

Inria

RESEARCH CENTER

FIELD

Perception, Cognition and Interaction

Activity Report 2019

Section Software

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CEDAR Project-Team

6. New Software and Platforms

6.1. Tatoonine

KEYWORDS: RDF - JSon - Knowledge database - Databases - Data integration - Polystore

FUNCTIONAL DESCRIPTION: Tatoonine 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

6.2. AIDES

KEYWORDS: Data Exploration - Active Learning

FUNCTIONAL DESCRIPTION: AIDES is a data exploration software. It allows a user to explore a huge (tabular) dataset and discover tuples matching his or her interest. Our system repeatedly proposes the most informative tuples to the user, who must annotate them as “interesting” / “not-interesting”, and as iterations progress an increasingly accurate model of the user’s interest region is built. Our system also focuses on supporting low selectivity, high-dimensional interest regions.

- Contact: Yanlei Diao

6.3. OntoSQL

KEYWORDS: RDF - Semantic Web - Querying - Databases

FUNCTIONAL DESCRIPTION: OntoSQL is a tool providing three main functionalities: - Loading RDF graphs (consisting of data triples and possibly a schema or ontology) into a relational database, - Saturating the data based on the ontology. Currently, RDF Schema ontologies are supported. - Querying the loaded data using conjunctive queries. Data can be loaded either from distinct files or from a single file containing them both. The loading process allows to choose between two storage schemas: - One triples table. - One table per role and concept. Querying provides an SQL translation for each conjunctive query according to the storage schema used in the loading process, then the SQL query is evaluated by the underlying relational database.

- Participants: Ioana Manolescu, Michaël Thomazo and Tayeb Merabti
- Partner: Université de Rennes 1
- Contact: Ioana Manolescu
- URL: <https://ontosql.inria.fr/>

6.4. ConnectionLens

KEYWORDS: Data management - Big data - Information extraction - Semantic Web

FUNCTIONAL DESCRIPTION: ConnectionLens treats a set of heterogeneous, independently authored data sources as a single virtual graph, whereas nodes represent fine-granularity data items (relational tuples, attributes, key-value pairs, RDF, JSON or XML nodes. . .) and edges correspond either to structural connections (e.g., a tuple is in a database, an attribute is in a tuple, a JSON node has a parent. . .) or to similarity (sameAs) links. To further enrich the content journalists work with, we also apply entity extraction which enables to detect the people, organizations etc. mentioned in text, whether full-text or text snippets found e.g. in RDF or XML. ConnectionLens is thus capable of finding and exploiting connections present across heterogeneous data sources without requiring the user to specify any join predicate.

- Contact: Manolescu Ioana
- Publication: [ConnectionLens: Finding Connections Across Heterogeneous Data Sources](#)
- URL: <https://team.inria.fr/cedar/connectionlens/>

6.5. INSEE-Extract

Spreadsheets extractor

KEYWORDS: RDF - Data extraction

FUNCTIONAL DESCRIPTION: Extract content of spreadsheets automatically and store it as RDF triples

- Participants: Ioana Manolescu, Xavier Tannier and Tien Duc Cao
- Contact: Tien Duc Cao
- Publication: [Extracting Linked Data from statistic spreadsheets](#)
- URL: <https://gitlab.inria.fr/cedar/excel-extractor>

6.6. INSEE-Search

KEYWORDS: Document ranking - RDF

FUNCTIONAL DESCRIPTION: Searching for relevant data cells (or data row/column) given a query in natural language (French)

- Participants: Ioana Manolescu, Xavier Tannier and Tien Duc Cao
- Contact: Tien Duc Cao
- Publications: [Extracting Linked Data from statistic spreadsheets - Searching for Truth in a Database of Statistics](#)

6.7. RDFQuotient

Quotient summaries of RDF graphs

KEYWORDS: RDF - Graph algorithmics - Graph visualization - Graph summaries - Semantic Web

FUNCTIONAL DESCRIPTION: RDF graphs can be large and heterogeneous, making it hard for users to get acquainted with a new graph and understand whether it may have interesting information. To help users figure it out, we have devised novel equivalence relations among RDF nodes, capable of recognizing them as equivalent (and thus, summarize them together) despite the heterogeneity often exhibited by their incoming and outgoing node properties. From these relations, we derive four novel summaries, called Weak, Strong, Typed Weak and Typed Strong, and show how to obtain from them compact and enticing visualizations.

- Participants: Ioana Manolescu, Pawel Guzewicz and François Goasdoué
- Partner: Université de Rennes 1
- Contact: Manolescu Ioana
- Publications: [hal-01325900v6 - Structural Summarization of Semantic Graphs](#)

6.8. AIDeMe

KEYWORDS: Active Learning - Data Exploration

SCIENTIFIC DESCRIPTION: AIDeMe is a large-scale interactive data exploration system that is cast in a principled active learning (AL) framework: in this context, we consider the data content as a large set of records in a data source, and the user is interested in some of them but not all. In the data exploration process, the system allows the user to label a record as “interesting” or “not interesting” in each iteration, so that it can construct an increasingly-more-accurate model of the user interest. Active learning techniques are employed to select a new record from the unlabeled data source in each iteration for the user to label next in order to improve the model accuracy. Upon convergence, the model is run through the entire data source to retrieve all relevant records.

A challenge in building such a system is that existing active learning techniques experience slow convergence in learning the user interest when such exploration is performed on large datasets: for example, hundreds of labeled examples are needed to learn a user interest model over 6 attributes, as we showed using a digital sky survey of 1.9 million records. AIDeMe employs a set of novel techniques to overcome the slow convergence problem:

- **Factorization:** We observe that a user labels a data record, her decision making process often can be broken into a set of smaller questions, and the answers to these questions can be combined to derive the final answer. This insight, formally modeled as a factorization structure, allows us to design new active learning algorithms, e.g., factorized version space algorithms [2], that break the learning problem into subproblems in a set of subspaces and perform active learning in each subspace, thereby significantly expediting convergence.
- **Optimization based on class distribution:** Another interesting observation is that when projecting the data space for exploration onto a subset of dimensions, the user interest pattern projected onto such a subspace often entails a convex object. When such a subspatial convex property holds, we introduce a new “dual-space model” (DSM) that builds not only a classification model from labeled examples, but also a polytope model of the data space that offers a more direct description of the areas known to be positive, areas known to be negative, and areas with unknown labels. We use both the classification model and the polytope model to predict unlabeled examples and choose the best example to label next.
- **Formal results on convergence:** We further provide theoretical results on the convergence of our proposed techniques. Some of them can be used to detect convergence and terminate the exploration process.
- **Scaling to large datasets:** In many applications the dataset may be too large to fit in memory. In this case, we introduce subsampling procedures and provide provable results that guarantee the performance of the model learned from the sample over the entire data source.

FUNCTIONAL DESCRIPTION: There is an increasing gap between fast growth of data and limited human ability to comprehend data. Consequently, there has been a growing demand for analytics tools that can bridge this gap and help the user retrieve high-value content from data. We introduce AIDeMe, a scalable interactive data exploration system for efficiently learning a user interest pattern over a large dataset. The system is cast in a principled active learning (AL) framework, which iteratively presents strategically selected records for user labeling, thereby building an increasingly-more-accurate model of the user interest. However, a challenge in building such a system is that existing active learning techniques experience slow convergence when learning the user interest on large datasets. To overcome the problem, AIDeMe explores properties of the user labeling process and the class distribution of observed data to design new active learning algorithms, which come with provable results on model accuracy, convergence, and approximation, and have evaluation results showing much improved convergence over existing AL methods while maintaining interactive speed.

RELEASE FUNCTIONAL DESCRIPTION: Project code can be found over: <https://gitlab.inria.fr/ldipalma/aideme>

- Participants: Luciano Di Palma and Enhui Huang
- Contact: Yanlei Diao
- URL: <http://www.lix.polytechnique.fr/aideme>

GRAPHIK Project-Team

6. New Software and Platforms

6.1. Docamex

KEYWORD: Ontologies

SCIENTIFIC DESCRIPTION: In many agri-food companies, food quality is often managed using expertise gained through experience. Overall quality enhancement may come from sharing collective expertise. In this paper, we describe the design and implementation of a complete methodology allowing an expert knowledge base to be created and used to recommend the technical action to take to maintain food quality. We present its functional specifications, defined in cooperation with several industrial partners and technical centres over the course of several projects carried out in recent years. We propose a systematic methodology for collecting the knowledge on a given food process, from the design of a questionnaire to the synthesis of the information from completed questionnaires using a mind map approach. We then propose an original core ontology for structuring knowledge as possible causal relationships between situations of interest. We describe how mind map files generated by mind map tools are automatically imported into a conceptual graph knowledge base, before being validated and finally automatically processed in a graph-based visual tool. A specific end-user interface has been designed to ensure that end-user experts in agri-food companies can use the tool in a convenient way. Finally, our approach is compared with current research.

FUNCTIONAL DESCRIPTION: Docamex is a software dedicated to expert knowledge capitalization and visualization.

NEWS OF THE YEAR: Reliability score implemented.

- Participants: Jérôme Fortin and Patrice Buche
- Contact: Jérôme Fortin
- Publication: [Expertise-based decision support for managing food quality in agri-food companies](#)

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.

RELEASE FUNCTIONAL DESCRIPTION: Plugin-extensible architecture, multi-project management, automatic construction of a web documentation of the ontology, adoption of semantic web conventions (IRIs and namespaces), integration of some Graal functionalities (homomorphisms and OWL 2 import), improvement of the import/export between Cogui knowledge bases and Graal dlgp format.

NEWS OF THE YEAR: 2019: new website and completely revised user documentation, following the release of version V3 (in 2018), which required heavy refactoring to benefit from NetBeans plugin-extensible platform architecture and graphical libraries (total replacement of the graphical editors).

- 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. Damn

Defeasible reasoning tool for multi-agent collaboration

KEYWORDS: Knowledge representation - Logic programming

FUNCTIONAL DESCRIPTION: Damn is an open source defeasible reasoning tool that allows the use of different semantics (ambiguity blocking/propagating with or without team defeat) in order to reason with incoherent or inconsistent knowledge. It allows the reasoning about preferences and their justification between different agents with a final aim of producing justified preferences on different outcomes (alternatives). These preferences are then used with a voting module (given certain voting strategy) to break ties and establish the chosen alternative. It is applied within the GLOPACK and NOAW projects.

NEWS OF THE YEAR: The HCI has been finalised: multi-users functionalities have been added (login, agents added, etc.).

- Contact: Madalina Croitoru
- URL: <https://hamhec.github.io/damn/home>

LACODAM Project-Team

6. New Software and Platforms

6.1. REMI

Mining Intuitive Referring Expressions in Knowledge Bases

KEYWORDS: RDF - Knowledge database - Referring expression

FUNCTIONAL DESCRIPTION: REMI takes an RDF knowledge base stored as an HDT file, and a set of target entities and returns a referring expression that is intuitive, i.e., the user is likely to understand it.

- Contact: Luis Galarraga Del Prado
- URL: <http://gitlab.inria.fr/lgalarra/remi>

6.2. HIPAR

Hierarchical Interpretable Pattern-aided Regression

KEYWORDS: Regression - Pattern extraction

FUNCTIONAL DESCRIPTION: Given a (tabular) dataset with categorical and numerical attributes, HIPAR is a Python library that can extract accurate hybrid rules that offer a trade-off between (a) interpretability, (b) accuracy, and (c) data coverage.

- Contact: Luis Galarraga Del Prado
- URL: <https://gitlab.inria.fr/opelgrin/hipar>

6.3. PyChronicle

KEYWORDS: Sequence - Sequential patterns - Pattern matching

FUNCTIONAL DESCRIPTION: Python library containing classes for representing sequences and chronicles, ie a representation of a temporal pattern. It implements efficient recognition algorithms to match chronicles in a long sequence.

- Participant: Thomas Guyet
- Contact: Thomas Guyet
- Publication: [Énumération des occurrences d'une chronique](#)
- URL: <https://gitlab.inria.fr/tguyet/pychronicles>

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.

RELEASE FUNCTIONAL DESCRIPTION: ShExJava now uses the Commons RDF API and so support RDF4J, Jena, JSON-LD-Java, OWL API and Apache Clerezza. It can parse ShEx schema in the ShEcC, ShEJ, ShExR formats and can serialize a schema in ShExJ.

To validate data against a ShExSchema using ShExJava, you have two different algorithms: - the refine algorithm: compute once and for all the typing for the whole graph - the recursive algorithm: compute only the typing required to answer a validate(node,ShapeLabel) call and forget the results.

- Contact: Iovka Boneva
- URL: <http://shexjava.lille.inria.fr/>

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

6.6. ShapeDesigner

KEYWORDS: Validation - Data Exploration - Verification

FUNCTIONAL DESCRIPTION: ShapeDesigner allows construct a ShEx or SHACL schema for an existing dataset. It combines algorithms to analyse the data and automatically extract shape constraints, and to edit and validate shape schemas.

- Contact: Jeremie Dusart
- URL: <https://gitlab.inria.fr/jdusart/shexjapp>

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 CONLL2012 and CONLLU annotation formats, and performing evaluation, notably 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. It currently supports use of the English or French language.

- Participant: Pascal Denis
- Partner: Orange Labs
- Contact: Pascal Denis
- URL: <https://gitlab.inria.fr/magnet/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>

6.3. metric-learn

KEYWORDS: Machine learning - Python - Metric learning

FUNCTIONAL DESCRIPTION: Distance metrics are widely used in the machine learning literature. Traditionally, practitioners would choose a standard distance metric (Euclidean, City-Block, Cosine, etc.) using a priori knowledge of the domain. Distance metric learning (or simply, metric learning) is the sub-field of machine learning dedicated to automatically constructing optimal distance metrics.

This package contains efficient Python implementations of several popular metric learning algorithms.

- Partner: Parietal
- Contact: Aurélien Bellet
- URL: <https://github.com/scikit-learn-contrib/metric-learn>

6.4. MyLocalInfo

KEYWORDS: Privacy - Machine learning - Statistics

FUNCTIONAL DESCRIPTION: Decentralized algorithms for machine learning and inference tasks which (1) perform as much computation as possible locally and (2) ensure privacy and security by avoiding personal data leaves devices.

- Contact: Nathalie Vauquier
- URL: <https://gitlab.inria.fr/magnet/mylocalinfo>

MOEX Project-Team

5. New Software and Platforms

5.1. Lazylav

Lazy lavender

KEYWORDS: Reproducibility - Multi-agent - Simulation

SCIENTIFIC DESCRIPTION: Lazy lavender aims at supporting mOeX's research on simulating knowledge evolution. It is not a general purpose simulator. However, it features some methodological innovations in term of facilitating publication, recording, and replaying of experiments.

FUNCTIONAL DESCRIPTION: Lazy Lavender is a simulation environment for cultural knowledge evolution, i.e. running randomised experiments with agent adjusting their knowledge while attempting to communicate. It can generate detailed report and data from the experiments and directions to repeat them.

NEWS OF THE YEAR: In 2019, we implemented facilities for dealing with population of agents and designed several synchronisation approaches. This led to seriously refactor the code.

- Participant: Jérôme Euzenat
- Contact: Jérôme Euzenat
- Publications: [Crafting ontology alignments from scratch through agent communication - Interaction-based ontology alignment repair with expansion and relaxation - First experiments in cultural alignment repair \(extended version\)](#)
- URL: <http://lazylav.gforge.inria.fr>

5.2. Alignment API

KEYWORDS: Ontologies - Alignment - Ontology engineering - Knowledge representation

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

We provide an implementation for this api which can be used for producing transformations, rules or bridge axioms independently from the algorithm that produced the alignment. The proposed implementation features: - a base implementation of the interfaces with all useful facilities, - a library of sample matchers, - a library of renderers (XSLT, RDF, SKOS, SWRL, OWL, C-OWL, SPARQL), - a library of evaluators (various generalisation of precision/recall, precision/recall graphs), - a flexible test generation framework that allows for generating evaluation data sets, - a library of wrappers for several ontology APIs, - a parser for the format.

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

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

NEWS OF THE YEAR: Link keys are fully supported by the EDOAL language. In particular it can transform them into SPARQL queries.

- Participants: Armen Inants, Chan Le Duc, Jérôme David, Jérôme Euzenat, Jérôme Pierson, Luz Maria Priego-Roche and Nicolas Guillouet
- Contact: Jérôme Euzenat
- Publications: [An API for ontology alignment - The Alignment API 4.0](#)
- URL: <http://alignapi.gforge.inria.fr/>

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. 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 [75]. 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.

6.5. OrphaMine: Data Mining Platform for Orphan Diseases

- Contact: Laureline Nevin
- 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.

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

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.

PETRUS Project-Team

5. New Software and Platforms

5.1. PLUG-DB ENGINE

KEYWORDS: Databases - Personal information - Privacy - Hardware and Software Platform

FUNCTIONAL DESCRIPTION: en 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., support for wireless communication, secure authentication, sensing capabilities, battery powered ...). 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). In OwnCare, PlugDB acts as a secure personal cloud to manage medical/social data for people receiving care at home. It should be deployed over 10.000 patient in the Yvelines district. The industrialization process covers the development of a complete testing environment, the writing of a detailed documentation and the development of additional features (e.g., embedded ODBC driver, TPM support, flexible access control model and embedded code upgrade notably). It has also required the design of a new hardware platform equipped with a battery power supply, introducing new energy consumption issues for the embedded software.

- 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: This software system is an implementation of a distributed evaluator of SPARQL queries. It makes it possible to evaluate SPARQL queries on billions of triples distributed across multiple nodes in a cluster, while providing attractive performance figures.

RELEASE FUNCTIONAL DESCRIPTION: - Faster load routine which widely improves this phase performances 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 chooses 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. 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 for Indoor Navigation and Augmented Reality with Smartphones](#)
- URL: <http://tyrex.inria.fr/projects/mrb.html>

5.4. Benchmarks Attitude Smartphones

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

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

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

5.5. 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: [Scalable Machine Learning for Predicting At-Risk Profiles Upon Hospital Admission](#)

5.6. MuIR

Mu Intermediate Representation

KEYWORDS: Optimizing compiler - Querying

FUNCTIONAL DESCRIPTION: This is a prototype of an intermediate language representation, i.e. an implementation of algebraic terms, rewrite rules, query plans, cost model, query optimizer, and query evaluators (including a distributed evaluator of algebraic terms using Apache Spark).

- Contact: Pierre Genevès

VALDA Project-Team

6. New Software and Platforms

6.1. 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: Miscellaneous enhancements and bug fixes. Addition of a tutorial.

- Participants: Pierre Senellart and Yann Ramusat
- Contact: Pierre Senellart
- Publications: [Provenance and Probabilities in Relational Databases: From Theory to Practice - ProvSQL: Provenance and Probability Management in PostgreSQL](#)
- URL: <https://github.com/PierreSenellart/provsql>

6.2. 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: Fix formatting of theorems (and proof sketches) to be faithful to the way they are formatted in the base document class (this will change some difference in the appearance of documents typeset with earlier versions of apxproof), Configurable `mainbodyrepeatedtheorem` command to add some styling to repeated theorems, Allow using apxproof without `bibunits` (e.g., for `biblatex` compatibility), Restore predefined theorem counters, allowing more robust use of apxproof when the base document class predefines theorems.

NEWS OF THE YEAR: Major 1.2.0 release with a much more faithful rendering of theorems compared to the original base classes, bug fixes, compatibility enhancements (in particular, with respect to the use of `biblatex` or of `fancyvrb`).

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

WIMMICS Project-Team

6. New Software and Platforms

6.1. CORESE

COncceptual REsource Search Engine

KEYWORDS: Semantic Web - Search Engine - RDF - SPARQL

FUNCTIONAL DESCRIPTION: Corese is a Semantic Web Factory, it implements W3C RDF, RDFS, OWL RL, SHACL, 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: Recommendation 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
- Contact: Serena Villata

6.5. Qakis

Question-Answering 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 to 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
- Contact: Elena Cabrio
- URL: <http://www.qakis.org/>

ZENITH Project-Team

6. New Software and Platforms

6.1. PI@ntNet

KEYWORDS: Plant identification - Deep learning - Citizen science

FUNCTIONAL DESCRIPTION: PI@ntNet is a participatory platform and information system dedicated to the production of botanical data through deep learning-based plant identification. It includes 3 main front-ends, an Android app (the most advanced and the most used one), an iOS app (being currently re-developed) and a web version. The main feature of the application is to return the ranked list of the most likely species providing an image or an image set of an individual plant. In addition, PI@ntNet's search engine returns the images of the dataset that are the most similar to the queried observation allowing interactive validation by the users. The back-office running on the server side of the platform is based on Snoop visual search engine (a software developed by ZENITH) and on NewSQL technologies for the data management. The application is distributed in more than 180 countries (10M downloads) and allows identifying about 20K plant species at present time.

- Participants: Antoine Affouard, Jean-Christophe Lombardo, Pierre Bonnet, Hervé Goëau, Mathias Chouet and Julien Champ
- Contact: Alexis Joly
- Publication: [PI@ntNet app in the era of deep learning](#)

6.2. ThePlantGame

KEYWORD: Crowd-sourcing

FUNCTIONAL DESCRIPTION: ThePlantGame is a participatory game whose purpose is the production of big taxonomic data to improve our knowledge of biodiversity. One major contribution is the active training of the users based on innovative sub-task creation and assignment processes that are adaptive to the increasing skills of the user. Thousands of players are registered and produce on average about tens new validated plant observations per day. The accuracy of the produced taxonomic tags is very high (about 95%), which is quite impressive considering the fact that a majority of users are beginners when they start playing.

- Participants: Maximilien Servajean and Alexis Joly
- Contact: Alexis Joly
- Publication: [Crowdsourcing Thousands of Specialized Labels: A Bayesian Active Training Approach](#)

6.3. Chiaroscuro

KEYWORDS: Privacy - P2P - Data mining

FUNCTIONAL DESCRIPTION: Chiaroscuro is a complete solution for clustering personal data with strong privacy guarantees. The execution sequence produced by Chiaroscuro is massively distributed on personal devices, coping with arbitrary connections and disconnections. Chiaroscuro builds on our novel data structure, called Diptych, which allows the participating devices to collaborate privately by combining encryption with differential privacy. Our solution yields a high clustering quality while minimizing the impact of the differentially private perturbation.

- Participants: Tristan Allard, Georges Hebrail, Florent Masegla and Esther Pacitti
- Contact: Florent Masegla
- Publication: [Chiaroscuro: Transparency and Privacy for Massive Personal Time-Series Clustering](#)

6.4. DfAnalyzer

Dataflow Analysis

KEYWORDS: Data management - Monitoring - Runtime Analysis

FUNCTIONAL DESCRIPTION: DfAnalyzer is a tool for monitoring, debugging, steering, and analysis of dataflows while being generated by scientific applications. It works by capturing strategic domain data, registering provenance and execution data to enable queries at runtime. DfAnalyzer provides lightweight dataflow monitoring components to be invoked by high performance applications. It can be plugged in scripts, or Spark applications, in the same way users already plug visualization library components.

- Participants: Vitor Sousa Silva, Daniel De Oliveira, Marta Mattoso and Patrick Valduriez
- Partners: COPPE/UFRJ - Uff
- Contact: Patrick Valduriez
- Publication: [DfAnalyzer: Runtime Dataflow Analysis of Scientific Applications using Provenance](#)
- URL: <https://github.com/vssousa/dfanalyzer-spark>

6.5. CloudMdsQL Compiler

KEYWORDS: Optimizing compiler - NoSQL - Data integration

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

- Participants: Boyan Kolev, Oleksandra Levchenko and Patrick Valduriez
- Contact: Patrick Valduriez
- Publication: [CloudMdsQL: Querying Heterogeneous Cloud Data Stores with a Common Language](#)

6.6. Savime

Simulation And Visualization IN-Memory

KEYWORDS: Data management. - Distributed Data Management

FUNCTIONAL DESCRIPTION: SAVIME is a multi-dimensional array DBMS for scientific applications. It supports a novel data model called TARS (Typed ARray Schema), which extends the basic array data model with typed arrays. In TARS, the support of application dependent data characteristics is provided through the definition of TAR objects, ready to be manipulated by TAR operators. This approach provides much flexibility for capturing internal data layouts through mapping functions, which makes data ingestion independent of how simulation data has been produced, thus minimizing ingestion time.

- Participants: Hermano Lustosa, Fabio Porto and Patrick Valduriez
- Partner: LNCC - Laboratório Nacional de Computação Científica
- Contact: Patrick Valduriez
- Publication: [TARS: An Array Model with Rich Semantics for Multidimensional Data](#)

6.7. OpenAlea

KEYWORDS: Bioinformatics - Biology

FUNCTIONAL DESCRIPTION: OpenAlea is an open source project primarily aimed at the plant research community. It is a distributed collaborative effort to develop Python libraries and tools that address the needs of current and future works in Plant Architecture modeling. It includes modules to analyze, visualize and model the functioning and growth of plant architecture. It was formally developed in the Inria VirtualPlants team.

RELEASE FUNCTIONAL DESCRIPTION: OpenAlea 2.0 adds to OpenAlea 1.0 a high-level formalism dedicated to the modeling of morphogenesis that makes it possible to use several modeling paradigms (Blackboard, L-systems, Agents, Branching processes, Cellular Automata) expressed with different languages (Python, L-Py, R, Visual Programming, ...) to analyse and simulate shapes and their development.

- Participants: Christian Fournier, Christophe Godin, Christophe Pradal, Frédéric Boudon, Patrick Valduriez, Esther Pacitti and Yann Guédon
- Partners: CIRAD - INRA
- Contact: Christophe Pradal
- Publications: [OpenAlea: Scientific Workflows Combining Data Analysis and Simulation](#) - [OpenAlea: A visual programming and component-based software platform for plant modeling](#)

6.8. 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](#)

6.9. museval

KEYWORDS: Source Separation - Metric

SCIENTIFIC DESCRIPTION: museval is a Python package aimed at evaluating audio source separation algorithm on the musdb corpus.

It is a scientific tool of high impact, but of limited transfer importance, since it is only (but widely) used by the community to evaluate performance in scientific publications.

FUNCTIONAL DESCRIPTION: The BSSEval metrics, as implemented in the [MATLAB toolboxes](http://bass-db.gforge.inria.fr/bss_eval/) and their re-implementation in [mir_eval](http://craffel.github.io/mir_eval/#module-mir_eval.separation) are widely used in the audio separation literature. One particularity of BSSEval is to compute the metrics after optimally matching the estimates to the true sources through linear distortion filters. This allows the criteria to be robust to some linear mismatches. Apart from the optional evaluation for all possible permutations of the sources, this matching is the reason for most of the computation cost of BSSEval, especially considering it is done for each evaluation window when the metrics are computed on a framewise basis.

For this package, we enabled the option of having `_time invariant_` distortion filters, instead of necessarily taking them as varying over time as done in the previous versions of BSS eval. First, enabling this option `_significantly reduces_` the computational cost for evaluation because matching needs to be done only once for the whole signal. Second, it introduces much more dynamics in the evaluation, because time-varying matching filters turn out to over-estimate performance. Third, this makes matching more robust, because true sources are not silent throughout the whole recording, while they often were for short windows.

RELEASE FUNCTIONAL DESCRIPTION: This version makes museval compatible with the latest MUSDB package version

- Participant: Antoine Liutkus
- Contact: Antoine Liutkus
- Publication: [The 2018 Signal Separation Evaluation Campaign](#)

6.10. Imitates

Indexing and mining Massive Time Series

KEYWORDS: Time Series - Indexing - Nearest Neighbors

FUNCTIONAL DESCRIPTION: Time series indexing is at the center of many scientific works or business needs. The number and size of the series may well explode depending on the concerned domain. These data are still very difficult to handle and, often, a necessary step to handling them is in their indexing. Imitates is a Spark Library that implements two algorithms developed by Zenith. Both algorithms allow indexing massive amounts of time series (billions of series, several terabytes of data).

- Partners: New York University - Université Paris-Descartes
- Contact: Florent Masegla
- Publication: [ParCorr: efficient parallel methods to identify similar time series pairs across sliding windows](#)

6.11. VersionClimber

KEYWORDS: Software engineering - Deployment - Versionning

FUNCTIONAL DESCRIPTION: VersionClimber is an automated system to help update the package and data infrastructure of a software application based on priorities that the user has indicated (e.g. I care more about having a recent version of this package than that one). The system does a systematic and heuristically efficient exploration (using bounded upward compatibility) of a version search space in a sandbox environment (Virtual Env or conda env), finally delivering a lexicographically maximum configuration based on the user-specified priority order. It works for Linux and Mac OS on the cloud.

- Participants: Christophe Pradal, Dennis Shasha, Sarah Cohen-Boulakia and Patrick Valduriez
- Partners: CIRAD - New York University
- Contact: Christophe Pradal
- Publication: [VersionClimber: version upgrades without tears](#)
- URL: <https://versionclimber.readthedocs.io/>

6.12. UMX

open-unmix

KEYWORDS: Source Separation - Audio

SCIENTIFIC DESCRIPTION: Implements state of the art audio/music source separation with DNNs.

This software is intended to serve as a reference in the domain. It has notably been the object of several scientific communications: 1. An Overview of Lead and Accompaniment Separation in Music <https://hal-lirmm.ccsd.cnrs.fr/lirmm-01766781/> 2. Music separation with DNNs: making it work (ISMIR 2018 Tutorial) https://sigsep.github.io/ismir2018_tutorial/index.html#/cover

FUNCTIONAL DESCRIPTION: This software implements audio source separation with deep learning, using pytorch and tensorflow frameworks.

It comprises the code for both training and testing the separation networks, in a flexible manner.

Pre and post-processing around the actual deep neural nets include sophisticated specific multichannel filtering operations.

- Authors: Antoine Liutkus, Fabian Robert Stoter and Emmanuel Vincent
- Contact: Antoine Liutkus
- Publication: [An Overview of Lead and Accompaniment Separation in Music](#)

ALICE Team

6. New Software and Platforms

6.1. VORPALINE

VORPALINE mesh generator

KEYWORDS: 3D modeling - Unstructured heterogeneous meshes

SCIENTIFIC DESCRIPTION: This software is the result of the team's work on the parameterization of surfaces and volumes, on the generation of Voronoi diagrams and mesh generation.

FUNCTIONAL DESCRIPTION: VORPALINE is a surfacic and volumetric mesh generator, for simplicial meshes (triangles and tetrahedra), for quad-dominant and hex-dominant meshes. It also contains surfacic and volumic parameterization modules.

RELEASE FUNCTIONAL DESCRIPTION: Computer vision algorithms allow us to reconstruct surfaces in a 3d scene. The colours associated with these surfaces can be stored in textures, but these are often incomplete due to a lack of reliable data. For example, some points on the surface are not present in the images, are insufficiently illuminated or, on the contrary, in a reflection that does not give the true color of the object. We have developed in Vorpaline an algorithm capable of generating these missing colors from those present in their vicinity. The originality of our approach is the optimization according to the neighbourhoods defined on the surface and not in the texture space.

- Participants: Bruno Lévy, Dmitry Sokolov and Nicolas Ray
- Contact: Bruno Lévy
- URL: <http://alice.loria.fr/index.php/erc-vorpaline.html>

AVIZ Project-Team

6. New Software and Platforms

6.1. 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, Cartolabe provides the user with a map of the thematics, authors and articles . 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

- Participants: Philippe Caillou, Jean-Daniel Fekete, Jonas Renault and Anne-Catherine Letournel
- Partners: LRI - Laboratoire de Recherche en Informatique - CNRS
- Contact: Philippe Caillou
- URL: <http://www.cartolabe.fr/>

6.2. 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.

- Authors: Jean-Daniel Fekete, Petra Isenberg and Christoph Kinkeldey
- Contact: Petra Isenberg

6.3. PAOHvis

Parallel Aggregated Ordered Hypergraph Visualization

KEYWORDS: Dynamic networks - Hypergraphs

FUNCTIONAL DESCRIPTION: Parallel Aggregated Ordered Hypergraph (PAOH) is a novel technique to visualize dynamic hypergraphs [26]. Hypergraphs are a generalization of graphs where edges can connect more than two vertices. Hypergraphs can be used to model co-authorship networks with multiple authors per article, or networks of business partners. A dynamic hypergraph evolves over discrete time slots. A PAOH display represents vertices as parallel horizontal bars and hyperedges as vertical lines that connect two or more vertices. We believe that PAOH is the first technique with a highly readable representation of dynamic hypergraphs without overlaps. It is easy to learn and is well suited for medium size dynamic hypergraph networks such as those commonly generated by digital humanities projects - our driving application domain (see Fig. 3).

- Contact: Paola Tatiana Llerena Valdivia
- URL: <https://aviz.fr/paohvis>

6.4. AR Collaborative Visualization

KEYWORDS: Augmented reality - Collaborative science - Android

FUNCTIONAL DESCRIPTION: Allows to look at VTK datasets using AR-HMD (Microsoft HoloLens) in multi-users environments (i.e., one headset per user). A Multi-touch tablet is provided per user to manipulate the environment.

- Contact: Mickael Sereno

6.5. Platforms

6.5.1. *Vispubdata.org*

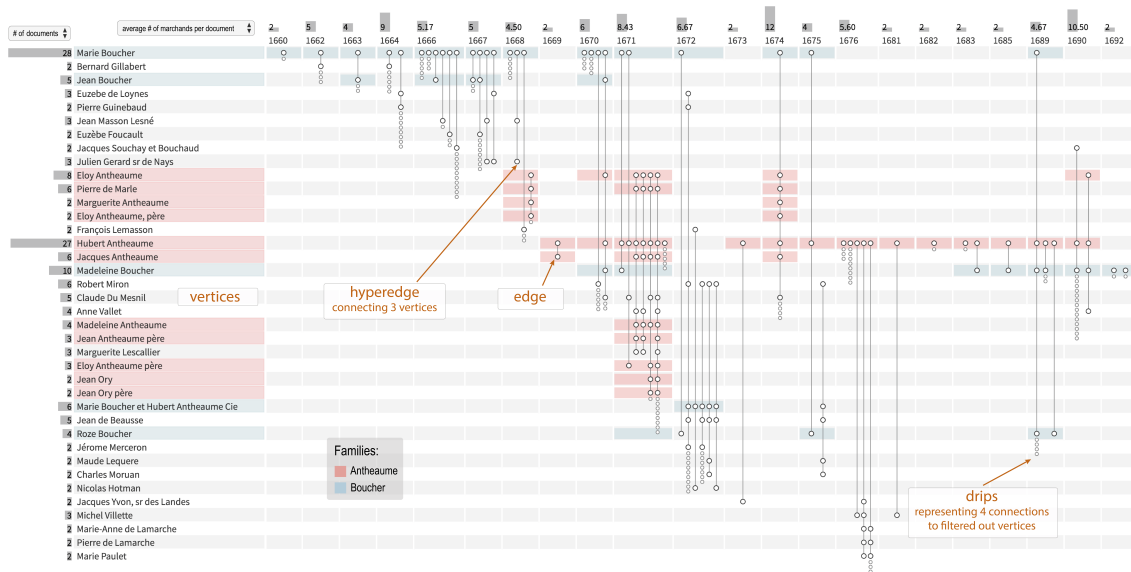


Figure 3. Using Dynamic Hypergraphs to Reveal the Evolution of the Business Network of a 17th Century French Woman Merchant

AVIZ members are making available for research a dataset of IEEE VIS publications at <http://vispubdata.org>. This dataset is actively being used for research and conference organization.

EX-SITU Project-Team

6. New Software and Platforms

6.1. Digiscope

KEYWORDS: 2D - 3D - Node.js - Unity 3D - Video stream

FUNCTIONAL DESCRIPTION: Through the Digiscope application, the users can connect to a remote workspace and share files, video and audio streams with other users. Application running on complex visualization platforms can be easily launched and synchronized.

- Partners: Maison de la simulation - UVSQ - CEA - ENS Cachan - LIMSI - LRI - Laboratoire de Recherche en Informatique - CentraleSupélec - Telecom Paris
- Contact: Olivier Gladin
- URL: <http://www.digiscope.fr>

6.2. Touchstone2

KEYWORD: Experimental design

FUNCTIONAL DESCRIPTION: Touchstone2 is a graphical user interface to create and compare experimental designs. It is based on a visual language: Each experiment consists of nested bricks that represent the overall design, blocking levels, independent variables, and their levels. Parameters such as variable names, counterbalancing strategy and trial duration are specified in the bricks and used to compute the minimum number of participants for a balanced design, account for learning effects, and estimate session length. An experiment summary appears below each brick assembly, documenting the design. Manipulating bricks immediately generates a corresponding trial table that shows the distribution of experiment conditions across participants. Trial tables are faceted by participant. Using brushing and fish-eye views, users can easily compare among participants and among designs on one screen, and examine their trade-offs.

Touchstone2 plots a power chart for each experiment in the workspace. Each power curve is a function of the number of participants, and thus increases monotonically. Dots on the curves denote numbers of participants for a balanced design. The pink area corresponds to a power less than the 0.8 criterion: the first dot above it indicates the minimum number of participants. To refine this estimate, users can choose among Cohen's three conventional effect sizes, directly enter a numerical effect size, or use a calculator to enter mean values for each treatment of the dependent variable (often from a pilot study).

Touchstone2 can export a design in a variety of formats, including JSON and XML for the trial table, and TSL, a language we have created to describe experimental designs. A command-line tool is provided to generate a trial table from a TSL description.

Touchstone2 runs in any modern Web browser and is also available as a standalone tool. It is used at ExSitu for the design of our experiments, and by other Universities and research centers worldwide. It is available under an Open Source licence at <https://touchstone2.org>.

- Partner: University of Zurich
- Contact: Wendy Mackay
- URL: <https://touchstone2.org>

6.3. UnityCluster

KEYWORDS: 3D - Virtual reality - 3D interaction

FUNCTIONAL DESCRIPTION: UnityCluster 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.

UnityCluster provides an easy solution for running existing Unity 3D applications on any display that requires a rendering cluster with several computers. UnityCluster 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. UnityCluster manages data distribution and synchronization among the computers to obtain a consistent image on the entire wall-sized display surface.

UnityCluster 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.

UnityCluster 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.

- Partner: Inria
- Contact: Cédric Fleury

6.4. VideoClipper

KEYWORD: Video recording

FUNCTIONAL DESCRIPTION: VideoClipper is an IOS app for Apple Ipad, designed to guide the capture of video during a variety of prototyping activities, including video brainstorming, interviews, video prototyping and participatory design workshops. It relies heavily on Apple's AVFoundation, a framework that provides essential services for working with time-based audiovisual media on iOS (<https://developer.apple.com/avfoundation/>). Key uses include: transforming still images (title cards) into video tracks, composing video and audio tracks in memory to create a preview of the resulting video project and saving video files into the default Photo Album outside the application.

VideoClipper consists of four main screens: project list, project, capture and import. The project list screen shows a list with the most recent projects at the top and allows the user to quickly add, remove or clone (copy and paste) projects. The project screen includes a storyboard composed of storylines that can be added, cloned or deleted. Each storyline is composed of a single title card, followed by one or more video clips. Users can reorder storylines within the storyboard, and the elements within each storyline through direct manipulation. Users can preview the complete storyboard, including all titlecards and videos, by pressing the play button, or export it to the Ipad's Photo Album by pressing the action button.

VideoClipper offers multiple tools for editing titlecards and storylines. Tapping on the title card lets the user edit the foreground text, including font, size and color, change background color, add or edit text labels, including size, position, color, and add or edit images, both new pictures and existing ones. Users can also delete text labels and images with the trash button. Video clips are presented via a standard video player, with standard interaction. Users can tap on any clip in a storyline to: trim the clip with a non-destructive trimming tool, delete it with a trash button, open a capture screen by clicking on the camera icon, label the clip by clicking a colored label button, and display or hide the selected clip by toggling the eye icon.

VideoClipper is currently in beta test, and is used by students in two HCI classes at the Université Paris-Saclay, researchers in ExSitu as well as external researchers who use it for both teaching and research work. A beta test version is available on demand under the Apple testflight online service.

- Contact: Wendy Mackay

6.5. WildOS

KEYWORDS: Human Computer Interaction - Wall displays

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

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

WildOS relies on Web technologies, most notably Javascript and node.js, as well as node-webkit and HTML5. This makes it inherently portable (it is currently tested on Mac OS X and Linux). While applications can be developed only with these Web technologies, it is also possible to bridge to existing applications developed in other environments if they provide sufficient access for remote control. Sample applications include a web browser, an image viewer, a window manager, and the BrainTwister application developed in collaboration with neuroanatomists at NeuroSpin.

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

- Contact: Michel Beaudouin-Lafon
- URL: <https://bitbucket.org/mblinsitu/wildos>

6.6. Platforms

6.6.1. 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.

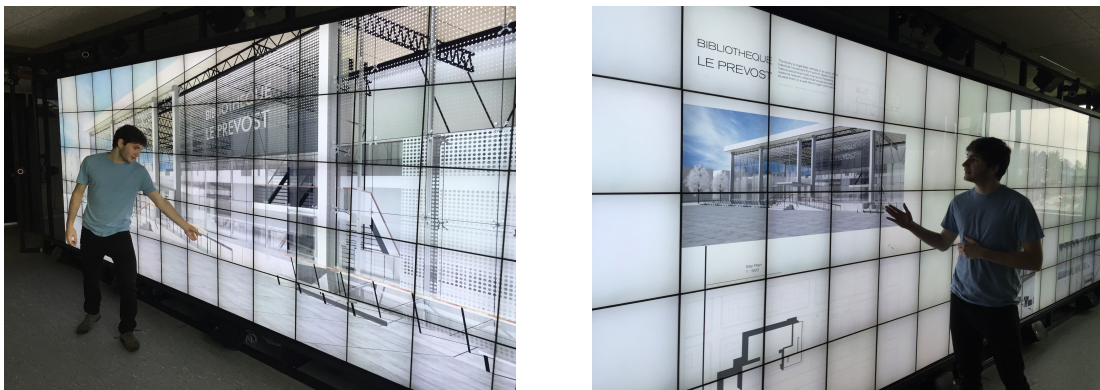


Figure 1. The WILDER platform.

GRAPHDECO Project-Team

5. New Software and Platforms

5.1. SynDraw

KEYWORDS: Non-photorealistic rendering - Vector-based drawing - Geometry Processing

FUNCTIONAL DESCRIPTION: The SynDraw library extracts occluding contours and sharp features over a 3D shape, computes all their intersections using a binary space partitioning algorithm, and finally performs a raycast to determine each sub-contour visibility. The resulting lines can then be exported as an SVG file for subsequent processing, for instance to stylize the drawing with different brush strokes. The library can also export various attributes for each line, such as its visibility and type. Finally, the library embeds tools allowing one to add noise into an SVG drawing, in order to generate multiple images from a single sketch. SynthDraw is based on the geometry processing library libIGL.

RELEASE FUNCTIONAL DESCRIPTION: This first version extracts occluding contours, boundaries, creases, ridges, valleys, suggestive contours and demarcating curves. Visibility is computed with a view graph structure. Lines can be aggregated and/or filtered. Labels and outputs include: line type, visibility, depth and aligned normal map.

- Authors: Adrien Bousseau, Bastien Wailly and Adele Saint-Denis
- Contact: Bastien Wailly

5.2. DeepSketch

KEYWORDS: 3D modeling - Sketching - Deep learning

FUNCTIONAL DESCRIPTION: DeepSketch is a sketch-based modeling system that runs in a web browser. It relies on deep learning to recognize geometric shapes in line drawings. The system follows a client/server architecture, based on the Node.js and WebGL technology. The application's main targets are iPads or Android tablets equipped with a digital pen, but it can also be used on desktop computers.

RELEASE FUNCTIONAL DESCRIPTION: This first version is built around a client/server Node.js application whose job is to transmit a drawing from the client's interface to the server where the deep networks are deployed, then transmit the results back to the client where the final shape is created and rendered in a WebGL 3D scene thanks to the THREE.js JavaScript framework. Moreover, the client is able to perform various camera transformations before drawing an object (change position, rotate in place, scale on place) by interacting with the touch screen. The user also has the ability to draw the shape's shadow to disambiguate depth/height. The deep networks are created, trained and deployed with the Caffe framework.

- Authors: Adrien Bousseau and Bastien Wailly
- Contact: Adrien Bousseau

5.3. DPP

Delaunay Point Process for image analysis

KEYWORDS: Computer vision - Shape recognition - Delaunay triangulation - Stochastic process

FUNCTIONAL DESCRIPTION: The software extract 2D geometric structures (planar graphs, polygons...) from images

- Participants: Jean-Dominique Favreau, Florent Lafarge and Adrien Bousseau
- Contact: Florent Lafarge
- Publication: [Extracting Geometric Structures in Images with Delaunay Point Processes](#)

5.4. sibr-core

System for Image-Based Rendering

KEYWORD: Graphics

SCIENTIFIC DESCRIPTION: Core functionality to support Image-Based Rendering research. The core provides basic support for camera calibration, multi-view stereo meshes and basic image-based rendering functionality. Separate dependent repositories interface with the core for each research project. This library is an evolution of the previous SIBR software, but now is much more modular.

We plan to release the core module, as well as the code for several of our research papers, as well as papers from other authors for comparisons and benchmark purposes.

FUNCTIONAL DESCRIPTION: sibr-core 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.

- Authors: Sebastien Bonopera, Jérôme Esnault, Siddhant Prakash, Simon Rodriguez, Théo Thonat, Gaurav Chaurasia, Julien Philip and George Drettakis
- Contact: George Drettakis

5.5. SGTDP

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 three 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 open-source renderer format. It handles the conversion of complex materials and shade trees from 3DSMAX including materials made for V-Ray. The overall quality of the produced images with exported scenes has 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 have 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 high 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 CPU cores.

The scene data (geometry, textures, materials) and the cameras are automatically transferred 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.

We have recently integrated the platform with the sibr-core software library, allowing us to read Mitsuba scenes. We have written a tool to allow camera placement to be used for rendering and for reconstruction of synthetic scenes, including alignment of the exact and reconstructed version of the scenes. This dual-representation scenes can be used for learning and as ground truth. We can also perform various operations on the ground truth data within sibr-core, e.g., compute shadow maps of both exact and reconstructed representations etc.

- Authors: Laurent Boiron, Sébastien Morgenthaler, Georgios Kopanas, Julien Philip and George Drettakis
- Contact: George Drettakis

5.6. 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. In addition, in order to develop a demo showcasing the technology, a multiplayer VR scene was created proving the integration of IBR with the rest of the engine.

- Authors: Sebastian Vizcay and George Drettakis
- Contact: George Drettakis

5.7. DeepRelighting

Deep Geometry-Aware Multi-View Relighting

KEYWORD: Graphics

SCIENTIFIC DESCRIPTION: Implementation of the paper: Multi-view Relighting using a Geometry-Aware Network (<https://hal.inria.fr/hal-02125095>), based on the sibr-core library.

- Participants: Julien Philip and George Drettakis
- Contact: George Drettakis
- Publication: <https://hal.inria.fr/hal-02125095>

5.8. SingleDeepMat

Single-image deep material acquisition

KEYWORDS: Materials - 3D - Realistic rendering - Deep learning

SCIENTIFIC DESCRIPTION: Cook-Torrance SVBRDF parameter acquisition from a single Image using Deep learning

FUNCTIONAL DESCRIPTION: Allows material acquisition from a single picture, to then be rendered in a virtual environment. Implementation of the paper <https://hal.inria.fr/hal-01793826/>

RELEASE FUNCTIONAL DESCRIPTION: Based on Pix2Pix implementation by AffineLayer (Github)

- Participants: Valentin Deschaintre, Miika Aittala, Frédo Durand, George Drettakis and Adrien Bousseau
- Partner: CSAIL, MIT
- Contact: Adrien Bousseau
- Publication: [Single-Image SVBRDF Capture with a Rendering-Aware Deep Network](#)
- URL: <https://team.inria.fr/graphdeco/projects/deep-materials/>

5.9. MultiDeepMat

Multi-image deep material acquisition

KEYWORDS: 3D - Materials - Deep learning

SCIENTIFIC DESCRIPTION: Allows material acquisition from multiple pictures, to then be rendered in a virtual environment. Implementation of the paper <https://hal.inria.fr/hal-02164993>

RELEASE FUNCTIONAL DESCRIPTION: Code fully rewritten since the SingleDeepMat project, but some function are imported from it.

- Participants: Valentin Deschaintre, Miika Aittala, Frédo Durand, George Drettakis and Adrien Bousseau
- Contact: Adrien Bousseau
- Publication: [Flexible SVBRDF Capture with a Multi-Image Deep Network](#)
- URL: <https://team.inria.fr/graphdeco/projects/multi-materials/>

5.10. GuidedDeepMat

Guided deep material acquisition

KEYWORDS: Materials - 3D - Deep learning

SCIENTIFIC DESCRIPTION: Deep large scale HD material acquisition guided by an example small scale SVBRDF

RELEASE FUNCTIONAL DESCRIPTION: Code based on the MultiDeepMat project code.

- Participants: Valentin Deschaintre, George Drettakis and Adrien Bousseau
- Contact: Adrien Bousseau

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 Noviale, Valérie Gouranton, Bruno Arnaldi, Vincent Goupil, Carl-Johan Jorgensen, Emeric Goga, Adrien Reuzeau and Alexandre Audinot
- 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 enhanced Petri net and state machine models 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.

RELEASE FUNCTIONAL DESCRIPTION: Adding state machine handling for scenario description in addition to the already existing petri net format. Improved scenario editor

- Participants: Florian Noviale, Valérie Gouranton, Bruno Arnaldi, Vincent Goupil, Emeric Goga, Carl-Johan Jorgensen, Adrien Reuzeau and Alexandre Audinot
- Contact: Valérie Gouranton
- Publications: [Versatile Scenario Guidance for Collaborative Virtual Environments - Roles in Collaborative Virtual Environments for Training - 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 60000 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: Cedric Riou, Thierry Gaugry, Anatole Lécuyer, Fabien Lotte, Jussi Tapio Lindgren, Laurent Bougrain, Maureen Clerc and Théodore Papadopoulo
- Partners: INSERM - GIPSA-Lab
- Contact: Anatole Lécuyer
- URL: <http://openvibe.inria.fr>

6.4. Platforms

6.4.1. Immerstar

- Participants: Florian Nouviale, Ronan Gaugne
- URL: <http://www.irisa.fr/immersia/>

With the two virtual reality technological platforms 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 was granted by an Inria funding for the 2015-2019 period which had enabled several important evolutions. In particular, in 2018, a haptic system covering the entire volume of the Immersia platform was installed, allowing various configurations from single haptic device usage to dual haptic devices usage with either one or two users. In addition, a motion platform designed to introduce motion feedback for powered wheelchair simulations has also been incorporated (see Figure 2).

We celebrated the twentieth anniversary of the Immersia platform in November 2019 by inaugurating the new haptic equipment. We proposed scientific presentations and received 150 participants, and visits for the support services in which we received 50 persons.

Immersia hosted and supported several projects and experiments during the year such as the Adapt [34], Sunset [2] or Introspect ([19], [29]) projects. Moreover, the platform was involved in the multidisciplinary project LSI led by the invited professor Franz Fischnaller from the Academy of Fine Arts of Torino. The project was implemented in Immersia with the support of the Immersia staff and deployed in the Ars Electronica center 3



Figure 2. Immersia platform: (Left) “Scale-One” Haptic system for one or two users. (Right) Motion platform for a powered wheelchair simulation.



Figure 3. (Left) The LSI project in Immersia. (Right) The LSI project in Ars Electronica.

ILDA Project-Team

6. New Software and Platforms

6.1. Smarties

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

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

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

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

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 facilities, astronomy, power distribution systems.

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

- Participants: Caroline Appert, Olivier Chapuis and Emmanuel Pietriga
- Contact: Emmanuel Pietriga
- Publications: [Rapid Development of User Interfaces on Cluster-Driven Wall Displays with jBricks - A Toolkit for Addressing HCI Issues in Visual Language Environments](#)
- URL: <http://zvtm.sf.net>

6.3. MapMosaic

KEYWORDS: Geo-visualization - Data visualization

SCIENTIFIC DESCRIPTION: GIS software applications and other mapping tools enable users to correlate data from multiple layers and gain insight from the resulting visualizations. However, most of these applications only feature basic, monolithic layer compositing techniques. These techniques do not always support users effectively in their tasks, as we observed during interviews with GIS experts. MapMosaic is a novel approach based on dynamic visual compositing that enables users to interactively create and manipulate local composites of multiple vector and raster map layers, taking into account the semantics and attribute values of objects and fields in the compositing process. We evaluated MapMosaic's interaction model against that of QGIS (a widely-used desktop GIS) and MAPublisher (a professional cartography tool) using the "Cognitive Dimensions" framework and through an analytical comparison, showing that MapMosaic's model is more flexible and can support users more effectively in their tasks.

FUNCTIONAL DESCRIPTION: MapMosaic is a novel approach to combine geographical layers based on dynamic visual compositing that enables users to interactively create and manipulate local composites of multiple vector and raster map layers. It takes into account the semantics and attribute values of objects and fields in the compositing process. MapMosaic aims at better supporting GIS users in their tasks such as correlating data from multiple layers and gaining insight from the resulting visualizations.

RELEASE FUNCTIONAL DESCRIPTION: First public release.

- Participants: Maria Jesus Lobo, Caroline Appert and Emmanuel Pietriga
- Contact: Emmanuel Pietriga
- Publications: [MapMosaic: Dynamic Layer Compositing for Interactive Geovisualization - An Evaluation of Interactive Map Comparison Techniques](#)
- URL: <http://ilda.saclay.inria.fr/mapmuxing/mapmosaic/index.html>

6.4. Baia

Before-and-after satellite image animation

KEYWORDS: Geo-visualization - 2D animation

SCIENTIFIC DESCRIPTION: Before-and-after image pairs show how entities in a given region have evolved over a specific period of time. Satellite images are a major source of such data, that capture how natural phenomena or human activity impact a geographical area. These images are used both for data analysis and to illustrate the resulting findings to diverse audiences. The simple techniques used to display them, including juxtaposing, swapping and monolithic blending, often fail to convey the underlying phenomenon in a meaningful manner. Baia is a framework to create advanced animated transitions, called animation plans, between before-and-after images. Baia relies on a pixel-based transition model that gives authors much expressive power, while keeping animations for common types of changes easy to create thanks to predefined animation primitives.

FUNCTIONAL DESCRIPTION: Baia is a framework to create advanced animated transitions, called animation plans, between before-and-after satellite images.

Before-and-after image pairs show how entities in a given region have evolved over a specific period of time. Satellite images are a major source of such data, that capture how natural phenomena or human activity impact a geographical area. These images are used both for data analysis and to illustrate the resulting findings to diverse audiences. The simple techniques used to display them, including juxtaposing, swapping and monolithic blending, often fail to convey the underlying phenomenon in a meaningful manner.

Baia relies on a pixel-based transition model that gives authors much expressive power. The animation editor enables authors to easily represent common types of changes thanks to predefined animation primitives and to sequence different changes across time.

RELEASE FUNCTIONAL DESCRIPTION: First public release

- Participants: Maria Jesus Lobo, Caroline Appert and Emmanuel Pietriga
- Contact: Emmanuel Pietriga
- Publication: [Animation Plans for Before-and-After Satellite Images](#)
- URL: <http://ilda.saclay.inria.fr/mapmuxing/baia/index.html>

6.5. LODAtlas

KEYWORDS: LOD - Linked open data - Semantic Web

SCIENTIFIC DESCRIPTION: The Web of Data is growing fast, as exemplified by the evolution of the Linked Open Data (LOD) cloud over the last ten years. One of the consequences of this growth is that it is becoming increasingly difficult for application developers and end-users to find the datasets that would be relevant to them. Semantic Web search engines, open data catalogs, datasets and frameworks such as LODStats and LOD Laundromat, are all useful but only give partial, even if complementary, views on what datasets are available on the Web. LODAtlas is a portal that enables users to find datasets of interest. Users can make different types of queries about both the datasets' metadata and contents, aggregated from multiple sources. They can then quickly evaluate the matching datasets' relevance, thanks to LODAtlas' summary visualizations of their general metadata, connections and contents.

FUNCTIONAL DESCRIPTION: The Web of Data is growing fast, as exemplified by the evolution of the Linked Open Data (LOD) cloud over the last ten years. One of the consequences of this growth is that it is becoming increasingly difficult for application developers and end-users to find the datasets that would be relevant to them. Semantic Web search engines, open data catalogs, datasets and frameworks such as LODStats and LOD Laundromat, are all useful but only give partial, even if complementary, views on what datasets are available on the Web. LODAtlas is a portal that enables users to find datasets of interest. Users can make different types of queries about both the datasets' metadata and contents, aggregated from multiple sources. They can then quickly evaluate the matching datasets' relevance, thanks to LODAtlas' summary visualizations of their general metadata, connections and contents.

- Participants: Caroline Appert, Marie Destandau, Ioana Manolescu, François Goasdoué, Sejla Cebiric, Hande Ozaygen and Emmanuel Pietriga
- Contact: Emmanuel Pietriga
- Publication: [Browsing Linked Data Catalogs with LODAtlas](#)
- URL: <http://lodatlas.lri.fr>

6.6. TouchTokens

KEYWORDS: Tangible interface - HCI

SCIENTIFIC DESCRIPTION: TouchTokens make it possible to easily build interfaces that combine tangible and gestural input using passive tokens and a regular multi-touch surface. The tokens constrain users' grasp, and thus, the relative spatial configuration of fingers on the surface, theoretically making it possible to design algorithms that can recognize the resulting touch patterns. See associated scientific articles below.

FUNCTIONAL DESCRIPTION: TouchTokens allow interface designers to build low-cost tangible interfaces. The technique consists in recognizing multi-touch patterns that are associated with specific passive tokens. Those physical tokens can be made out of any material to get tracked on any touch-sensitive surface. Implementations of the recognizer (in both TUIO and Android) and vector descriptions of the tokens ready for 3D-printing or laser-cutting are available

- Participants: Caroline Appert, Rafael Morales Gonzalez, Emmanuel Pietriga and Gilles Bailly
- Contact: Caroline Appert
- Publications: [TouchTokens: Guiding Touch Patterns with Passive Tokens - Passive yet Expressive TouchTokens - Custom-made Tangible Interfaces with TouchTokens](#)
- URL: <https://www.lri.fr/~appert/touchtokens/>

6.7. Platforms

6.7.1. Platform: WILDER

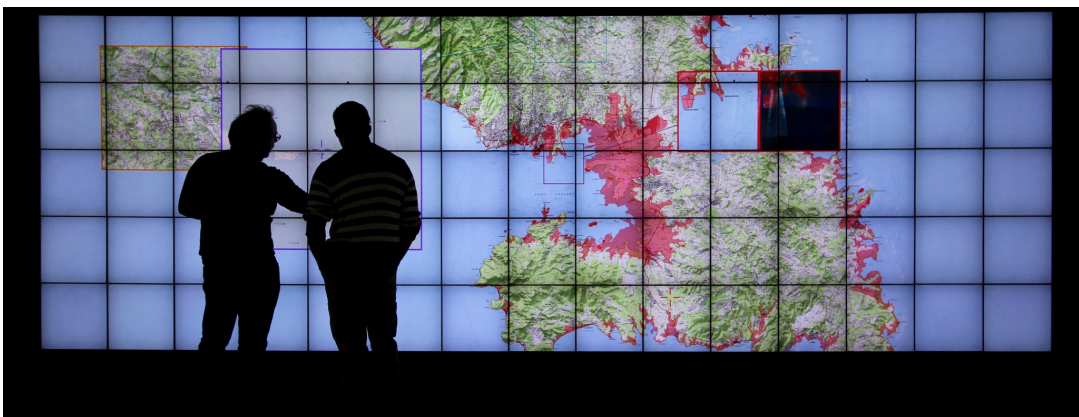
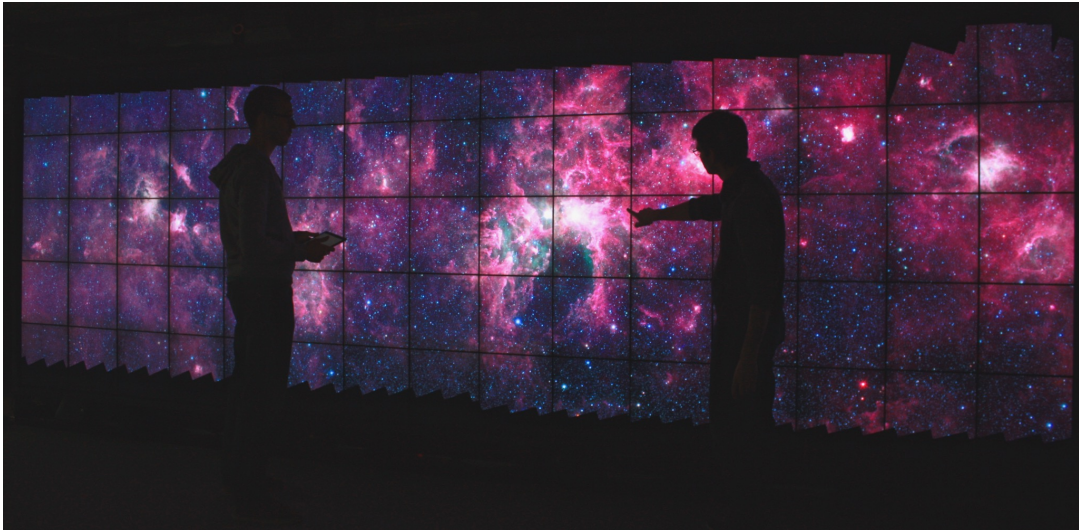


Figure 2. Example application area for ultra-high-resolution wall-sized displays: geographical information systems, and astronomical data analysis.

Ultra-high-resolution wall-sized displays [31] feature a very high pixel density over a large physical surface. Such platforms have properties that make them well-suited to the visualization of very large datasets. They can represent the data with a high level of detail while at the same time retaining context: users can transition from an overview of the data to a detailed view simply by physically moving in front of the wall display. Wall displays also offer good support for collaborative work, enabling multiple users to simultaneously visualize and interact with the displayed data. To make them interactive, wall-sized displays are increasingly coupled with input devices such as touch frames, motion-tracking systems and wireless multitouch devices, in order to enable multi-device and multi-user interaction with the displayed data. Application areas for such visualization platforms range from the monitoring of complex infrastructures and crisis management situations to tools for the exploratory visualization of scientific data.

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

IMAGINE Project-Team

6. New Software and Platforms

6.1. MyCF

My Corporis Fabrica

KEYWORDS: 3D modeling - Simulation - Health - Ontologies - Anatomy - Patientspecific - 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

6.2. 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 definition (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](#)

6.3. Platforms

6.3.1. RUMBA

RUMBA is a next-generation 3D animation software targeted to professional animation studios, developed jointly by Mercenaries Engineering, TEAMTO and IMAGINE. Development was funded in part by FUI projects COLLODI 1 and COLLODI 2. RUMBA has been used in production by TEAMTO since 2017. We are using RUMBA as a platform for developing new algorithms in sketch-based animation, based on our previous work during Martin Guay's PhD thesis. This includes many improvements to allow those methods to work in a professional workflow.

6.3.2. Sky Engine

Sky Engine is a realtime game engine developed by Maxime Garcia as part of his PhD thesis, which incorporates several shape modeling and animation tools developed within the team. It is hoped that it will supersede Expressive as a platform for future integration of research results of the team involving real-time, story-driven shape modeling, animation and cinematography.

LOKI Project-Team

6. New Software and Platforms

6.1. Polyphony

KEYWORDS: Human Computer Interaction - Toolkit - Engineering of Interactive Systems

FUNCTIONAL DESCRIPTION: Polyphony is an experimental toolkit demonstrating the use of Entity-Component-System (ECS) to design Graphical User Interfaces (GUI). It also extends the original ECS model to support advanced interfaces.

NEWS OF THE YEAR: Design and implementation of a first version of the toolkit and associated examples as a proof of concept.

- Participants: Thibault Raffailac and Stéphane Huot
- Contact: Stéphane Huot
- Publications: [Applying the Entity-Component-System Model to Interaction Programming - Polyphony: Programming Interfaces and Interactions with the Entity-Component-System Model](#)
- URL: <https://gitlab.inria.fr/Loki/PolyphonyECS>

6.2. Esquisse

KEYWORDS: Vector graphics - 3D interaction - Human Computer Interaction

SCIENTIFIC DESCRIPTION: Trace figures are contour drawings of people and objects that capture the essence of scenes without the visual noise of photos or other visual representations. Their focus and clarity make them ideal representations to illustrate designs or interaction techniques. In practice, creating those figures is a tedious task requiring advanced skills, even when creating the figures by tracing outlines based on photos. To mediate the process of creating trace figures, we introduce the open-source tool Esquisse. Informed by our taxonomy of 124 trace figures, Esquisse provides an innovative 3D model staging workflow, with specific interaction techniques that facilitate 3D staging through kinematic manipulation, anchor points and posture tracking. Our rendering algorithm (including stroboscopic rendering effects) creates vector-based trace figures of 3D scenes. We validated Esquisse with an experiment where participants created trace figures illustrating interaction techniques, and results show that participants quickly managed to use and appropriate the tool.

FUNCTIONAL DESCRIPTION: Esquisse is an add-on for Blender that can be used to rapidly produce trace figures. It relies on a 3D model staging workflow, with specific interaction techniques that facilitate the staging through kinematic manipulation, anchor points and posture tracking. Staged 3D scenes can be exported to SVG thanks to Esquisse's dedicated rendering algorithm.

NEWS OF THE YEAR: First version of Esquisse, implementing both staging and vector rendering.

- Contact: Sylvain Malacria
- Publication: [Esquisse: Using 3D Models Staging to Facilitate the Creation of Vector-based Trace Figures](#)
- URL: <https://github.com/LokiResearch/Esquisse>

6.3. RayCursor

Source code for the pointing technique RayCursor

KEYWORDS: Virtual reality - Interaction technique

FUNCTIONAL DESCRIPTION: This is a Unity Project containing the source code and prefab for the pointing technique RayCursor to be easily integrated in other Unity Projects.

- Contact: Géry Casiez
- Publications: [RayCursor: a 3D Pointing Facilitation Technique based on Raycasting - Improving Raycasting using Proximity Selection and Filtering](#)
- URL: <http://ns.inria.fr/loki/raycursor/>

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. Spectral Viewer

KEYWORD: Image

FUNCTIONAL DESCRIPTION: An open-source (spectral) image viewer that supports several images formats: ENVI (spectral), exr, png, jpg.

- Partner: LP2N (CNRS - UMR 5298)
- Contact: Romain Pacanowski
- URL: <https://adufay.gitlabpages.inria.fr/SpectralViewer/index.html>

6.3. otmap

C++ optimal transport solver on 2D grids

KEYWORDS: Optimal transportation - Eigen - C++ - Image processing - Numerical solver

FUNCTIONAL DESCRIPTION: This is a lightweight implementation of "Instant Transport Maps on 2D Grids".

It currently supports L2-optimal maps from an arbitrary density defined on a uniform 2D grid (aka an image) to a square with uniform density. Inverse maps and maps between pairs of arbitrary images are then recovered through numerical inversion and composition resulting in density preserving but approximately optimal maps.

This code also includes with 3 mini applications:

- otmap: computes the forward and backward maps between one image and a uniform square or between a pair of images. The maps are exported as .off quad meshes. - stippling: adapt a uniformly distributed point cloud to a given image. - barycenters: computes linear (resp. bilinear) approximate Wasserstein barycenters between a pair (resp. four) images.

- Contact: Gaël Guennebaud

MAVERICK Project-Team

5. New Software and Platforms

5.1. 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/>

5.2. HQR

High Quality Renderer

KEYWORDS: Lighting simulation - Materials - Plug-in

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

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

5.3. 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>

5.4. 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>

5.5. Vrender

KEYWORDS: 3D - Vector graphics

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://maverick.inria.fr/Software/VRender/>

5.6. X3D TOOLKIT

X3D Development pateform

KEYWORDS: X3D - Geometric modeling

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://maverick.inria.fr/Software/X3D/>

5.7. 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

MFX Project-Team

6. New Software and Platforms

6.1. Chill

Chill, node-based graphical interface for IceSL

KEYWORDS: 3D - Additive manufacturing

SCIENTIFIC DESCRIPTION: ChiLL is an effort to explore visual modeling tools for IceSL. The core idea behind Chill is to propose a node-based modeling interface, which is a popular way to facilitate the design of 3D objects without going directly through code. Our approach creates a bridge between nodes-based editing and scripting, as the syntax for creating a new node is identical to the scripting language used in IceSL.

FUNCTIONAL DESCRIPTION: In Chill a user creates 3D shapes by connecting various nodes arranged in a directed graph. The shape visualization is updated instantly as the graph is modified.

NEWS OF THE YEAR: Chill was publicly released during the summer of 2019. We will broadly communicate about it in 2020.

- Participants: Jimmy Etienne, Pierre Bedell, Thibault Tricard, Yamil Salim Perchy and Sylvain Lefebvre
- Contact: Sylvain Lefebvre

6.2. IceSL

KEYWORD: Additive manufacturing

SCIENTIFIC DESCRIPTION: IceSL is the software developed within MFX, that serves as a research platform, a showcase of our research results, a test bed for comparisons and a vector of collaborations with both academic and industry partners. The software is freely available both as a desktop (Windows/Linux) and an online version.

FUNCTIONAL DESCRIPTION: IceSL allows users 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.

NEWS OF THE YEAR: In 2019, IceSL has been featured in news, exhibitions and fairs as a well-established tool for 3D printing. Additionally, since its inception, IceSL's community has grown significantly together with the number of new features included in it for slicing and modeling.

Regarding new features and additions to the software in 2019, IceSL has gone through many changes, primarily focused on improving the user experience and scalability/stability of algorithms. The most visible change is the complete rework of the slicing parameters GUI, with the addition of category-icons to allow for a quick access to settings. We can also note the upgrade of the renderer to support wide and high resolution screens, and the possibility to choose an experimental renderer (based on HCSG, published last year).

On the slicing front, we added new features, long requested, from the community: ironing, automatic spiralization, selection of different nozzle diameters, minimum time per layer, etc. A new GUI to customize the supports points was also added to help with the generation of supports.

The social community of IceSL has been growing steadily. Our twitter account has around 338 followers, 187 users frequently interacting in its Google forum (respectively, a progress of 69% and 25% since last year). Downloads have increased by 78% from last year (55K downloads total). In addition, Slice Crafter, the online version, has a cumulative of around 15K sliced objects.

- Participants: Frédéric Claux, Jean Hergel, Jérémie Dumas, Jonas Martinez-Bayona, Samuel Hornus, Sylvain Lefebvre, Pierre Bedell, Cédric Zanni, Noémie Vennin, Thibault Tricard, Jimmy Etienne, Yamil Salim Perchy and Pierre-Alexandre Hugron
- Contact: Sylvain Lefebvre
- URL: <https://icesl.loria.fr>

6.3. Platforms

Participants: Pierre Bedell, Noémie Vennin, Pierre-Alexandre Hugron.

We continued our active participation within the Creativ'Lab, a common experimental platform funded by Inria, Loria, CNRS and Région Grand Est. We added novel machines (DLP resin printers and large format printers) to explore new problems related to the specificity of each technology. We are also in the process of revisiting some of our techniques in the context of resin 3D printing.

This year we kept developing our custom-made hardware, in particular our color filament 3D printers. In this context we also elaborated our own colored PLA filament (using a filament extrusion device, PLA pellets and pigments). This was instrumental to the success of the corresponding research [15]. Finally, we started the assembly of a 3D printer based on a robotic arm, in the context of our research on curved 3D printing.

We are making these installations available to industrial partners and other research teams.

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 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 or di-symmetric). The viewpoints allow to cover the range of possible framings for the specified entities. The computation of such viewpoints relies on a database of framings that are dynamically adapted to the 3D scene by using a manifold parametric representation and guarantee the visibility of the specified entities. The set of viewpoints is also automatically annotated with cinematographic tags such as shot scales, angles, compositions, relative placement of entities, line of interest.

- Participants: 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 previzualization 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 occlutations 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: [hal-01612939v1](#) - [hal-01393066v1](#) - [hal-01332716v1](#) - [hal-01332711v2](#) - [hal-01095084v1](#)

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 environments. 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 automatically 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, Georges Dumont, Pierre Puchaud, Anthony Sorel, Claire Livet and Louise Demestre
- Contact: Charles Pontonnier
- Publications: [Motion-based prediction of external forces and moments and back loading during manual material handling tasks - A case study with custom : a comparison of normal and altered gait with an ankle brace](#) - [Motion-based prediction of hands and feet contact efforts during asymmetric handling tasks](#) - [MusIC method enhancement by a sensitivity study of its performance: application to a lower limbs musculoskeletal model](#) - [Ground Reaction Forces and Moments Prediction of Challenging Motions: Fencing Lunges](#) - [CusToM: a Matlab toolbox for musculoskeletal simulation](#) - [The MusIC method: a fast and quasi-optimal solution to the muscle forces estimation problem](#)

6.8. Immerstar Platform

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

With the two platforms of virtual reality, Immersia (<http://www.irisa.fr/immersia/>) and Immermove (<http://m2slab.com/index.php/facilities-4/>), 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 continued this year with 23 new cameras. 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 in 2017. In 2018, a Scale One haptic device has been installed. It allows, as in the CPER proposal, one or two handed haptic feedback in the full space covered by Immersia and possibility of carrying the user.

We celebrated the twentieth anniversary of the Immersia platform in November 2019 by inaugurating the new haptic equipment. We proposed scientific presentations and received 150 participants, and visits for support services where we received 50 persons.

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: Damien Caselli, Pierre-Antoine Cinquin, Pascal Guitton and H el ene Sauz eon
- Partner: Universit e de Bordeaux
- Contact: Pascal Guitton
- Publications: [Towards Truly Accessible MOOCs for Persons with Cognitive Disabilities: Design and Field Assessment - Online e-learning and cognitive disabilities: A systematic review](#)

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

6.3. Platforms

6.3.1. HOBIT

In 2019, we have continued working on the HOBIT platform dedicated to teaching and training of Optics at University. This has led to a version that we are able to export. A first system has been installed at University of Jena (Germany). We are currently finalizing a licensing contract to export the technology worldwide.

6.3.2. CARDS

Part of the e-Tac project, we have conceived a system composed of hardware and software components that allows us to augment pieces of papers in an interactive way (see Figure 3). 12 copies of this platform have been deployed at school. See also 7.1 .

6.3.3. OpenViBE

We have continued developing and extending the OpenViBE open-source BCI platform. As new functionalities, we have notably added the use of Riemannian geometry for EEG classification, which includes computation of covariance matrices and covariance matrix means, projection to tangent space and various covariance matrices classifiers, both with or without supervised or unsupervised adaptation. We have also added a new visualization module which can display any number of BCI commands and associate real-time feedback. In addition to these new functionalities, we have carefully improved and cleaned OpenViBE code, in order to standardize / clarify / simplify / modernize it and to secure and reduce memory allocations, to reduce unnecessary function calls, type changes and casts. This aimed at facilitating the handling of the code by new contributors and to update the different dependencies of OpenViBE, thus improving its compatibility, security and stability.

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. 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

6.4. 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

6.5. Module Gudhi : Skeleton-Blockers

Skeleton-Blockers data-structure

KEYWORDS: C++ - Mesh - Triangulation - Topology - 3D

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

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

6.6. DPP

Delaunay Point Process for image analysis

KEYWORDS: Computer vision - Shape recognition - Delaunay triangulation - Stochastic process

FUNCTIONAL DESCRIPTION: The software extract 2D geometric structures (planar graphs, polygons...) from images

- Participants: Jean-Dominique Favreau, Florent Lafarge and Adrien Bousseau
- Contact: Florent Lafarge
- Publication: [Extracting Geometric Structures in Images with Delaunay Point Processes](#)

6.7. KIPPI

KInetic Polygonal Partitioning of Images

KEYWORDS: Computer vision - Computational geometry - Image segmentation

SCIENTIFIC DESCRIPTION: The scientific description of the algorithm is detailed in [Bauchet and Lafarge, KIPPI: KInetic Polygonal Partitioning of Images, CVPR 2018]

FUNCTIONAL DESCRIPTION: KIPPI decompose an image, or a bounded 2D space, into convex polygons. The method exploits a kinetic framework for propagating and colliding line-segments until forming convex polygons.

- Participants: Jean-Philippe Bauchet and Florent Lafarge
- Contact: Florent Lafarge

6.8. Module CGAL: 3D Point-Set Shape Detection

KEYWORD: CGAL

FUNCTIONAL DESCRIPTION: This package implements the efficient RANSAC method for shape detection, contributed by Schnabel et al. From an unstructured point set with unoriented normals, the algorithm detects a set of shapes. Five types of primitive shapes are provided by this package: plane, sphere, cylinder, cone and torus. Detecting other types of shapes is possible by implementing a class derived from a base shape.

- Participants: Clément Jamin, Pierre Alliez and Sven Oesau
- Contact: Pierre Alliez

6.9. CGAL module: Classification

KEYWORDS: Classification - Point cloud - Mesh

FUNCTIONAL DESCRIPTION: This CGAL module aims at classifying 3D data, typically point clouds, into arbitrary classes of interest. The module offers the user the possibility to segment data i) locally or globally, and ii) in a supervised or unsupervised way.

- Authors: Florent Lafarge and Simon Giraudot
- Contact: Florent Lafarge

6.10. SMICER

KEYWORDS: Geometric modeling - Computational geometry - Polyhedral meshes

FUNCTIONAL DESCRIPTION: The software allows the decomposition of a 3D domain into a polyhedra from a set of planar shapes

- Participants: Florent Lafarge and Pierre Alliez
- Contact: Florent Lafarge

6.11. Stochastic Vectorization

KEYWORDS: Vector graphics - Stochastic models

FUNCTIONAL DESCRIPTION: The software converts a line-drawing image into Bezier curves.

- Participants: Jean-Dominique Favreau, Florent Lafarge and Adrien Bousseau
- Contact: Florent Lafarge
- Publication: [01309271](#)

ALMANACH Project-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: Eric 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. FSMB

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

- Participant: Eric de La Clergerie
- Contact: Eric 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

5. New Software and Platforms

5.1. intphys

IntPhys: A Benchmark for Visual Intuitive Physics Reasoning

KEYWORDS: Competition - Physical simulation - Artificial intelligence - Video Game

FUNCTIONAL DESCRIPTION: The intphys benchmark can be applied to any vision system, engineered, or trained, provided it can output a scalar when presented with a video clip, which should correspond to how physically plausible the video clip is. Our test set contains well matched videos of possible versus impossible events, and the metric consists in measuring how well the vision system can tell apart the possible from the impossible events..

- Contact: Mathieu Bernard
- URL: <http://www.intphys.com>

5.2. shennong

KEYWORDS: Speech processing - Python - Information extraction - Audio signal processing

FUNCTIONAL DESCRIPTION: Shennong is a Python library which implement the most used methods for speech features extraction. Features extraction is the first step of every speech processing pipeline.

Shennong provides the following functionalities: - implementation of the main methods from state of the art (including pre and post processing) - exhaustive documentation and tests - usage from a Python API or a command line tool - simple and coherent interface

- Contact: Mathieu Bernard
- URL: <https://coml.lscp.ens.fr/docs/shennong>

5.3. Seshat

Seshat Audio Annotation Platform

KEYWORDS: Audio - Speech - Web Application - Speech-text alignment

FUNCTIONAL DESCRIPTION: A web application to ease audio annotation campaigns, while also enabling the campaign manager to ensure that all annotations stick to a predefined format.

- Partner: ENS Paris
- Contact: Hadrien Titeux
- URL: <https://github.com/bootphon/seshat>

5.4. pyGammaAgreement

KEYWORDS: Reliability - Measures

FUNCTIONAL DESCRIPTION: Python library for measuring inter and intra annotator reliability for annotation sequences

- Contact: Emmanuel Dupoux

5.5. phonemizer

KEYWORD: Text

FUNCTIONAL DESCRIPTION:

- Conversion of a text into its phonemic representation
- Wrapper on speech synthesis programs espeak and festival
- Contact: Mathieu Bernard
- URL: <https://github.com/bootphon/phonemizer>

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.

FUNCTIONAL DESCRIPTION: Combines deep neural networks and multichannel signal processing for speech enhancement and separation of musical recordings.

NEWS OF THE YEAR: Version 1.1 was slightly modified in order to issue a test license to the French Ministry of Interior.

- Participants: Aditya Nugraha, Emmanuel Vincent and Antoine Liutkus
- 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: New models have been trained for German, as well as two bilingual models: one combining French and German phones, and one combining French and English phones. Also, a web server has been set up for on line real-time speech recognition.

- Participants: Dominique Fohr, Odile Mella, Mathieu Hu, Denis Juvet and Irina Illina
- 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 the 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, etc.). 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.

RELEASE FUNCTIONAL DESCRIPTION: Version 3.0 integrates a phonetization based on a deep learning algorithm. In addition, the phonetization step is managed by API REST (client/server mode). The NLP part provides an output of descriptors in the format that can be used by HTS and Merlin systems.

NEWS OF THE YEAR: The latest version can use the LORIA-PHON deep learning based grapheme-to-phoneme converter through a web API.

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

6.4. LORIA-PHON

LORIA grapheme-to-phoneme converter

KEYWORDS: Grapheme-to-phoneme converter - Neural networks

FUNCTIONAL DESCRIPTION: LORIA-PHON is a deep-learning based software for grapheme-to-phoneme conversion. It currently works for French. A web API is available for using it in a client/server mode. It properly interfaces with the SOJA software used for speech synthesis.

NEWS OF THE YEAR: new software

- Participants: Mathieu Hu, Denis Jouvét, Vincent Colotte and Louis Delebecque
- Contact: Vincent Colotte

6.5. Dynalips-Player

High realistic lip synchronization for 3d animated characters

KEYWORDS: 3D animation - Graphics - Speech Synthesis

FUNCTIONAL DESCRIPTION: Dynalips provides a solution to synchronize precisely and automatically the movements of the lips of a 3D character with speech (we address 3D animation movies and video games). We have developed a demonstrator that illustrates the whole process: from audio + text to the generation of the animation trajectory, and controlling the animation of a 3D model (e.g. an avatar). The demonstrator is composed mainly by the player developed in Unity 3D (but can be used with any other system) and plays the animation synchronously with speech in realtime. It is possible to generate an animation for Autodesk Maya 3D.

NEWS OF THE YEAR: The player has been extended to be multilingual thanks to two developments within two projects. In fact, within the METAL project, a lipsync for German has been developed. In addition, within the ATT Dynalips, we have built a lipsync for English.

- Partners: Université de Lorraine - Sayens (SATT Grand Est)
- Contact: Slim Ouni
- URL: <http://www.dynalips.com>

6.6. VisArtico

Visualization of multimodal speech data

KEYWORDS: Data visualization - 3D movement - Speech processing - Videos

SCIENTIFIC DESCRIPTION: VisArtico is a visualization software of multimodal data. It is possible to visualize the positions of real or virtual sensors and to animate them simultaneously with acoustics. This software can be useful for researchers in speech production, audiovisual speech synthesis or articulatory speech analysis.

FUNCTIONAL DESCRIPTION: VisArtico is a user-friendly software which allows visualizing multimodal data acquired by several systems: an articulograph, motion capture system, depth camera. This visualization software has been designed so that it can directly use the data provided by the different systems to display the spatial and temporal positions of the sensors (real and virtual). Moreover, VisArtico allows viewing the sensors augmented with visual information by indicating graphically the data for the tongue, lips and jaw.

RELEASE FUNCTIONAL DESCRIPTION: The current version allows the user to manage different modalities (articulatory, gestural, acoustic and video). It is possible to do automatic alignment, or even speech recognition. Several spatial data processing tools have been added (referential change, head movement suppression, merging data from multiple sources, ...).

NEWS OF THE YEAR: The software has undergone several improvements. Mainly, several branches have been merged in order to have as many features as possible available within the master branch.

- Participants: Ilef Ben Farhat, Loïc Mangeonjean, Slim Ouni and Louis Abel
- Partners: CNRS - Université de Lorraine
- Contact: Slim Ouni
- Publication: [VisArtico: a visualization tool for articulatory data](#)
- URL: <http://visartico.loria.fr>

6.7. Xarticulators

KEYWORDS: Medical imaging - Natural language processing

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.

RELEASE FUNCTIONAL DESCRIPTION: The new version allows MRI films to be processed and, above all, it offers a better transition from the shape of the vocal tract to the area function, which corresponds to an approximation of the vocal tract using a series of elementary tubes from the glottis to the lips.

NEWS OF THE YEAR: This year we completed the software to evaluate the articulatory model built from static images on dynamic images and we added a module to monitor the contour of the language using deep learning.

- Contact: Yves Laprie
- Publication: [Articulatory model of the epiglottis](#)

6.8. DCASE 2019 baseline

Baseline system for the task 4 of DCASE 2019 Challenge

KEYWORDS: Audio signal processing - Audio source classification - Machine learning - Smart home

FUNCTIONAL DESCRIPTION: This is the baseline system for the task 4 of the challenge on Detection and Classification of Acoustic Scenes and Events (DCASE) 2019. The algorithm performs sound events detection and classification. From an audio recording, the target of the system is to provide not only the event class but also the event time boundaries given that multiple events can be present in an audio recording. The baseline approach relies on convolutional and recurrent neural networks (CRNN) and a mean-teacher model to exploit a large amount of unbalanced and unlabeled training data together with a small weakly annotated (without timestamps) training set and a strongly annotated (with timestamps) synthetic set to improve system performance.

RELEASE FUNCTIONAL DESCRIPTION: This version includes a mean teacher model to exploit the various training sets with that have different levels of annotations, as provided in the task 4 of the DCASE 2019 challenge.

- Participants: Nicolas Turpault and Romain Serizel
- Contact: Nicolas Turpault
- Publication: [Sound event detection in domestic environments with weakly labeled data and sound-scape synthesis](#)
- URL: https://github.com/turpaultn/DCASE2019_task4/tree/public/baseline

PANAMA Project-Team

6. New Software and Platforms

6.1. 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: A Software Development Initiative (ADT REVELATION) started in April 2018 for the maturation of FAuST. A first step achieved this year was to complete and robustify Matlab wrappers, to code Python wrappers with the same functionality, and to setup a continuous integration process. A second step was to simplify the parameterization of the main algorithms. The roadmap for next year includes showcasing examples and optimizing computational efficiency. – 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, Adrien Leman and Hakim Hadj-Djilani
- 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](#) - [FA \$\mu\$ ST: 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/>

6.2. 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:

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

- Srđan Kitić, 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, Allgo, to test it on the web.

NEWS OF THE YEAR: In 2018, the code has been robustified with the help of InriaTech for a potential industrial transfer. – In 2017, a web interface to demonstrate the potential of SPADE has been setup using the Allgo platform.

- Participants: Nancy Bertin, Clement Gaultier, Ewen Camberlein, Romain Lebarbenchon, Alexandre Sanchez, Rémi Gribonval and Srdan Kitic
- Contact: Rémi Gribonval
- Publications: [Audio Declipping by Cosparsity Hard Thresholding - Sparsity and cosparsity for audio declipping: a flexible non-convex approach](#)
- URL: <http://spade.inria.fr/>

6.3. 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 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/>.

Version 2.2.2 (current version) has been released in May 2018. This version was developed in the PANAMA team through the Inria funded ADT "FFWD" (FASST For Wider Dissemination). A version 3.0 is currently under development and will be released in 2019.

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.

NEWS OF THE YEAR: Version 2.2.2 (current version) has been released in May 2018. This version was developed in the PANAMA team through the Inria funded ADT FFWD (FASST For Wider Dissemination). A version 3.0 is currently under development and will be released in 2019.

- 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/>

6.4. Multi-channel BSS Locate Basic

KEYWORDS: Audio - Localization - Signal processing - Multichannel signal

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

NEWS OF THE YEAR: In 2018, with the help of InriaTech, selected parts of Multi-channel BSS Locate were ported to C++ in the perspective of a transfer

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

6.5. VoiceHome-2

KEYWORDS: Speech processing - Audio signal processing - Source Separation - Source localization

SCIENTIFIC DESCRIPTION: New, extended version of the voiceHome corpus for distant-microphone speech processing in domestic environments. This 5-hour corpus includes short reverberated, noisy utterances (smart home commands) spoken in French by 12 native French talkers in diverse realistic acoustic conditions and recorded by an 8-microphone device at various angles and distances and in various noise conditions. Noise-only segments before and after each utterance are included in the recordings. Clean speech and spontaneous speech recorded in 12 real rooms distributed in 4 different homes are also available. All data have been fully annotated.

- Participants: Nancy Bertin, Ewen Camberlein, Romain Lebarbenchon, Emmanuel Vincent, Sunit Sivasankaran, Irina Illina and Frédéric Bimbot
- Contact: Nancy Bertin
- Publication: [VoiceHome-2, an extended corpus for multichannel speech processing in real homes](#)

SEMAGRAMME Project-Team

5. New Software and Platforms

5.1. ACGtk

Abstract Categorical Grammar Development Toolkit

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

SCIENTIFIC DESCRIPTION: Abstract Categorical Grammars (ACG) are a grammatical formalism in which grammars are based on typed lambda-calculus. A grammar generates two languages: the abstract language (the language of parse structures), and the object language (the language of the surface forms, e.g., strings, or higher-order logical formulas), which is the realization of the abstract language.

ACGtk provides two software tools to develop and to use ACGs: *acgc*, which is a grammar compiler, and *acg*, which is an interpreter of a command language that allows one, in particular, to parse and realize terms.

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

RELEASE FUNCTIONAL DESCRIPTION: This version removes the dependency to obsolete packages. It also provides a better handling of the command line interface.

NEWS OF THE YEAR: The new version removes dependencies to obsolete libraries. It improves the command line interface and prepares the integration of new functionalities and optimizations.

- 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 Categorical Grammars](#) - [ACGTK: un outil de développement et de test pour les grammaires catégorielles abstraites](#) - [Discourse Modeling with Abstract Categorical Grammars](#) - [On the expressive power of Abstract Categorical Grammars: Representing context-free formalisms](#) - [Towards abstract categorical grammars](#)
- URL: <http://acg.loria.fr/>

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).

NEWS OF THE YEAR: In 2019, the Grew software was enriched with a new syntax for edges (it is now possible to use feature structures as edge labels).

The Grew-match tool (<http://match.grew.fr>) is an online service available where a user can query different corpora with graph matching requests. All UD corpora (157 in 90 different languages in v2.5) are available and data from several other projects can also be queried. In the last 12 months (December 2018 to November 2019), 32,465 requests were received on the Grew-match server. The number of requests has increased in the last months (7,948 in November 2019).

An experiment was conducted to test the usage of the matching part of Grew on larger graphs. In the internship of Axel Didier, we experiment graph query on the French lexical network, RL-Fr.

- Participants: Bruno Guillaume, Guy Perrier and Guillaume Bonfante
- Contact: Bruno Guillaume
- Publications: [Application de la réécriture de graphes au traitement automatique des langues - Application of Graph Rewriting to Natural Language Processing](#)
- URL: <http://grew.fr/>

5.4. ZombiLingo

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

FUNCTIONAL DESCRIPTION: ZombiLingo is a prototype of a GWAP (Game With A Purpose) where gamers have to give linguistic information about the syntax of natural language sentences, currently in French, and later to other languages.

NEWS OF THE YEAR: Karën Fort and Bruno Guillaume proposed a new version of ZombiLingo this year. It is named ZombiLudik (<https://zombiludik.org>) and the main difference is that the linguistic data used are now based on the Universal Dependencies (UD) framework. Due to the recent success of the UD project, this format is now used for data in 90 different languages and we hope to find new collaborations to work on a similar games for some foreign languages. A first demonstration version was built on English data (<https://en.zombiludik.org>). Karën Fort and Bruno Guillaume presented the English version of the game in June during the NIEUW consortium meeting in London.

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

Auctus Team

6. New Software and Platforms

6.1. HuMoSoft

Human Motion Analysis Software

KEYWORDS: Movement analysis - 3D movement

FUNCTIONAL DESCRIPTION: HuMoSoft is based on the ROS platform. The acquisition data can come from different depth sensors, for example Kinect, via the NuiTrack JDK. An extended Kalman filter has been implemented, and motion analysis uses the RULA method.

- Authors: Jessica Colombel and David Daney
- Contact: Sylvain Pion
- URL: <https://gitlab.inria.fr/auctus/kombos-server>

6.2. KCADL

Kinematic Chain Appropriate Design Library

KEYWORDS: Interval analysis - Uncertainty - Kinematics

FUNCTIONAL DESCRIPTION: Software for the modelling and analysis of imprecise serial kinematic chains. Chain objects are built by iteratively adding rigid-body segments with associated joint connections (e.g., fixed, revolutes, prismatic). Several standard options are provided to model each segment (e.g., Denavit-Hartenberg parameters, transformation matrices, twists). Each option accepts interval and non-interval arguments, allowing to model the uncertainties and variabilities of imprecise serial kinematic chains and also the conventional precise serial kinematic chains. Forward Kinematic (FK) and Inverse Kinematic (IK) solvers are available for Chain objects. The FK solver computes an outer bound of the set of poses associated with a set of joint configurations. The IK solver computes an outer bound of the set of joint configurations associated with a set of poses.

- Participant: Joshua Pickard
- Contact: Joshua Pickard
- Publication: [hal-02367664, version 1](#)
- URL: <https://gitlab.inria.fr/auctus/kinematic-chain-appropriate-design-library>

6.3. AUCTUS-MOVER

AUCTUS panda MOVER project

KEYWORDS: Automatic control - Variability

FUNCTIONAL DESCRIPTION: Software for controlling the Franka Emika Panda robot to study human motor variabilities. Consists of a torque-based controller for the Franka Emika Panda collaborative robot with the following actuation modes: auto mode - the robot follows a predefined trajectory, manual mode - the robot is in a constrained gravity compensation mode (the constraints may be adapted online). A graphical interface allows the operator to switch between modes. Software for calibrating the robot with respect to the Optitrack motion capture system is also included.

- Contact: Joshua Pickard
- URL: https://gitlab.inria.fr/auctus/auctuspanda/tree/mover_project

6.4. AUCTUS-RT

AUCTUS - Redunancy Tubes

KEYWORD: Variability

FUNCTIONAL DESCRIPTION: Software for modelling and analyzing human motor variabilities along a path. Currently used to study the redundant motions associated with the upper limb. Anatomical constraints for the shoulder, elbow, and wrist may be customized for a human subject using: maximal and minimal bounding regression equations, spherical polygon constraints. A constrained imprecise kinematic model of the subject is obtained and the task redundancies and joint redundancies associated with the constrained imprecise kinematic model are able to be evaluated via branch-and-bound exploration to determine achievable and non-achievable redundant motions of the human. For n redundant degrees-of-freedom, this provides an n -dimensional redundant workspace describing the human's capabilities. Along a path, this provides an $(n+1)$ -dimensional redundant workspace tube.

- Contact: Joshua Pickard
- URL: <https://gitlab.inria.fr/auctus/redundancy-tubes>

6.5. WoobotSim

KEYWORDS: Robotics - Dynamic Analysis

FUNCTIONAL DESCRIPTION: WoobotSim is a simulator that reports the dynamics of the parties involved in an industrial task implying a strong interaction between a machine tool, an operator and a handled object, it also offers the possibility to add a cobot as an actor. Developed on Matlab, this simulator allows to visualize the efforts exchanged by the participants during the task, as well as the dynamics of the object being manipulated. For the specific case of woodworking shaper. It includes a wood cutting model. A model of task control by the craftsman and a model of the robot.

- Contact: Nassim Benhabib

6.6. Arcol

The Arcol platform provides technical support for the short, medium and long term experimental developments carried out within the framework of Auctus' scientific and dissemination activities.

These technological developments are essentially software related in the context of human motion capture and real-time control of collaborative robots. Arcol aims at easing their implementation, deployment, documentation and support.

Implementations include:

- a software component for online estimation of the state of one or more human "subjects" of a collaborative robotics experiment; visualization tool for replaying a number of simulated experiments;
- an integrating architecture allowing the simple addition of hardware components (sensors, robots,...) and the configuration of an experiment by describing the hardware components included, the nature of the treatments to be performed and the history files (logs) to be constituted.

To date the work done is:

- help and realization of an experimental setup for the study of the motor variability of a user ;
- assistance and realization of an experimental setup for the study of the interaction wrenches during a machining task of a piece of wood in an industrial context ;
- implementation and deployment of a method for using Inria integration tools for the team's code ;
- development of a solution allowing to simply interface the ROS framework with the Unity3D software, in a modular and easily deployable experimentation perspective.

CHORALE Team

5. New Software and Platforms

5.1. Perception360

Perception360 is an integration software platform for all perception developments in the Inria CHORALE team. All functions have been coded in a modular and scalable ROS environment by including a generic model to take into account the different sensors (monocular perspective vision (RGB), vision stereo perspective (RGB-D), spherical vision (RGB and RGB-D)).

The main application concerns representation of the environment (multi-layers topological and spherical representation of the environment), Localization, SLAM and Navigation.

Features

Robot vision (Perspective and Omnidirectional RGB-D sensors)

3D mapping

- Image acquisition
- Registration
- Sensor Calibration
- Visual odometry
- Localization
- Keyframe based mapping

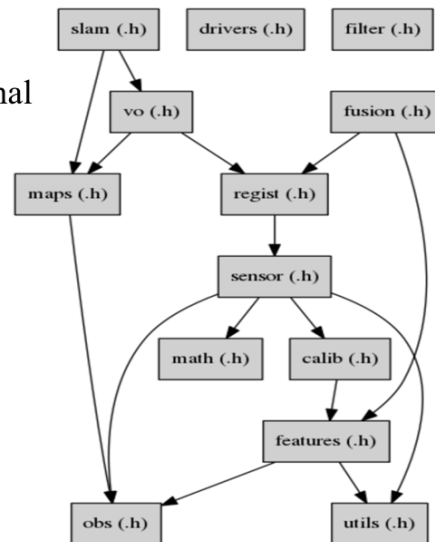


Figure 1. PERCEPTION360

5.2. ICAV

ICAV is an Intelligent and Connected Autonomous Vehicle. It is composed of a Renault ZOE robotized by Ecole Centrale of Nantes (by the team setup by Philippe Martinet in LS2N/ARMEN).

The robotization allows to have access to the control of:

- Steering angle (or steering torque)
- Braking torque
- Acceleration
- Gear box
- Blinking light

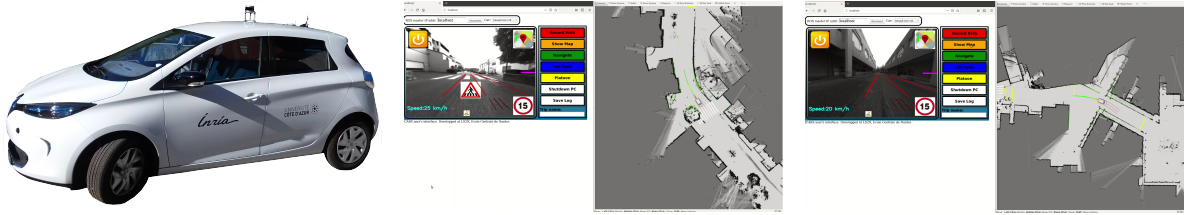


Figure 2. ICAV platform and its web interface

In its original version, it is composed of embedded sensors:

- Car odometry and velocity
- Low cost GPS (Ublox 6)
- Low cost IMU
- Lidar VLP16 from Velodyne
- Two front cameras in the bumper
- One rear camera in the bumper

and one embedded computer, with a web interface connected to a simple tablet. All the equipments are connected to the existing comfort battery. This equipment has been funded by UCA (Digital Reference Centre) and delivered late 2018.

In addition, in the framework of a collaboration between CHORALE and LS2N/ARMEN one global application of Mapping/Localization/Navigation/Parking is installed in the vehicle. This application is using LIDAR VLP16 based mapping algorithm developed in Nantes including the last two years collaboration work between CHORALE and ARMEN. In January 2019, we have done the map of the Inria Sophia Antipolis Center, and other places of Sophia Antipolis. On all places, it is possible to localize the vehicle, register a path and then proceed to autonomous navigation (if we obtain the authorization to make it). Fast prototyping tools environment called ICARS is available for both simulation and development purposes.

In december 2019, we have evaluated the navigation algorithm on the new experimental site made available by CASA.



Figure 3. CASA experimental site in Sophia Antipolis

In the near future, in the framework of the project SPHERE we will integrate a novel 360 degree camera system with the Perception360 platform and embed this system in ICAV. A global 360 degree navigation system will be developed.

5.3. DRONIX

In 2019, we have defined and installed a capture motion system composed of 6 cameras coming from the QUALISYS company. This system allows to track and localize a multi robot system.



Figure 4. DRONIX platform

In our applications, we will consider the use of UAVs and possibly the collaboration between UAVs and AGV. The DRONIX platform will be used for real time navigation, and as a ground truth system. The system has a central computer and each robots will have possible access to the global information by wifi.

CHROMA Project-Team

6. New Software and Platforms

6.1. Ground Elevation and Occupancy Grid Estimator (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

6.2. 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 management 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, Lukas Rummelhard, Jean-Alix David and Christian Laugier
- Partners: CEA - CNRS
- Contact: Christian Laugier

6.3. 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: Lukas Rummelhard

6.4. 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, Lukas Rummelhard and Jean-Alix David
- Contact: Lukas Rummelhard

6.5. 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. Therefore any program executed on the vehicle can be used with the simulation and reciprocally.

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

6.6. EKF Odom

EKF based localisation for vehicles

KEYWORDS: Localization - Autonomous Cars

FUNCTIONAL DESCRIPTION: This software fuses IMU data with wheel rotation or speed measurement inside an Extended Kalman Filter. It estimates the state position, orientation, speed, angular speed, acceleration.

- Authors: Thomas Genevois and Christian Laugier
- Contact: Christian Laugier
- URL: <https://team.inria.fr/chroma/en/>

6.7. Light Vehicle Simulation

Simulation of a light vehicle in Gazebo environment

KEYWORD: Simulation

FUNCTIONAL DESCRIPTION: This simulation represents a light 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. Therefore any program executed on the vehicle can be used with the simulation and reciprocally.

- Authors: Thomas Genevois and Christian Laugier
- Contact: Christian Laugier
- URL: <https://team.inria.fr/chroma/en/>

6.8. CarHybridSim

Hybrid simulation for autonomous cars with high traffic

KEYWORDS: Simulation - Autonomous Cars

FUNCTIONAL DESCRIPTION: Open source tool for simulating autonomous vehicles in complex, high traffic, scenarios. The hybrid simulation fully integrates and synchronizes a microscopic, multi-modal traffic simulator and a complex 3D simulator.

- Contact: Mario Garzon Oviedo
- URL: https://github.com/marioney/hybrid_simulation

6.9. SimuDronesGR

Simulation of UAV fleets with Gazebo/ROS

KEYWORDS: Robotics - Simulation

FUNCTIONAL DESCRIPTION: The simulator includes the following functionality : 1) Simulation of the mechanical behavior of an Unmanned Aerial Vehicle : * Modeling of the body's aerodynamics with lift, drag and moment * Modeling of rotors' aerodynamics using the forces and moments' expressions from Philippe Martin's and Erwan Salaün's 2010 IEEE Conference on Robotics and Automation paper "The True Role of Accelerometer Feedback in Quadrotor Control". 2) Gives groundtruth informations : * Positions in East-North-Up reference frame * Linear velocity in East-North-Up and Front-Left-Up reference frames * Linear acceleration in East-North-Up and Front-Left-Up reference frames * Orientation from East-North-Up reference frame to Front-Left-Up reference frame (Quaternions) * Angular velocity of Front-Left-Up reference frame expressed in Front-Left-Up reference frame. 3) Simulation of the following sensors : * Inertial Measurement Unit with 9DoF (Accelerometer + Gyroscope + Orientation) * Barometer using an ISA model for the troposphere (valid up to 11km above Mean Sea Level) * Magnetometer with the earth magnetic field declination * GPS Antenna with a geodesic map projection.

RELEASE FUNCTIONAL DESCRIPTION: Initial version

- Author: Vincent Le Doze
- Partner: Insa de Lyon
- Contact: Vincent Le Doze

6.10. cuda_US_grid

KEYWORDS: Robotics - Environment perception

FUNCTIONAL DESCRIPTION: This module generates occupation grids from data generated by an ultrasonic range sensor. 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: Christian Laugier and Thomas Genevois
- Partner: CEA
- Contact: Christian Laugier

6.11. Embedded Perception

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

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

6.12. spank

Swarm Protocol And Navigation Kontrol

KEYWORD: Protocoles

FUNCTIONAL DESCRIPTION: Communication and distance measurement in an uav swarm

- Contact: Stéphane d'Alu
- URL: <https://gitlab.inria.fr/dalu/spank>

6.13. S-NAMO-SIM

S-NAMO Simulator

KEYWORDS: Simulation - Navigation - Robotics - Planning

FUNCTIONAL DESCRIPTION: 2D Simulator of NAMO algorithms (Navigation Among Movable Obstacles)

ROS compatible

RELEASE FUNCTIONAL DESCRIPTION: Creation

- Contact: Benoit Renault

DEFROST Project-Team

6. New Software and Platforms

6.1. SOFA

Simulation Open Framework Architecture

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

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

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

6.2. SoftRobots

SoftRobots plugin for Sofa

KEYWORDS: Numerical simulations - Problem inverse - Soft robotics

FUNCTIONAL DESCRIPTION: This plugin allows the modeling of deformable robots in the Sofa platform. It allows the modeling of different actuators, such as cable, pneumatic pressure, hydraulics and other simpler types of actuation. It also contains useful tools for animation design or communication with the robot. Coupled with the SoftRobots.Inverse plugin, it also allows the control of these robots. More information can be found on the dedicated website.

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

6.3. Model Order Reduction Plugin for SOFA

KEYWORDS: Model Order Reduction - Sofa - Finite element modelling

SCIENTIFIC DESCRIPTION: This plugin allows speed-up of SOFA simulations by providing tools to create a reduced version of the SOFA simulation that runs at much higher rates but remains accurate. Starting with a snapshot of the object deformations on a high-dimensional Finite Element mesh, Proper Orthogonal Decomposition (POD) is used to compute a reduced basis of small dimension representing correctly all the possible deformations of the object. The original system describing the object motion is then greatly reduced. To keep numerical efficiency, a hyper-reduction method is used to speed-up the construction of the reduced system.

FUNCTIONAL DESCRIPTION: This plugin allows to dramatically reduce computational time in mechanical simulation in the SOFA framework. A reduced simulation, of much smaller dimension but still accurate is created in an automatic way by the plugin. Building the reduced model may take time, but this operation is made once only. The user can then benefit from a reduced and interactive version of his/her simulation without significant loss of accuracy.

RELEASE FUNCTIONAL DESCRIPTION: This is the first version of the plugin.

NEWS OF THE YEAR: Publication using this plugin accepted dans IEEE Transactions on Robotics

- Participants: Olivier Goury, Félix Vanneste, Christian Duriez and Eulalie Coevoet
- Contact: Olivier Goury
- Publication: [Fast, generic and reliable control and simulation of soft robots using model order reduction](#)
- URL: <https://project.inria.fr/modelorderreduction/>

6.4. SoftRobots.Inverse

KEYWORDS: Sofa - SoftRobots

FUNCTIONAL DESCRIPTION: This plugin builds on the plugin SoftRobots. Inside the plugin, there is some constraint components that are used to describe the robot (effectors, actuators, sensors). An optimisation algorithm is provided to find the efforts to put on actuators in order to place the robot in a the closest possible configuration than the one described by "effectors", or to a state described by "sensors". This method used to control the soft-robots in the task space is patented.

- Partners: CNRS - Université de Lille - Ecole Centrale de Lille
- Contact: Christian Duriez
- URL: <https://project.inria.fr/softrobot.inverse>

6.5. SofaPython3

KEYWORDS: Python - Numerical simulations - Sofa

FUNCTIONAL DESCRIPTION: This plugin allows to use Sofa as a library from any python3 program. It also allows to write new mechanical component for a Sofa simulation in python3.

- Contact: Christian Duriez
- URL: <https://github.com/SofaDefrost/plugin.SofaPython3/>

6.6. SofaQtQuick

runSofa2

KEYWORDS: Sofa - GUI (Graphical User Interface) - Modeling - Physical simulation

FUNCTIONAL DESCRIPTION: Smooth the user experience with Sofa By integrating authoring features into runSofa so we can design simulation in an integrated environment. We should be able to model scenes, simulate & debug them.

This tool replaces the old "runSofa" interface, today deprecated but still in use by most SOFA users.

SofaQtQuick provides a fluid and dynamic user experience for SOFA, thanks to the integration of authoring tools to design complex simulations directly in the 3D environment, rather that scripting them as it is done today.

FEATURES:

- *Scene graph editing
- *Interactive modeling

*Project oriented approach

*Prefab as reusable and parametric object

*2D Canvas

*Custom widgets per component

*Live coding

*Node base interface for data link debugging

*Everything with a non-linear workflow

Based on a code gift from Anatoscope, stringly inspired by Blender & Unity's workflow.

RELEASE FUNCTIONAL DESCRIPTION: 1st Beta version, unstable, but testable.

- Contact: Christian Duriez
- URL: <http://github.com/SofaDefrost/SofaQtQuick>

FLOWERS Project-Team

6. New Software and Platforms

6.1. Explauto

an autonomous exploration library

KEYWORD: Exploration

SCIENTIFIC DESCRIPTION: An important challenge in developmental robotics is how robots can be intrinsically motivated to learn efficiently parametrized policies to solve parametrized multi-task reinforcement learning problems, i.e. learn the mappings between the actions and the problem they solve, or sensory effects they produce. This can be a robot learning how arm movements make physical objects move, or how movements of a virtual vocal tract modulates vocalization sounds. The way the robot will collect its own sensorimotor experience has 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 [127], which has been extended to a more general family of autonomous exploration architectures by [1] and recently expressed as a compact and unified formalism [119]. The library is detailed in [120]. In Explauto, interest models are implementing the strategies of active selection of particular problems / goals in a parametrized multi-task reinforcement learning setup to efficiently learn parametrized policies. The agent can have different available strategies, parametrized problems, models, sources of information, or learning mechanisms (for instance imitate by mimicking vs by emulation, or asking help to one teacher or to another), and chooses between them in order to optimize learning (a process called strategic learning [124]). 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 [127]. 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 [1].

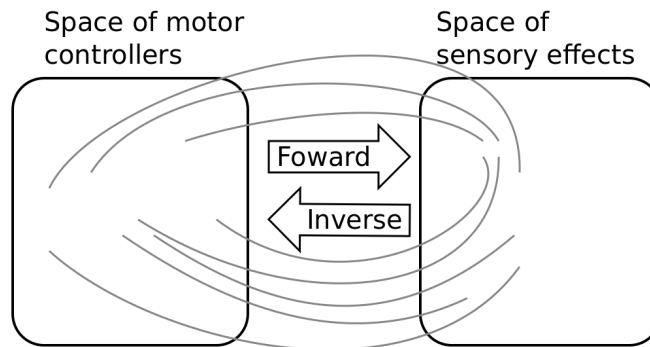


Figure 1. Complex parametrized policies involve high dimensional action and effect spaces. For the sake of visualization, the motor M and sensory S spaces are only 2D each in this example. The relationship between M and S is non-linear, dividing the sensorimotor space into regions of unequal stability: 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 the environment in which it evolves. Explauto provides also a unified interface to define exploration strategies using the InterestModel class. The library comes with two built-in interest models: random sampling as well as sampling maximizing the learning progress in forward or inverse predictions.

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

This library has been used in many experiments including:

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

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

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

6.2. KidBreath

KEYWORD: Machine learning

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

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

6.3. 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.

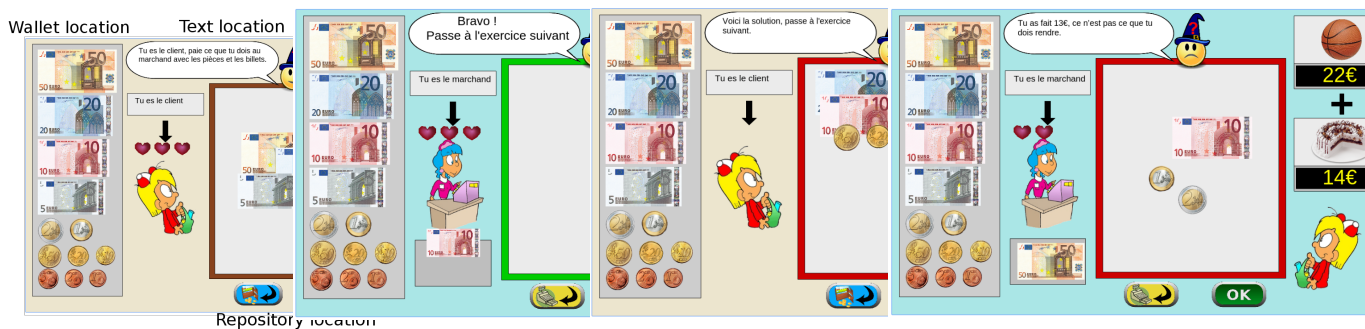


Figure 2. Four principal regions are defined in the graphical interface. The first is the wallet location where users can pick and drag the money items and drop them on the repository location to compose the correct price. The object and the price are present in the object location. Four different types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

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

6.4. Kidlearn: script for Kidbreath use

KEYWORD: PHP

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

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

6.5. 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: Pierre-Yves Oudeyer
- URL: <https://flowers.inria.fr/research/kidlearn/>

6.6. Poppy

KEYWORDS: Robotics - Education

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/>

6.7. Poppy Ergo Jr

KEYWORDS: Robotics - Education

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.

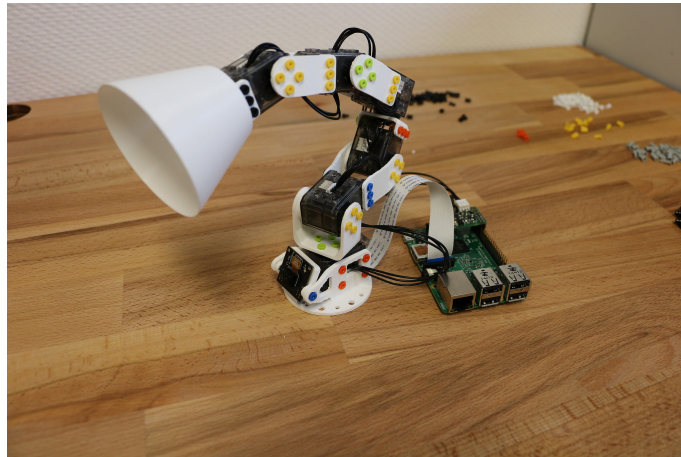


Figure 3. Poppy Ergo Jr, 6-DoFs arm robot for education

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

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

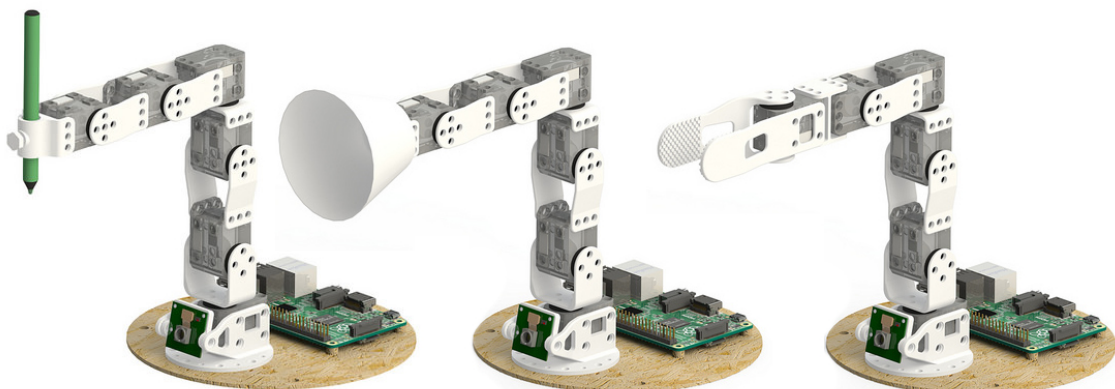


Figure 4. The available Ergo Jr tools: a pen holder, a lampshade and a gripper

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

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

6.8. S-RL Toolbox

Reinforcement Learning (RL) and State Representation Learning (SRL) for Robotics

KEYWORDS: Machine learning - Robotics

FUNCTIONAL DESCRIPTION: This repository was made to evaluate State Representation Learning methods using Reinforcement Learning. It integrates (automatic logging, plotting, saving, loading of trained agent) various RL algorithms (PPO, A2C, ARS, ACKTR, DDPG, DQN, ACER, CMA-ES, SAC, TRPO) along with different SRL methods (see SRL Repo) in an efficient way (1 Million steps in 1 Hour with 8-core cpu and 1 Titan X GPU).

- Partner: ENSTA
- Contact: David Filliat
- URL: <https://github.com/raffin/robotics-rl-srl>

6.9. Deep-Explauto

KEYWORDS: Deep learning - Unsupervised learning - Learning - Experimentation

FUNCTIONAL DESCRIPTION: Until recently, curiosity driven exploration algorithms were based on classic learning algorithms, unable to handle large dimensional problems (see explauto). Recent advances in the field of deep learning offer new algorithms able to handle such situations.

Deep explauto is an experimental library, containing reference implementations of curiosity driven exploration algorithms. Given the experimental aspect of exploration algorithms, and the low maturity of the libraries and algorithms using deep learning, proposing black-box implementations of those algorithms, enabling a blind use of those, seem unrealistic.

Nevertheless, in order to quickly launch new experiments, this library offers an set of objects, functions and examples, allowing to kickstart new experiments.

- Contact: Alexandre Pere

6.10. Orchestra

KEYWORD: Experimental mechanics

FUNCTIONAL DESCRIPTION: Orchestra is a set of tools meant to help in performing experimental campaigns in computer science. It provides you with simple tools to:

+ Organize a manual experimental workflow, leveraging git and lfs through a simple interface. + Collaborate with other peoples on a single experimental campaign. + Execute pieces of code on remote hosts such as clusters or clouds, in one line. + Automate the execution of batches of experiments and the presentation of the results through a clean web ui.

A lot of advanced tools exists on the net to handle similar situations. Most of them target very complicated workflows, e.g. DAGs of tasks. Those tools are very powerful but lack the simplicity needed by newcomers. Here, we propose a limited but very simple tool to handle one of the most common situation of experimental campaigns: the repeated execution of an experiment on variations of parameters.

In particular, we include three tools: + expedit: a tool to organize your experimental campaign results in a git repository using git-lfs (large file storage). + runaway: a tool to execute code on distant hosts parameterized with easy to use file templates. + orchestra: a tool to automate the use of the two previous tools on large campaigns.

- Contact: Alexandre Pere

6.11. Curious

Curious: Intrinsically Motivated Modular Multi-Goal Reinforcement Learning

KEYWORDS: Exploration - Reinforcement learning - Artificial intelligence

FUNCTIONAL DESCRIPTION: This is an algorithm enabling to learn a controller for an agent in a modular multi-goal environment. In these types of environments, the agent faces multiple goals classified in different types (e.g. reaching goals, grasping goals for a manipulation robot).

- Contact: Cedric Colas

6.12. teachDeepRL

Teacher algorithms for curriculum learning of Deep RL in continuously parameterized environments

KEYWORDS: Machine learning - Git

FUNCTIONAL DESCRIPTION: Codebase from our CoRL2019 paper <https://arxiv.org/abs/1910.07224>

This github repository provides implementations for the following teacher algorithms: - Absolute Learning Progress-Gaussian Mixture Model (ALP-GMM), our proposed teacher algorithm - Robust Intelligent Adaptive Curiosity (RIAC), from Baranes and Oudeyer, R-IAC: robust intrinsically motivated exploration and active learning. - Covar-GMM, from Moulin-Frier et al., Self-organization of early vocal development in infants and machines: The role of intrinsic motivation.

- Contact: Remy Portelas
- URL: <https://github.com/flowersteam/teachDeepRL>

6.13. Automated Discovery of Lenia Patterns

KEYWORDS: Exploration - Cellular automaton - Deep learning - Unsupervised learning

SCIENTIFIC DESCRIPTION: In many complex dynamical systems, artificial or natural, one can observe selforganization of patterns emerging from local rules. Cellular automata, like the Game of Life (GOL), have been widely used as abstract models enabling the study of various aspects of self-organization and morphogenesis, such as the emergence of spatially localized patterns. However, findings of self-organized patterns in such models have so far relied on manual tuning of parameters and initial states, and on the human eye to identify “interesting” patterns. In this paper, we formulate the problem of automated discovery of diverse self-organized patterns in such high-dimensional complex dynamical systems, as well as a framework for experimentation and evaluation. Using a continuous GOL as a testbed, we show that recent intrinsically-motivated machine learning algorithms (POP-IMGEPs), initially developed for learning of inverse models in robotics, can be transposed and used in this novel application area. These algorithms combine intrinsically motivated goal exploration and unsupervised learning of goal space representations. Goal space representations describe the “interesting” features of patterns for which diverse variations should be discovered. In particular, we compare various approaches to define and learn goal space representations from the perspective of discovering diverse spatially localized patterns. Moreover, we introduce an extension of a state-of-the-art POP-IMGEP algorithm which incrementally learns a goal representation using a deep auto-encoder, and the use of CPPN primitives for generating initialization parameters. We show that it is more efficient than several baselines and equally efficient as a system pre-trained on a hand-made database of patterns identified by human experts.

FUNCTIONAL DESCRIPTION: Python source code of experiments and data analysis for the paper " Intrinsically Motivated Discovery of Diverse Patterns in Self-Organizing Systems" (Chris Reinke, Mayalen Echeverry, Pierre-Yves Oudeyer in Submitted to ICLR 2020). The software includes: Lenia environment, exploration algorithms (IMGEPs, random search), deep learning algorithms for unsupervised learning of goal spaces, tools and configurations to run experiments, and data analysis tools.

- Contact: Chris Reinke
- URL: https://github.com/flowersteam/automated_discovery_of_lenia_patterns

6.14. ZPDES_ts

ZPDES in typescript

KEYWORDS: Machine learning - Education

FUNCTIONAL DESCRIPTION: ZPDES is a machine learning-based algorithm that allows you to customize the content of training courses for each learner's level. It has already been implemented in the Kidlern software in python with other algorithms. Here, ZPDES is implemented in typescript.

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

6.15. GEP-PG

Goal Exploration Process - Policy Gradient

KEYWORDS: Machine learning - Deep learning

FUNCTIONAL DESCRIPTION: Reinforcement Learning algorithm working with OpenAI Gym environments. A first phase implements exploration using a Goal Exploration Process (GEP). Samples collected during exploration are then transferred to the memory of a deep reinforcement learning algorithm (deep deterministic policy gradient or DDPG). DDPG then starts learning from a pre-initialized memory so as to maximize the sum of discounted rewards given by the environment.

- Contact: Cedric Colas

HEPHAISTOS Project-Team

5. New Software and Platforms

5.1. 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

5.2. PALGate

KEYWORDS: Health - Home care - Handicap

- Contact: David Daney

5.3. Platforms

5.3.1. ALIAS, *Algorithms Library of Interval Analysis for Systems*

Participants: Hiparco Lins Vieira, Jean-Pierre Merlet [correspondant], Yves Papegay.

URL: <http://www-sop.inria.fr/hephaistos/developpements/main.html>

The ALIAS library whose development started in 1998, is a collection of procedures based on interval analysis for systems solving and optimization.

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ALIAS is a core element for solving the usually complex equations we have to manage our robotics problems. We may mention as example our work on cable-driven parallel robot (see section 6.1.1) involves non-algebraic models whose exact solving is required while the unknowns of our system are physical entities that may usually be bounded (meaning that we are not interested in all solutions of the system but only in the one that make physical sense) and therefore interval analysis is appropriate (and quite often the only one that may manage to get exactly all solutions). This year we have also used ALIAS to provide certified solutions of the kinematics of a flexible parallel robots [17]. We have confirmed the solutions that has been provided by a computer intensive iterative methods and have shown that the interval analysis method was able to manage a more complex case for which the iterative method cannot be reasonably used. In a third example we combine interval analysis and Monte-Carlo method for developing a reliable motion planning for parallel manipulators [15] while interval analysis has been used for the design of parallel robot [14].

5.3.2. *Hardware platforms*

We describe here only the new platforms that have been developed or improved in 2019 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, our experimental flat and the activities detection platform implemented in the day hospital Institut Claude Pompidou and EHPAD Valrose, Nice). Among the MARIONET family we have reactivated and adapted the MARIONET-CRANE prototype for the experiment described in section 6.1.2 . We have also updated our parallel 6 – *PUS* prototype for the medical application mentioned in section 6.3 .

5.3.2.1. *REVMED: virtual reality and rehabilitation*

Inria and Université Côte d'Azur have agreed to fund us for developing the platform REVMED 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. The main idea is to have a modular rehabilitation station allowing to manage various exercise devices with a very low set-up time (typically 10 mn), that will be actuated in order to allow ergotherapists to favor the work of various muscles groups and the difficulty of the exercise, while monitoring the rehabilitation process with various external sensors, providing an objectification of the evaluation. Version 2 has been completed this year and we will proceed in 2020 to the first trials. These trials will consist in establishing walking patterns for non-pathological people in various conditions that will be created by a walk in a mountainous environment.

LARSEN Project-Team

6. New Software and Platforms

6.1. ROS Qt Control

KEYWORDS: Control - Robot Operating System (ROS) - 2D

SCIENTIFIC DESCRIPTION: This ROS module allows to easily develop different controllers for wheeled mobile robots: Controller class just has to be inherited, the new class only needing a constructor and a `chooseVelocities` method. A graphical user interface using Qt makes it easy to choose a controller and to set its parameters, and it displays odometric data sent by ROS and the velocities sent to ROS by the controller.

NEWS OF THE YEAR: The code structure has been modified in order to propose a class hierarchy, with controllers aiming to reach a given state and others built to follow a selected trajectory.

- Participant: Alexis Scheuer
- Contact: Alexis Scheuer

6.2. ISeeML

Introducing a Smooth, Efficient and Easy-to-use Motion Library

KEYWORDS: Mobile Computing, Transportation - Optimal control - Planning

SCIENTIFIC DESCRIPTION: The main interest of this library is to offer smooth (continuous-curvature) efficient (close to the optimal) motions for mobile robots. Obtained paths correspond to locally optimal motions with constant velocity for wheeled mobile robots, either car-like or with differential-wheels (e.g. Thymio or Turtlebot). Classical paths (with a discontinuous curvature profile) are also provided. Both paths can also be used for aerial robots, as the motion constraints of those are similar to those of wheeled mobile robots.

RELEASE FUNCTIONAL DESCRIPTION: Additionnal fonctionnalités for optimal control using ROS.

NEWS OF THE YEAR: Additionnal fonctionnalités for optimal control using ROS.

- Participant: Alexis Scheuer
- Contact: Alexis Scheuer
- Publication: [inria-00527913v1](#)
- URL: <http://iseeml.loria.fr>

PERVASIVE Project-Team (section vide)

RAINBOW Project-Team

5. New Software and Platforms

5.1. 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
- Partner: INSA Rennes
- Contact: Marie Babel

5.2. UsTk

Ultrasound toolkit for medical robotics applications guided from ultrasound images

KEYWORDS: Echographic imagery - Image reconstruction - Medical robotics - Visual tracking - Visual servoing (VS) - Needle insertion

FUNCTIONAL DESCRIPTION: UsTK, standing for Ultrasound Toolkit, is a cross-platform extension of ViSP software dedicated to 2D and 3D 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 acquiring 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 of ultrasound images, generate elastography images, track a flexible needle in sequences of 2D and 3D ultrasound images and track a target image template in sequences of 2D ultrasound images. All these modules were implemented on several robotic demonstrators to control the motion of an ultrasound probe or a flexible needle by ultrasound visual servoing.

- Participants: Alexandre Krupa and Fabien Spindler
- Partners: Inria - Université de Rennes 1
- Contact: Alexandre Krupa
- URL: <https://ustk.inria.fr>

5.3. ViSP

Visual servoing platform

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

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 Rainbow research. ViSP was designed to be independent from the hardware, to be simple to use, expandable and cross-platform. ViSP allows designing vision-based tasks for eye-in-hand and eye-to-hand systems from 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 300 fully documented classes organized in 17 different modules, with more than 408 examples and 88 tutorials are proposed to the user. ViSP is released under a dual licensing model. It is open-source with a GNU GPLv2 or GPLv3 license. A professional edition license that replaces GNU GPL is also available.

- Participants: Éric Marchand, Fabien Spindler and François Chaumette
- Partners: Inria - Université de Rennes 1
- Contact: Fabien Spindler
- URL: <http://visp.inria.fr>

5.4. Platforms

5.4.1. Robot Vision Platform

Participants: François Chaumette, Alexandre Krupa, Eric Marchand, Fabien Spindler [contact].

We exploit two industrial robotic systems built by Afma Robots in the nineties to validate our research 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). These robots are equipped with monocular RGB cameras. The Gantry robot also allows mounting grippers on its end-effector. Attached to this platform, we can also find a collection of various RGB and RGB-D cameras used to validate vision-based real-time tracking algorithms (see Sections 6.1.1 and 6.1.2). Note that four papers [32], [14], [52], [53] published by Rainbow in 2019 include results validated on this platform.

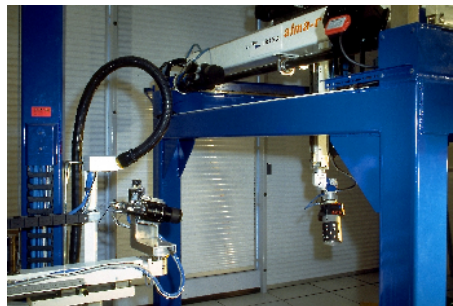


Figure 2. Rainbow robotics platform for vision-based manipulation

5.4.2. Mobile Robots

Participants: Marie Babel, Solenne Fortun, François Pasteau, Julien Pettré, Quentin Delamare, Fabien Spindler [contact].

For fast prototyping of algorithms in perception, control and autonomous navigation, the team uses a Pioneer 3DX from Adept (see Fig. 3 .a). This platform is equipped with various sensors needed for autonomous navigation and sensor-based control.

Moreover, to validate our research in personally assisted living topic (see Section 6.4.4), we have three electric wheelchairs, one from Permobil, one from Sunrise and the last from YouQ (see Fig. 3 .b). 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, ultrasound and time of flight sensors to perform the required servoing for assisting handicapped people. This year we also bought a wheelchair haptic simulator to develop new human interaction strategies in a virtual reality environment (see Fig. 3 (c)).

Pepper, a human-shaped robot designed by SoftBank Robotics to be a genuine day-to-day companion (see Fig. 3 .d) is also part of this platform. 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 robot-human interactions during locomotion (see Section 6.2.6).

Note that 2 papers and 1 PhD Thesis exploiting the mobile robots were published this year [42], [54], [1].

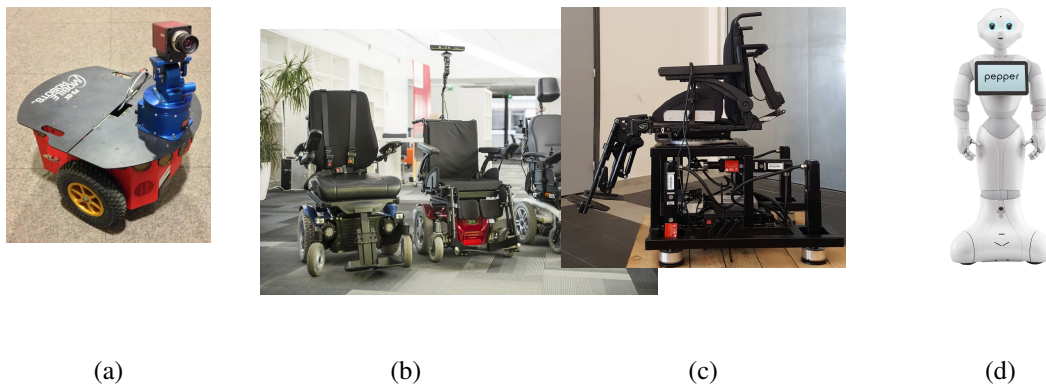


Figure 3. Mobile Robot Platform. a) Pioneer P3-DX robot, b) wheelchairs from Permobil, Sunrise and YouQ, c) Wheelchair haptic simulator, d) Pepper human-shaped robot

5.4.3. Medical Robotic Platform

Participants: Alexandre Krupa, Fabien Spindler [contact].

This platform is composed of two 6 DoF Adept Viper arms (see Figs. 4 .a–b). Ultrasound probes connected either to a SonoSite 180 Plus or an Ultrasonix SonixTouch 2D and 3D imaging system can be mounted on a force torque sensor attached to each robot end-effector. The haptic Virtuose 6D or Omega 6 device (see Fig. 7 .a) can also be used within this platform.

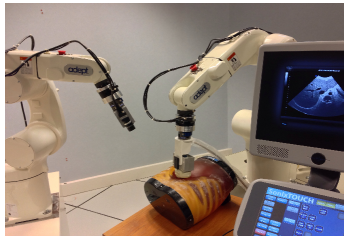
This year this platform was extended with a new ATI Nano43 force/torque sensor dedicated to needle insertion applications.

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 Sect. 6.4.3 and Sect. 6.4.2).

This platform was used to obtain experimental results presented in 4 new papers [6], [23], [38], [51].

5.4.4. Advanced Manipulation Platform

Participants: François Chaumette, Claudio Pacchierotti, Paolo Robuffo Giordano, Fabien Spindler [contact].



(a)



(b)

Figure 4. Rainbow medical robotic platforms. a) 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.

This new platform is composed by 2 Panda lightweight arms from **Franka Emika** equipped with torque sensors in all seven axes. An electric gripper, a camera or a soft hand from **qrobotics** can be mounted on the robot end-effector (see Fig. 5 .a) to validate our researches in coupling force and vision for controlling robot manipulators (see Section 6.2.12) and in shared control for remote manipulation (see Section 6.4.1). Other haptic devices (see Section 5.4.6) can also be coupled to this platform.

This year this platform was extended with a new Reflex TakkTile 2 gripper from **RightHand Labs** (see Fig. 5 .b). A new force/torque sensor from **Alberobotics** that can be mounted on the robot end-effector to get more precision during torque control was also bought.

Two new papers published this year include experimental results obtained with this platform [50], [66].



Figure 5. Rainbow advanced manipulation platform. a) One of the two Panda lightweight arms from Franka Emika, with mounted the Pisa SoftHand, b) the Reflex TakkTile 2 gripper that could be mounted on the Panda robot end-effector.

5.4.5. Unmanned Aerial Vehicles (UAVs)

Participants: Joudy Nader, Paolo Robuffo Giordano, Claudio Pacchierotti, Fabien Spindler [contact].

Rainbow is involved in several activities involving perception and control for single and multiple quadrotor UAVs. To this end, we purchased four quadrotors from Mikrokopter GmbH, Germany (see Fig. 6 .a), and one quadrotor from 3DRobotics, USA (see Fig. 6 .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 a NVIDIA Jetson TX2 board running Linux Ubuntu and the TeleKyb-3 software based on genom3 framework developed at LAAS in Toulouse (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. 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 2 papers [20], [25] and 2 PhD Theses [3] contain simulative and experimental results obtained with this platform [1].

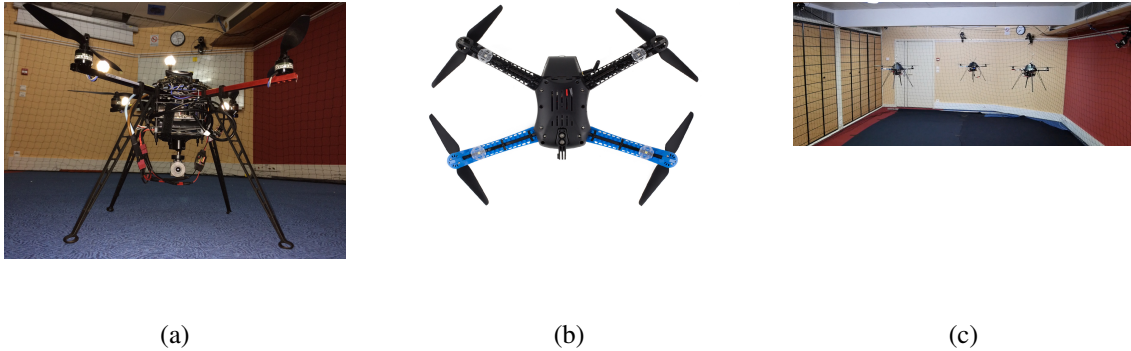


Figure 6. Unmanned Aerial Vehicles Platform. a) Quadrotor XL1 from Mikrokopter, b) Quadrotor Iris from 3DRobotics, c) Formation control with 3 XL1 from Mikrokopter.

5.4.6. Haptics and Shared Control Platform

Participants: Claudio Pacchierotti, Paolo Robuffo Giordano, Fabien Spindler [contact].

Various haptic devices are used to validate our research in shared control. We have a Virtuose 6D device from **Haption** (see Fig. 7 .a). This device is used as master device in many of our shared control activities (see Sections 6.4.2 and 6.4.3). It could also be coupled to the **Haption** haptic glove in loan from the University of Birmingham. An Omega 6 (see Fig. 7 .b) from **Force Dimension** and devices in loan from **Ultrahaptics** complete this platform that could be coupled to the other robotic platforms.

This platform was used to obtain experimental results presented in 9 papers [6], [50], [43], [44], [38], [45], [11], [51], [5] published this year.



(a)



(b)

Figure 7. Haptics and Shared Control Platform. a) Virtuose 6D and b) Omega 6 haptic devices

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 V2ProVue 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 V2proVue 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. Lookinlabs-Global

KEYWORD: Search Engine

FUNCTIONAL DESCRIPTION: Lookinlabs allows you to find, among teams/individuals/publications, those best matching your query.

- Authors: William Kokou Dedzoe and Jean Hany
- Contact: Vincent Claveau

6.2. TagEx

Yet another Part-of-Speech Tagger for French

KEYWORD: Natural language processing

FUNCTIONAL DESCRIPTION: TagEx is available as a web-service on <https://allgo.inria.fr> . Refer to Allgo for its usage.

- Contact: Vincent Claveau
- URL: <https://allgo.inria.fr/app/tagex>

6.3. NegDetect

Negation Detection

KEYWORD: Natural language processing

FUNCTIONAL DESCRIPTION: NegDetect relies on several layers of machine learning techniques (CRF, neural networks).

- Contact: Vincent Claveau

MAGRIT Team

6. New Software and Platforms

6.1. 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>

6.2. 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 [5].

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

6.3. NoLoDuDoCT

A non-local dual-domain cartoon and texture decomposition

KEYWORDS: Image analysis - Cartoon and texture decomposition

FUNCTIONAL DESCRIPTION: This is an algorithm decomposing images into cartoon and texture components. Spectrum components of textures are detected on the basis of a statistical hypothesis test, the null hypothesis modeling a purely cartoon patch. Statistics are estimated in a non-local way.

- Contact: Frédéric Sur
- Publication: [A non-local dual-domain approach to cartoon and texture decomposition](#)
- URL: <https://members.loria.fr/FSur/software/NoLoDuDoCT/>

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.

NEWS OF THE YEAR: Informal contacts told us that this library is used in academia and industry.

- Contact: Frédéric Sur
- Publication: [The grid method for in-plane displacement and strain measurement: a review and analysis](#)
- URL: <http://www.thegridmethod.net/>

6.5. BSpeckleRender

A Boolean model for deformed speckle rendering

KEYWORDS: Boolean model - Monte Carlo estimation - Experimental mechanics - Displacement fields

FUNCTIONAL DESCRIPTION: This library implements a new method for synthesizing speckle images deformed by an arbitrary deformation field set by the user. Such images are very useful for assessing the different methods based on digital image correlation (DIC) for estimating displacement fields in experimental mechanics. Since the deformations are very small, it is necessary to ensure that no additional bias is introduced by the image synthesis algorithm. The proposed method is based on the Monte Carlo evaluation of images generated by a Boolean model.

- Contact: Frédéric Sur
- Publication: [Rendering Deformed Speckle Images with a Boolean Model](#)
- URL: <https://members.loria.fr/FSur/software/BSpeckleRender/>

MORPHEO Project-Team

6. New Software and Platforms

6.1. 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, Matthieu Armando and Eymeric Amselem
- Contact: Edmond Boyer
- URL: <https://kinovis.inria.fr/lucyviewer/>

6.2. 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

6.3. 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 in the context of a software transfer contract, 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/>

6.4. 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/>

6.5. Adaptive mesh texture

KEYWORDS: 3D - Geometry Processing - Texturing

FUNCTIONAL DESCRIPTION: Tool for computing appearance information on a 3D scene acquired with a multi-view stereo (MVS) pipeline. Appearance information is sampled in an adaptive way so as to maximize the entropy of stored information. This is made possible through a homemade representation of appearance, different from the more traditional texture maps. This tool also includes a compression module, so as to optimize disk space.

RELEASE FUNCTIONAL DESCRIPTION: 1st version

- Authors: Matthieu Armando, Edmond Bover, Jean-Sébastien Franco and Vincent Leroy
- Partner: Microsoft
- Contact: Matthieu Armando
- URL: <https://gitlab.inria.fr/marmando/adaptive-mesh-texture>

PERCEPTION Project-Team

5. New Software and Platforms

5.1. NaoLab

Distributed middleware architecture for interacting with NAO

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

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

5.2. Associations of Audio Cues with 3D locations library

FUNCTIONAL DESCRIPTION: Library to associate some auditory cues with 3D locations (points). It provides an estimation of the emitting state of each of the input locations. There are two main assumptions : 1 - The 3D locations are valid during the acquisition interval related to the audio cues 2 - The 3D locations are the only possible locations for the sound sources, no new locations will be created in this module

The software provides also a multimodal fusion library

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

5.3. Audio Cue Extractor Library

FUNCTIONAL DESCRIPTION: This module extracts auditory cues from the raw audio streams. The interaural time difference (ITD) is estimated using cross-correlation methods.

- Participants: Antoine Deleforge, Radu Horaud and Soraya Arias
- Contact: Soraya Arias

5.4. Audiovisual Robots and Heads

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

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

5.5. GLLiM

Gaussian Locally Linear Mapping

KEYWORDS: Regression - Machine learning - Gaussian mixture

SCIENTIFIC DESCRIPTION: GLLiM is a flexible tool for probabilistic non-linear regression using Gaussian mixtures. Using an inverse regression strategy with a reduced number of parameters, it is particularly suited for high- to low-dimensional regression tasks. It also enables the modeling of additional unobserved non-linear effects on input data. The method was published in [Deleforge et al., IJNS 2015]. The toolbox include an example of application to head pose estimation from synthetic images.

- Participant: Antoine Deleforge
- Contact: Antoine Deleforge
- Publication: [hal-00863468, version 3](#)
- URL: https://team.inria.fr/perception/gllim_toolbox/

5.6. Litbot

Live together with robots

KEYWORDS: Speaker Localization - Audio tracking - Visual tracking - NAO Robot - Computer vision - Signal processing

SCIENTIFIC DESCRIPTION: Litbot stands for "Live together with robots". This library aims to provide algorithms and associated software packages to perform audio-visual speaker localization and tracking with a consumer robot (in particular a NAO robot). The scope of this project is two-fold. The first is to develop the robust speaker localization and tracking algorithm in the presence of other audio-visual sources like TV. The second is to modify or optimize the original algorithm to be fit into real-time system. This library benefits from the work done with Online Multiple Sound-Source Localization package developed by X. Li.

FUNCTIONAL DESCRIPTION: This project develops algorithms and associated software packages to perform audio-visual speaker localization and tracking with a consumer robot. This version of the litbot library provides new functions to integrate the Samsung robotic platform to handle ROS middleware (robotic defacto standard) and modifies and optimizes tracking and audio localization processes (better handling of the residual noise signals, performance improved to match real time).

- Participants: Xiaofei Li, Yutong Ban, Soraya Arias, Radu Horaud, Guillaume Sarrazin and Bastien Mourgue
- Contact: Radu Horaud

5.7. Online Multiple Sound-Source Localization

KEYWORDS: Audio signal processing - Multiple sound-source localization - Matlab - Direct-path RTF

FUNCTIONAL DESCRIPTION: This project tackles multiple sound-source localization in noisy and reverberant environments, using binaural recordings of an acoustic scene. It provides Matlab routines to estimate multiple sound source (such as speakers) locations based on direct-path relative transfer function (DP-RTF) estimation.

- Participants: Xiaofei Li and Radu Horaud
- Contact: Radu Horaud
- Publications: [Multiple-Speaker Localization Based on Direct-Path Features and Likelihood Maximization with Spatial Sparsity Regularization - Estimation of the Direct-Path Relative Transfer Function for Supervised Sound-Source Localization](#)

5.8. RMP

RoMPers

KEYWORDS: Middleware - Robotics - NAO Robot

SCIENTIFIC DESCRIPTION: Robot Middleware developed by Perception. It follows the development done on RobotHandler and NAOLab. Its goal is to provide an abstraction which allows an easy access to robot sensors. In the same time, this high level access is independant of the robot.

FUNCTIONAL DESCRIPTION: Robot Middleware developed by Perception. It follows the development done on RobotHandler and NAOLab. Its goal is to provide an abstraction which allows an easy access to robot sensors. In the same time, this high level access is independant of the robot. And it also provides tools for sensor calibration (audio, video), video annotation, etc

- Participant: Guillaume Sarrazin
- Contact: Soraya Arias

5.9. SE-VAE-alpha-stable

KEYWORDS: Audio signal processing - Speech processing - Deep learning - Neural networks

FUNCTIONAL DESCRIPTION: This software provides an iterative algorithm for enhancing a speech signal in a noisy monophonic recording. The algorithm is detailed in the following paper: "Speech enhancement with variational autoencoders and alpha-stable distributions" Simon Leglaive, Umut Simsekli, Antoine Liutkus, Laurent Girin, Radu Horaud IEEE International Conference on Acoustics Speech and Signal Processing (ICASSP), Brighton, UK, May 2019

- Contact: Simon Leglaive

5.10. Sound recognition library

FUNCTIONAL DESCRIPTION: This recognition module is based on supervised learning.

- Participants: Maxime Janvier and Radu Horaud
- Contact: Radu Horaud

5.11. SE-VAE-NMF

KEYWORDS: Audio signal processing - Speech processing - Deep learning - Neural networks

FUNCTIONAL DESCRIPTION: This software provides an iterative algorithm for enhancing a speech signal in a noisy monophonic recording. The algorithm is detailed in the following paper: "A variance modeling framework based on variational autoencoders for speech enhancement" Simon Leglaive, Laurent Girin, Radu Horaud Proc. of the IEEE International Workshop on Machine Learning for Signal Processing (MLSP), Aalborg, Denmark, September 2018

- Contact: Simon Leglaive
- Publication: [hal-01832826v1](#)

SIROCCO Project-Team

6. New Software and Platforms

6.1. M360CT

Multi-360 Calibration Toolkit

KEYWORDS: Omnidirectional camera - Calibration - FTV - 6DoF

FUNCTIONAL DESCRIPTION: Based on multiple synchronized sequences of a chessboard pattern moving in the scene, the algorithm computes the internal and external camera parameters of the different cameras under the unified spherical model. This software is composed of two executables, the first one for the individual calibration of each camera, the second one for the fusion of all the outputs of the first executable. The work has been submitted at APP with the number IDNN.FR.001.510008.S.P.2018.000.10800.

- Participants: Cédric Le Cam, Thomas Maugey and Laurent Guillo
- Contact: Thomas Maugey
- URL: <http://project.inria.fr/ftv360>

6.2. Context-adaptive neural network based prediction for image compression

KEYWORDS: Deep learning - Image compression - Intra prediction - Neural networks

FUNCTIONAL DESCRIPTION: This code implements (i) the learning of deep neural networks for intra-prediction of video compression and (ii) a video coder/decoder integrating the learned deep neural networks. This code allows to reproduce the results of the paper "Thierry Dumas, Aline Roumy and Christine Guillemot. Context-adaptive neural network based prediction for image compression, IEEE Transactions on Image Processing, 2019." To this end, the code implements the pre-processing of an image database (i.e. extraction of a set of pairs containing a block to be predicted and its context) to yield a training set. Then, from this learning set, the code implements the learning of one deep neural network per block size (fully-connected network at size 8x8 and smaller, and convolutional network at bigger size). The code contains the parameters of all deep networks learned from the preprocessed ILSVRC2012 training database. Then, the code contains a modified version of the HEVC video compression test model (HM 16.9), which integrates the learned prediction functions and the signalling of the intra prediction mode (for both classical HEVC intra prediction modes and the learned neural networks).

- Contact: Aline Roumy
- URL: https://github.com/thierydumas/context_adaptive_neural_network_based_prediction

6.3. LFDE-FLEX

LFDE-FLEX: A Framework for Learning Based Depth from a Flexible Subset of Dense and Sparse Light Field Views

KEYWORDS: Light fields - Depth estimation - Deep learning

FUNCTIONAL DESCRIPTION: The code implements a learning based depth estimation framework suitable for both densely and sparsely sampled light fields. The proposed framework consists of three processing steps: initial depth estimation, fusion with occlusion handling, and refinement. The estimation can be performed from a flexible subset of input views. The fusion of initial disparity estimates, relying on two warping error measures, allows us to have an accurate estimation in occluded regions and along the contours. In contrast with methods relying on the computation of cost volumes, the proposed approach does not need any prior information on the disparity range.

- Participants: Jinglei Shi, Xiaoran Jiang and Christine Guillemot
- Contact: Jinglei Shi

6.4. EPI-SENet

EPI-based light field view extrapolation network

KEYWORDS: Light fields - Deep learning - View synthesis

FUNCTIONAL DESCRIPTION: This code implements a learning based algorithm for light field view extrapolation from axial volumes of sheared epipolar plane images (EPIs). The learned SENet network is based on tensorflow backend. The inputs of this network are multiple views in a row of a structured dense light field. The network predicts novel views in order to extend the light field baseline by a factor which can go up to 4 times the initial baseline. The code also performs digital refocusing with the original and extrapolated views. As with extended numerical aperture in classical imaging, the extrapolated light field gives refocused images with a shallower depth of field (DOF), leading to more accurate refocusing results.

- Participants: Zhaolin Xiao, Jinglei Shi, Xiaoran Jiang and Christine Guillemot
- Contact: Xiaoran Jiang

6.5. 4D-SFE

4D-SFE: 4D Scene Flow Estimator from Light Fields

KEYWORDS: Light fields - Scene Flow - Motion analysis - Depth estimation

FUNCTIONAL DESCRIPTION: This software implements a method for scene flow estimation from light fields by computing an optical flow, a disparity map and a disparity variation map for the whole light field. It takes as inputs two consecutive frames from a light field video, as well as optical flow and disparity maps estimated for each view of the light field (e.g. with a deep model like PWC-Net) and saved as .flo files. First the light field is divided into 4D clusters called superrays, then a neighboring weighted graph is built between the different clusters and finally a 4D affine model is fitted for every cluster, using the initial estimations from the optical flow and disparity estimations that are contained in the cluster and in the neighboring clusters.

- Participants: Pierre David and Christine Guillemot
- Contact: Christine Guillemot

6.6. LMVS-Net

LMVS-Net: Lightweight Neural Network for Monocular View Synthesis with Occlusion Handling

KEYWORDS: Light fields - View synthesis - Deep learning

FUNCTIONAL DESCRIPTION: This code implements the method described in A Lightweight Neural Network for Monocular View Synthesis with Occlusion Handling, allowing to perform monocular view synthesis in a stereo setting. From one input image, it computes a view laterally located, left-side or right-side, and with the required disparity range depending on user input. It is also able to retrieve a disparity map from the input image, as well as a confidence map to distinguish the occluded regions, as well as to evaluate the pixelwise accuracy of the prediction. The code was developed using Keras and TensorFlow.

- Participants: Simon Evain and Christine Guillemot
- Contact: Simon Evain

6.7. 4D-LFDE

KEYWORDS: Light fields - Depth estimation

FUNCTIONAL DESCRIPTION: This code implements a learning based solution for disparity estimation for either densely or sparsely sampled light fields from 4 corner input views. The code contains two parts "DispEstim" and "DispPropa". The DispEstim module (implemented in tensorflow) takes the 4 corner views of a light field, and estimates the disparity information for these input view positions. The DispPropa module (implemented in Matlab) then generates one disparity map per target view position by propagating corner disparity maps and by applying an occlusion-aware soft 3D reconstruction method. The final output is a .mat file which contains disparity maps for every view positions of a light field.

- Participants: Xiaoran Jiang, Christine Guillemot and Jinglei Shi
- Contact: Xiaoran Jiang

6.8. Compression of omnidirectional images on the sphere

KEYWORDS: Image compression - Omnidirectional image

FUNCTIONAL DESCRIPTION: This code implements a compression scheme of omnidirectional images. The approach operates directly on the sphere, without the need to project the data on a 2D image. More specifically, from the sphere pixelization, called healpix, the code implements the partition of the set of pixels into blocks, a block scanning order, an intra prediction between blocks, and a Graph Fourier Transform for each block residual. Finally, the image to be displayed in the viewport is generated.

- Contact: Aline Roumy

6.9. Performance evaluation of interactive video compression schemes and navigation model for omnidirectional images

KEYWORDS: Image compression - Omnidirectional image

FUNCTIONAL DESCRIPTION: This code consists of two parts. First, the code generates typical navigation paths of users viewing omnidirectional images. This generation relies on Markov modeling of the user behavior (probability to choose a first viewing direction to start the navigation, probability to choose a head motion direction, probability of continuing the head motion in the same direction, probability to stop the head motion). The second part of the code implements various criteria to evaluate the compression performance. Three criteria are computed: the distortion averaged along a set of typical navigation paths, the transmission rate related to these navigation paths, and also the storage cost of the compressed image to be able to serve any possible image request. From these 3 criteria, weighted Bjontegaard metric, and iso values are computed.

- Contact: Aline Roumy

6.10. Interactive compression for omnidirectional images and texture maps of 3D models

KEYWORDS: Image compression - Random access

FUNCTIONAL DESCRIPTION: This code implements a new image compression algorithm that allows to navigate within a static scene. To do so, the code provides access in the compressed domain to any block and therefore allows extraction of any subpart of the image. This codec implements this interactive compression for two image modalities: omnidirectional images and texture maps of 3D models. For omnidirectional images the input is a 2D equirectangular projection of the 360 image. The output is the image seen in the viewport. For 3D models, the input is a texture map and the 3D mesh. The output is also the image seen in the viewport.

The code consists of three parts: (A) an offline encoder (B) an online bit extractor and (C) a decoder. The offline encoder (i) partitions the image into blocks, (ii) optimizes the positions of the access blocks, (iii) computes a set of geometry aware predictions for each block (to cover all possible navigation paths), (iv) implements transform quantization for all blocks and their predictions, and finally (v) evaluates the encoding rates. The online bit extractor (Part B) first computes the optimal and geometry aware scanning order. Then it extracts in the bitstream, the sufficient amount of information to allow the decoding of the requested blocks. The last part of the code is the decoder (Part C). The decoder reconstructs the same scanning order as the one computed at the online bit extractor. Then, the blocks are decoded (inverse transform, geometry aware predictions, ...) and reconstructed. Finally the image in the viewport is generated.

- Contact: Aline Roumy

6.11. Platforms

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

Participants: 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 the context of the project ADT ATeP 2016-2018 (funded by Inria), such datasets were 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 have been made available to the community via a public web site. In 2019, we have published and presented our dataset at the ACM MMSys conference [28].

6.11.2. CLIM processing toolbox

Participants: Pierre Allain, Christine Guillemot, Laurent Guillo.

As part of the ERC Clim project, the EPI Sirocco is developing a light field processing toolbox. The toolbox and libraries are developed in C++ and the graphical user interface relies on Qt. As input data, this tool accepts both sparse light fields acquired with High Density Camera Arrays (HDCA) and denser light fields captured with plenoptic cameras using microlens arrays (MLA). At the time of writing, in addition to some simple functionalities, such as re-focusing, change of viewpoints, with different forms of visualization, the toolbox integrates more advanced tools for scene depth estimation from sparse and dense light fields, for super-ray segmentation and scene flow estimation, and for light field denoising and angular interpolation using anisotropic diffusion in the 4D ray space. The toolbox is now being interfaced with the C/C++ API of the tensorflow platform, in order to execute deep models developed in the team for scene depth and scene flow estimation, view synthesis, and axial super-resolution.

Stars Project-Team

5. New Software and Platforms

5.1. 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, 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>

5.2. 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

THOTH Project-Team

6. New Software and Platforms

6.1. 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
- Partner: Naver Labs Europe
- Contact: Nicolas Jourdan
- Publication: [LCR-Net: Localization-Classification-Regression for Human Pose](#)
- URL: <https://thoth.inrialpes.fr/src/LCR-Net/>

6.2. 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: D. Chen, L. Jacob, and J. Mairal. Biological Sequence Modeling with Convolutional Kernel Networks. *Bioinformatics*, volume 35, issue 18, pages 3294-3302, 2019.

- Participants: Laurent Jacob, Dexiong Chen and Julien Mairal
- Partners: CNRS - UGA
- Contact: Julien Mairal
- Publication: [Biological Sequence Modeling with Convolutional Kernel Networks](#)
- URL: <https://gitlab.inria.fr/dchen/CKN-seq>

6.3. 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] (<https://hal.archives-ouvertes.fr/hal-01511145v2/document>).

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%. We also provide an extensive ablative analysis to investigate the influence of each component in the proposed framework.

- Participants: Karteek Alahari, Cordelia Schmid and Pavel Tokmakov
- Contact: Pavel Tokmakov
- Publication: [hal-01511145v2](#)
- URL: <http://lear.inrialpes.fr/research/lvo/>

6.4. 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, Xavier Martin, Ivan Laptev and Cordelia Schmid
- Contact: Gül Varol
- Publication: [Learning from Synthetic Humans](#)
- URL: <http://www.di.ens.fr/willow/research/surreal/>

6.5. attn2d

Pervasive Attention

KEYWORDS: NLP - Deep learning - Machine translation

SCIENTIFIC DESCRIPTION: Pervasive attention : 2D Convolutional Networks for Sequence-to-Sequence Prediction

FUNCTIONAL DESCRIPTION: An open source PyTorch implementation of the pervasive attention model described in: Maha Elbayad, Laurent Besacier, and Jakob Verbeek. 2018. Pervasive Attention: 2D Convolutional Networks for Sequence-to-Sequence Prediction. In Proceedings of the 22nd Conference on Computational Natural Language Learning (CoNLL 2018)

- Participants: Maha Elbayad and Jakob Verbeek
- Contact: Maha Elbayad
- Publication: [Pervasive Attention: 2D Convolutional Neural Networks for Sequence-to-Sequence Prediction](#)
- URL: <https://github.com/elbayadm/attn2d>

6.6. Cyanure

Cyanure: An Open-Source Toolbox for Empirical Risk Minimization

KEYWORD: Machine learning

FUNCTIONAL DESCRIPTION: Cyanure is an open-source C++ software package with a Python interface. The goal of Arsenic is to provide state-of-the-art solvers for learning linear models, based on stochastic variance-reduced stochastic optimization with acceleration mechanisms and Quasi-Newton principles. Arsenic can handle a large variety of loss functions (logistic, square, squared hinge, multinomial logistic) and regularization functions (l_2 , l_1 , elastic-net, fused Lasso, multi-task group Lasso). It provides a simple Python API, which is very close to that of scikit-learn, which should be extended to other languages such as R or Matlab in a near future.

RELEASE FUNCTIONAL DESCRIPTION: version initiale

- Participant: Julien Mairal
- Contact: Julien Mairal
- URL: <http://thoth.inrialpes.fr/people/mairal/arsenic/welcome.html>

WILLOW Team

6. New Software and Platforms

6.1. Pinocchio

KEYWORDS: Robotics - Biomechanics - Mechanical multi-body systems

FUNCTIONAL DESCRIPTION: Pinocchio instantiates state-of-the-art Rigid Body Algorithms for poly-articulated systems based on revisited Roy Featherstone's algorithms. In addition, Pinocchio instantiates analytical derivatives of the main Rigid-Body Algorithms like the Recursive Newton-Euler Algorithms or the Articulated-Body Algorithm. Pinocchio is first tailored for legged robotics applications, but it can be used in extra contexts. It is built upon Eigen for linear algebra and FCL for collision detection. Pinocchio comes with a Python interface for fast code prototyping.

- Partner: CNRS
- Contact: Justin Carpentier
- URL: <https://github.com/stack-of-tasks/pinocchio>

6.2. VRAnalogy

Visual Relations detector using Analogy

KEYWORDS: Computer vision - Machine learning

FUNCTIONAL DESCRIPTION: Implementation of the paper "Detecting Unseen Visual Relations Using Analogies", Peyre et al', ICCV19

- Contact: Julia Peyre

6.3. d2-net

D2-Net: A Trainable CNN for Joint Description and Detection of Local Features

KEYWORD: Feature points

FUNCTIONAL DESCRIPTION: This repository contains the implementation of the following paper:

"D2-Net: A Trainable CNN for Joint Detection and Description of Local Features". M. Dusmanu, I. Rocco, T. Pajdla, M. Pollefeys, J. Sivic, A. Torii, and T. Sattler. CVPR 2019.

- Participants: Mihai Dusmanu, Ignacio Rocco Spremolla, Tomas Pajdla, Marc Pollefeys, Josef Sivic, Akihiko Torii and Torsten Sattler
- Contact: Ignacio Rocco Spremolla
- Publication: [D2-Net: A Trainable CNN for Joint Detection and Description of Local Features](#)
- URL: <https://github.com/mihaidusmanu/d2-net>

6.4. CrossTask

Cross-task weakly supervised learning from instructional videos

KEYWORDS: Videos - Machine learning

FUNCTIONAL DESCRIPTION: Open source release of the software package for the CVPR'19 paper "Cross-task weakly supervised learning from instructional videos" by D. Zhukov, J.-B. Alayrac, R. G. Cinbis, D. Fouhey, I. Laptev and J. Sivic

- Participants: Dimitri Zhukov, Jean-Baptiste Alayrac, Cinbis Gokberk, David Fouhey, Ivan Laptev and Josef Sivic
- Contact: Dimitri Zhukov
- URL: <https://github.com/DmZhukov/CrossTask>

6.5. MImE

Manipulation Imitation Environments

KEYWORDS: Robotics - Simulator - Computer vision

FUNCTIONAL DESCRIPTION: Simulation environment for learning robotics manipulation policies.

- Contact: Igor Kalevtykh
- URL: <https://github.com/ikalevtykh/mime/>

6.6. iReal

iReal: Implementing interactive scene understanding for a mixed reality device

KEYWORDS: Computer vision - Augmented reality - Demonstration

FUNCTIONAL DESCRIPTION: The goal of this project is to build a demonstration prototype of a smart personal assistant that sees and understands its surroundings to help the user navigate in unfamiliar environments, recognize new people and operate never seen before devices. The assistant will be implemented on the Microsoft HoloLens mixed reality device and will integrate the latest research software for automatic visual recognition and scene understanding developed in the Inria Willow team

- Contact: Mauricio Diaz

6.7. Sim2RealAugment

Learning to Augment Synthetic Images for Sim2Real Policy Transfer

KEYWORDS: Robotics - Computer vision

FUNCTIONAL DESCRIPTION: Implements the method described in Learning to Augment Synthetic Images for Sim2Real Policy Transfer (2019), A. Pashevich, R. Strudel, I. Kalevtykh, I. Laptev and C. Schmid, in Proc. IROS'19, Macau, China.

- Contact: Ivan Laptev
- URL: <http://pascal.inrialpes.fr/data2/sim2real/>

6.8. HowTo100M

HowTo100M: Learning a Text-Video Embedding by Watching Hundred Million Narrated Video Clips

KEYWORDS: Computer vision - Video analysis

FUNCTIONAL DESCRIPTION: Implements the method provides the dataset used in the paper HowTo100M: Learning a Text-Video Embedding by Watching Hundred Million Narrated Video Clips (2019), A. Miech, D. Zhukov, J.-B. Alayrac, M. Tapaswi, I. Laptev and J. Sivic, in Proc. ICCV'19, Seoul, South Korea.

- Contact: Ivan Laptev
- URL: <https://www.di.ens.fr/willow/research/howto100m/>

6.9. ObMan

Learning joint reconstruction of hands and manipulated objects

KEYWORDS: Computer vision - 3D reconstruction

FUNCTIONAL DESCRIPTION: Implements the method and provides dataset used in the paper Learning joint reconstruction of hands and manipulated objects (2019), Y. Hasson, G. Varol, D. Tzionas, I. Kalevatykh, M. Black, I. Laptev and C. Schmid, in Proc. CVPR'19, Long Beach, CA, USA.

- Contact: Yana Hasson
- URL: <https://hassony2.github.io/obman.html>