RESEARCH CENTER

FIELD
Perception, Cognition and Interaction

Activity Report 2017

Section Software

Edition: 2018-02-19

CEDAR Team

6. New Software and Platforms

6.1. RDF-Commons

KEYWORDS: Data management - RDF
FUNCTIONAL DESCRIPTION: RDF-Commons is a set of modules providing the abilities to: - load and store RDF data in a DBMS - parse RDF conjunctive queries - encode URIs and literals into integers - encode RDF conjunctive queries - build statistics on RDF data - estimate the cost of the evaluation of a conjunctive query - saturate the RDF data, with respect to an RDF Schema - reformulate a conjunctive query with respect to an RDF Schema - propose algebraic plans

- Contact: Ioana Manolescu

6.2. RDFSummary

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

6.3. Tatooine

KEYWORDS: Data integration - Databases - Knowledge database - JSon - RDF - Polystore
FUNCTIONAL DESCRIPTION: Tatooine allows to jointly query data sources of heterogeneous formats and data models (relations, RDF graphs, JSON documents etc.) under a single interface. It is capable of evaluating conjunctive queries over several such data sources, distributing computations between the underlying single-data model systems and a Java-based integration layer based on nested tuples.

- Participants: François Goasdoué, Ioana Manolescu, Javier Letelier Ruiz, Michaël Thomazo, Oscar Santiago Mendoza Rivera, Raphael Bonaque, Swen Ribeiro, Tien Duc Cao and Xavier Tannier
- Contact: Ioana Manolescu

GRAPHIK Project-Team

6. New Software and Platforms

6.1. GRAAL

KEYWORDS: Knowledge database - Ontologies - Querying - Data management
SCIENTIFIC DESCRIPTION: Graal is a Java toolkit dedicated to querying knowledge bases within the framework of existential rules, aka Datalog+/-.
FUNCTIONAL DESCRIPTION: Graal has been designed in a modular way, in order to facilitate software reuse and extension. It should make it easy to test new scenarios and techniques, in particular by combining algorithms. The main features of Graal are currently the following: (1) a data layer that provides generic interfaces to store various kinds of data and query them with (union of) conjunctive queries, currently: MySQL, PostgreSQL, Sqlite, in memory graph and linked list structures, (2) an ontological layer, where an ontology is a set of existential rules, (3) a knowledge base layer, where a knowledge base is composed of a fact base (abstraction of the data via generic interfaces) and an ontology, (4) algorithms to process ontology-mediated queries, based on query rewriting and/or forward chaining (or chase), (5) a rule analyzer, which performs a syntactic and structural analysis of an existential rule set, (6) several IO formats, including imports from OWL 2.

RELEASE FUNCTIONAL DESCRIPTION: The new version (1.3.0) apports some bug fixes, makes the dlgp parser more flexible (dlgp being our serialization format for existential rules) and improves the efficiency of the forward chaining (chase) algorithms.
NEWS OF THE YEAR: A new stable version (1.3.0) has been delivered. Moreover, the Graal website has been deeply restructured and enriched with new tools, available online or for download, and documentation including tutorials, examples of use, and technical documentation about all Graal modules.

- Participants: Marie-Laure Mugnier, Clément Sipieter, Jean-François Baget, Mélanie König, Michel Leclère and Swan Rocher
- Contact: Marie-Laure Mugnier
- Publications: Graal: A Toolkit for Query Answering with Existential Rules - Datalog+, RuleML and OWL 2: Formats and Translations for Existential Rules
- URL: https://github.com/graphik-team

6.2. Cogui

KEYWORDS: Knowledge database - Ontologies - GUI (Graphical User Interface)
SCIENTIFIC DESCRIPTION: Cogui is a visual tool for building and verifying graphical knowledge bases (KB). Knowledge bases are represented under graphical form (close to conceptual graphs). There is a complete correspondence with the logical existential rule (or Datalog+) framework.
FUNCTIONAL DESCRIPTION: Cogui is a freeware written in Java. It allows to graphically create a KB, to handle its structure and content, and to control it. Currently, it supports Conceptual Graphs and import/export in RDFS and Datalog+. 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.
NEWS OF THE YEAR: Cogui is currently under heavy refactoring to benefit from NetBeans graphical libraries, as well as the plugin-based architecture and Java 9 Jigsaw.

- Participants: Alain Gutierrez, Michel Chein, Marie-Laure Mugnier, Michel Leclère and Madalina Croitoru
- Partner: LIRMM
- Contact: Michel Chein
- URL: http://www.lirmm.fr/cogui/

6.3. CoGui-Capex

KEYWORD: Ontologies
SCIENTIFIC DESCRIPTION: CoGui-Capex is a decision support tool dedicated to food industry based on the CoGui editor. Its knowledge base represents the causal links between food descriptors and actions which can be undertaken by operators to control food quality on the line. Since 2016, the version of CoGui-Capex for Neatbeans environnement is coupled with the so-called "Knowledge book" developed by INRA I2M team in Bordeaux.
FUNCTIONAL DESCRIPTION: CoGui-Capex is a decision support tool dedicated to food industry.

RELEASE FUNCTIONAL DESCRIPTION: The new version of Cogui-Capex has been coupled with the tool "MakeBook".
NEWS OF THE YEAR: CoGui-Capex has been been delivered to the industral partner Régilait, a powder milk producer.

- Participants: Jérôme Fortin, Patrice Buche, Alain Gutierrez and Clément Sipieter
- Partners: INRA - LIRMM
- Contact: Jérôme Fortin

6.4. NoAWVote

KEYWORD: Social choice
SCIENTIFIC DESCRIPTION: NoAWVote is a decision-making system which relies on the fair aggregation of individual preferences, i.e. the preference profile. It allows to: - Compute collective preferences according to different voting methods such as, among others, k-approval, Borda, Kemeny-Young, - Filter the individual preferences according to the voters characteristics (categories such as age, location, etc.), - Cluster individual preferences into group preferences according to some given categories, these groups' preferences being then aggregated themselves, - Format the aggregation result (single winner, k-top alternatives, full ranking)
FUNCTIONAL DESCRIPTION: NoAWVote is a software providing a decision-making mechanism which relies on the fair aggregation of individual preferences which is developed within the context of the H2020 Projects NoAW project.

RELEASE FUNCTIONAL DESCRIPTION: The first release of the tool contains the described functionalities.
NEWS OF THE YEAR: The development of the tool started this year.

- Participants: Pierre Bisquert, Madalina Croitoru, Patrice Buche, Rallou Thomopoulos and Nikolaos Karanikolas
- Partner: INRA
- Contact: Pierre Bisquert
- Publication: Selection of agro-waste valorisation routes based on a computational social choice and argumentation decision support tool

6.5. Genetix

KEYWORDS: Biological sequences - Propositional logic
SCIENTIFIC DESCRIPTION: Genetix is a design assistant for biologists. The tool allows experts to precompute biological designs (corresponding to DNA sequences) implementing an intended boolean function. The software includes a parallel generator of sequences running on HPC clusters which is able to manage functions with up to 4 input variables. An open database allows biologists to explore and query available designs.
FUNCTIONAL DESCRIPTION: Genetix is a tool for generating biological sequences implementing boolean functions.

RELEASE FUNCTIONAL DESCRIPTION: The first version of the tool is able to generate biological implementations of boolean functions with up to 4-inputs.

NEWS OF THE YEAR: The development of Genetix started this year.

- Participants: Michel Leclère, Federico Ulliana and Guillaume Perution Kihli
- Contact: Michel Leclère
- Publication: Scalable composition frameworks for multicellular logic
- URL: http://genetix.lirmm.fr/

LACODAM Project-Team

6. New Software and Platforms

6.1. EcoMata

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

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

6.2. PATURMATA

KEYWORDS: Bioinformatics - Biology
SCIENTIFIC DESCRIPTION: The Paturmata tool-box provides means for qualitative modeling and the exploration of agrosystems, specifically management of herd based on pasture. The system is modeled using a hierarchical hybrid model described in the timed automata formalism.
FUNCTIONAL DESCRIPTION: In the PaturMata software, users can create a pasture system description by entering herds and plots information. For each herd, the only parameter is the number of animals. For each plot, users should enter the surface, the density, the herb height, the distance to the milking shed, a herb growth profile and an accessibility degree. Users then specify pasturing and fertilization strategies. Finally, users can launch a pasture execution. PaturMata displays the results and a detailed trace of pasture. Users can launch a batch of different strategies and compare the results in order to find the best pasture strategy. PaturMata is developed in Java (Swing for the GUI) and the model-checker that is called for the timed properties verification is UPPAAL.

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

6.3. Promise

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

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

6.4. GWASDM

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

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

- Contact: Dominique Lavenier

6.5. DCM

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

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

6.6. NTGSP

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

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

6.7. Relevant Interval Rules Miner

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

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

6.8. OCL

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

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

LINKS Project-Team

6. New Software and Platforms

6.1. ShEx validator

Validation of Shape Expression schemas
KEYWORDS: Data management - RDF
FUNCTIONAL DESCRIPTION: Shape Expression schemas is a formalism for defining constraints on RDF graphs. This software allows to check whether a graph satisfies a Shape Expressions schema.

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

6.2. gMark

gMark: schema-driven graph and query generation
KEYWORDS: Semantic Web - Data base
FUNCTIONAL DESCRIPTION: gMark allow the generation of graph databases and an associated set of query from a schema of the graph.gMark is based on the following principles: - great flexibility in the schema definition - ability to generate big size graphs - ability to generate recursive queries - ability to generate queries with a desired selectivity

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

6.3. SmartHal

KEYWORD: Bibliography
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. On top of this, we have build a tool for producing the citation lists for the evaluation report of the LIFL, which can be easily adapter to other Labs.

- Contact: Joachim Niehren
- URL: http://smarthal.lille.inria.fr/

6.4. QuiXPath

KEYWORDS: XML - NoSQL - Data stream
SCIENTIFIC DESCRIPTION: The QuiXPath tools supports a very large fragment of XPath 3.0. The QuiXPath library provides a compiler from QuiXPath to FXP, which is a library for querying XML streams with a fragment of temporal logic.
FUNCTIONAL DESCRIPTION: QuiXPath is a streaming implementation of XPath 3.0. It can query large XML files without loading the entire file in main memory, while selecting nodes as early as possible.

- Contact: Joachim Niehren
- URL: https://project.inria.fr/quix-tool-suite/

6.5. X-FUN

KEYWORDS: Programming language - Compilers - Functional programming - Transformation - XML
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: Joachim Niehren and Pavel Labath
- Contact: Joachim Niehren

MAGNET Project-Team

6. New Software and Platforms

6.1. CoRTex

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

- Participant: Pascal Denis
- Contact: Pascal Denis
- URL: https://gforge.inria.fr/projects/cortex/

6.2. Mangoes

MAgnet liNGuistic wOrd vEctorS
KEYWORDS: Word embeddings - NLP
FUNCTIONAL DESCRIPTION: Process textual data and compute vocabularies and co-occurrence matrices. Input data should be raw text or annotated text. Compute word embeddings with different state-of-the art unsupervised methods. Propose statistical and intrinsic evaluation methods, as well as some visualization tools.

- Contact: Nathalie Vauquier
- URL: https://gitlab.inria.fr/magnet/mangoes

MOEX Project-Team (section vide)

ORPAILLEUR Project-Team

6. New Software and Platforms

6.1. ARPEnTAge

Analyse de Régularités dans les Paysages : Environnement, Territoires, Agronomie
KEYWORDS: Stochastic process - Hidden Markov Models
FUNCTIONAL DESCRIPTION: ARPEnTAge is a software based on stochastic models (HMM2 and Markov Field) for analyzing spatio-temporal data-bases. 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.

- Partner: INRA
- Contact: Jean-François Mari
- URL: http://carottage.loria.fr/index_in_english.html

6.2. CarottAge

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. CarottAge is currently used by INRA researchers interested in mining the changes in territories related to the loss of biodiversity (projects ANR BiodivAgrim and ACI Ecoger) and/or water contamination. CarottAge is also used for mining hydromorphological data. Actually a comparison was performed with three other algorithms classically used for the delineation of river continuum and CarottAge proved to give very interesting results for that purpose.

- Participants: Florence Le Ber and Jean-François Mari
- Partner: INRA
- Contact: Jean-François Mari
- URL: http://carottage.loria.fr/index_in_english.html

6.3. CORON

KEYWORDS: Data mining - Closed itemset - Frequent itemset - Generator - Association rule - Rare itemset
FUNCTIONAL DESCRIPTION: The Coron platform is a KDD toolkit organized around three main components: (1) Coron-base, (2) AssRuleX, and (3) pre- and post-processing modules.

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. 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.

- Participants: Adrien Coulet, Aleksey Buzmakov, Amedeo Napoli, Florent Marcuola, Jérémie Bourseau, Laszlo Szathmary, Mehdi Kaytoue, Victor Codocedo and Yannick Toussaint
- Contact: Amedeo Napoli
- URL: http://coron.loria.fr/site/index.php

6.4. Tuuurbine

KEYWORD: Semantic Web
FUNCTIONAL DESCRIPTION: Tuuurbine: a Generic Ontology Guided Case-Based Inference Engine. 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. This new system, called Tuuurbine, 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).

- Contact: Emmanuel Nauer
- URL: http://tuuurbine.loria.fr/

6.5. LatViz: Visualization of Concept Lattices

- Contact: Amedeo Napoli
- URL: http://latviz.loria.fr/
- KEYWORDS: Formal Concept Analysis, Pattern Structures, Concept Lattice, Implications, Visualization

FUNCTIONAL DESCRIPTION.

LatViz is a tool allowing the construction, the display and the exploration of concept lattices. LatViz proposes some noticeable improvements over existing tools and introduces various functionalities focusing on interaction with experts, such as visualization of pattern structures for dealing with complex non-binary data, AOC-poset which is composed of the core elements of the lattice, concept annotations, filtering based on various criteria and a visualization of implications [70]. This way the user can effectively perform interactive exploratory knowledge discovery as often needed in knowledge engineering.

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

6.6. OrphaMine: Data Mining Platform for Orphan Diseases

- Contact: Chedy Raïssi
- URL: http://orphamine.inria.fr/
- KEYWORDS: Bioinformatics, data mining, biology, health, data visualization, drug development.

FUNCTIONAL DESCRIPTION.

The OrphaMine platform enables visualization, data integration and in-depth analytics in the domain of "orphan diseases", where data is extracted from the OrphaData ontology (http://www.orpha.net/consor/cgi-bin/index.php). At present, we aim at building a true collaborative portal that will serve different actors: (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.

6.7. Siren: Interactive and Visual Redescription Mining

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

FUNCTIONAL DESCRIPTION.

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

New features, such as a visualization of the contribution of individual literals in the queries and the simplification of queries as a post-processing, have been added to the tool, during the internship of IUT student Laëtitia Lemière.

PETRUS Project-Team

5. New Software and Platforms

5.1. PLUG-DB ENGINE

KEYWORDS: Databases - Personal information - Privacy - Hardware and Software Platform
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 PETRUS 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). PlugDB engine has been registered first at APP (Agence de Protection des Programmes) in 2009 - a new version being registered every two years and the hardware datasheets in 2015. PlugDB has been experimented in the field, notably in the healthcare domain. We also recently set up an educational platform on top of PlugDB, named SIPD (Système d'Information privacy-by-Design) and used at ENSIIE, INSA CVL and UVSQ through the Versailles Sciences Lab fablab, to raise students awareness of privacy protection problems and embedded programming. As a conclusion, PlugDB combines several research contributions from the team, at the crossroads of flash data management, embedded data processing and secure distributed computations. It then strongly federates all members of our team (permanent members, PhD students and engineers). It is also a vector of visibility, technological transfer and dissemination and gives us the opportunity to collaborate with researchers from other disciplines around a concrete privacy-enhancing platform. PlugDB is now being industrialized in the context of the OwnCare Inria Innovation Lab (II-Lab).

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

TYREX Project-Team

5. New Software and Platforms

5.1. sparqlgx

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

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

RELEASE FUNCTIONAL DESCRIPTION: - Faster load routine which widely improves this phase perfomances by reading once the initial triple file and by partitioning data in the same time into the correct predicate files. - Improving the generated Scala-code of the translation process with mapValues. This technic allows not to break the partitioning of KeyValueRDD while applying transformations to the values instead of the traditional map that was done prior. - Merging and cleaning several scripts in bin/ such as for example sgx-eval.sh and sde-eval.sh - Improving the compilation process of compile.sh - Cleaner test scripts in tests/ - Offering the possibility of an easier deployment using Docker.

- Participants: Damien Graux, Thomas Calmant, Louis Jachiet, Nabil Layaïda and Pierre Genevès
- Contact: Pierre Genevès
- Publications: Optimizing sparql query evaluation with a worst-case cardinality estimation based on statistics on the data - The SPARQLGX System for Distributed Evaluation of SPARQL Queries
- URL: https://github.com/tyrex-team/sparqlgx

5.2. musparql

KEYWORDS: SPARQL - RDF - Property paths
FUNCTIONAL DESCRIPTION: reads a SPARQL request and translates it into an internal algebra. Rewrites the resulting term into many equivalent versions, then choses one of them and executes it on a graph.

- Participant: Louis Jachiet
- Contact: Nabil Layaïda
- Publication: Extending the SPARQL Algebra for the optimization of Property Paths
- URL: https://gitlab.inria.fr/tyrex/musparql

5.3. SPARUB

SPARQL UPDATE Benchmark generator.
KEYWORDS: SPARQL - RDF

SCIENTIFIC DESCRIPTION: One aim of the RDF data model, as standardized by the W3C, is to facilitate the evolution of data over time without requiring all the data consumers to be changed. To this end, one of the latest addition to the SPARQL standard query language is an update language for RDF graphs. The research on efficient and scalable SPARQL evaluation methods increasingly relies on standardized methodologies for benchmarking and comparing systems. However, current RDF benchmarks do not support graphs updates. We propose and share SPARUB: a benchmark for the SPARQL update language on RDF graphs. The aim of SPARUB is not to be yet another rdf benchmark. Instead it provides the mean to automatically extend and improve existing RDF benchmarks along a new dimension of data updates, while preserving their structure and query scenarios.
FUNCTIONAL DESCRIPTION: SPARUB is a simple tool to generate additional scenarios of test from an already existing N-Triples dataset and some SPARQL queries while focusing on the SPARQL UPDATE fragment (which is part of SPARQL 1.1). It simply extends already existing benchmarking methods taking an RDF dataset and (optionally) SPARQL queries to provide a complete scenario of test. Moreover, a list of predefined metrics is also available to extract interesting figures of the tests.

Technically, SPARUB is a bash script sparub.sh which takes a triple file and an optional list of SPARQL queries as arguments. It will then generate a scenario divided into several steps to benchmark an RDF storage system allowing the SPARQL evaluation on the various functionalities of the SPARQL UPDATE standard extension.

- Participants: Damien Graux, Pierre Genevès and Nabil Layaïda
- Contact: Pierre Genevès
- Publication: SPARUB: SPARQL UPDATE Benchmark
- URL: https://github.com/tyrex-team/sparub

5.4. MRB

Mixed Reality Browser
KEYWORDS: Augmented reality - Geolocation - Indoor geolocalisation - Smartphone
FUNCTIONAL DESCRIPTION: MRB displays PoI (Point of Interest) content remotely through panoramics with spatialized audio, or on-site by walking to the corresponding place, it can be used for indoor-outdoor navigation, with assistive audio technology for the visually impaired. It is the only browser of geolocalized data to use XML as a native format for PoIs, panoramics, 3D audio and to rely on HTML5 both for the iconic and full information content of PoIs. Positioning in MRB is based on a PDR library, written in C++ and Java and developed by the team, which provides the user's location in real time based on the interpretation of sensors. Three main modules have been designed to build this positioning system: (i) a pedometer that estimates the distance the user has walked and his speed, (ii) 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), and (iii) a map-matching algorithm that provides a new location based on a given OpenStreetMap file description and the current user's trajectory.

- Participant: Thibaud Michel
- Contact: Nabil Layaïda
- Publications: On Mobile Augmented Reality Applications based on Geolocation - Attitude Estimation with Smartphones
- URL: http://tyrex.inria.fr/projects/mrb.html

5.5. TyrAr

Geo Augmented Reality on a Smartphone
KEYWORDS: Augmented reality - Smartphone - Geolocation

FUNCTIONAL DESCRIPTION: This application is an AR viewer to name the mountains, cities and historical buildings over the camera feed of the smartphone. The user can turn on himself with his device to discover names and information about Points of Interest (POIs). POIs are directly extracted from the OSM database thanks to the Overpass Turbo API. POIs are displayed on the screen with their name, an icon and an extra information. City POIs exhibit the number of inhabitants, mountains are associated to their altitude and historical buildings display their date of construction.

- Participant: Thibaud Michel
- Contact: Nabil Layaïda
- Publication: On Mobile Augmented Reality Applications based on Geolocation
- URL: http://tyrex.inria.fr/projects/mrb.html

5.6. AmiAr

Smart Home Augmented Reality on a Smartphone
KEYWORDS: Augmented reality - Smart home - Smartphone - Indoor geolocalisation
FUNCTIONAL DESCRIPTION: This application is a proof of concept of a Geo AR system in a smart apartment. This setup has been conducted in EquipEx Amiqual4Home. The goal here is to control objects in the apartment using widgets over the video feed from the camera. For example, a user points a lamp with his smartphone, a widget appears, then he uses a slider in this widget to modify the light intensity.

- Participant: Thibaud Michel
- Contact: Nabil Layaïda
- Publication: On Mobile Augmented Reality Applications based on Geolocation

5.7. GreAR

Grenoble AR-Tour based on geolocation.
KEYWORDS: Augmented reality - Geolocation - Smartphone
FUNCTIONAL DESCRIPTION: This application is an AR navigator specifically designed for pedestrians. This application was initially developed during the Venturi FP7 (2011-2015) project and has been updated with our AR framework since then. Between two visually driven AR experiences (at the time, developed by partners), the navigator provides the user with an audio and visual guidance through a pre-defined touristic path in Grenoble. The position of the user is obtained through a fusion of GPS signal (when available), pedometer estimates and a map-matching algorithm exploiting OpenStreetMap. As the GPS signal is poor in several parts of the old city the integration of the pedometer enables the navigator to obtain a sufficiently reliable position estimate, crucial for AR applications and geofencing. Within the application, there are several options given to the user to view the navigation path through the city, ranging from a satellite image of the streets to a vector map. In the navigation pane, the geofences relating to the AR experiences and other points of interest can be seen.

- Participant: Thibaud Michel
- Contact: Nabil Layaïda
- Publication: On Mobile Augmented Reality Applications based on Geolocation
- URL: http://tyrex.inria.fr/projects/mrb.html

5.8. Benchmarks Attitude Smartphones

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

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

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

5.9. MedAnalytics

KEYWORDS: Big data - Predictive analytics - Distributed systems
FUNCTIONAL DESCRIPTION: We implemented a method for the automatic detection of at-risk profiles based on a fine-grained analysis of prescription data at the time of admission. The system relies on an optimized distributed architecture adapted for processing very large volumes of medical records and clinical data. We conducted practical experiments with real data of millions of patients and hundreds of hospitals. We demonstrated how the various perspectives of big data improve the detection of at-risk patients, making it possible to construct predictive models that benefit from volume and variety. This prototype implementation is described in the 2017 preprint available at: https://hal.inria.fr/hal-01517087/document.

- Participants: Pierre Genevès and Thomas Calmant
- Partner: CHU Grenoble
- Contact: Pierre Genevès
- Publication: Predicting At-Risk Patient Profiles from Big Prescription Data

Valda Team

5. New Software and Platforms

5.1. ProvSQL

KEYWORDS: Databases - Provenance - Probability
FUNCTIONAL DESCRIPTION: The goal of the ProvSQL project is to add support for (m-)semiring provenance and uncertainty management to PostgreSQL databases, in the form of a PostgreSQL extension/module/plugin.
NEWS OF THE YEAR: ProvSQL becomes usable for a large range of queries. Support for semirings and m-semirings is present, support for probability computation has been added through a variety of techniques, including knowledge compilation, support for where-provenance is currently being implemented.

- Participants: Pierre Senellart and Yann Ramusat
- Contact: Pierre Senellart
- Publication: Provenance and Probabilities in Relational Databases: From Theory to Practice
- URL: https://github.com/PierreSenellart/provsql

5.2. Thymeflow

KEYWORD: Personal information
FUNCTIONAL DESCRIPTION: ThymeFlow allows in particular the development of plugins for both interacting with existing Web sources and presenting users with rich interfaces and query facilities over their personal information. A preliminary version of ThymeFlow tools has also been deployed on the Cozy Cloud personal cloud system. The model allows the open-source community to contribute individual plugins while we focus on providing users with useful ways to exploit their personal information.
NEWS OF THE YEAR: Minor maintenance.

- Participants: David Montoya, Pierre Senellart, Serge Abiteboul and Su Yang
- Partner: ENGIE
- Contact: Pierre Senellart
- Publication: Personal Knowledge Base Systems
- URL: https://github.com/thymeflow/thymeflow/

5.3. apxproof

KEYWORD: LaTeX
FUNCTIONAL DESCRIPTION: apxproof is a LaTeX package facilitating the typesetting of research articles with proofs in appendix, a common practice in database theory and theoretical computer science in general. The appendix material is written in the LaTeX code along with the main text which it naturally complements, and it is automatically deferred. The package can automatically send proofs to the appendix, can repeat in the appendix the theorem environments stated in the main text, can section the appendix automatically based on the sectioning of the main text, and supports a separate bibliography for the appendix material.

RELEASE FUNCTIONAL DESCRIPTION: Ability to specify a sectioning counter, Compilation fix of proofs-ketch in inline mode
NEWS OF THE YEAR: Overall software maintenance. Support for more document classes. Some new features.

- Participant: Pierre Senellart
- Contact: Pierre Senellart
- URL: https://github.com/PierreSenellart/apxproof

WIMMICS Project-Team

6. New Software and Platforms

6.1. CORESE

COnceptual REsource Search Engine
KEYWORDS: Semantic Web - Search Engine - RDF - SPARQL
FUNCTIONAL DESCRIPTION: Corese is a Semantic Web Factory, it implements W3C RDF, RDFS, SPARQL 1 .1 Query and Update as well as RDF Inference Rules.

Furthermore, Corese query language integrates original features such as approximate search and extended Property Path. It provides STTL: SPARQL Template Transformation Language for RDF graphs. It also provides LDScript: a Script Language for Linked Data. Corese provides distributed federated query processing.

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

6.2. DBpedia

KEYWORDS: RDF - SPARQL
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.

RELEASE FUNCTIONAL DESCRIPTION: The new release is based on updated Wikipedia dumps and the inclusion of the DBpedia history extraction of the pages.

- Participants: Fabien Gandon and Elmahdi Korfed
- Contact: Fabien Gandon
- URL: http://wiki.dbpedia.org/

6.3. Discovery Hub

Discovery Hub Exploratory Search Engine
KEYWORD: Search Engine
FUNCTIONAL DESCRIPTION: Recommandation system on top of DBpedia

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

6.4. Fuzzy labelling argumentation module

Fuzzy labelling algorithm for abstract argumentation
KEYWORDS: Artificial intelligence - Multi-agent - Knowledge representation - Algorithm

FUNCTIONAL DESCRIPTION: The goal of the algorithm is to compute the fuzzy acceptability degree of a set of arguments in an abstract argumentation framework. The acceptability degree is computed from the trustworthiness associated with the sources of the arguments.

- Participant: Serena Villata Milanesio
- Contact: Serena Villata Milanesio

6.5. Qakis

Question-Answening wiki framework based system
KEYWORD: Natural language
FUNCTIONAL DESCRIPTION: 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: Alessio Palmero Aprosio, Amine Hallili, Elena Cabrio, Fabien Gandon, Julien Cojan and Serena Villata Milanesio
- Contact: Elena Cabrio
- URL: http://www.qakis.org/

ZENITH Project-Team

6. New Software and Platforms

6.1. LogMagnet

KEYWORDS: Data mining - Data stream
FUNCTIONAL DESCRIPTION: 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.

- Participants: Florent Masseglia and Julien Diener
- Contact: Florent Masseglia
- URL: https://team.inria.fr/zenith/?s=LogMagnet

6.2. Pl@ntNet - Mobile - Androïd

KEYWORDS: Bioinformatics - Biology
FUNCTIONAL DESCRIPTION: This is the Android front-end of the Pl@ntNet platform, publicly available on Google play: https://play.google.com/store/apps/details?id=org.plantnet&hl=fr The main feature of the app is to identify plant species from photographs, through a visual recognition software making use of deep learning technologies. The number of species and the number of images used by the application evolve with the contributions of the Pl@ntNet community.

- Participant: Julien Champ
- Partners: INRA - CIRAD - IRD
- Contact: Alexis Joly
- URL: https://play.google.com/store/apps/details?id=org.plantnet&hl=en

6.3. Pl@ntNet - Mobile -IOS

KEYWORDS: Bioinformatics - Biology
FUNCTIONAL DESCRIPTION: This is the iOS front-end of the Pl@ntNet platform, publicly available on Apple store: https://itunes.apple.com/fr/app/plantnet/id600547573?mt=8 The main feature of the app is to identify plant species from photographs, through a visual recognition software making use of deep learning technologies. The number of species and the number of images used by the application evolve with the contributions of the Pl@ntNet community.

- Participant: Hervé Goëau
- Partners: INRA - CIRAD - IRD
- Contact: Alexis Joly
- URL: https://itunes.apple.com/fr/app/plantnet/id600547573?mt=8

6.4. Pl@ntNet - Web - Angular

KEYWORDS: Bioinformatics - Biology

FUNCTIONAL DESCRIPTION: This is the web front-end of the Pl@ntNet platform, publicly available at: http://identify.plantnet-project.org/ The main feature of the app is to identify plant species from photographs, through a visual recognition software making use of deep learning technologies. The number of species and the number of images used by the application evolve with the contributions of the Pl@ntNet community.

- Participant: Alexis Joly
- Partners: INRA - CIRAD - IRD
- Contact: Alexis Joly
- URL: https://identify.plantnet-project.org/

6.5. Pl@ntNet - DataStore

KEYWORDS: Bioinformatics - Biology
FUNCTIONAL DESCRIPTION: Datastore of the Pl@ntNet platform dedicated to the management of botanical data (observations + taxonomy) based on Apache CouchDB, Node.JS, Angular.JS, Apache Lucene.

- Participant: Hervé Goëau
- Partners: INRA - CIRAD - IRD
- Contact: Alexis Joly
- URL: https://plantnet.org/

6.6. Pl@ntNet - API

KEYWORDS: Bioinformatics - Biology
FUNCTIONAL DESCRIPTION: REST API of the Pl@ntNet platform. It provides services for data access, authentication, logging, contribution management, etc. It is mainly based on Node.JS + CouchDB.

- Authors: Samuel Dufour Kowalski, Alexis Joly, Pierre Bonnet and Antoine Affouard
- Partners: INRA - CIRAD - IRD
- Contact: Alexis Joly
- URL: https://plantnet.org/

6.7. Snoop

FUNCTIONAL DESCRIPTION: Snoop is a C++ framework dedicated to large-scale content-based image retrieval. Its main features are (i) the extraction and efficient indexing of visual features (hand-crafted or learned through deep learning), (ii) the search of similar images through approximate k-nearest neighbors and (iii), the supervised recognition of trained visual concepts. The framework can be used either as a set of C++ libraries or as a set of web services through a RESTFUL API.

- Participants: Alexis Joly, Jean-Christophe Lombardo and Olivier Buisson
- Partner: INA (Institut National de l'Audiovisuel)
- Contact: Alexis Joly

6.8. PlantRT

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

- Participants: Alexis Joly, Esther Pacitti, Julien Champ, Maximilien Servajean and Miguel Liroz-Gistau
- Contact: Maximilien Servajean

6.9. SciFloware

Scientific Workflow Middleware
KEYWORDS: Bioinformatics - Distributed Data Management
FUNCTIONAL DESCRIPTION: SciFloware is 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.

- Participants: Didier Parigot and Dimitri Dupuis
- Contact: Didier Parigot
- URL: http://www-sop.inria.fr/members/Didier.Parigot/pmwiki/Scifloware

6.10. CloudMdsQL Compiler

FUNCTIONAL DESCRIPTION: CloudMdsQL (Cloud Multidatastore Query Language) is a functional SQL-like language, capable of querying multiple cloud data stores (SQL, NoSQL, HDFS, etc.). The compiler parses a CloudMdsQL query and generates an optimized query execution plan to be processed by a query operator engine.

- Authors: Boyan Kolev and Patrick Valduriez
- Contact: Patrick Valduriez

6.11. Triton Server

End-to-end Graph Mapper
KEYWORD: Web Application
FUNCTIONAL DESCRIPTION: A server for managing graph data and applications for mobile social networks. The server is built on top of the OrientDB graph database system and a distributed middleware. It provides an End-to-end Graph Mapper (EGM) for modeling the whole application as (i) a set of graphs representing the business data, the in-memory data structure maintained by the application and the user interface (tree of graphical components), and (ii) a set of standardized mapping operators that maps these graphs with each other.

- Participants: Didier Parigot, Patrick Valduriez and Benjamin Billet
- Contact: Didier Parigot
- Publication: End-to-end Graph Mapper

6.12. Hadoop_g5k

FUNCTIONAL DESCRIPTION: 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.

- Participants: Miguel Liroz-Gistau, Patrick Valduriez and Reza Akbarinia
- Contact: Patrick Valduriez
- URL: https://www.grid5000.fr/mediawiki/index.php/Hadoop_On_Execo

ALICE Project-Team

6. New Software and Platforms

6.1. Graphite

Graphite: The Numerical Geometry Workbench
KEYWORDS: 3D modeling - Numerical Geometry - Texturing - Lighting - CAD - Visualization
SCIENTIFIC DESCRIPTION: 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.
FUNCTIONAL DESCRIPTION: Graphite is a dedicated software platform in numerical geometry that enables, among other things, 3D modelling and texture baking.

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

6.2. GEOGRAM

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

- Participant: Bruno Lévy
- Contact: Bruno Lévy
- URL: http://alice.loria.fr

6.3. OpenNL

Open Numerical Library
KEYWORDS: 3D modeling - Numerical algorithm
SCIENTIFIC DESCRIPTION: Open Numerical Library is a library for solving sparse linear systems, especially designed for the Computer Graphics community. The goal for OpenNL is to be as small as possible, while offering the subset of functionalities required by this application field. The Makefiles of OpenNL can generate a single .c + .h file, very easy to integrate in other projects. The distribution includes an implementation of the Least Squares Conformal Maps parameterization method.
FUNCTIONAL DESCRIPTION: Open Numerical Library is a library for solving sparse linear systems, especially designed for the Computer Graphics community. The goal for OpenNL is to be as small as possible, while offering the subset of functionalities required by this application field.

RELEASE FUNCTIONAL DESCRIPTION: * OpenMP parallel solver * more compact data structures, X2 acceleration * SuperLU weak coupling (dynamically loads SuperLU .so if available) (latest version available as part of geogram http://alice.loria.fr/software/geogram/doc/html/index.html)

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

6.4. IceSL

KEYWORD: Additive manufacturing
FUNCTIONAL DESCRIPTION: IceSL allows to model complex shapes through CSG boolean operations. Objects can be directly prepared and sent to a 3d printer for fabrication, without the need to compute an intermediate 3D mesh.

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

6.5. LibSL

Simple Library For Graphics
KEYWORDS: 3D - Graphics
FUNCTIONAL DESCRIPTION: LibSL is a toolbox for rapid prototyping of computer graphics algorithms, under both OpenGL, DirectX 9 - 10, Windows and Linux.

- Participant: Sylvain Lefebvre
- Contact: Sylvain Lefebvre

6.6. 3DPrintScaffoldings

KEYWORDS: 3D - 3D modeling - Additive manufacturing
FUNCTIONAL DESCRIPTION: Support generation for additive manufacturing. Optimizes scaffolding made of vertical pillars and horizontal bars that are optimized to use minimal material, be easily removed and support the part at all stages of the fabrication process.

- Participants: Jean Hergel, Jérémie Dumas and Sylvain Lefebvre
- Partner: Université de Lorraine
- Contact: Sylvain Lefebvre
- URL: http://shapeforge.loria.fr/icesl/

6.7. VORPALINE

VORPALINE mesh generator
KEYWORDS: 3D modeling - Unstructured heterogeneous meshes
FUNCTIONAL DESCRIPTION: VORPALINE is a surfacic and volumetric mesh generator, for simplicial meshes (triangles and tetrahedra), for quad-dominant and hex-dominant meshes.

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

AVIZ Project-Team

5. New Software and Platforms

5.1. Cartolabe

KEYWORD: Information visualization
FUNCTIONAL DESCRIPTION: The goal of Cartolabe is to build a visual map representing the scientific activity of an institution/university/domain from published articles and reports. Using the HAL Database and building upon the AnHALytics processing chain, Cartolabe provides the user with a map of the thematics, authors and articles and their dynamics along time. ML techniques are used for dimensionality reduction, cluster and topics identification, visualisation techniques are used for a scalable 2D representation of the results.
NEWS OF THE YEAR: Improvement of the graphical interface

- Contact: Philippe Caillou
- URL: http://cartolabe.lri.fr/

5.2. BitConduite

BitConduite Bitcoin explorer
KEYWORDS: Data visualization - Clustering - Financial analysis - Cryptocurrency
FUNCTIONAL DESCRIPTION: BitConduite is a web-based visual tool that allows for a high level explorative analysis of the Bitcoin blockchain. It offers a data transformation back end that gives us an entity-based access to the blockchain data and a visualization front end that supports a novel high-level view on transactions over time. In particular, it facilitates the exploration of activity through filtering and clustering interactions. This gives analysts a new perspective on the data stored on the blockchain.

- Contact: Petra Isenberg

EX-SITU Project-Team

6. New Software and Platforms

6.1. Platforms

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], Olivier Gladin.

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

6.1.3. WILDER

Participants: Michel Beaudouin-Lafon [correspondant], Cédric Fleury, Olivier Gladin.

WILDER (Figure 1) is our second experimental ultra-high-resolution interactive environment, which follows the WILD platform developed in 2009. It features a wall-sized display with seventy-five 20" LCD screens, i.e. a 5m50 x 1m80 (18' x 6') wall displaying 14 400 x 4 800 = 69 million pixels, powered by a 10-computer cluster and two front-end computers. The platform also features a camera-based motion tracking system that lets users interact with the wall, as well as the surrounding space, with various mobile devices. The display uses a multitouch frame (the largest of its kind in the world) to make the entire wall touch sensitive.

WILDER was inaugurated in June, 2015. It is one of the ten platforms of the Digiscope Equipment of Excellence and, in combination with WILD and the other Digiscope rooms, provides a unique experimental environment for collaborative interaction.

In addition to using WILD and WILDER for our research, we have also developed software architectures and toolkits, such as WildOS and Unity Cluster, that enable developers to run applications on these multi-device, cluster-based systems.

Figure 1. The WILDER platform.

GRAPHDECO Project-Team

5. New Software and Platforms

5.1. SGTDGP

Synthetic Ground Truth Data Generation Platform
KEYWORD: Graphics
FUNCTIONAL DESCRIPTION: The goal of this platform is to render large numbers of realistic synthetic images for use as ground truth to compare and validate image-based rendering algorithms and also to train deep neural networks developed in our team.

This pipeline consists of tree major elements that are:

- Scene exporter
- Assisted point of view generation
- Distributed rendering on Inria's high performance computing cluster

The scene exporter is able to export scenes created in the widely-used commercial modeler 3DSMAX to the Mitsuba opensource renderer format. It handles the conversion of complex materials and shade trees from 3DSMAX including materials made for VRay. The overall quality of the produced images with exported scenes have been improved thanks to a more accurate material conversion. The initial version of the exporter was extended and improved to provide better stability and to avoid any manual intervention.

From each scene we can generate a large number of images by placing multiple cameras. Most of the time those points of view has to be placed with a certain coherency. This task could be long and tedious. In the context of image-based rendering, cameras have to be placed in a row with a specific spacing. To simplify this process we have developed a set of tools to assist the placement of hundreds of cameras along a path.

The rendering is made with the open source renderer Mitsuba. The rendering pipeline is optimised to render a large number of point of view for single scene. We use a path tracing algorithm to simulate the light interaction in the scene and produce hight dynamic range images. It produces realistic images but it is computationally demanding. To speed up the process we setup an architecture that takes advantage of the Inria cluster to distribute the rendering on hundreds of CPUs cores.

The scene data (geometry, textures, materials) and the cameras are automatically transfered to remote workers and HDR images are returned to the user.

We already use this pipeline to export tens of scenes and to generate several thousands of images, which have been used for machine learning and for ground-truth image production.

- Contact: George Drettakis

5.2. Unity IBR

KEYWORD: Graphics
FUNCTIONAL DESCRIPTION: Unity IBR (for Image-Based Rendering in Unity) This is a software module that proceeds the development of IBR algorithms in Unity. In this case, algorithms are developed for the context of EMOTIVE EU project. The rendering technique was changed during the year to evaluate and compare which one produces better results suitable for Game Development with Unity (improvement of image quality and faster rendering). New features were also added such as rendering of bigger datasets and some debugging utilities. Software was also updated to keep compatibility with new released versions of Unity game engine.

- Contact: George Drettakis

5.3. SIBR

Simple Image-Based Rendering
KEYWORD: Graphics
FUNCTIONAL DESCRIPTION: This is a framework containing libraries and tools used internally for research projects based on Image-Base Rendering. It includes both preprocessing tools (computing data used for rendering) and rendering utilities and serves as the basis for many research projects in the group.

It includes basic support for a large set of computer graphics and computer vision functionalities and includes implementations of several image-based rendering algorithms. The code base has become quite mature and is in the process of being used for tech transfer.

- Contact: George Drettakis

HYBRID Project-Team

6. New Software and Platforms

6.1. #FIVE

Framework for Interactive Virtual Environments
KEYWORDS: Virtual reality - 3D - 3D interaction - Behavior modeling
SCIENTIFIC DESCRIPTION: #FIVE (Framework for Interactive Virtual Environments) is a framework for the development of interactive and collaborative virtual environments. #FIVE was developed to answer the need for an easier and a faster design and development of virtual reality applications. #FIVE provides a toolkit that simplifies the declaration of possible actions and behaviours of objects in a VE. It also provides a toolkit that facilitates the setting and the management of collaborative interactions in a VE. It is compliant with a distribution of the VE on different setups. It also proposes guidelines to efficiently create a collaborative and interactive VE. The current implementation is in C# and comes with a Unity3D engine integration, compatible with MiddleVR framework.
FUNCTIONAL DESCRIPTION: #FIVE contains software modules that can be interconnected and helps in building interactive and collaborative virtual environments. The user can focus on domain-specific aspects for his/her application (industrial training, medical training, etc) thanks to #FIVE's modules. These modules can be used in a vast range of domains using virtual reality applications and requiring interactive environments and collaboration, such as in training for example.

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

6.2. #SEVEN

Sensor Effector Based Scenarios Model for Driving Collaborative Virtual Environments
KEYWORDS: Virtual reality - Interactive Scenarios - 3D interaction
SCIENTIFIC DESCRIPTION: #SEVEN (Sensor Effector Based Scenarios Model for Driving Collaborative Virtual Environments) is a model and an engine based on petri nets extended with sensors and effectors, enabling the description and execution of complex and interactive scenarios
FUNCTIONAL DESCRIPTION: #SEVEN enables the execution of complex scenarios for driving Virtual Reality applications. #SEVEN's scenarios are based on an enhanced Petri net model which is able to describe and solve intricate event sequences. #SEVEN comes with an editor for creating, editing and remotely controlling and running scenarios. #SEVEN is implemented in C# and can be used as a stand-alone application or as a library. An integration to the Unity3D engine, compatible with MiddleVR, also exists.

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

6.3. OpenVIBE

KEYWORDS: Neurosciences - Interaction - Virtual reality - Health - Real time - Neurofeedback - Brain-Computer Interface - EEG - 3D interaction
FUNCTIONAL DESCRIPTION: OpenViBE is a free and open-source software platform devoted to the design, test and use of Brain-Computer Interfaces (BCI). The platform consists of a set of software modules that can be integrated easily and efficiently to design BCI applications. The key features of OpenViBE software are its modularity, its high-performance, its portability, its multiple-users facilities and its connection with high-end/VR displays. The designer of the platform enables to build complete scenarios based on existing software modules using a dedicated graphical language and a simple Graphical User Interface (GUI). This software is available on the Inria Forge under the terms of the AGPL licence, and it was officially released in June 2009. Since then, the OpenViBE software has already been downloaded more than 40000 times, and it is used by numerous laboratories, projects, or individuals worldwide. More information, downloads, tutorials, videos, documentations are available on the OpenViBE website.

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

6.4. Platforms

6.4.1. Immerstar

- Participants : Florian Nouviale, Ronan Gaugne

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

ILDA Project-Team

6. New Software and Platforms

6.1. Smarties

FUNCTIONAL DESCRIPTION: The Smarties system provides an easy way to add mobile interactive support to collaborative applications for wall displays.

It consists of (i) a mobile interface that runs on mobile devices for input, (ii) a communication protocol between the mobiles and the wall application, and (iii) libraries that implement the protocol and handle synchronization, locking and input conflicts. The library presents the input as an event loop with callback functions and handles all communication between mobiles and wall application. Developpers 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: Big data - Visualization - Data visualization - Information visualization - 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 facilitites, astronomy, power distribution systems.

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

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

6.3. Platforms

6.3.1. Platform: WILDER

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

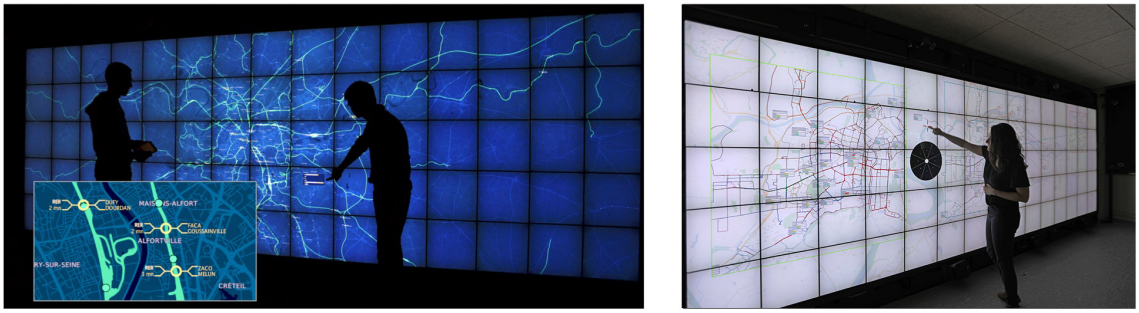

Figure 2. Geovisualization applications running on the WILDER platform. Real-time monitoring of railroad traffic in France (left), real-time monitoring of mobile sensors measuring air quality in Korean cities (right).

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.

WILDER was used in the projects that led to the following publications this year: [22], [24], [18].

IMAGINE Project-Team

5. New Software and Platforms

5.1. Expressive

KEYWORDS: 3D modeling - 3D - 3D interaction - 2D - Procedural - Terrain - Sketching
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: Antoine Begault, Cédric Zanni, Guillaume Cordonnier, Marie-Paule Cani, Maxime Garcia, Maxime Quiblier, Rémi Brouet and Ulysse Vimont
- Partner: INPG
- Contact: Marie-Paule Cani

5.2. MyCF

My Corporis Fabrica
KEYWORDS: Patientspecific - Anatomy - Ontologies - Health - Simulation - 3D modeling - Medical imaging
FUNCTIONAL DESCRIPTION: Knowledge-based 3D anatomical modeling using MyCF The MyCF software eases the creation of 3D anatomical models for visualization and mechanical simulation. As input, the user provides a list of anatomical entities or functions to simulate, using keywords or navigating in reference 3D model. As output, she gets a 3D model ready to visualize, or to simulate.

- Participants: Ali Hamadi Dicko, Federico Ulliana, François Faure and Olivier Palombi
- Partner: Université Joseph-Fourier
- Contact: Olivier Palombi
- URL: http://www.mycorporisfabrica.org

5.3. Natron

KEYWORDS: Computer vision - Image analysis - Video sequences
FUNCTIONAL DESCRIPTION: Compositing consists in combining computer-generated images and live-action videos, editing them, and adding visual effects. The applications range from green-screen compositing to the insertion of real characters in a virtual set. Natron performs all these tasks, with a professional quality user interface.

- Authors: Alexandre Gauthier-Foichat, Alexandre Gauthier-Foichat and Frédéric Devernay
- Contact: Frédéric Devernay
- URL: http://natron.fr/

5.4. Kino AI

Artificial intelligence for cinematography

KEYWORDS: Video analysis - Post-production
FUNCTIONAL DESCRIPTION: Kino AI is an implementation of the method described in our patent "automatic generation of cinematographic rushes using video processing". Starting from a single ultra high definitiion (UltraHD) recording of a live performance, we track and recognize all actors present on stage and generate one or more rushes suitable for cinematographic editing of a movie.

- Partner: IIIT Hyderabad
- Contact: Rémi Ronfard
- Publications: Multi-Clip Video Editing from a Single Viewpoint - Zooming On All Actors: Automatic Focus+Context Split Screen Video Generation

MANAO Project-Team

6. New Software and Platforms

6.1. Eigen

KEYWORD: Linear algebra
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.

RELEASE FUNCTIONAL DESCRIPTION: In 2017, we released three revisions of the 3.3 branch with few fixes of compilation and performance regressions, some doxygen documentation improvements, and the addition of transpose, adjoint, conjugate methods to SelfAdjointView to ease writing generic code.

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

6.2. Elasticity Skinning

KEYWORD: 3D animation
FUNCTIONAL 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: Brian Wyvill, Damien Rohmer, Florian Canezin, Gaël Guennebaud, Loïc Barthe, Marie-Paule Cani, Mathias Paulin, Olivier Gourmel and Rodolphe Vaillant
- 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

MAVERICK Project-Team

6. New Software and Platforms

6.1. Diffusion curves

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

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

6.2. 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.

- Participants: Emmanuel Turquin, François Sillion, Frédo Durand and Stéphane Grabli
- Contact: François Sillion

6.3. GigaVoxels

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

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

6.4. GRATIN

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

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

6.5. 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 developpement of new algorithms for global illumination, those benefiting from the existing algorithms for handling materials, geometry and light sources.

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

6.6. libylm

LibYLM
KEYWORD: Spherical harmonics
FUNCTIONAL DESCRIPTION: This library implements spherical and zonal harmonics. It provides the means to perform decompositions, manipulate spherical harmonic distributions and provides its own viewer to visualize spherical harmonic distributions.

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

6.7. MobiNet

KEYWORDS: Co-simulation - Education - Programmation

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

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

6.8. 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: Cyril Soler, François Sillion and George Drettakis
- Contact: Cyril Soler

6.9. PROLAND

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

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

6.10. ShwarpIt

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

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

6.11. Vrender

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

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

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

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

6.12. X3D TOOLKIT

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

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

MIMETIC Project-Team

6. New Software and Platforms

6.1. AsymGait

Asymmetry index for clinical gait analysis based on depth images
KEYWORDS: Motion analysis - Kinect - Clinical analysis
SCIENTIFIC DESCRIPTION: The system uses depth images delivered by the Microsoft Kinect to retrieve the gait cycles first. To this end it is based on a analyzing the knees trajectories instead of the feet to obtain more robust gait event detection. Based on these cycles, the system computes a mean gait cycle model to decrease the effect of noise of the system. Asymmetry is then computed at each frame of the gait cycle as the spatial difference between the left and right parts of the body. This information is computed for each frame of the cycle.
FUNCTIONAL DESCRIPTION: AsymGait is a software package that works with Microsoft Kinect data, especially depth images, in order to carry-out clinical gait analysis. First it identifies the main gait events using the depth information (footstrike, toe-off) to isolate gait cycles. Then it computes a continuous asymmetry index within the gait cycle. Asymmetry is viewed as a spatial difference between the two sides of the body.

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

6.2. Cinematic Viewpoint Generator

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

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

6.3. Directors Lens Motion Builder

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

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

6.4. Kimea

Kinect IMprovement for Egronomics Assessment
KEYWORDS: Biomechanics - Motion analysis - Kinect
SCIENTIFIC DESCRIPTION: Kimea consists in correcting skeleton data delivered by a Microsoft Kinect in an ergonomics purpose. Kimea is able to manage most of the occlultations that can occur in real working situation, on workstations. To this end, Kimea relies on a database of examples/poses organized as a graph, in order to replace unreliable body segments reconstruction by poses that have already been measured on real subject. The potential pose candidates are used in an optimization framework.
FUNCTIONAL DESCRIPTION: Kimea gets Kinect data as input data (skeleton data) and correct most of measurement errors to carry-out ergonomic assessment at workstation.

- Participants: Franck Multon, Hubert Shum and Pierre Plantard
- Partner: Faurecia
- Contact: Franck Multon
- Publications: Usability of corrected Kinect measurement for ergonomic evaluation in constrained environment - Validation of an ergonomic assessment method using Kinect data in real workplace conditions - Ergonomics Measurements using Kinect with a Pose Correction Framework - Filtered Pose Graph for Efficient Kinect Pose Reconstruction - Reliability of Kinect measurements for assessing the movement of operators in ergonomic studies

6.5. Populate

KEYWORDS: Behavior modeling - Agent - Scheduling
SCIENTIFIC DESCRIPTION: The software provides the following functionalities:

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

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

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

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

With a good configuration of agents characteristics (based on statistics), we demonstrated that tasks schedules produced by Populate are representative of human ones. In conjunction with TopoPlan, it has been used to populate a district of Paris as well as imaginary cities with several thousands of pedestrians navigating in real time.
FUNCTIONAL DESCRIPTION: Populate is a toolkit dedicated to task scheduling under time and space constraints in the field of behavioral animation. It is currently used to populate virtual cities with pedestrian performing different kind of activities implying travels between different locations. However the generic aspect of the algorithm and underlying representations enable its use in a wide range of applications that need to link activity, time and space. The main scheduling algorithm relies on the following inputs: an informed environment description, an activity an agent needs to perform and individual characteristics of this agent. The algorithm produces a valid task schedule compatible with time and spatial constraints imposed by the activity description and the environment. In this task schedule, time intervals relating to travel and task fulfillment are identified and locations where tasks should be performed are automatically selected.

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

6.6. The Theater

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

- Participant: Marc Christie
- Contact: Marc Christie

6.7. CusToM

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

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

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

6.8. MotionGraphVR

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

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

6.9. Platforms

6.9.1. Immerstar Platform

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

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

MINT2 Team (section vide)

Mjolnir Team

6. New Software and Platforms

6.1. InspectorWidget

An opensource suite to track and analyze users behaviors in their applications
KEYWORD: Instrumentation
FUNCTIONAL DESCRIPTION: InspectorWidget is a set of opensource tools to track and analyze users' behaviors in interactive software. It works with closed applications that do not provide source code nor scripting capabilities, covers the whole pipeline of software analysis and does not require programming skills. To achieve this, InspectorWidget combines low-level event logging (e.g. mouse and keyboard events) and high-level screen features (e.g. interface widgets) captured though computer vision techniques, or through accessibility hooks when exposed by applications.
NEWS OF THE YEAR: InspectorWidget now supports the collection and annotation of User Interface accessibility features.

- Participants: Christian Frisson, Sylvain Malacria, Stéphane Huot and Gilles Bailly
- Contact: Sylvain Malacria
- Publication: InspectorWidget: a System to Analyze Users Behaviors in Their Applications
- URL: https://github.com/InspectorWidget/InspectorWidget

6.2. WhichFingers

WhichFingers: Identifying Fingers on Touch Surfaces and Keyboards using Vibration Sensors
KEYWORDS: Interaction - HCI
SCIENTIFIC DESCRIPTION: HCI researchers lack low-latency and robust systems to support the design and development of interaction techniques using finger identification. We developed a low-cost prototype using piezo-based vibration sensors attached to each finger. By combining the events from an input device with the information from the vibration sensors we demonstrate how to achieve low-latency and robust finger identification. Our prototype was evaluated in a controlled experiment, using two keyboards and a touchpad, showing single-touch recognition rates of 98.2% for the keyboard and 99.7% for the touchpad, and 94.7% for two simultaneous touches. These results were confirmed in an additional laboratory-style experiment with ecologically valid tasks. Last we present new interaction techniques made possible using this technology.
FUNCTIONAL DESCRIPTION: WhichFingers consists in a hardware and a software components.

The hardware component consists of five Minisense 100 vibration sensors attached to each finger. The sensors use flexible PVDF piezoelectric polymer film loaded by a mass to offer high sensitivity to detect contact vibrations. They produce a voltage as large as 90V depending on the intensity of the shock or vibration. The five sensors are plugged into a micro-controller and sends the raw values to the host computer at 1000 Hz.

The software component monitors low-level interaction touch and key events, and declares the vibration sensor that created the highest voltage as the finger that produced the input event.

- Participants: Géry Casiez and Sylvain Malacria
- Contact: Géry Casiez
- Publication: WhichFingers: Identifying Fingers on Touch Surfaces and Keyboards using Vibration Sensors

6.3. Lagmeters

Systems to measure end-to-end latency in interactive systems

KEYWORDS: Interaction - Latency
FUNCTIONAL DESCRIPTION: The first method works with most optical mice and allows accurate and real time latency measures up to 5 times per second. In addition, the technique allows easy insertion of probes at different places in the system – i.e. mouse events listeners – to investigate the sources of latency.

The second method relies on a vibration sensor attached to a finger and a photo-diode to detect the screen response. Both are connected to a micro-controller connected to a host computer using a low-latency USB communication protocol in order to combine software and hardware probes to help determine where the latency comes from. We provide source code and materials to replicate both the hardware and software.

- Participants: Géry Casiez, Nicolas Roussel, Stéphane Huot, Thomas Pietrzak, Sébastien Poulmane, Stéphane Conversy, Damien Marchal and Matthieu Falce
- Partners: Université Lille 1 - Inria
- Contact: Géry Casiez
- Publications: Characterizing Latency in Touch and Button-Equipped Interactive Systems - Looking through the Eye of the Mouse: A Simple Method for Measuring End-to-end Latency using an Optical Mouse
- URL: http://ns.inria.fr/mjolnir/lagmeter/

6.4. libParamTuner

Cross-platform library to ease the interactive tuning of parameters at run time and without the need to recompile code.
KEYWORD: Interaction
FUNCTIONAL DESCRIPTION: libParamTuner provides a lightweight syntax to bind some variables of an application to the parameters defined in an XML file. Each modification of the XML file updates in real time the associated parameters in the application. A graphical interface allows editing the XML file, using interactive controls dynamically created for each parameter.

- Participants: Géry Casiez, Marc Baloup and Veis Oudjail
- Partners: Université Lille 1 - Inria
- Contact: Géry Casiez
- Publication: libParamTuner : interactive tuning of parameters without code recompilation
- URL: https://github.com/casiez/libparamtuner

6.5. liblag

Library implementing latency compensation techniques for interactive systems
KEYWORDS: Interaction - Latency
FUNCTIONAL DESCRIPTION: The library comprises the management of a set of multitouch input devices, the implementation of latency compensation techniques from the state-of-the-art and new latency compensation techniques developed in the project, and a system to handle artificial latency.

The library is developed in C++ using the Qt framework to allow compiling the same code on a wide range of devices and platforms.

- Contact: Géry Casiez
- Publication: Dispositif à affichage prédictif
- URL: http://mjolnir.lille.inria.fr/turbotouch/

POTIOC Project-Team

6. New Software and Platforms

6.1. Aïana

KEYWORD: Multimedia player
FUNCTIONAL DESCRIPTION: This software aims to make accessible the playing of a MOOC composed of various information flows (boards, videos, subtitles ...). It is not intended to be "reserved" for people with disabilities but rather to be open to as many as possible by allowing each user to adapt the interface, and therefore the use, to its users own capabilities and needs.

- Authors: Marc Chambon, Julien Grynberg, Hélène Sauzéon, Pascal Guitton and Pierre-Antoine Cinquin
- Partner: Université de Bordeaux
- Contact: Pascal Guitton

6.2. HybridOptics : Hybrid Optical Platform

KEYWORDS: Augmented reality - Education - Tangible interface
FUNCTIONAL DESCRIPTION: The software platform - gets the values of the sensors - computes in real-time the result of the simulation - generates pedagogical supports that are directly linked to the simulation (projected on the work table) - allows the user to control several parameters from a dedicated application on a tablet

- Participants: Benoît Coulais, Lionel Canioni, Bruno Bousquet, Martin Hachet and Jean-Paul Guillet
- Contact: Martin Hachet
- URL : https://project.inria.fr/hobit/fr/

TITANE Project-Team

6. New Software and Platforms

6.1. CGAL Barycentric_coordinates_2

Module CGAL : Barycentric coordinates 2D
KEYWORD: Computational geometry
FUNCTIONAL DESCRIPTION: This package offers an efficient and robust implementation of two-dimensional closed-form generalized barycentric coordinates defined for simple two-dimensional polygons.

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

6.2. dtk-nurbs-probing

KEYWORDS: Algorithm - CAD - Numerical algorithm - Geometric algorithms
FUNCTIONAL DESCRIPTION: This library offers tools for computing intersection between linear primitives and the constitutive elements of CAD objects (curves and surfaces). It is thus possible to compute intersections between a linear primitive with a trimmed or untrimmed NURBS surface, as well with Bezier surfaces. It is also possible, in the xy plane, to compute the intersections between linear primitives and NURBS curves as well as Bezier curves.

- Participants: Come Le Breton, Laurent Busé and Pierre Alliez
- Contact: Come Le Breton

6.3. MeshMantics

KEYWORDS: Classification - 3D modeling
FUNCTIONAL DESCRIPTION: This software component enables the classification of surface meshes in accordinace to common outdoor urban classes such as ground, facades, walls, roofs and vegetation.

- Participants: Florent Lafarge, Pierre Alliez and Yannick Verdié
- Contact: Pierre Alliez

6.4. Module CGAL : Point Set Processing

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

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

6.5. Module CGAL : Scale space surface reconstruction

KEYWORD: Geometric algorithms

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

- Participants: Pierre Alliez and Thijs Van Lankveld
- Contact: Pierre Alliez

6.6. Skeleton-Blockers

Skeleton-Blockers data-structure
KEYWORDS: Topology - Triangulation - Mesh - C++ - 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/

6.7. 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 can be done either with a command line or with a graphical user interface that allows to combine several operations including several simplification methods.

- Participants: David Salinas, Florent Lafarge and Pierre Alliez
- Contact: David Salinas

ALMANACH Team

6. New Software and Platforms

6.1. Enqi

- Author: Benoît Sagot
- Contact: Benoît Sagot

6.2. SYNTAX

KEYWORD: Parsing
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: Benoît Sagot and Pierre Boullier
- Contact: Pierre Boullier
- URL: http://syntax.gforge.inria.fr/

6.3. FRMG

KEYWORDS: Parsing - French
FUNCTIONAL DESCRIPTION: FRMG is a large-coverage linguistic meta-grammar of French. It can be compiled (using MGCOMP) into a Tree Adjoining Grammar, which, in turn, can be compiled (using DyALog) into a parser for French.

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

6.4. 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://team.inria.fr/almanach/melt/

6.5. dyalog-sr

KEYWORDS: Parsing - Deep learning - Natural language processing
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. In 2017, DyALog-SR has been extended into DyALog-SRNN by adding deep neuronal layers implemented with the Dynet library. The new version has participated to the evaluation campaigns CONLL UD 2017 (on more than 50 languages) and EPE 2017.

- Contact: Éric De La Clergerie

6.6. Crapbank

French Social Media Bank
KEYWORDS: Treebank - User-generated content
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

6.7. DyALog

KEYWORD: Logic programming
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/

6.8. SxPipe

KEYWORD: Surface text processing
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 processing chain dedicated to applying to raw corpora a cascade of surface processing steps (tokenisation, wordform detection, non-deterministic spelling correction...). It is used as a preliminary step before ALMAnaCH's parsers (e.g., FRMG) and for surface processing (named entities recognition, text normalization, unknown word extraction and processing...).

- Participants: Benoît Sagot, Djamé Seddah and Éric Villemonte De La Clergerie
- Contact: Benoît Sagot
- URL: http://lingwb.gforge.inria.fr/

6.9. Mgwiki

KEYWORDS: Parsing - French
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.

- Participant: Éric Villemonte De La Clergerie
- Contact: Éric Villemonte De La Clergerie
- URL: http://alpage.inria.fr/frmgwiki/

6.10. WOLF

WOrdnet Libre du Français (Free French Wordnet)
KEYWORDS: WordNet - French - Semantic network - Lexical resource
FUNCTIONAL DESCRIPTION: The WOLF (Wordnet Libre du Français, Free French Wordnet) is a free semantic lexical resource (wordnet) for French.

The WOLF has been built from the Princeton WordNet (PWN) and various multilingual resources.

- Contact: Benoît Sagot
- URL: http://alpage.inria.fr/~sagot/wolf-en.html

6.11. vera

KEYWORD: Text mining
FUNCTIONAL DESCRIPTION: Automatic analysis of answers to open-ended questions based on NLP and statistical analysis and visualisation techniques (vera is currently restricted to employee surveys).

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

6.12. Alexina

Atelier pour les LEXiques INformatiques et leur Acquisition
KEYWORD: Lexical resource
FUNCTIONAL DESCRIPTION: Alexina is ALMAnaCH's framework for the acquisition and modeling of morphological and syntactic lexical information. The first and most advanced lexical resource developed in this framework is the Lefff, a morphological and syntactic lexicon for French.

- Participant: Benoît Sagot
- Contact: Benoît Sagot
- URL: http://gforge.inria.fr/projects/alexina/

6.13. FQB

French QuestionBank
KEYWORD: Treebank
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

6.14. Sequoia corpus

KEYWORD: Treebank
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

COML Team

6. New Software and Platforms

6.1. abkhazia

KEYWORDS: Speech recognition - Speech-text alignment
FUNCTIONAL DESCRIPTION: The Abkhazia sofware makes it easy to obtain simple baselines for supervised ASR (using Kaldi) and ABX tasks (using ABXpy) on the large corpora of speech recordings typically used in speech engineering, linguistics or cognitive science research.

- Contact: Emmanuel Dupoux
- URL: https://github.com/bootphon/abkhazia

6.2. TDE

Term Discovery Evaluation
KEYWORDS: NLP - Speech recognition - Speech
SCIENTIFIC DESCRIPTION: This toolbox allows the user to judge of the quality of a word discovery algorithm. It evaluates the algorithms on these criteria : - Boundary : efficiency of the algorithm to found the actual boundaries of the words - Group : efficiency of the algorithm to group similar words - Token/Type: efficiency of the algorithm to find all words from the corpus (types), and to find all occurences (token) of these words. - NED : Mean of the edit distance across all the word pairs found by the algorithm - Coverage : efficiency of the algorithm to find every discoverable phone in the corpus
FUNCTIONAL DESCRIPTION: Toolbox to evaluate algorithms that segment speech into words. It allows the user to evaluate the efficiency of algorithms to segment speech into words, and create clusters of similar words.

- Contact: Emmanuel Dupoux
- URL : https://github.com/bootphon/TDE

6.3. ABXpy

KEYWORDS: Evaluation - Speech recognition - Machine learning
FUNCTIONAL DESCRIPTION: The ABX package gives a performance score to speech recognition systems by measuring their capacity to discriminate linguistic contrasts (accents, phonemes, speakers, etc...)

- Contact: Emmanuel Dupoux
- URL : https://github.com/bootphon/ABXpy

6.4. h5features

KEYWORD: File format
FUNCTIONAL DESCRIPTION: The h5features python package provides easy to use and efficient storage of large features data on the HDF5 binary file format.

- Contact: Emmanuel Dupoux
- URL : https://github.com/bootphon/h5features

MULTISPEECH Project-Team

6. New Software and Platforms

6.1. dnnsep

Multichannel audio source separation with deep neural networks
KEYWORDS: Audio - Source Separation - Deep learning
SCIENTIFIC DESCRIPTION: dnnsep is the only source separation software relying on multichannel Wiener filtering based on deep learning. Deep neural networks are used to initialize and reestimate the power spectrum of the sources at every iteration of an expectation-maximization (EM) algorithm. This results in state-of-the-art separation quality for both speech and music.
FUNCTIONAL DESCRIPTION: Combines deep neural networks and multichannel signal processing for speech enhancement and separation of musical recordings.
NEWS OF THE YEAR: In 2017, we changed the type of multichannel filter used and modified the software so that it runs online in real time.

- Participants: Aditya Nugraha, Laurent Pierron, Emmanuel Vincent, Antoine Liutkus, Romain Serizel and Floris Fournier
- Contact: Emmanuel Vincent

6.2. KATS

Kaldi-based Automatic Transcription System
KEYWORD: Speech recognition
FUNCTIONAL DESCRIPTION: KATS is a multipass system for transcribing audio data, and in particular radio or TV shows in French, English or Arabic. It is based on the Kaldi speech recognition tools. It relies on Deep Neural Network (DNN) modeling for speech detection and acoustic modeling of the phones (speech sounds). Higher order statistical language models and recurrent neural network language models can be used for improving performance through rescoring of multiple hypotheses.
NEWS OF THE YEAR: Better acoustic models have been developed for French, English and Arabic languages. An NN-based speech detection module has been included, as well as rescoring with RNN language models.

- Contact: Dominique Fohr

6.3. SOJA

Speech Synthesis platform in JAva
KEYWORDS: Speech Synthesis - Audio
SCIENTIFIC DESCRIPTION: SOJA relies on a non uniform unit selection algorithm. Phonetic and linguistic features are extracted and computed from the text to drive selection of speech units in a recorded corpus. The selected units are concatenated to obtain the speech signal corresponding to the input text.
FUNCTIONAL DESCRIPTION: SOJA is a software for Text-To-Speech synthesis (TTS). It performs all steps from text input to speech signal output. A set of associated tools is available for elaborating a corpus for a TTS system (transcription, alignment. . .). Currently, the corpus contains about 3 hours of speech recorded by a female speaker. Most of the modules are in Java, some are in C. The SOJA software runs under Windows and Linux. It can be launched with a graphical user interface or directly integrated in a Java code or by following the client-server paradigm.
NEWS OF THE YEAR: SOJA now supports the unit selection with emotion tags.

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

6.4. Xarticulators

KEYWORD: Medical imaging
FUNCTIONAL DESCRIPTION: The Xarticulators software is intended to delineate contours of speech articulators in X-ray and MR images, construct articulatory models and synthesize speech from X-ray films. This software provides tools to track contours automatically, semi-automatically or by hand, to make the visibility of contours easier, to add anatomical landmarks to speech articulators and to synchronize images with the sound. In addition we also added the possibility of processing digitized manual delineation results made on sheets of papers when no software is available. Xarticulators also enables the construction of adaptable linear articulatory models from the X-ray or MR images and incorporates acoustic simulation tools to synthesize speech signals from the vocal tract shape. Recent work was on the possibility of synthesizing speech from 2D-MRI films, and on the construction of better articulatory models for the velum, lips and epiglottis.
NEWS OF THE YEAR: New models of the lips, velum and epiglottis have been added. Xarticulators generates area functions from an MRI film annotated in terms of articulators.

- Contact: Yves Laprie
- Publication: Articulatory model of the epiglottis

6.5. Platforms

6.5.1. Platform MultiMod: Multimodal Acquisition Data Platform

We have set up an acquisition hardware platform to acquire multimodal data in speech communication context. The system was previously composed of the articulograph Carstens AG501 (which was acquired as part of the EQUIPEX ORTOLANG), 4 Vicon cameras (a motion capture system), and an Intel RealSense camera which contains four components: a video camera, an infrared laser projector, an infrared camera, and a microphone array. With such heterogeneous hardware the synchronization is essential; this is achieved through a trigger device. All the data processing is performed with the PLAVIS software.

This year, we have replaced the 4 Vicon cameras by 8 optitrack cameras. The new motion capture system allows acquiring higher spatial and temporal resolution data, and allows faster acquisition and processing.

We are currently using the system to acquire expressive audiovisual data to build an expressive audiovisual speech synthesis in addition to a lipsync system.

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

PANAMA Project-Team

6. New Software and Platforms

6.1. VoiceHome Corpus

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

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

6.2. FAuST

KEYWORDS: Learning - Sparsity - Fast transform - Multilayer sparse factorisation
SCIENTIFIC DESCRIPTION: FAuST allows to approximate a given dense matrix by a product of sparse matrices, with considerable potential gains in terms of storage and speedup for matrix-vector multiplications.
FUNCTIONAL DESCRIPTION: Faust 1.x contains Matlab routines to reproduce experiments of the PANAMA team on learned fast transforms.

Faust 2.x contains a C++ implementation with Matlab / Python wrappers (work in progress).
NEWS OF THE YEAR: In 2017, new Matlab code for fast approximate Fourier Graph Transforms have been included. based on the approach described in the papers:

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

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

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

6.3. SketchMLBox

KEYWORD: Clustering

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

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

6.4. SPADE

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

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

- Srdan Kitic, Nancy Bertin, Remi Gribonval. Sparsity and cosparsity for audio declipping: a flexible non-convex approach. LVA/ICA 2015 - The 12th International Conference on Latent Variable Analysis and Signal Separation, Aug 2015, Liberec, Czech Republic.
FUNCTIONAL DESCRIPTION: SPADE is a declipping algorithm developed by the PANAMA project-team. To the best of our knowledge SPADE achieves state-of-the-art audio declipping quality. Real-time processing of audio streams is possible.

The web site http://spade.inria.fr provides example audio files and allows users to test SPADE on their own files, either by downloading Matlab routines or using Inria's software demonstration platform, A||go, to test it on the web.
NEWS OF THE YEAR: In 2017, a web interface to demonstrate the potential of SPADE has been setup using the A||go platform.

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

6.5. FASST

Flexible Audio Source Separation Toolbox

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

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

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

A new version is currently under development in the PANAMA team through the Inria funded ADT "FFWD" (FASST For Wider Dissemination) and will be released in 2018.
FUNCTIONAL DESCRIPTION: FASST is a Flexible Audio Source Separation Toolbox designed to speed up the conception and automate the implementation of new model-based audio source separation algorithms. It is the only audio source separation software available to the public (QPL licence) which simultaneously exploits spatial and spectral cues on the sources to separate.

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

6.6. PHYSALIS

KEYWORDS: Source localization - Cosparsity
SCIENTIFIC DESCRIPTION: PHYSALIS (Physics-Driven Cosparse Analysis) gathers algorithms for (joint) source localization and estimation, expressed as inverse problems and addressed with co-sparse regularization. A particular emphasis is put on the acoustic and EEG settings.
FUNCTIONAL DESCRIPTION: PHYSALIS is distributed as a set of Matlab routines to reproduce experimental results from the Ph.D. thesis of Srdan Kitic.
NEWS OF THE YEAR: In 2017, the code of PHYSALIS has been packaged at the occasion of the writing of an overview chapter on co-sparse source localization.

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

SEMAGRAMME Project-Team

5. New Software and Platforms

5.1. ACGtk

Abstract Categorial Grammar Development Toolkit
KEYWORDS: Natural language processing - NLP - Syntactic analysis - Semantics
FUNCTIONAL DESCRIPTION: ACGtk provides softwares for developing and using Abstract Categorial Grammars (ACG).

- Participants: Philippe De Groote, Jiri Marsik, Sylvain Pogodalla and Sylvain Salvati
- Contact: Sylvain Pogodalla
- Publications: A syntax-semantics interface for Tree-Adjoining Grammars through Abstract Categorial Grammar - ACGTK: un outil de développement et de test pour les grammaires catégorielles abstraites - Discourse Modeling with Abstract Categorial Grammars - On the expressive power of Abstract Categorial Grammars: Representing context-free formalisms - Towards abstract categorial grammars
- URL: http://calligramme.loria.fr/acg/

5.2. Dep2pict

KEYWORDS: Syntactic analysis - Semantics
FUNCTIONAL DESCRIPTION: Dep2pict is a program for drawing graphical representation of dependency structures of natural language sentences. Dep2pict takes into account the modified format mixing surface and deep syntactic information used in deep-sequoia.

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

5.3. Grew

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

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

5.4. LEOPAR

KEYWORD: Parsing
FUNCTIONAL DESCRIPTION: Parser for natural language based on interacation grammars

- Participants: Bruno Guillaume, Guillaume Bonfante and Guy Perrier
- Contact: Bruno Guillaume

5.5. ZombiLingo

KEYWORDS: Syntactic analysis - Natural language processing - Lexical resource - Collaborative science

FUNCTIONAL DESCRIPTION: ZombiLingo is a prototype of a GWAP where gamers have to give linguistic information about the syntax of natural language sentence, currently in French, and later to other languages.

- Authors: Bruno Guillaume, Karën Fort, Nicolas Lefebvre and Valentin Stern
- Contact: Karën Fort
- URL: http://zombilingo.org/

5.6. Platforms

5.6.1. SLAMtk

SLAMtk is a processing chain of transcriptions of interviews for the SLAM project (see Section 7.1.1). In particular, it products of a full anonymized and randomized version of the resources. Some extensions, based on Distagger (tagging of disfluencies) and MElt (tagging of part-of-speech and lemmas), have been implemented in order to run linguistic analyses. The tool was reimplemented in order to propose generic treatments for the different corpora.

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

CHROMA Project-Team

6. New Software and Platforms

6.1. CUDA-HSBOF

FUNCTIONAL DESCRIPTION: Ce logiciel est une implémentation du filtre d'Occupation Bayésien à Echantillonnage Hybride (HSBOF) sur GPU. Cette version favorise l'intégration dans un système embarqué sur puce.

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

6.2. E.R.C.I.

Estimation du risque de collision aux intersections

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

6.3. Embedded Perception

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

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

6.4. kinetics

FUNCTIONAL DESCRIPTION: Software computing decision support strategies and decision-making

- Contact: Jilles Dibangoye

6.5. VI-SFM

FUNCTIONAL DESCRIPTION: Experimentary the closed Form Solution for usual-initial data fusion agains real and simulated fusion

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

6.6. Ground Elevation and Occupancy Grid Estilmator (GEOG - Estimator)

KEYWORDS: Robotics - Environment perception

FUNCTIONAL DESCRIPTION: GEOG-Estimator is a system of joint estimation of the shape of the ground, in the form of a Bayesian network of constrained elevation nodes, and the ground-obstacle classification of a pointcloud. Starting from an unclassified 3D pointcloud, it consists of a set of expectation-maximization methods computed in parallel on the network of elevation nodes, integrating the constraints of spatial continuity as well as the influence of 3D points, classified as ground-based or obstacles. Once the ground model is generated, the system can then construct a occupation grid, taking into account the classification of 3D points, and the actual height of these impacts. Mainly used with lidars (Velodyne64, Quanergy M8, IBEO Lux), the approach can be generalized to any type of sensor providing 3D pointclouds. On the other hand, in the case of lidars, free space information between the source and the 3D point can be integrated into the construction of the grid, as well as the height at which the laser passes through the area (taking into account the height of the laser in the sensor model). The areas of application of the system spread across all areas of mobile robotics, it is particularly suitable for unknown environments. GEOG-Estimator was originally developed to allow optimal integration of 3D sensors in systems using 2D occupancy grids, taking into account the orientation of sensors, and indefinite forms of grounds. The ground model generated can be used directly, whether for mapping or as a pre-calculation step for methods of obstacle recognition or classification. Designed to be effective (real-time) in the context of embedded applications, the entire system is implemented on Nvidia graphics card (in Cuda), and optimized for Tegra X2 embedded boards. To ease interconnections with the sensor outputs and other perception modules, the system is implemented using ROS (Robot Operating System), a set of opensource tools for robotics.

- Authors: Amaury Nègre, Lukas Rummelhard, Lukas Rummelhard, Jean-Alix David and Christian Laugier
- Contact: Christian Laugier

6.7. CMCDOT

KEYWORDS: Robotics - Environment perception
FUNCTIONAL DESCRIPTION: CMCDOT is a Bayesian filtering system for dynamic occupation grids, allowing parallel estimation of occupation probabilities for each cell of a grid, inference of velocities, prediction of the risk of collision and association of cells belonging to the same dynamic object. Last generation of a suite of Bayesian filtering methods developed in the Inria eMotion team, then in the Inria Chroma team (BOF, HSBOF, ...), it integrates the managment of hybrid sampling methods (classical occupancy grids for static parts, particle sets for parts dynamics) into a Bayesian unified programming formalism , while incorporating elements resembling the Dempster-Shafer theory (state "unknown", allowing a focus of computing resources). It also offers a projection system of the estimated scene in the near future, to reference potential collisions with the ego-vehicle or any other element of the environment, as well as very low cost pre-segmentation of coherent dynamic spaces (taking into account speeds). It takes as input instantaneous occupation grids generated by sensor models for different sources, the system is composed of a ROS package, to manage the connectivity of I / O, which encapsulates the core of the embedded and optimized application on GPU Nvidia (Cuda), allowing real-time analysis of the direct environment on embedded boards (Tegra X1, X2). ROS (Robot Operating System) is a set of open source tools to develop software for robotics. Developed in an automotive setting, these techniques can be exploited in all areas of mobile robotics, and are particularly suited to highly dynamic and uncertain environment management (eg urban scenario, with pedestrians, cyclists, cars, buses, etc.).

- Authors: Amaury Nègre, Amaury Nègre, Lukas Rummelhard, Lukas Rummelhard, Jean-Alix David and Christian Laugier
- Contact: Olivier Simonin

6.8. cuda_grid_fusion

KEYWORDS: Robotics - Environment perception

FUNCTIONAL DESCRIPTION: This module, directly implemented in ROS / Cuda, performs the merge of occupancy grids, defined in the format proposed in CMCDOT (probabilities integrating the "visibility" information of the cell, via the coefficients "unknown") thanks to an original method, allowing not only consistency with the rest of the system, but also a nuanced consideration of confidence criteria towards the various sources of information.

- Authors: Lukas Rummelhard and Jean-Alix David
- Contact: Olivier Simonin

6.9. cuda_laser_grid

KEYWORDS: Robotics - Environment perception
FUNCTIONAL DESCRIPTION: This module generates occupation grids from "almost" planar lidar. The sensor model, as well as the outputs, have been modified, in order to be fully consistent with the CMCDOT and grid fusion module formats.

- Authors: Amaury Nègre, Amaury Nègre, Lukas Rummelhard, Lukas Rummelhard and Jean-Alix David
- Contact: Olivier Simonin

6.10. CMCDOT-Tools

KEYWORD: Robotics
FUNCTIONAL DESCRIPTION: Tools for CMCDOT Software

- Authors: Amaury Nègre, Lukas Rummelhard, Lukas Rummelhard, Jean-Alix David, Mathias Perrollaz, Procopio Silveira-Stein, Jérôme Lussereau and Nicolas Vignard
- Contact: Olivier Simonin

6.11. DWA Planner on occupancy grid

Dynamic Window Approach Planner based on occupancy grid
KEYWORD: Navigation
FUNCTIONAL DESCRIPTION: This program considers : - a given target - an occupancy grid which represents the environment - the odometry of the vehicle With these data, it computes the commands for a safe navigation towards the target.

- Authors: Christian Laugier and Thomas Genevois
- Partner: CEA
- Contact: Olivier Simonin

6.12. Zoe Simulation

Simulation of Inria's Renault Zoe in Gazebo environment
KEYWORD: Simulation
FUNCTIONAL DESCRIPTION: This simulation represents the Renault Zoe vehicle considering the realistic physical phenomena (friction, sliding, inertia, ...). The simulated vehicle embeds sensors similar to the ones of the actual vehicle. They provide measurement data under the same format. Moreover the software input/output are identical to the vehicle's. Therefoe any program executed on the vehicle can be used with the simulation and reciprocally.

- Authors: Christian Laugier, Nicolas Turro and Thomas Genevois
- Contact: Olivier Simonin

6.13. PedSim-ROS

FUNCTIONAL DESCRIPTION: Simulation of moving people and mobile robots that can detect agents around them. Integration of ROS mobile robots with the PedSim simulator.

- Contact: Jacques Saraydaryan

DEFROST Project-Team

6. New Software and Platforms

6.1. Simulation de neurochirurgie

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

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

6.2. SOFA

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

- Participants: Christian Duriez, François Faure, Hervé Delingette and Stéphane Cotin
- Partner: IGG
- Contact: Stéphane Cotin
- URL: http://www.sofa-framework.org

6.3. SoftRobots

SoftRobots plugin for Sofa
KEYWORDS: Numerical simulations - Problem inverse - Soft robotics
FUNCTIONAL DESCRIPTION: 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.

- Participants: Christian Duriez, Olivier Goury, Jérémie Dequidt, Damien Marchal, Eulalie Coevoet, Erwan Douaille and Félix Vanneste
- Contact: Christian Duriez
- URL: https://project.inria.fr/softrobot/

FLOWERS Project-Team

6. New Software and Platforms

6.1. 3rd hand infrastructure

KEYWORDS: Interaction - Robotics - Infrastructure software - Framework - Robot Operating System (ROS)
FUNCTIONAL DESCRIPTION: The infrastructure is predicate-based to handle relational actions and covers perception (scene description generation, human actions recognition), decision making (teleoperated, scripted or learning from demonstrations), interaction with end users (GUI, voice, gestures) and parallel executions of robotic actions (hold, pick, grasp, bring, ...).

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

6.2. Aversive++

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

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

6.3. 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 has been extended to include the "unified model for regression". The implementation of several of the function approximators have been made real-time compatible.

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

6.4. Explauto

an autonomous exploration library
SCIENTIFIC DESCRIPTION: An important challenge in developmental robotics is how robots can be intrinsically motivated to learn efficiently parametrized policies to solve parametrized multi-task reinforcement learning problems, i.e. learn the mappings between the actions and the problem they solve, or sensory effects they produce. This can be a robot learning how arm movements make physical objects move, or how movements of a virtual vocal tract modulates vocalization sounds. The way the robot will 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 optimize the parametrized policies. In the recent year, work in developmental learning has explored various families of algorithmic principles which allow the efficient guiding of learning and exploration.

Explauto is a framework developed to study, model and simulate curiosity-driven learning and exploration in real and simulated robotic agents. Explauto's scientific roots trace back from Intelligent Adaptive Curiosity algorithmic architecture [51], which has been extended to a more general family of autonomous exploration architectures by [3] and recently expressed as a compact and unified formalism [40]. The library is detailed in [41]. In Explauto, interest models are implementing the strategies of active selection of particular problems / goals in a parametrized multi-task reinforcement learning setup to efficiently learn parametrized policies. The agent can have different available strategies, parametrized problems, models, sources of information, or learning mechanisms (for instance imitate by mimicking vs by emulation, or asking help to one teacher or to another), and chooses between them in order to optimize learning (a processus called strategic learning [47]). Given a set of parametrized problems, a particular exploration strategy is to randomly draw goals/ RL problems to solve in the motor or problem space. More efficient strategies are based on the active choice of learning experiments that maximize learning progress using bandit algorithms, e.g. maximizing improvement of predictions or of competences to solve RL problems [51]. This automatically drives the system to explore and learn first easy skills, and then explore skills of progressively increasing complexity. Both random and learning progress strategies can act either on the motor or on the problem space, resulting in motor babbling or goal babbling strategies.

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

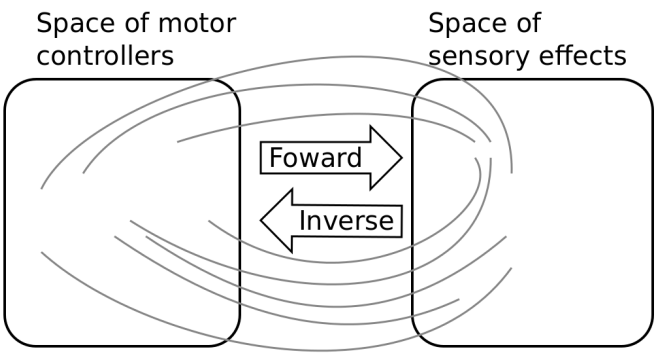

Figure 1. Complex parametrized policies involve high dimensional action and effect spaces. For the sake of visualization, the motor M and sensory S spaces are only 2D each in this example. The relationship between M and S is non-linear, dividing the sensorimotor space into regions of unequal stability: small regions of S can be reached very precisely by large regions of M, or large regions in S can be very sensitive to variations in M.: s as well as a non-linear and redundant relationship. This non-linearity can imply redundancy, where the same sensory effect can be attained using distinct regions in M.

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

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

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

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

This library has been used in many experiments including:

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

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

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

6.5. HiPi Board

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

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

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

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

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

6.6. IKPy

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

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

6.7. KERAS-QR

KERAS with Quick Reset
KEYWORDS: Library - Deep learning

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

6.8. KidBreath

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

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

6.9. Kidlearn: money game application

FUNCTIONAL DESCRIPTION: The games is instantiated in a browser environment where students are proposed exercises in the form of money/token games (see Figure 2). For an exercise type, one object is presented with a given tagged price and the learner has to choose which combination of bank notes, coins or abstract tokens need to be taken from the wallet to buy the object, with various constraints depending on exercises parameters. The games have been developed using web technologies, HTML5, javascript and Django.

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

6.10. Kidlearn: script for Kidbreath use

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

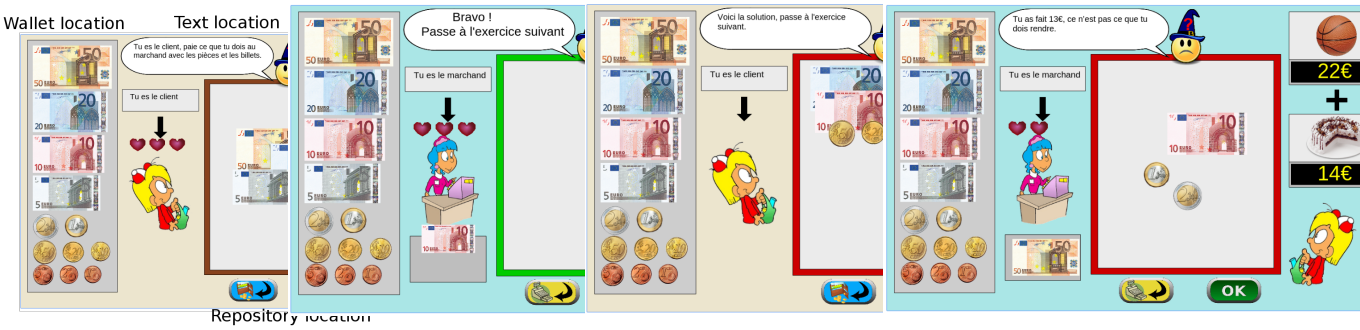

Figure 2. Four principal regions are defined in the graphical interface. The first is the wallet location where users can pick and drag the money items and drop them on the repository location to compose the correct price. The object and the price are present in the object location. Four different types of exercises exist: M : customer/one object, R : merchant/one object, MM : customer/two objects, RM : merchant/two objects.

Github link to explanation about it : https://github.com/flowersteam/kidlearn/.

- Contact: Benjamin Clement

6.11. KidLearn

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

6.12. Kinect 2 Server

Kinect 2 server
KEYWORDS: Depth Perception - Speech recognition - Gesture recognition - Kinect
FUNCTIONAL DESCRIPTION: The server written in C# uses the Kinect SDK v2 to get the RGBD raw image, skeleton tracking information, recognized speech. It also uses the text-to-speech from Microsoft. Then it streams JSON data over the network using the Publisher/Subscriber pattern from the ZeroMQ network library. A Linux client has been written in Python but it can be written in any other language that is compatible with ZeroMQ. Features are controllable through a Graphical User Interface on Windows, or through the code from any Linux/Windows client. The clients can for instance enable features (speech recognition on, skeleton tracking off, . . .) and parameters (set new speech to recognize, change language, . . .) from remote.

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

6.13. Multimodal

FUNCTIONAL DESCRIPTION: The python code provides a minimum set of tools and associated libraries to reproduce the experiments in [98] , together with the choreography datasets. The code is primarily intended for reproduction of the 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

6.14. 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
- URL: http://www.optitrack.com/

6.15. Pixl Board

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

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

The board is used in the Poppy Ergo Jr robot.

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

6.16. Poppy

FUNCTIONAL DESCRIPTION: The Poppy Project team develops open-source 3D printed robots platforms based on robust, flexible, easy-to-use and reproduce hardware and software. In particular, the use of 3D printing and rapid prototyping technologies is a central aspect of this project, and makes it easy and fast not only to reproduce the platform, but also to explore morphological variants. Poppy targets three domains of use: science, education and art.

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

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

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

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

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

6.17. Poppy Ergo Jr

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

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

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

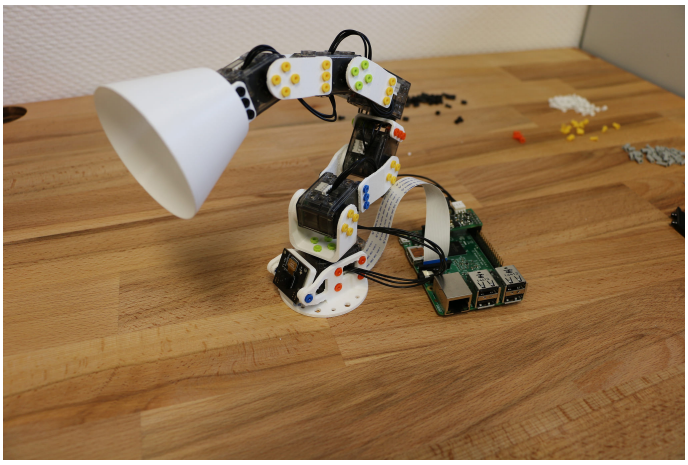

Figure 3. Poppy Ergo Jr, 6-DoFs arm robot for education

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

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

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

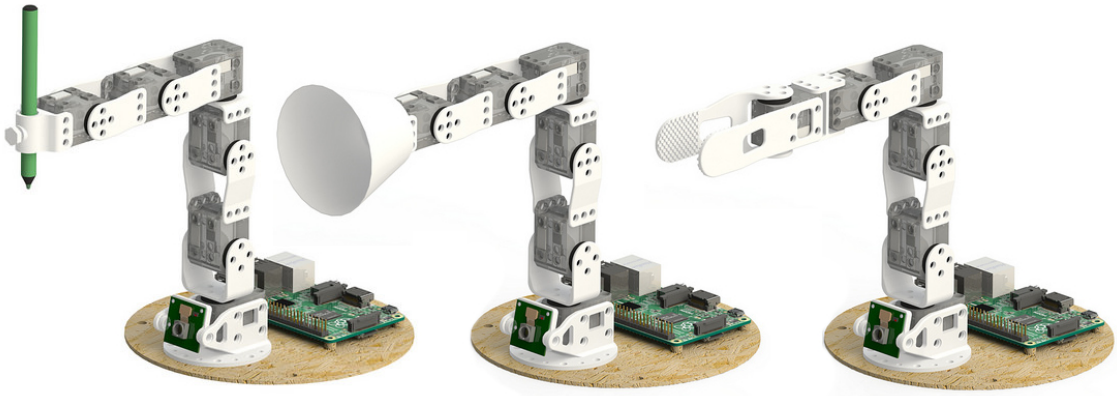

Figure 4. The available Ergo Jr tools: a pen holder, a lampshade and a gripper

6.18. Poppy Ergo Jr Installer

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

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

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

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

6.19. Poppy Ergo Jr Simulator

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

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

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

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

6.20. ProMP

Probabilistic Movement Primitives
KEYWORDS: Interaction - Robotics - Probability - Motion model - Robot Operating System (ROS)
FUNCTIONAL DESCRIPTION: Joint-space primitives with a task-space constraint: The primitives are stored in joint-space but demonstrations are provided both in joint space and task space, context. Thanks to this context, task-space goals can be requested to these joint-space primitives. The benefit is that requesting a new task-space goal does not require to call an IK method which would return demonstrations-agnostic joint configurations.

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

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

6.21. PyPot

SCIENTIFIC DESCRIPTION: Pypot is a framework developed to make it easy and fast to control custom robots based on Dynamixel motors. This framework provides different levels of abstraction corresponding to different types of use. Pypot can be used to:

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

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

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

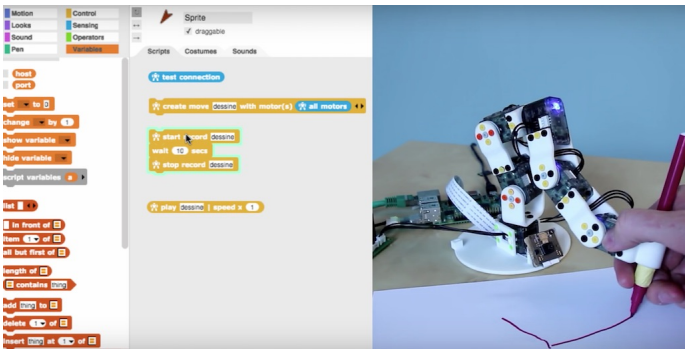

Figure 5. Example of using pypot to program a robot to reproduce a drawn shape

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

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

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

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

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

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

Figure 6. Using Snap! to program a robot by demonstration and create complex choreographies

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

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

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

6.22. PyQMC

Python library for Quasi-Metric Control

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

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

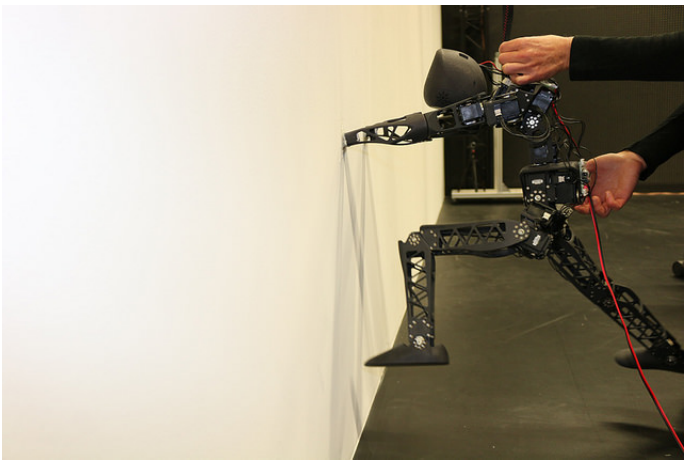

Figure 7. Artistic project exploring the concept of robotic move.

6.23. ROS Optitrack Publisher

KEYWORDS: Target tracking - Robot Operating System (ROS)
FUNCTIONAL DESCRIPTION: This package allows to publish optitrack markers declared as rigid bodies as TF transforms. Data is gathered through the embedded VRPN server of Motive/Arena. Only rigid bodies are requested to the server, thus single points in 2D/3D are ignored. VRPN server can be enable in View > Data streaming in Motive.

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

6.24. ThifloNet

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

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

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

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

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

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

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: Jean-Pierre Merlet and Odile Pourtallier
- Contact: Jean-Pierre Merlet

6.2. PALGate

KEYWORDS: Health - Home care - Handicap

- Contact: David Daney

6.3. Platforms

6.3.1. ALIAS, Algorithms Library of Interval Analysis for Systems

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:

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

6.3.2. Hardware platforms

We describe here only the new platforms that have been developed in 2017 while we maintain a very large number of platforms (e.g. the cable-driven parallel robots of the MARIONET family, the ANG family of walking aids or our experimental flat).

6.3.2.1. GMSIVE ADT: virtual reality and rehabilitation

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

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

6.3.2.2. Activities detection platform

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

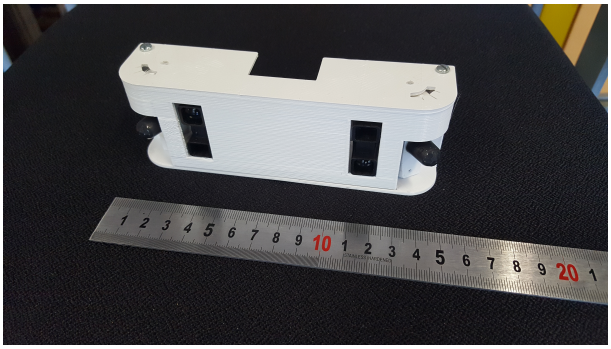


Figure 1. A station for activities detection. The 4 sensors allow to determine the presence of the subject in a given zone, his/her direction of motion and speed even at night

6.3.2.3. Instrumented cane

An alternate to the walker is using a cane for elderly support and for rehabilitation. We have developed two cane prototypes instrumented with accelerometers and force sensor (figure 2) with the purpose of monitoring the walking pattern and assess rehabilitation exercises in a more objective way. These canes have also led lights that are automatically activated at night when the cane is in motion while the ambient lightning is low with the purpose of decreasing the fall risk and to help for navigation.

6.3.2.4. Instrumented gloves

An important part of a rehabilitation process is to assess, on a regular basis, the motricity of the patient. The standard protocol for this assessment is to ask the patient to perform standardized motion while a therapist

Figure 2. Instrumented cane

puts the palm of his/her hand in opposition to measure the pressure exerted by the patient. This intuitive measurement is converted into a simplified ranking from 0 to 5 but, as mentioned by therapists, the subjectivity of this ranking is high. We have developed a glove that is able to measure the pressure and may provide a more objective assessment.

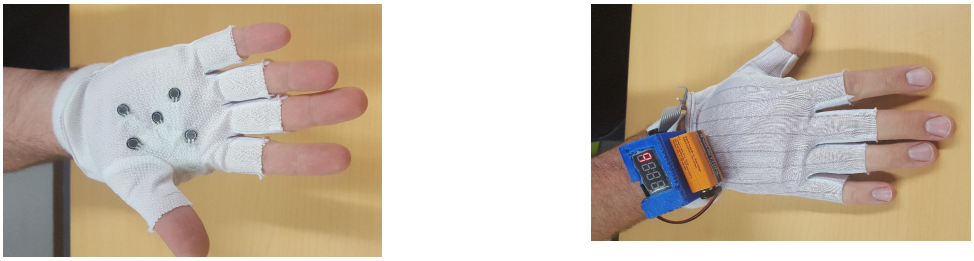


Figure 3. Instrumented glove for rehabilitation assessment

LAGADIC Project-Team

6. New Software and Platforms

6.1. bib2html

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

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

6.2. DESlam

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

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

6.3. HandiViz

Driving assistance of a wheelchair
KEYWORDS: Health - Persons attendant - Handicap
FUNCTIONAL DESCRIPTION: The HandiViz software proposes a semi-autonomous navigation framework of a wheelchair relying on visual servoing.

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

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

6.4. Perception360

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

- Contact: Patrick Rives

6.5. SINATRACK

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

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

6.6. UsTk

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

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

6.7. ViSP

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

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

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

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

6.8. Platforms

6.8.1. Robot Vision Platform

Participant: Fabien Spindler [contact].

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

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

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

6.8.2. Mobile Robots

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

6.8.2.1. Indoor Mobile Robots

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

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

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

6.8.2.2. Outdoor Vehicles

A camera rig has been developed in Sophia Antipolis. It can be fixed to a standard car (see Fig. 4), which is driven at a variable speed depending on the road/traffic conditions, with an average speed of 30 km/h and a maximum speed of 80 km/h. The sequences are recorded at a frame rate of 20 Hz, whith a synchronization of the six global shutter cameras of the stereo system, producing spherical images with a resolution of 2048x665 pixels (see Fig. 4). Such sequences are fused offline to obtain maps that can be used later for localization or for scene rendering (in a similar fashion to Google Street View) as shown in the video http://www-sop.inria.fr/members/Renato-Jose.Martins/iros15.html.

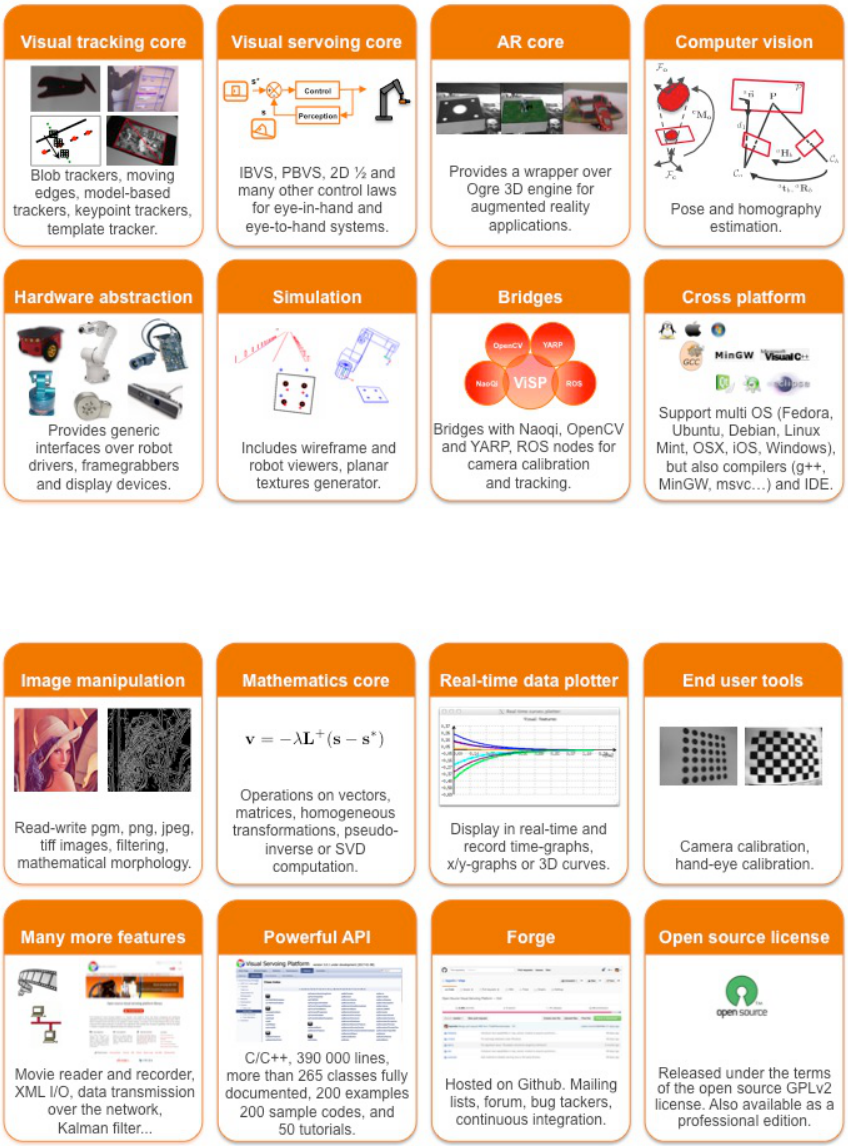
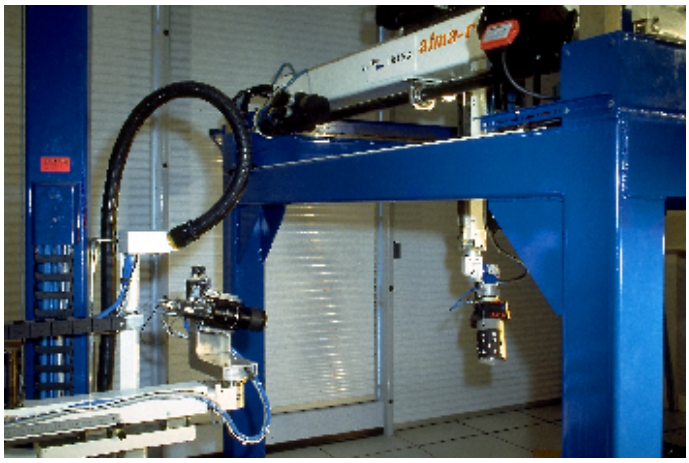


Figure 1. This figure highlights ViSP main capabilities for visual tracking, visual servoing, and augmented reality that may benefit from computer vision algorithms. ViSP allows controlling specific platforms through hardware abstraction or in simulation. ViSP provides also bridges over other frameworks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



(a) (b)

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

6.8.3. Medical Robotic Platform

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

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

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

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

6.8.4. Humanoid Robots

Participants: Giovanni Claudio, Fabien Spindler [contact].

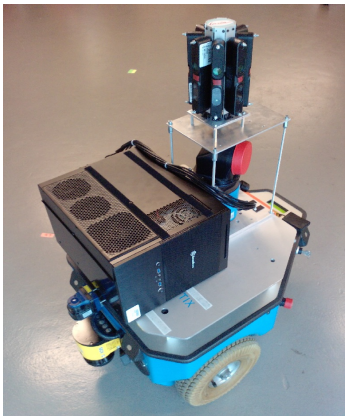
Romeo is a humanoid robot from SoftBank Robotics which is intended to be a genuine personal assistant and companion. Only the upper part of the body (trunk, arms, neck, head, eyes) is working. This research platform is used to validate our researches in visual servoing and visual tracking for object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

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

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

6.8.5. Unmanned Aerial Vehicles (UAVs)

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



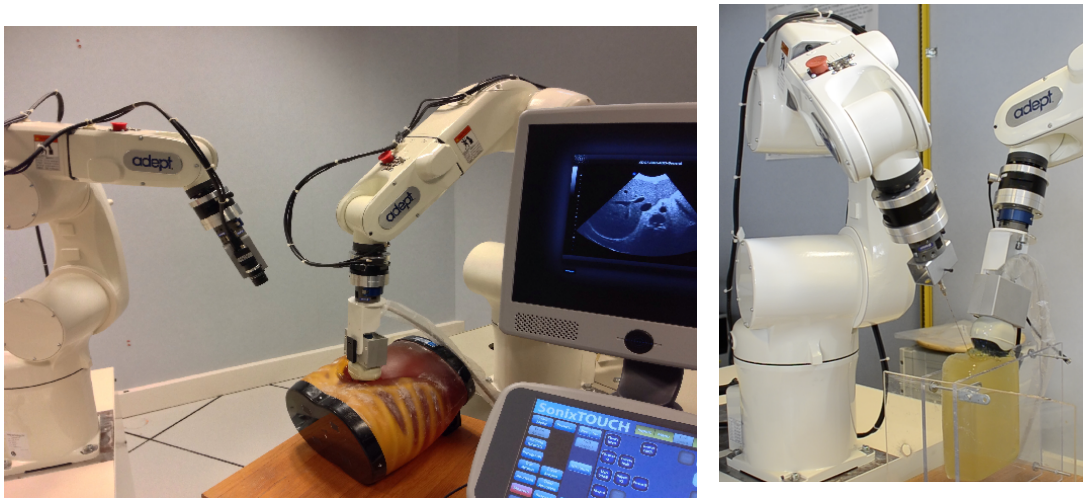
(a)

(b)

(c)

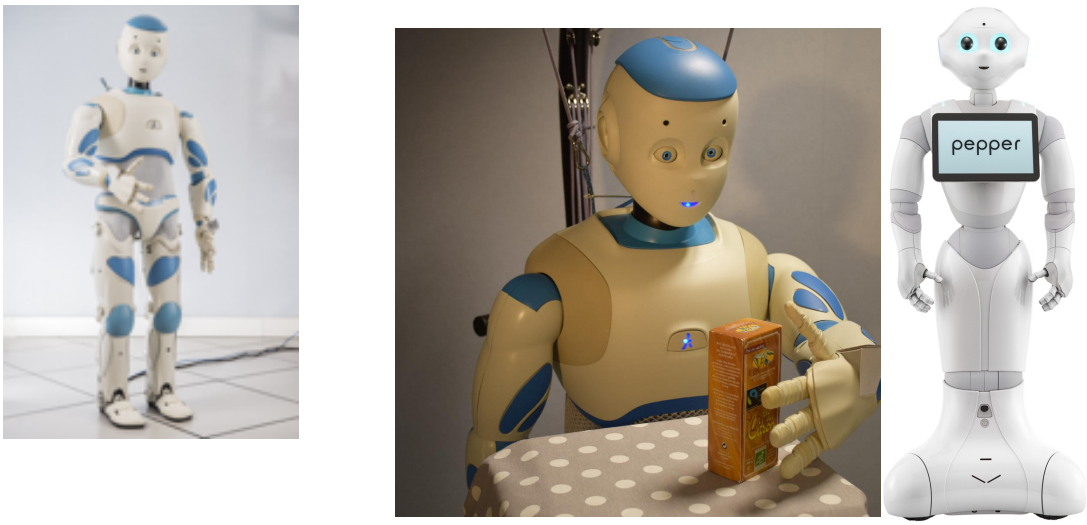
Figure 3. a) Hannibal platform, b) Pioneer P3-DX robot, c) wheelchairs from Permobil, Sunrise and YouQ.

Figure 4. Globeye stereo sensor and acquisition system.



(a) (b)

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



(a) (b)

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

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

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

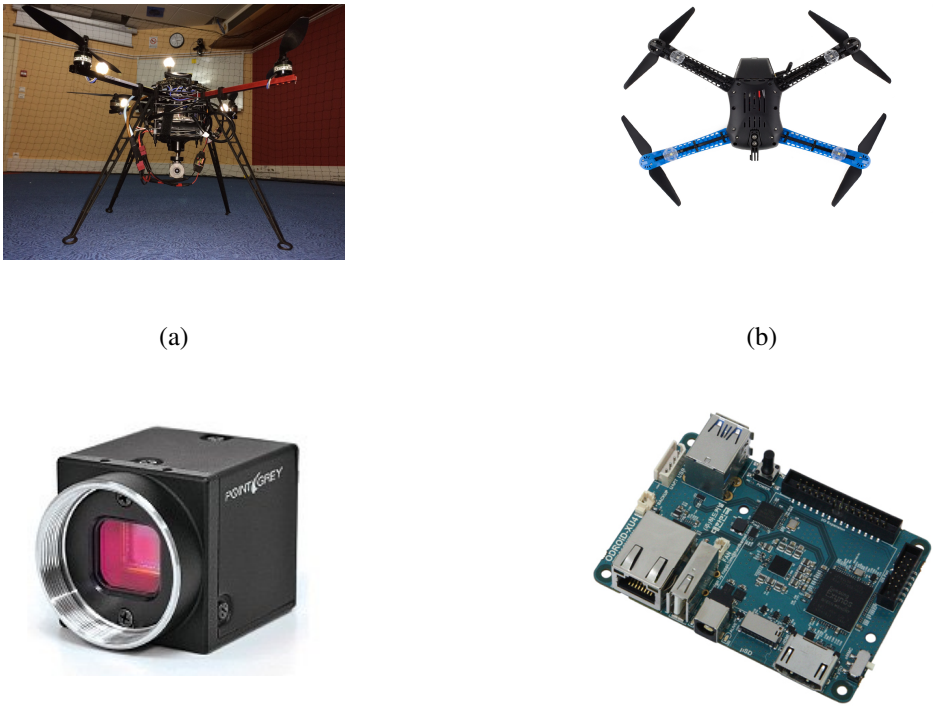


Figure 7. a) Quadrotor XL1 from Mikrokopter, b) Quadrotor Iris from 3DRobotics, c) Flea Color USB3 camera, d) Odroid XU4 board

LARSEN Project-Team

6. New Software and Platforms

6.1. ProMP_iCub

iCub Learning Trajectories with ProMP
KEYWORDS: Gaussian processes - Robotics
FUNCTIONAL DESCRIPTION: A set of matlab modules to learn, replay and infer the continuation of trajectories in robotics using Probabilistic Movement Primitives (ProMP).

- Contact: Serena Ivaldi
- Publication: Prediction of Intention during Interaction with iCub with Probabilistic Movement Primitives
- URL: https://github.com/inria-larsen/icubLearningTrajectories

6.2. Limbo

LIbrary for Model-based Bayesian Optimization
KEYWORDS: Black-box optimization - C++ - Global optimization - Machine learning - Policy Learning - Bayesian optimization - Gaussian processes
FUNCTIONAL DESCRIPTION: Limbo is an open-source C++11 library for Gaussian processes and Bayesian Optimization which is designed to be both highly flexible and very fast. It can be used to optimize functions for which the gradient is unknown, evaluations are expensive, and where runtime cost matters (e.g., on embedded systems or robots). Benchmarks on standard functions show that Limbo is about 2 times faster than BayesOpt (another C++ library) for a similar accuracy.
NEWS OF THE YEAR: Release 2.0 (2017) with: - serialization of Gaussian process models - new architecture for kernel and mean functions - automatic and extensive benchmarks for Gaussian processes regression and Bayesian optimization (generated weekly) - better random generator (thread-safe, c++11) - generation of the documentation for each release

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

6.3. xsens_driver

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

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

RELEASE FUNCTIONAL DESCRIPTION: Support of fourth generation of devices. Support of ubuntu 16.04. Support of ROS Jade and ROS Kinetic.
NEWS OF THE YEAR: version 2.1.0 (2017-04-14) - several bugfixes and a new option.

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

6.4. sferes2

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

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

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

6.5. libdynamixel

KEYWORD: Robotics
FUNCTIONAL DESCRIPTION: The libdynamixel is a high-performance C++11 interface to the Dynamixel actuators (including the Dynamixel Pro range). It provides a high-level interface (designed to be easy to sue), a low-level interface (designed to add no overhead on top of the protocol), and a command-line tool for scripting and maintenance operations. The main emphasis is on performance and compatibility with modern C++.

- Contact: Jean-Baptiste Mouret
- URL: http://github.com/resibots/libdynamixel

PERVASIVE INTERACTION Project-Team

5. New Software and Platforms

5.1. DomiCube

- Participant: Rémi Pincent
- Contact: Rémi Pincent

5.2. EmoPRAMAD

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

The evaluation conducted though EmoPRAMAD concerns both unimodal (facial only) and bimodal conditions (facial/sound). The emotions set is composed of 4 basic emotions (joy, fear, anger, sadness) and a neutral state. While experimenting, the software collects several parameters in order to evaluate more than correctness of the answers: time to respond, length of mouse moves, etc.

- Contact: Dominique Vaufreydaz

5.3. Online Movie Director

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

5.4. PALGate

KEYWORDS: Health - Home care - Handicap

- Contact: David Daney

5.5. PrimaCV

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

5.6. 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 curently under development, coupling a 3D virtual environment and a building energy simulator. The 3D virtual environment is based on the JMonkey 3D engine. New houses can be easily imported using SweetHome 3D and Blender. The building energy simulator is EnergyPlus. The 3D engine and the energy engine are coupled using the Functional Mock-up Interface (FMI) standard. Using this standard will allow to easily switch between existing building energy simulators.

- Participant: Patrick Reignier
- Contact: Patrick Reignier

5.7. SmartServoFramework

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

5.8. Unix Interface for InfraRed Sensor

- Author: Pierre Baret
- Contact: James Crowley

5.9. Platforms

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

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

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

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

RITS Project-Team

5. New Software and Platforms

5.1. PML-SLAM

KEYWORD: Localization
SCIENTIFIC DESCRIPTION: Simultaneous Localization and Mapping method based on 2D laser data.

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

5.2. V2Provue

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

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

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

- Contact: Fawzi Nashashibi

5.3. SimConVA

Connected Autonomous Vehicles Simulator
FUNCTIONAL DESCRIPTION: The software provides an interface between the network simulator ns-3 (https://www.nsnam.org/) and the modular prototyping framework RTMaps (https://intempora.com/).

This code allows to create an RTMaps component which activates and controls the ns-3 simulator. The component handles the sending and reception of data packets between ns-3 and RTMaps for each vehicle. It also handles the mobility of vehicles in ns-3 using their known position in RTMaps.

- Authors: Pierre Merdrignac, Oyunchimeg Shagdar and Jean-Marc Lasgouttes
- Contact: Jean-Marc Lasgouttes

LINKMEDIA Project-Team

6. New Software and Platforms

6.1. Platforms

6.1.1. A||GO multimedia web services

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

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

MAGRIT Project-Team

6. New Software and Platforms

6.1. Ltrack

KEYWORDS: Augmented reality - Visual tracking
FUNCTIONAL DESCRIPTION: The Inria development action LTrack aims at developing an Android platform in order to facilitate the transfer of some of our algorithms onto mobile devices. For the moment, the tracking-by-synthesis algorithm has been implemented (up to our knowledge, for the first time on a mobile device) in order to rigidly track a real object in real time assuming that a CAD model of this object is available. The design and implementation of the platform have been guided by the need to enable easy integration of any tracking algorithm based on combining video data and other sensor information.
NEWS OF THE YEAR: A recovery procedure based on key-frames has been designed when the number of inliers tracked keypoints is too small.

- Contact: Marie-Odile Berger

6.2. PoLAR

Portable Library for Augmented Reality
FUNCTIONAL DESCRIPTION: PoLAR (Portable Library for Augmented Reality) is a framework which aims to help creating graphical applications for augmented reality, image visualization and medical imaging. PoLAR was designed to offer powerful visualization functionalities without the need to be a specialist in Computer Graphics. The framework provides an API to state-of-the-art libraries: Qt to build GUIs and OpenSceneGraph for high-end visualization, for researchers and engineers with a background in Computer Vision to be able to create beautiful AR applications, with little programming effort. The framework is written in C++ and published under the GNU GPL license

- Contact: Erwan Kerrien
- URL: http://polar.inria.fr

6.3. Fast>VP

KEYWORDS: Vanishing points - Image rectification
FUNCTIONAL DESCRIPTION: Fast>VP is a fast and effective tool to detect vanishing points in uncalibrated images of urban or indoor scenes.

This tool also allows automatic rectification of the vertical planes in the scene, namely generating images where these planes appear as if they were observed from a fronto-parallel view.

It is the Matlab implementation of the algorithm described in [6].

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

6.4. TheGridMethod

The grid method toolbox
KEYWORD: Experimental mechanics
FUNCTIONAL DESCRIPTION: This Matlab toolbox implements several efficient and state-of-the art algorithms to estimate displacement and strain fields from grid images deposited on the surface of a specimen submitted to mechanical testing.

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

MORPHEO Project-Team

6. New Software and Platforms

6.1. 4D repository

KEYWORDS: 4D - Dynamic scene
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: Edmond Boyer
- URL: http://4drepository.inrialpes.fr/

6.2. Lucy Viewer

KEYWORDS: Data visualization - 4D - Multi-Cameras
SCIENTIFIC 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. Such data is available from the 4D repository website hosted by Inria Grenoble.

With Lucy Viewer, the user can use the mouse to zoom in onto the 4D models, zoom out, rotate, translate and view from an arbitrary angle as the 4D sequence is being played. The texture information is read from the images at each frame in the sequence and applied onto the meshes. This helps the user visualize the 3D scene in a realistic manner. The user can also freeze the motion at a particular frame and inspect a mesh in detail. Lucy Viewer lets the user to also select a subset of cameras from which to apply texture information onto the meshes. The supported formats are meshes in .OFF format and associated images in .PNG or .JPG format.
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, Jean-Sébastien Franco and Matthieu Armando
- Contact: Edmond Boyer
- URL: https://kinovis.inria.fr/lucyviewer/

6.3. Shape Tracking

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

- Contact: Edmond Boyer

6.4. QuickCSG V2

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

SCIENTIFIC DESCRIPTION: See the technical report "QuickCSG: Arbitrary and Faster Boolean Combinations of N Solids", Douze, Franco, Raffin.

The extension of the algorithm to self-intersecting meshes is described in "QuickCSG with self-intersections", a document inside the package.
FUNCTIONAL DESCRIPTION: QuickCSG is a library and command-line application that computes Boolean operations between polyhedra. The basic algorithm is described in the research report "QuickCSG: Arbitrary and Faster Boolean Combinations of N Solids", Douze, Franco, Raffin. The input and output polyhedra are defined as indexed meshes. In version 2, that was developed for Pixologic, the meshes can be self-intersecting, in which case the inside and outside are defined by the non-zero winding rule. The operation can be any arbitrary Boolean function, including one that is defined as a CSG tree. The focus of QuickCSG is speed. Robustness to degeneracies is obtained by carefully applied random perturbations.

- Authors: Matthys Douze, Jean-Sébastien Franco and Bruno Raffin
- Contact: Jean-Sébastien Franco
- URL: https://kinovis.inria.fr/quickcsg/

6.5. CVTGenerator

KEYWORDS: Mesh - Centroidal Voronoi tessellation - Implicit surface
FUNCTIONAL DESCRIPTION: CVTGenerator is a program to build Centroidal Voronoi Tessellations of any 3D meshes and implicit surfaces.

- Partner: INP Grenoble
- Contact: Li Wang
- URL: http://cvt.gforge.inria.fr/

6.6. Platforms

6.6.1. Platform Kinovis

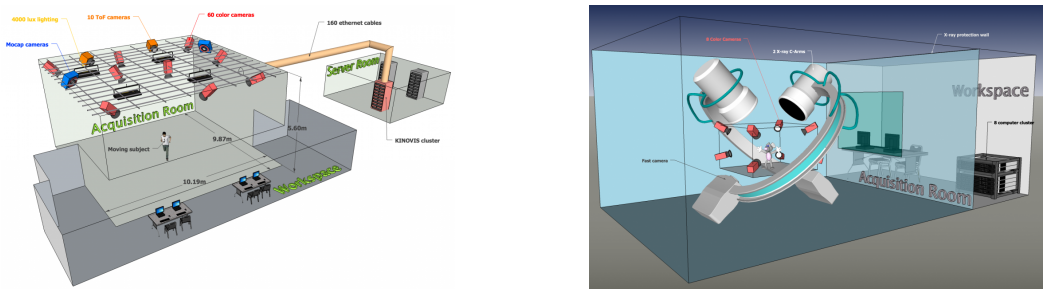


Figure 3. Kinovis platforms: on the left the Inria platform; on the right Grenoble Hospital platform.

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 (see Figure3). 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. 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 Julien Pansiot is managing the technical resources of both platforms.

PERCEPTION Project-Team

5. New Software and Platforms

5.1. ECMPR

Expectation Conditional Maximization for the Joint Registration of Multiple Point Sets
FUNCTIONAL DESCRIPTION: Rigid registration of two or several point sets based on probabilistic matching between point pairs and a Gaussian mixture model

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

5.2. Mixcam

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

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

5.3. NaoLab

Distributed middleware architecture for interacting with NAO
FUNCTIONAL DESCRIPTION: This software provides a set of librairies and tools to simply the control of NAO robot from a remote machine. The main challenge is to make easy prototuping applications for NAO ising C++ and Matlab programming environments. Thus NaoLab provides a prototyping-friendly interface to retrieve sensor date (video and sound streams, odometric data...) and to control the robot actuators (head, arms, legs...) from a remote machine.This interface is available on Naoqi SDK, developed by Aldebarab company, Naoqi SDK is needed as it provides the tools to acess the embedded NAO services (low-level motor command, sensor data access...)

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

5.4. Stereo matching and recognition library

KEYWORD: Computer vision

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

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

5.5. Platforms

5.5.1. Audio-Visual Head Popeye+

In 2016 our audio-visual platform was upgraded from Popeye to Popeye+. Popeye+ has two high-definition cameras with a wide field of view. We also upgraded the software libraries that perform synchronized acquisition of audio signals and color images. Popeye+ has been used for several datasets.
Websites:
https://team.inria.fr/perception/projects/popeye/
https://team.inria.fr/perception/projects/popeye-plus/
https://team.inria.fr/perception/avtrack1/
https://team.inria.fr/perception/avdiar/

5.5.2. NAO Robots

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

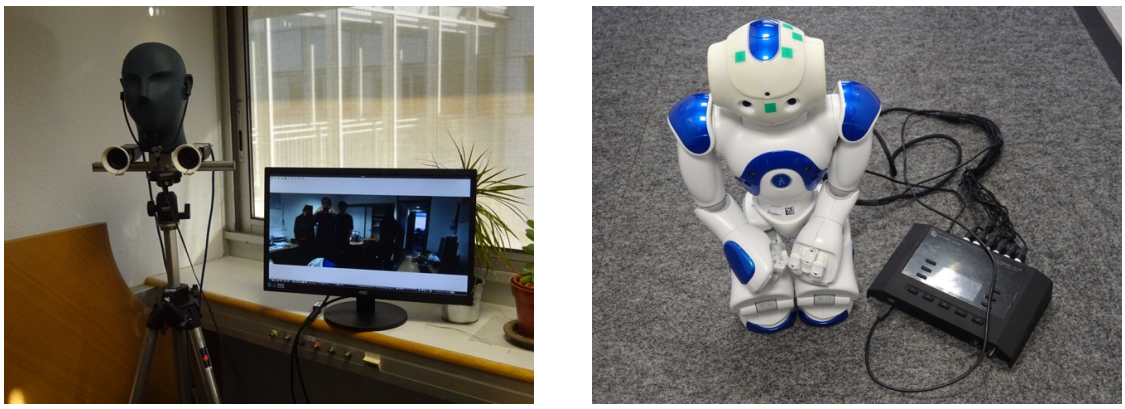


Figure 2. The Popeye+ audio-visual platform (left) delivers high-quality, high-resolution and wide-angle images at 30FPS. The NAO prototype used by PERCEPTION in the EARS STREP project has a twelve-channel spherical microphone array synchronized with a stereo camera pair.

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

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

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

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

Websites:
https://team.inria.fr/perception/nao/
https://team.inria.fr/perception/research/naolab/

SIROCCO Project-Team

6. New Software and Platforms

6.1. SaccadicModel

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

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

6.2. QuantizationAE

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

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

6.3. LF-Inpainting

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

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

6.4. LF-HLRA

Light fields homography-based low rank approximation

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

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

6.5. GBR-MVimages

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

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

6.6. Platforms

6.6.1. Light field editor

Participants: Pierre Allain, Laurent Guillo, Christine Guillemot.

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

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

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

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

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

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

6.6.3. Light fields datasets

Participants: Pierre Allain, Christine Guillemot, Laurent Guillo.

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

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

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

STARS Project-Team

6. New Software and Platforms

6.1. EGMM-BGS

KEYWORD: 2D
FUNCTIONAL DESCRIPTION: This alogorithm allows to distinguish between the mobile pixels (except shadows) and pixels belonging to the background of the image.

- Participants: Anh Tuan Nghiem, François Brémond and Vasanth Bathrinarayanan
- Contact: François Brémond

6.2. MTS

Multi camera Tracking System
KEYWORD: Vision
FUNCTIONAL DESCRIPTION: This tool allows to find an appearence of interest in a following system with multi cameras.

- Participants: François Brémond and Slawomir Bak
- Contact: François Brémond

6.3. PALGate

KEYWORDS: Health - Home care - Handicap

- Contact: David Daney

6.4. PrintFoot Tracker

KEYWORD: Video analysis
FUNCTIONAL DESCRIPTION: Following of mobile object moving from single camera video streams.

- Participants: Duc Phu Chau, François Brémond and Monique Thonnat
- Contact: François Brémond

6.5. Proof Of Concept Néosensys (Poc-NS)

KEYWORD: Video analysis
FUNCTIONAL DESCRIPTION: This software is composed of 3 applications dedicated to show the techniques that will be applied by Néosensys Stars start-up. The software PoC-NS is a graphical interface allowing switching between these 3 applications. These applications are dedicated to help videosurveillance opertators in stores, in the fight against theft. There are the following: 1. Auto-side swith: allows to swith from a camera to another one by a single translation moving (left-riht) in a set of cameras in parallel. 2. Re-identification: Based on EGMM-BGS and PrintFoot Tracker software (both registed at APP), this application allows to find a person in several camera registrations, during a specific time, by clicking once on the person in a video. 3. Assisted following: allows (by hand) to follow a person in a camera network, with the feature of an automatic switch from a camera to another one when the person moves in a controlled area.

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

6.6. py_ad

py action detection
FUNCTIONAL DESCRIPTION: Action Detection framework Allows user to detect action in video stream. It uses model trained in py_ar.

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

6.7. 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: François Brémond and Michal Koperski
- Contact: Michal Koperski

6.8. 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

6.9. py_tra3d

py trajectories 3d
KEYWORD: Videos
SCIENTIFIC DESCRIPTION: New video descriptor which fuses 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: François Brémond and Michal Koperski
- Contact: Michal Koperski

6.10. 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: Etienne Corvée, François Brémond, Thanh Hung Nguyen and Vasanth Bathrinarayanan
- Partners: CEA - CHU Nice - USC Californie - Université de Hamburg - I2R
- Contact: François Brémond
- URL: https://team.inria.fr/stars/software

6.11. sup_ad

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

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

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

6.12. 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

6.13. bomotech

KEYWORDS: 3D - Video analysis - Kinect - 2D
FUNCTIONAL DESCRIPTION: Software dedicated to walking analysis using a Kinect deep camera.

- Authors: Melaine Gautier and Baptiste Fosty
- Partner: Mélaine Gautier
- Contact: Melaine Gautier

6.14. BMC_1

- Authors: Anaïs Ducoffe, Julien Badie, Manikandan Bakthavatchalam, Vasanth Bathrinarayanan, Anh Tuan Nghiem, Duc Phu Chau, Slawomir Bak, Ghada Bahloul and Nicolas Chleq
- Contact: François Brémond

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

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

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

6.17. sup_ad_ont

SUP Activity detection with ontologies
KEYWORD: Activity recognition
FUNCTIONAL DESCRIPTION: SUP plugin for activity detection, with manually defined ontologies.

- Participants: François Brémond, Michal Koperski and Dario Dotti
- Contact: Michal Koperski

THOTH Project-Team

6. New Software and Platforms

6.1. ACT-detector

Action Tubelet Detector for Spatio-Temporal Action Localization
KEYWORDS: Spatio-temporal - Localisation - Video analysis - Motion detection - Object detection
FUNCTIONAL DESCRIPTION: Current state-of-the-art approaches for spatio-temporal action detection rely on detections at the frame level that are then linked or tracked across time. In this paper, we leverage the temporal continuity of videos instead of operating at the frame level. We propose the ACtion Tubelet detector (ACT-detector) that takes as input a sequence of frames and outputs tubelets, ie., sequences of bounding boxes with associated scores. The same way state-of-the-art object detectors rely on anchor boxes, our ACT-detector is based on anchor cuboids. We build upon the state-of-the-art SSD framework. Convolutional features are extracted for each frame, while scores and regressions are based on the temporal stacking of these features, thus exploiting information from a sequence. Our experimental results show that leveraging sequences of frames significantly improves detection performance over using individual frames. The gain of our tubelet detector can be explained by both more relevant scores and more precise localization. Our ACT-detector outperforms the state of the art methods for frame-mAP and video-mAP on the J-HMDB and UCF-101 datasets, in particular at high overlap thresholds.

- Participants: Philippe Weinzaepfel, Vittorio Ferrari, Cordelia Schmid and Vasiliki Kalogeiton
- Contact: Vasiliki Kalogeiton
- Publication: Action Tubelet Detector for Spatio-Temporal Action Localization
- URL: http://thoth.inrialpes.fr/src/ACTdetector/

6.2. Joint object-action learning

Joint learning of object and action detectors
KEYWORDS: Detection - Video sequences - Zero-shot
SCIENTIFIC DESCRIPTION: we propose to jointly detect object-action instances in uncontrolled videos, e.g. cat eating, dog running or car rolling. We build an end-to-end two stream network architecture for joint learning of objects and actions. We cast this joint learning problem by leveraging a multitask objective. We compare our proposed end-to-end multitask architecture with alternative ones: (i) treating every possible combination of actions and objects as a separate class (Cartesian) and (ii) considering a hierarchy of objects-actions: the first level corresponds to objects and the second one to the valid actions for each object (hierarchical). We show that our method performs as well as these two alternatives while (a) requiring fewer parameters and (b) enabling zero-shot learning of the actions performed by a specific object, i.e., when training for an object class alone without its actions, our multitask network is able to predict actions for that object class by leveraging actions performed by other objects. our multitask objective not only allows to effectively detect object-action pairs but also leads to performance improvements on each individual task (i.e., detection of either objects or actions). We compare to the state of the art for object-action detection on the Actor-Action (A2D) dataset and we outperform it.

FUNCTIONAL DESCRIPTION: While most existing approaches for detection in videos focus on objects or human actions separately, we aim at jointly detecting objects performing actions, such as cat eating or dog jumping. We introduce an end-to-end multitask objective that jointly learns object-action relationships. We compare it with different training objectives, validate its effectiveness for detecting objects-actions in videos, and show that both tasks of object and action detection benefit from this joint learning. Moreover, the proposed architecture can be used for zero-shot learning of actions: our multitask objective leverages the commonalities of an action performed by different objects, e.g. dog and cat jumping , enabling to detect actions of an object without training with these object-actions pairs. In experiments on the A2D dataset, we obtain state-of-the-art results on segmentation of object-action pairs. We finally apply our multitask architecture to detect visual relationships between objects in images of the VRD dataset.

- Participants: Vasiliki Kalogeiton, Philippe Weinzaepfel, Vittorio Ferrari and Cordelia Schmid
- Contact: Vasiliki Kalogeiton
- Publication: Joint learning of object and action detectors
- URL: https://github.com/vkalogeiton/joint-object-action-learning

6.3. BlitzNet

A Real-Time Deep Network for Scene Understanding
KEYWORD: Computer vision
FUNCTIONAL DESCRIPTION: Real-time scene understanding has become crucial in many applications such as autonomous driving. This deep architecture, called BlitzNet, jointly performs object detection and semantic segmentation in one forward pass, allowing real-time computations. Besides the computational gain of having a single network to perform several tasks, object detection and semantic segmentation benefit from each other in terms of accuracy.

- Participants: Mikita Dvornik, Konstantin Shmelkov, Julien Mairal and Cordelia Schmid
- Contact: Mikita Dvornik
- Publication: BlitzNet: A Real-Time Deep Network for Scene Understanding
- URL: https://github.com/dvornikita/blitznet

6.4. LCR-Net

Localization-Classification-Regression Network for Human Pose
KEYWORDS: Object detection - Recognition of human movement
FUNCTIONAL DESCRIPTION: We propose an end-to-end architecture for joint 2D and 3D human pose estimation in natural images. Key to our approach is the generation and scoring of a number of pose proposals per image, which allows us to predict 2D and 3D pose of multiple people simultaneously. Our architecture contains 3 main components: 1) the pose proposal generator that suggests potential poses at different locations in the image, 2) a classifier that scores the different pose proposals , and 3) a regressor that refines pose proposals both in 2D and 3D.

- Participants: Grégory Rogez, Philippe Weinzaepfel and Cordelia Schmid
- Contact: Grégory Rogez
- Publication: LCR-Net: Localization-Classification-Regression for Human Pose
- URL: https://thoth.inrialpes.fr/src/LCR-Net/

6.5. CKN-seq

Convolutional Kernel Networks for Biological Sequences
KEYWORD: Bioinformatics

SCIENTIFIC DESCRIPTION: The growing amount of biological sequences available makes it possible to learn genotype-phenotype relationships from data with increasingly high accuracy. By exploiting large sets of sequences with known phenotypes, machine learning methods can be used to build functions that predict the phenotype of new, unannotated sequences. In particular, deep neural networks have recently obtained good performances on such prediction tasks, but are notoriously difficult to analyze or interpret. Here, we introduce a hybrid approach between kernel methods and convolutional neural networks for sequences, which retains the ability of neural networks to learn good representations for a learning problem at hand, while defining a well characterized Hilbert space to describe prediction functions. Our method outperforms state-of-the-art convolutional neural networks on a transcription factor binding prediction task while being much faster to train and yielding more stable and interpretable results.
FUNCTIONAL DESCRIPTION: CKN-Seq is a software package for predicting transcription factor binding sites. It was shipped with the BiorXiv preprint

D. Chen, L. Jacob, and J. Mairal. Predicting Transcription Factor Binding Sites with Convolutional Kernel Networks. 2017.

The software is implemented in PyTorch.

- Participants: Laurent Jacob, Dexiong Chen and Julien Mairal
- Partners: CNRS - UGA
- Contact: Julien Mairal
- Publication: Predicting Transcription Factor Binding Sites with Convolutional Kernel Networks
- URL: https://gitlab.inria.fr/dchen/CKN-seq

6.6. CKN-TensorFlow

Convolutional Kernel Networks in TensorFlow
KEYWORD: Machine learning
SCIENTIFIC DESCRIPTION: This software package implements a new image representation based on a multilayer kernel machine. Unlike traditional kernel methods where data representation is decoupled from the prediction task, we learn how to shape the kernel with supervision. We proceed by first proposing improvements of the recently-introduced convolutional kernel networks (CKNs) in the context of unsupervised learning, then, we derive backpropagation rules to take advantage of labeled training data. The resulting model is a new type of convolutional neural network, where optimizing the filters at each layer is equivalent to learning a linear subspace in a reproducing kernel Hilbert space (RKHS).
FUNCTIONAL DESCRIPTION: This is the implementation in TensorFlow of the Convolutional Kernel Networks method for image classification, described in the paper J. Mairal. End-to-End Kernel Learning with Supervised Convolutional Kernel Networks. Adv. Neural Information Processing Systems (NIPS), 2016.

- Participants: Ghislain Durif and Julien Mairal
- Contact: Ghislain Durif
- Publication: End-to-End Kernel Learning with Supervised Convolutional Kernel Networks

6.7. Stochs

fast stochastic solvers for machine learning
KEYWORD: Machine learning
FUNCTIONAL DESCRIPTION: The stochs library provides efficient C++ implementations of stochastic optimization algorithms for common machine learning settings, including situations with finite datasets augmented with random perturbations (e.g. data augmentation or dropout). The library is mainly used from Python through a Cython extension. Currently, SGD, (S-)MISO and (N-)SAGA are supported, for dense and sparse data. See the following reference for details:

A. Bietti and J. Mairal. Stochastic Optimization with Variance Reduction for Infinite Datasets with Finite-Sum Structure. arXiv 1610.00970, 2017.

- Participants: Alberto Bietti and Julien Mairal
- Contact: Alberto Bietti
- Publication: Stochastic Optimization with Variance Reduction for Infinite Datasets with Finite-Sum Structure
- URL: https://github.com/albietz/stochs

6.8. MODL

Massive Online Dictionary Learning
KEYWORDS: Pattern discovery - Machine learning
FUNCTIONAL DESCRIPTION: Matrix factorization library, usable on very large datasets, with optional sparse and positive factors.

- Participants: Arthur Mensch, Gaël Varoquaux, Bertrand Thirion and Julien Mairal
- Contact: Arthur Mensch
- Publications: Subsampled online matrix factorization with convergence guarantees - Stochastic Subsampling for Factorizing Huge Matrices
- URL: http://github.com/arthurmensch/modl

6.9. Loter

Loter: A software package to infer local ancestry for a wide range of species
KEYWORDS: Local Ancestry Inference - Bioinformatics
SCIENTIFIC DESCRIPTION: Admixture between populations provides opportunity to study biological adaptation and phenotypic variation. Admixture studies can rely on local ancestry inference for admixed individuals, which consists of computing at each locus the number of copies that originate from ancestral source populations. Loter is a software package that does not require any biological parameter besides haplotype data in order to make local ancestry inference available for a wide range of species.
FUNCTIONAL DESCRIPTION: Loter is a Python package for haplotype phasing and local ancestry inference.
NEWS OF THE YEAR: The software package was shipped with the biorxiv preprint T. Dias-Alves, J. Mairal, and M. Blum. Loter: A Software Package to Infer Local Ancestry for a Wide Range of Species. preprint BiorXiv. 2017

- Participants: Thomas Dias-Alves, Michael Blum and Julien Mairal
- Partners: UGA - CNRS
- Contact: Julien Mairal
- Publication: Loter: A software package to infer local ancestry for a wide range of species
- URL: https://github.com/bcm-uga/Loter

6.10. SPAMS

SPArse Modeling Software
KEYWORDS: Signal processing - Machine learning
FUNCTIONAL DESCRIPTION: SPAMS is an open-source software package for sparse estimation
NEWS OF THE YEAR: The version 2.6.1 of the software package is now compatible with Python v3, R v3, comes with pre-compiled Matlab packages, and is now available on the conda and PyPi package managers.

- Participants: Ghislain Durif and Julien Mairal
- Contact: Julien Mairal
- URL: http://spams-devel.gforge.inria.fr/

6.11. MP-Net

KEYWORD: Motion analysis
FUNCTIONAL DESCRIPTION: This is a public implementation of the method described in the following paper: Learning Motion Patterns in Videos [CVPR 2017].

The problem of determining whether an object is in motion, irrespective of the camera motion, is far from being solved. We address this challenging task by learning motion patterns in videos. The core of our approach is a fully convolutional network, which is learnt entirely from synthetic video sequences, and their ground-truth optical flow and motion segmentation. This encoder-decoder style architecture first learns a coarse representation of the optical flow field features, and then refines it iteratively to produce motion labels at the original high-resolution. The output label of each pixel denotes whether it has undergone independent motion, i.e., irrespective of the camera motion. We demonstrate the benefits of this learning framework on the moving object segmentation task, where the goal is to segment all the objects in motion. To this end we integrate an objectness measure into the framework. Our approach outperforms the top method on the recently released DAVIS benchmark dataset, comprising real-world sequences, by 5.6

- Participants: Pavel Tokmakov, Karteek Alahari and Cordelia Schmid
- Contact: Pavel Tokmakov
- Publication: Learning Motion Patterns in Videos
- URL: http://thoth.inrialpes.fr/research/mpnet/

6.12. LVO

Learning Video Object Segmentation with Visual Memory
KEYWORD: Video analysis
FUNCTIONAL DESCRIPTION: This is a public implementation of the method described in the following paper: Learning Video Object Segmentation with Visual Memory [ICCV 2017].

This paper addresses the task of segmenting moving objects in unconstrained videos. We introduce a novel two-stream neural network with an explicit memory module to achieve this. The two streams of the network encode spatial and temporal features in a video sequence respectively, while the memory module captures the evolution of objects over time. The module to build a "visual memory" in video, i.e., a joint representation of all the video frames, is realized with a convolutional recurrent unit learned from a small number of training video sequences. Given a video frame as input, our approach assigns each pixel an object or background label based on the learned spatio-temporal features as well as the "visual memory" specific to the video, acquired automatically without any manually-annotated frames. The visual memory is implemented with convolutional gated recurrent units, which allows to propagate spatial information over time. We evaluate our method extensively on two benchmarks, DAVIS and Freiburg-Berkeley motion segmentation datasets, and show state-of-the-art results. For example, our approach outperforms the top method on the DAVIS dataset by nearly 6

- Participants: Karteek Alahari, Cordelia Schmid and Pavel Tokmakov
- Contact: Pavel Tokmakov
- Publication: Learning Video Object Segmentation with Visual Memory
- URL: http://lear.inrialpes.fr/research/lvo/

6.13. SURREAL

Learning from Synthetic Humans
KEYWORDS: Synthetic human - Segmentation - Neural networks

FUNCTIONAL DESCRIPTION: The SURREAL dataset consisting of synthetic videos of humans, and models trained on this dataset are released in this package. The code for rendering synthetic images of people and for training models is also included in the release.

- Participants: Gül Varol Simsekli, Xavier Martin, Ivan Laptev and Cordelia Schmid
- Contact: Gül Varol Simsekli
- Publication: Learning from Synthetic Humans
- URL: http://www.di.ens.fr/willow/research/surreal/

WILLOW Project-Team

6. New Software and Platforms

6.1. LOUPE

Learnable mOdUle for Pooling fEatures
KEYWORDS: Video analysis - Computer vision
FUNCTIONAL DESCRIPTION: LOUPE (Learnable mOdUle for Pooling fEatures) is a Tensorflow toolbox that implements several modules for pooling features such as NetVLAD, NetRVLAD, NetFV and Soft-DBoW. It also allows to use their Gated version. This toolbox was mainly use in the winning approach of the Youtube 8M Large Scale Video Understanding challenge

- Participants: Antoine Miech, Ivan Laptev and Josef Sivic
- Contact: Antoine Miech
- Publication: Learning from Video and Text via Large-Scale Discriminative Clustering
- URL: https://github.com/antoine77340/LOUPE

6.2. object-states-action

KEYWORD: Computer vision
FUNCTIONAL DESCRIPTION: Code for the paper Joint Discovery of Object States and Manipulation Actions, ICCV 2017: Many human activities involve object manipulations aiming to modify the object state. Examples of common state changes include full/empty bottle, open/closed door, and attached/detached car wheel. In this work, we seek to automatically discover the states of objects and the associated manipulation actions. Given a set of videos for a particular task, we propose a joint model that learns to identify object states and to localize state-modifying actions. Our model is formulated as a discriminative clustering cost with constraints. We assume a consistent temporal order for the changes in object states and manipulation actions, and introduce new optimization techniques to learn model parameters without additional supervision. We demonstrate successful discovery of seven manipulation actions and corresponding object states on a new dataset of videos depicting real-life object manipulations. We show that our joint formulation results in an improvement of object state discovery by action recognition and vice versa.

- Participants: Jean-Baptiste Alayrac, Josef Sivic, Ivan Laptev and Simon Lacoste-Julien
- Contact: Jean-Baptiste Alayrac
- Publication: Joint Discovery of Object States and Manipulation Actions
- URL: https://github.com/jalayrac/object-states-action

6.3. SURREAL

Learning from Synthetic Humans
KEYWORDS: Synthetic human - Segmentation - Neural networks
FUNCTIONAL DESCRIPTION: The SURREAL dataset consisting of synthetic videos of humans, and models trained on this dataset are released in this package. The code for rendering synthetic images of people and for training models is also included in the release.

- Participants: Gül Varol Simsekli, Xavier Martin, Ivan Laptev and Cordelia Schmid
- Contact: Gül Varol Simsekli
- Publication: Learning from Synthetic Humans
- URL: http://www.di.ens.fr/willow/research/surreal/

6.4. UNREL

Weakly-supervised learning of visual relations
KEYWORDS: Recognition - Computer vision
FUNCTIONAL DESCRIPTION: Open source release of the software package for the ICCV17 paper by Peyre et al. "Weakly-supervised learning of visual relations". The package provides a full implementation of the method (training and evaluation) and the release of the UnRel dataset. Links to all of these are available at the project page http://www.di.ens.fr/willow/research/unrel/

- Participants: Julia Peyre, Ivan Laptev, Cordelia Schmid and Josef Sivic
- Contact: Julia Peyre
- Publication: Weakly-supervised learning of visual relations
- URL: http://www.di.ens.fr/willow/research/unrel/

6.5. BIOGAN

GANs for Biological Image Synthesis
KEYWORDS: Computer vision - Biology
FUNCTIONAL DESCRIPTION: This software package implements the method in the ICCV 2017 paper by Osokin et al. "GANs for Biological Image Synthesis".

- Participants: Federico Vaggi, Anton Osokin and Anatole Chessel
- Contact: Anton Osokin
- Publication: GANs for Biological Image Synthesis

6.6. KernelImageRetrieval

Kernel square-loss exemplar machines for image retrieval
KEYWORD: Computer vision
FUNCTIONAL DESCRIPTION: This software package contains the code for the CVPR'17 paper by Rezende et al. "Kernel square-loss exemplar machines for image retrieval". It provides the implementation of all variants of the pipeline as well as the trained parameters for each of the tested base features.

- Participants: Jean Ponce, Francis Bach, Patrick Pérez and Rafael Sampaio De Rezende
- Contact: Rafael Sampaio De Rezende
- Publication: Kernel Square-Loss Exemplar Machines for Image Retrieval
- URL: https://github.com/rafarez/slem/

6.7. SCNet

SCNet: Learning semantic correspondence
KEYWORD: Computer vision
FUNCTIONAL DESCRIPTION: This software package implements the method for the ICCV'17 paper by Han et al. "SCNet: Learning Semantic Correspondence". The package provides the code, the training and testing subsets and the trainable architecture.

- Participants: Rafael Sampaio De Rezende, Bumsub Ham, Minsu Cho, Cordelia Schmid and Jean Ponce
- Contact: Rafael Sampaio De Rezende
- Publication: SCNet: Learning Semantic Correspondence
- URL: https://github.com/k-han/SCNet/

6.8. CNNGeometric

Convolutional neural network architecture for geometric matching
KEYWORD: Computer vision
FUNCTIONAL DESCRIPTION: Open source release of the software package for the CVPR'17 paper by Rocco et al. "Convolutional neural network architecture for geometric matching". This release provides a full implementation of the method, including code for training models, and testing on standard datasets, as well as trained models.

- Participants: Ignacio Rocco Spremolla, Relja Arandjelovic and Josef Sivic
- Contact: Ignacio Rocco Spremolla
- Publication: Convolutional neural network architecture for geometric matching
- URL: http://www.di.ens.fr/willow/research/cnngeometric/

6.9. LSDClustering

Large-Scale Discriminative Clustering
KEYWORDS: Video analysis - Computer vision
FUNCTIONAL DESCRIPTION: This software package implements the method in the ICCV'17 paper by Miech et al. "Learning from Video and Text via Large-Scale Discriminative Clustering".

- Participants: Antoine Miech, Jean-Baptiste Alayrac, Piotr Bojanowski, Ivan Laptev and Josef Sivic
- Contact: Antoine Miech
- Publication: Learning from Video and Text via Large-Scale Discriminative Clustering
- URL: http://www.di.ens.fr/willow/research/learningvideotext/