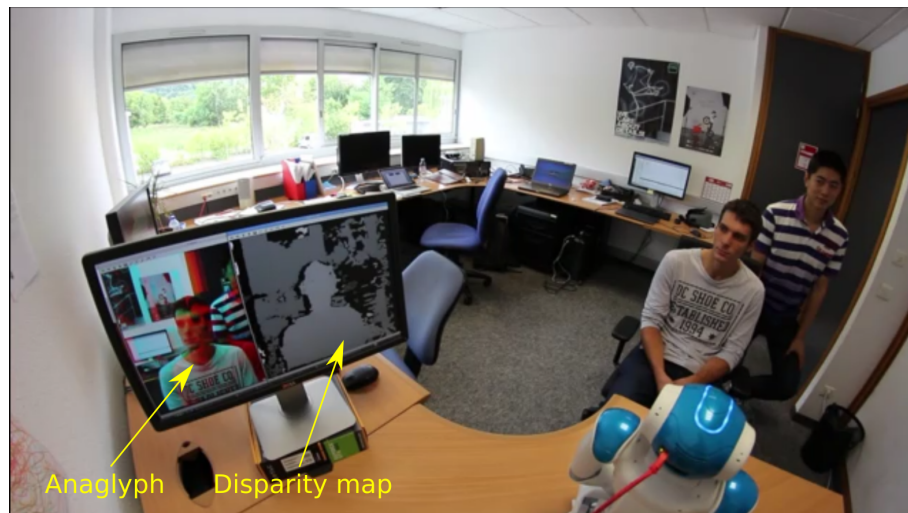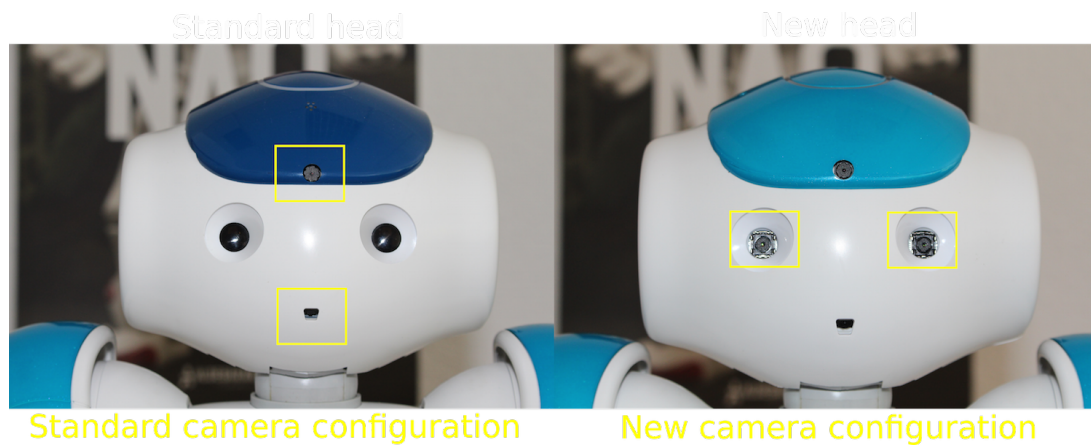
5.3. Audiovisual Robotic Heads

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

FUNCTIONAL DESCRIPTION

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

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

5.4. MIXCAM Platform

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

FUNCTIONAL DESCRIPTION

We developed a multiple camera platform composed of both high-definition color cameras and low-resolution depth cameras. This platform combines the advantages of the two camera types. On one side, depth (time-of-flight) cameras provide coarse low-resolution 3D scene information. On the other side, depth and color cameras can be combined such as to provide high-resolution 3D scene reconstruction and high-quality rendering of textured surfaces. The software package developed during the period 2011-2015 contains the calibration of TOF cameras, alignment between TOF and color cameras, TOF-stereo fusion, and image-based rendering. These software developments were performed in collaboration with the Samsung Advanced Institute of Technology, Seoul, Korea. The multi-camera platform and the basic software modules are products of 4D Views Solutions SAS, a start-up company issued from the PERCEPTION group.

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

- Contact: Radu Horaud
- URL: https://team.inria.fr/perception/mixcam-project/
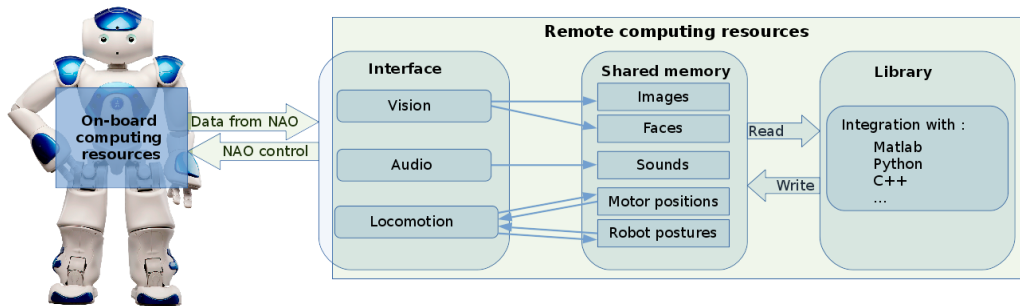
5.5. NaoLAB

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

FUNCTIONAL DESCRIPTION

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

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

PRIMA Project-Team

5. New Software and Platforms

5.1. OMiSCID

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

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

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

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

5.2. AppsGate

FUNCTIONAL DESCRIPTION

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

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

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

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

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

5.3. SPOK

SPOK: Simple Programming Kit pour Smart Homes
KEYWORDS: End User Development - Smart Home

- Contact: James Crowley, Alexandre Demeurre

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

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

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

5.4. DomiCube

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

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

5.5. EmoPRAMAD

KEYWORDS: Health - Home care

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

FUNCTIONAL DESCRIPTION

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

The evaluation conducted 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.

5.6. MobileRGBD

KEYWORDS: Benchmark corpus - Health - Home Care

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

FUNCTIONAL DESCRIPTION

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

5.7. Online Movie Director

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

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

5.8. PALGate

KEYWORDS: Health - Home care - Handicap

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

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

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

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

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

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

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

5.9. PERFECT MATCH STEREO

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

5.10. PrimaCV

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

FUNCTIONAL DESCRIPTION

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

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

5.11. STEREO VIEWFINDER

FUNCTIONAL DESCRIPTION

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

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

5.12. SmartEnergy

FUNCTIONAL DESCRIPTION

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

- Participant: Patrick Reignier
- Contact: Patrick Reignier

5.13. SmartServoFramework

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

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

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

6. New Software and Platforms

6.1. Fixation Analysis

FUNCTIONAL 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
- Contact: Olivier Le Meur

6.2. 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

6.3. Saccadic model

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. This study is based on the following paper [20]. 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).

- Participants: Olivier Le Meur
- Contact: Olivier Le Meur

6.4. Hierarchical super-resolution based inpainting

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

- Participants: Olivier Le Meur
- Contact: Olivier Le Meur

6.5. Video Inpainting for Loss Concealment

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

FUNCTIONAL DESCRIPTION

From an input binary mask and a source video, the software performs an examplar-based inpainting. The motion information of the impaired areas is first recovered with a Bilinear Motion Field Interpolation (BMFI). The texture information is then recovered using a spatio-temporal examplar-based inpainting algorithm. The method to recover the texture proceeds in two steps: it first inpaints a low resolution version using an examplar-based method. Details of the inpainted corrupted areas of the input video are then retrieved using a nearest neighbor field (NNF) based super-resolution technique. A NNF is computed between an interpolated version of the concealed LR video and the known part of the received video at native resolution. In the same vein as in single-image super-resolution, the NNF is used to recover the high frequencies of the inpainted areas of the video.

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

6.6. Video Inpainting for Editing

KEYWORDS: Video Inpainting - Editing
FUNCTIONAL DESCRIPTION

This software performs video inpainting for both static or free-moving camera videos. The method can be used for object removal, error concealment, and background reconstruction applications. To inpaint a frame, the method starts by aligning all the frames of a group of pictures (GOP). This is achieved by a region-based homography computation method which allows us to strengthen the spatial consistency of aligned frames. Then, from the stack of aligned frames, an energy function based on both spatial and temporal coherency terms is globally minimized. This energy function is efficient enough to provide high quality results even when the number of pictures in the GoP is rather small, e.g. 20 neighboring frames. This reduces the algorithm complexity and makes the approach well suited for near real-time video editing applications as well as for loss concealment applications.

- Participants: Mounira Ebdelli
- Contact: Olivier Le Meur

<div align="center">**STARS Project-Team**</div>

6. New Software and Platforms

6.1. 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 Gaffé and Annie Ressouche
- Contact: Annie Ressouche
- URL: http://www-sop.inria.fr/teams/pulsar/projects/Clem/

6.2. 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, François Brémond and Vasanth Bathrinarayanan
- Contact: François Brémond

6.3. 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 François Brémond
- Contact: François Brémond

6.4. 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, Anaïs Ducoffe, Sofia Zaidenberg, Anais Ducoffe, Annunziato Polimeni and Julien Gueytat
- Partner: Neosensys
- Contact: Anaïs Ducoffe

6.5. 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, François Brémond and Monique Thonnat
- Contact: François Brémond

6.6. 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, François Brémond, Annunziato Polimeni and Yves Pichon
- Partner: Neosensys
- Contact: François Brémond

6.7. 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 - USC Californie - Université de Hamburg - I2R
- Contact: François Brémond
- URL: https://team.inria.fr/stars/software

6.8. 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 François Brémond
- Contact: François Brémond
- URL: http://www-sop.inria.fr/teams/pulsar/EvaluationTool/ViSEvAl_Description.html

6.9. py_ad

py action detection
FUNCTIONAL DESCRIPTION

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

- Participants: Michal Koperski and François Brémond
- Contact: Michal Koperski

6.10. 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 François Brémond
- Contact: Michal Koperski

6.11. 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

6.12. 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 François Brémond
- Contact: Michal Koperski

6.13. 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 is a 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 François Brémond
- Contact: Michal Koperski

WILLOW Project-Team

6. New Software and Platforms

6.1. Visual Place Recognition with Repetitive Structures

A new version of the open-source release of the software package for visual localization in urban environments has been made publicly available in July 2015. The software package implements the method [A. Torii et al., CVPR 2013] (journal version published this year in [5]) for representing visual data containing repetitive structures (such as building facades or fences), which often occur in urban environments and present significant challenge for current image matching methods. This is an extended version that includes geometric verification. The first version was made available in 2013 and has been updated in May 2014. The current version of the software is available at http://www.di.ens.fr/willow/research/repttile/download/repttile_demo_ver04.zip.

6.2. 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" [21]. 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/.

6.3. 24/7 place recognition by view synthesis

Open source release of the software package for our paper "24/7 place recognition by view synthesis" [16]. It provides code for computing VLAD descriptors, performing feature matching and view synthesis. Link to the code is available at our project page http://www.ok.ctrl.titech.ac.jp/~torii/project/247/.

6.4. Weakly Supervised Object Recognition with Convolutional Neural Networks

Open-source release of the software package for weakly supervised object recognition with convolutional neural networks has been made publicly available in May 2015. The software package implements the method [M. Oquab et al., CVPR 2015] [14] for object category recognition and localization using convolutional neural networks with weak supervision (without bounding box annotations). The method (i) outputs accurate image-level labels, (ii) predicts approximate locations (but not extents) of objects, and (iii) performs comparably to its fully-supervised counterparts using object bounding box annotation for training. The current version of the software is available at http://www.di.ens.fr/willow/research/weakcnn/.

6.5. Unsupervised Object Discovery and Localization in the Wild

This package contains source code for unsupervised object discovery and localizatoin from image collections. From an arbitrary collection of images in the wild, the method effectively discover dominant object instances and localize them by bounding boxes. The localization accuracy of discovered objects measured at standard benchmarks for object localization is significantly better than the state-of-the-art methods in co-localization, while using no supervision on image collections. The package is available from http://www.di.ens.fr/willow/research/objectdiscovery/.

6.6. Joint Static and Dynamic Guidance Filter

Open-source release of the software package for depth upsampling, texture removal, and scale-space filtering has been made publicly available. The software package implements the newly developed method [10] for robust filtering with joint static and dynamic guidance. The software is available at http://www.di.ens.fr/willow/research/sdfilter/.