DIGITAL TECHNOLOGY AND HERITAGE

Challenges and issues

NUMÉRIQUE ET PATRIMOINE - ENJEUX ET QUESTIONS ACTUELS

11/12 MARCH 2021

Digital Conference

Conférence en ligne

GOUVERNEMENT
Liberté
Égalité
Fraternité

AGENCE NATIONALE DE LA RECHERCHE
ANR

Cultural Heritage
AND GLOBAL CHANGE

Digital applied to heritage represents an important field of digital humanities, and also of what is now known as “heritage science”.

Digital technology encompasses all aspects of heritage, from cultural to natural, tangible to intangible, physical to digital. It brings together heterogeneous scientific competence in a dialogue that stimulates creativity and opens new perspectives for the understanding, transmission and sharing of heritage elements. This significant progress, in a field with a high social impact, will be touched upon through the presentation of the aims and results of recent or ongoing research, and of the challenges and issues researchers are confronted with, may they be ethical, technical, methodological or conceptual.

The objective of this event is to create the conditions for a scientific exchange on the current challenges of the digitization of heritage and the exploration of new possibilities offered by digital tools for the production and dissemination of knowledge.

It will bring together leading researchers in the field as well as project leaders who are currently financed by the Agence nationale de la recherche (ANR) and its funding partner agencies in the context of national, European and international projects, in particular the "Digital Heritage" call, which was launched in 2017 by the Joint Programming Initiative on Cultural Heritage and Global Change (JPI CH) or as part of the Generic Call for Proposals (AAPG), in particular in the «Digital revolution: relationship to knowledge and culture» panel.

The conference, organized by the ANR and the JPI CH in collaboration with the French Ministry of Culture, will mainly be open to specialists of computer science and Heritage science in the field of digital applied to Heritage.

AGENCE NATIONALE DE LA RECHERCHE
ANR

The ANR is the funding agency for project-based research in France. It is a public body under the authority of the French Ministry for Research. Its mission is to fund and promote pure and applied research, technical innovation and technology transfer, as well as partnerships between research teams in public and private sectors, on national, European and international levels.

The ANR is also the main operator of Investments for the Future programmes (PIA 1, 2, 3) in the field of higher education and research. The ANR has ISO 9001 certification for all its project selection processes.

www.anr.fr

JPI Cultural Heritage

« Joint Programming » is a concept introduced by the European Commission in July 2008 and is at the core of the 10 Joint Programming Initiatives (JPIs) which aim to implement the European Research Area (ERA). The concept intends to tackle som current challenges that cannot be solved solely on the national level and to enable Member States and Associated Countries to deal with critical issues through a joint transnational approaches. JPIs are Member State-led initiatives, bringing together national research funding organisations, ministries and research councils both in Europe and beyond, with the aim to better align and use the 85 per cent of research and innovation investments spent at national level, to avoid duplication and fragmentation.

The JPI CH, created in 2010, is coordinated by the French Ministry of Culture (MIC), with the support of the Ministry of Higher Education, Research and Innovation and its funding Agency, the ANR). Its main objective is to improve coordination at the EU level of research on cultural heritage in its broader sense – including tangible, intangible and digital assets – by identifying short and long-term needs and priorities and to concentrate and increase human, material and financial resources allocated to research.

Several activities are implemented to reach this objective – funding, networking, programming, communication and dissemination, training, research valorization and coordination – and a Strategic Research and Innovation Agenda is shared by all the JPI CH members. Published in 2014, it was updated in 2020.

Organised around the following four Priority Areas, it fully takes into account the changes that have occurred in the cultural heritage field as well as the ten years of existence of the JPI CH:
1. A reflective heritage for a resilient society
2. Sustainable management of cultural heritage
3. Cultural heritage in a changing context
4. Cultural heritage facing climate and environmental change.

www.heritageresearch-hub.eu

THURSDAY 11 MARCH 2021

1.30 PM OPENING

- **Pascal Liévaux,** Chair of the JPI Cultural Heritage
  Curator, Directorate-General for Heritage and Architecture, Ministry of Culture, France
- Director General of Heritage and Architecture, Ministry of Culture, France

2.00 PM

- **Anne Bajart,** Deputy Head of Unit, DG Connect, Interactive technologies, Digital for Culture and Education, European Commission

2.15 PM

- **Thierry Damerval,** ANR, CEO, France

2.30 PM–4.00 PM

Topic I DIGITIZATION AND PATRIMONIALIZATION: A CRITICAL APPROACH

Moderated by *Paulina Florjanowicz, Director of the Departments of Cultural Heritage, Ministry of Culture and National Heritage, MKiDN, Poland*

Digitization is a means more and more often used to conserve and protect all or parts of a heritage asset. Nevertheless, this operation is carried out according to how the asset is socially, economically or politically perceived. It is also performed in the context of technical constraints that do not always allow for a full account of all the elements of the heritage asset to be conserved and protected. Therefore, digitization may lead to creating or reinforcing stereotypes that could hinder the comprehension of the heritage asset, or, subsequently, the progress of knowledge. This session will examine the critical approaches which are applied to the patrimonialization of heritage via digital technology in order to reduce interpretation biases.

- **Dream (JPI CH):** The Dictionary / Grammar Reading Machine: Computational tools for accessing the World's Linguistic Heritage
  *Coordinated by **Harald Hammarström**, Uppsala University Department of Linguistics and Philology and presented with **Guillaume Segerer**, CNRS*
- **Material (ANR):** Micro-geometry Approach of Texture Reproduction of Artistic Legacy.
  *Coordinated by **Nicolas Holzschuch**, INRIA Rhône-Alpes - MAVERICK*
  *Presented by **Solenn Nieto**, Université de Bordeaux et **Romain Pacanowski**, INRIA Bordeaux*
- **DigiCONFLICT (JPI CH):** Digital Heritage in Cultural Conflicts
  *Coordinated and presented by **Gil Pasternak**, De Montfort University*
- **Memo-Mines (ANR):** Converting Memorial Traces into Numerical Mediations: The case of mining memory
  *Coordinated by **Sylvie Merviel**, Université de Valenciennes et du Hainaut-Cambrésis - Laboratoire DeVisu and presented with **Stéphane Chaudiron**, Université de Lille*

4.00 PM POSTER SESSION

Presentation of five posters (ALEGORIA, ANTRACT, APPI, DAPHNE, E-ROMA) and meeting with project leaders

ALEGORIA	**Advanced Linking and Exploitation of diGitized geOgRaphic Iconographic heritage** *Coordinated by **Valérie Gouet-Brunet**, Institut national de l'information géographique et forestière (IGN) / LaSTIG*
ANTRACT	**Transdisciplinary Analysis of French Newsreels (1945–1969)** *Coordinated by **Pascale Goetschel**, Université Panthéon Sorbonne - Centre d'histoire sociale du XX^e siècle (CHS)*
APPI	**Digitalized atlas of the entire Picard dialect** *Coordinated by **Esther Baiwir**, Université Charles de Gaulle - Lille 3 - UDL SHS - Alithila*
DAPHNE	**Discovering knowledge in historical prosopographical databases** *Coordinated by **Cédric Du Mouza**, Conservatoire National des Arts et Métiers (CNAM) - CEDRIC*
E-ROMA	**Expressive restoration of Gallo-Romanian statues by virtual sculpture and animation** *Coordinated by **Raphaëlle Chaine**, CNRS - Délégation Régionale Rhône Auvergne – LIRIS*

4.30 PM - 6.00 PM

Topic II DIGITAL TECHNOLOGY AS A NEW MEANS TO ARTICULATE CONSERVATION AND DISSEMINATION

Moderated by *Costanza Miliani, Director of Institute of Heritage Science, CNR, Italy*

The digital tool can make elements of local, national or international Heritage available to the public, without any restriction of access, or any temporal or geographical constraint. In particular, it offers the possibility of making available heritage assets that require drastic conservation measures for their protection. The digital tool has also the advantage of increasing opportunities in terms of cultural mediation, and of proposing interactive tools that involve the public in discovery courses, thus making them actors of their own knowledge acquisition process. Research presented during this session will centre on the use of public-friendly digital tools, with a particular emphasis on initiatives aimed at arousing public's awareness of heritage issues.

- **Cadeah (JPI CH):** European History Reloaded: Curation and Appropriation of Digital Audiovisual Heritage
  *Coordinated by **Eggo Müller**, Universiteit Utrecht and presented with **Maria Eriksson**, HumLab, Uneå University, Sweden*
- **Home (JPI CH):** History Of Medieval Europe
  *Coordinated and presented by **Dominique Stutzmann**, CNRS - Délégation Régionale Ile-de-France Ouest et Nord – IRHT*
- **Schedar (JPI CH):** Safeguarding the Cultural Heritage of Dance Through Augmented Reality
  *Coordinated by **Yiorgos Chrysanthou**, University of Cyprus*
  *Presented by **Franck Multon**, Université Rennes 2 - MimeTIC*
- **Arch (JPI CH):** Ancient Coinage as Related Cultural Heritage
  *Coordinated by **Andrew Meadows**, New College, Oxford University and presented with **Frederique Duyrat**, Bibliothèque nationale de France*

FRIDAY 12 MARCH 2021

9.00 AM-10.30 AM

Topic III FROM ONE TECHNOLOGY TO ANOTHER: DEPLOYING THE POSSIBILITIES OF DIGITAL TECHNOLOGY

Moderated by *Marieke van Erp, Head of the Digital Humanities Lab, Royal Academy, The Netherlands*

Since the first attempts to digitalize heritage, the possibilities offered by digital technology have considerably increased. It is now possible to link several media to a same object. This now raises the question of migrating data to new systems.

- **KAMoulox (ANR):** On-line Unmixing for Large Historical Archives
  *Coordinated and presented by **Antoine Liutkus**, INRIA Centre Nancy - Grand Est*
- **Read-it (JPI CH):** Lire l'Europe : Advanced data investigation tool
  *Coordinated and presented by **Brigitte Ouvry-Vial**, Université du Mans*
- **Reseed (ANR):** Semantic Reverse-Engineering of Digital Heritage Objects
  *Coordinated and presented by **Florent Laroche**, École Centrale de Nantes - Laboratoire des sciences du numérique de Nantes (LS2N - ex IRCCyN et LINA)*
- **Epique (ANR):** Towards a Quantitative Epistemology - Reconstructing the Long-term Evolution of Sciences through Large Scale analysis of science production
  *Coordinated and presented by **Bernd Amann**, Sorbonne Université - LIP6*

10.30 AM SESSION POSTER

Presentation of nine posters (ECLAT, HBDEX, HORAE, HYPEROTLET, INTROSPECT, RESTAURE, SCHOPPER, SUMUM, URBANIA) and meeting with project leaders

ECLATS	**Automatic Extraction of Geolinguistic Atlas Content and Spatial Analysis: application to Dialectology** *Coordinated by **Paule-Annick Davoine**, Institut National Polytechnique de Grenoble (INPG) - Polytech Grenoble - LIG*
HBDEX	**Exploitation of Historical Big Data for the Digital Social Sciences: application to financial data** *Coordinated by **Pierre-Cyril Hautcoeur**, PSE Ecole d'économie de Paris*
HORAE	**Hours – Recognition, Analysis, Edit(ion)s** *Coordinated by **Dominique Stutzmann**, CNRS - Délégation Régionale Ile-de-France Ouest et Nord - IRHT*
HYPEROTLET	**Documenting documentation: European and French-speaking tradition** *Coordinated by **Bertrand Müller**, CNRS - Délégation Régionale Ile-de-France Paris B - CMH*
INTROSPECT	**Introspection of the archaeological material culture in the digital era** *Coordinated by **Valérie Gouranton**, INRIA - INSA Rennes*
RESTAURE	**Computational Resources and Processing for Regional Languages** *Coordinated by **Delphine Bernhard**, Université de Strasbourg - LiLPa*
SCHOPPER	**Simulating prehistoric humans behaviors in their palaeo-environments for investigation** *Coordinated by **Sophie Grégoire**, Université de Perpignan - UPVD CERP*
SUMUM	**A Multiscale and Multimodal Strategy of documentation of Tangible CH objects: acquisition, processing, study and diffusion** *Coordinated by **Alamin Mansouri**, Université Bourgogne Franche-Comté (COMUE UBFC) - ImViA*
URBANIA	**Digital valorising of historical scale models of cities for adaptative and innovative uses** *Coordinated by **Gilles Halin**, CNRS- Délégation Régionale Provence et Corse - CNRS DR12_UMR MAP*

11.15 AM

PROJECT VALORIZATION EXPERIENCE: AÏOLI COLLABORATIVE PLATFORM

*Coordinated by **Livio de Luca**, Modèles et simulations pour l'Architecture et le Patrimoine MAP-CNRS*

*Presented by **Violette Abergel** and **Adeline Manuel**, Modèles et simulations pour l'Architecture et le Patrimoine MAP-CNRS*

12.15 PM

Concluding words: Étienne Anheim, Senior researcher EHESS

About the projects:

. **JPI CH:** projects funded by the ANR and national partner funding agencies, as part of the «Digital Heritage» call for projects launched in 2017 by the JPI CH

. **ANR:** projects funded within the framework of the Generic Call for Projects (AAPG), in particular within the «Digital revolution: relationship to knowledge and culture» panel

Projects presented during the ROUND TABLES

ARCH

Ancient Coinage as Related Cultural Heritage

ARCH (University of Oxford; Bibliothèque nationale de France; University of Valencia. Associate partners: University of Orléans; CNRS, Bordeaux) uses Linked Open Data (LOD) technology to establish an overarching platform for the study, curation, archiving and preservation of the monetary heritage of the ancient world.

AN OVERACHING PLATERFORM TO STUDY ANCIENT COINAGE

Using the newly developed nomisma.org knowledge organisation system it will create a framework consisting at the highest level of a single, unified portal across multiple online typological resources currently under development. These resources will in turn be linked to a body of data drawn from two major European collections, as well as a large corpus of material drawn from commercial contexts (auction catalogues). The overarching portal will serve as a central point of access to this data for multiple audiences, as well as a demonstration of the extensibility of this approach to other geographic areas. As a proof of concept of the research applicability of this framework, ARCH will develop one geographical focus – Pre-Roman Spain and southern Gaul – in the form of a specific online reference tool, drawing on public collections and objects in commerce, as well as a programme of research designed to exploit the opportunities offered by such a systematic and LOD infrastructure. This will examine questions of monetary and cultural connectivity and interaction across the borders of Spain and France in antiquity, in collaboration with leading scholars in the field.

Despite the pandemic (see below), work has been able to continue on the key work of cataloguing the collection in Paris, and the development of the overall typological framework. The results of this are now publicly available online for certain regions; more will be released within the first quarter of 2021.

ACCESS TO THE PLATFORM WILL BE GRADUALLY OPENED IN 2021

COVID-19 has had a significant impact in all three partner countries on our ability to build the infrastructure and, thus, conduct the necessary research. Extensions have been and are being sought to address this. It is now planned to launch the main portal for the project in the spring of 2021. The Spanish element of the project should follow thereafter. The conference planned for Easter 2021 is currently and optimistically postponed to September 2021. A full launch of the web resource is envisaged for December 2021, and a book publishing the results of the research will follow in 2022-23. At this point we envisage no new outputs beyond those promised in the proposal. Nevertheless, we would like to stress that the ARCH project has built the platform for a successful bid the ERC (https://cordis.europa.eu/project/id/865680) for a €1.9m consolidator grant to extend the approach pioneered in ARCH to Asia Minor.

Coin catalogued in the BnF Catalogue Général, with reference to new LOD typology.

. **JPI CH funding:** 226 829 €
. **Year:** 2017
. **Partners:** University of Valencia UVEG (Spain) ; Bibliothèque nationale de France (France) ; University of Oxford (United Kingdom)

https://www.greekcoinage.org

ROUND TABLE

CADEAH

European History Reloaded: Curation and Appropriation of Digital European Audiovisual Heritage

CADEAH researches the online circulation and appropriation of audiovisual heritage using an integrated and interdisciplinary approach. It combines state of the art tracing and tracking technologies, critical cultural analysis and ethnographic fieldwork.

UNDERSTANDING ONLINE REUSE OF ARCHIVAL MATERIAL

CADEAH started in September 2018 and is now – with few COVID-19 related delays after March 2020 - at the beginning of the 3rd project year.

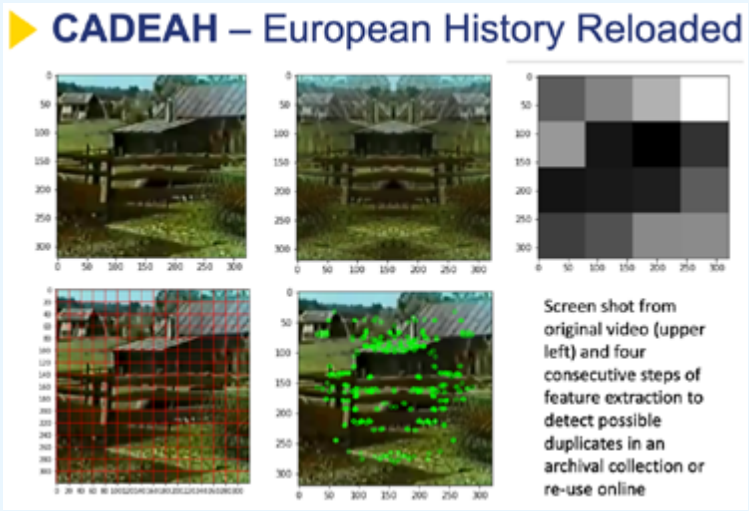
WP 1 (University of Umeå): Tracking & tracing appropriated audiovisual heritage is tracking and tracing video reuse and remix of archival material online. The development of a scalable Video Reuse Detector (VRD) was quite a challenge, particularly compared with the financial and computational power of existing corporate video tracing and tracking technologies that facilitate for commercial copyright protection online. WP 1 is testing a beta version of VRD on an internal sample. VRD trials with collections from archival partners of the EUscreen network are planned for 2021.

WP 2 (Czech Institute for Contemporary History, Prague): Narratives of European history in appropriated digital heritage studies the rhetorical, narrative and visual strategies of remixed audiovisual heritage. WP 2 thus focused on the contradictory strategies of post-communist countries to secure access to archival sources (Sommer, manuscript) and raised awareness of online audiovisual heritage within the university community of historians (Gjuričová 2019a, b).

WP 3 (Utrecht University): Digital ethnography of heritage appropriation and users' identity work takes an in-depth look at online heritage appropriation cultures, with a focus on individuals and communities that engage in the creative appropriation of audiovisual heritage online. WP 3 reviewed the debates on Remix culture (Waysdorf, accepted) and conducted two case studies on remix cultures, the aforementioned culture of Vaporwar Remix (Waysdorf, 2019; under review) and appropriation of archive sources of Eurovision by the Eurovision Again fans initiative (Waysdorf 2020).

OPEN SOURCE VDR WILL SOON EQUIP PUBLIC ARCHIVES

CADEAH generates information on the logics of online video tracking and tracing software and shares this information with archiving professionals (Snickars / Mahler / Oomen 2019; Müller / Waysdorf 2019; Müller 2020) and will provide public archives with open source VDR. The project contributes to a growing awareness of archival heritage online within the academic community of historians (Gjuričová 2019a, b). Project efforts have also linked research on archival remixes online with the field of fan studies, to be further explored in a future project on popular heritage with partners from the archives sector and international scholars in heritage studies, archeology, game studies and fan studies.



Screen shot from original video (upper left) and four consecutive steps of feature extraction to detect possible duplicates in an archival collection or re-use online

. **JPI CH funding:** 670 645 €
. **Year:** 2018
. **Partners:** Institute of Contemporary History of the Academy for Science of the Czech Republic ; Universiteit Utrecht, Department of Media and Culture Studies (The Netherlands) ; University of Umeå (Sweden)

https://www.cadeah.eu/

DIGICONFLICT

Digital Heritage in Cultural Conflicts

DigiCONFLICT explores how Nation-states have used digital heritage to absorb objects and living memories of their citizens into national collections. Expanding the knowledge base, it equally empowered communities to diversify authorised heritage.

AN ANALYSIS OF THE CHALLENGES AND ACTORS OF HERITAGE DEVELOPMENTN

DigiCONFLICT used interviews, immersion and policies to investigate impacts of digital heritage on citizens, institutions, and their relationship. Case studies revealed how limited digital literacy and independent resources hinder citizens to fully engage with heritagisation. State initiatives with communities target public emotions through heritagisation of personal objects and memories. When conflict between personal and collective sentiments arise, assets are marginalised. The result is heightened national feelings and increased social and digital divides. Regulation of digital heritage is needed to protect nonconformist heritages.

. *Manikowska, E, G Pasternak & M Thor Tureby, eds. 2020. «Cultural Heritage & Technology» (Special Issue). Santander Art & Culture Law Review 2/6 https://www.ejournals.eu/SAACLR/2020/2-2020/*

. *Pasternak, G. 2020. Remembering, Commemorating, Diversifying: Private Photographs & Communal History in the Age of Digital Heritage. In G Broadway, ed. Living Memory, 348-357. London: Independent Publishing Network*

. *Johansson, J & M Thor Tureby. 2019. Flyktingarna, det civila samhället och staten. En exposé över flyktingmottagandets svenska historia. I M Lilja, H Nilén, I Sillén & I Sjöqvist, red. Vi gör vad vi kan, 207–226. Stockholm: Liv i Sverige & Migra förlag*

DigiCONFLICT piloted community-empowerment workshops on digitization skills and connected stakeholders with policymakers to tackle the challenges facing heritage diversification in a digital world.

IMPROVE THE DIGITAL SKILLS OF COMMUNITIES

DigiCONFLICT expanded its planned research to consider the shortcomings of legal and institutional policies currently conditioning digital heritage practices. These will be explored further in a forthcoming collaborative conference with the European Solidarity Centre (June 2020). DigiCONFLICT also turned to analyse the efficacy of digital heritage in attempts to liberate heritage practices from the grasp of dominant powers. It thus explored the challenges facing local communities in efforts to penetrate the digital sphere. Some members are interested in developing programmes and transferable models to empower communities to enhance their digital visibility and ability to identify and diversify cultural heritage on their own terms.

Akrotiri, Cyprus, 2019. Preparations for the co-curated digital public display Voices from Our Photo Albums. Photo: Gil Pasternak.

. **JPI CH funding:** 569 584 €
. **Year:** 2018
. **Partners:** De Montfort University (United Kingdom) ; Linköping University (Sweden) ; Society Liber pro Arte (NGO) (Poland)

https://digiconflict.net/

ROUND TABLE

DREAM

The Digital Grammar Reading Machine

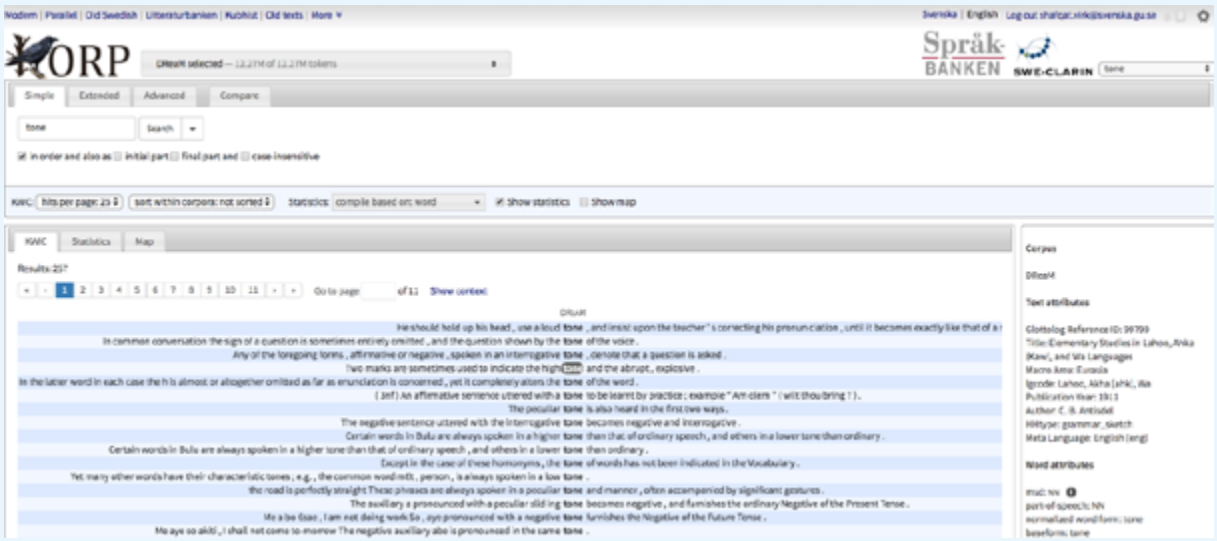
A wealth of information on the languages of the world is contained in print publications. It is now practical to digitize these in order to facilitate the manual and automatic collection of information about languages.

MORE THAN 10,000 GRAMMARS MADE AVAILABLE

We have collected over 10 000 grammars and dictionaries, via digital repositories and own digitization. The grammars have been OCRed and indexed, and the open-access subset has been made available to the general public with links and markup using NLP tools. Methods have been developed to extract useful linguistic information automatically from grammatical descriptions. Dictionaries have been ported to a smartphone App to be deployed in the relevant minority language communities. Several papers have been written on these topics. Interfaces have been opened with a growing community of researchers in linguistic typology on how to best extract and systematize information in descriptive grammars.

RETHINKING ACCESS TO INFORMATION SUBJECT TO COPYRIGHT

It has become clear that more research is needed on dialectic information gathering between a researcher and machine reading over a large set of sources. For this, novel interfaces are needed both for basic and advanced users. Do to copyright issues the original sources cannot always be made available to the general public as they are. However, various partial (extracted or summary) renderings of the same sources are likely to be unproblematic from this perspective. A better understanding of the legal issues and/or the possibilities for cooperation with the copyright holder are subject for future investigation. Usage surveys for smartphone dictionaries with minority communities are on the future agenda.



Screenshot of the KORP enhanced search interface for the DReaM collection of digital grammars

. **JPI CH funding:** 249 976 €
. **Year:** 2017
. **Partners:** Llacan, CNRS (France) ; Uppsala University/Department of Linguistics and Philology (Sweden) ; Universiteit Leiden (The Netherlands)

https://cl.lingfil.uu.se/~harald/dream.html

EPIQUE

Towards Quantitative Epistemology - Reconstructing the Evolution of Science on a Large Scale

The goal of the EPIQUE project is to develop new models and tools for the analysis of the evolution of scientific fields represented in scientific archives. The solutions are designed and validated in collaboration with experts in philosophy and the history of science with different archives and use cases.

NEW TOOLS FOR THE HISTORY OF SCIENCE

We have developed several representation of the evolution of scientific domains which can be extracted from the titles and the abstracts published in scientific archives like arXiv, Web of Science, ISTEX and HAL. These phylomemetic representations (in references to phylogenesis which studies the evolutionary development and diversification of a species or group of organisms) are based on the extraction of scientific research topics and their alignment in a temporal graph. We have defined various solutions based on different topic extraction and alignment approaches and used the Apache Spark platform to efficiently process archives containing millions of documents. New user interfaces allow domain experts to query and visualize the overall dynamics of scientific fields by using appropriate evolution measures (evolution degree, separation fusion of domains). Our methods have been studied and validated with several use cases and different specialized archives (economy, evolutionary biology, Glyphosate, COVID-19).

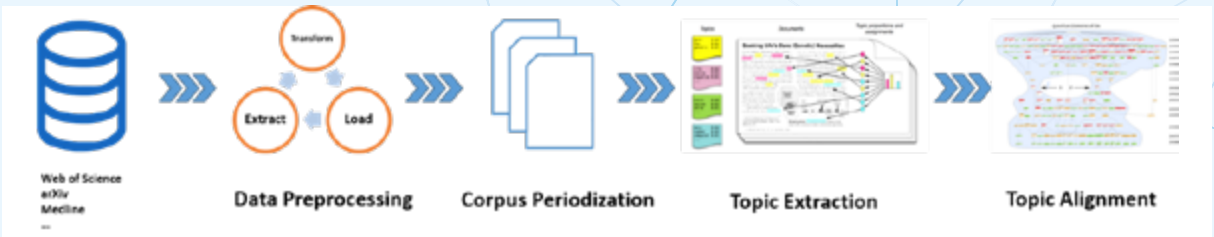
Highlights:

- ✔ Organization of a symposium within the framework of the ISHPSSB'20 conference.
- ✔ Reimplementation of the Gargantext platform on top of a cluster architecture.
- ✔ Réactualisation and demonstrations at several international conferences.
- ✔ International collaborations (Canada, Australia, Belgium).

MAKING PHYLOMEMIES AVAILABLE FOR NON-COMPUTER SCIENTISTS

We are currently working on the creation of user interfaces for the interactive exploration of phylomemies as well as on the definition of rules for their graphic representation. From a longer-term perspective, our aim is to extend our solutions for the exploration of scientific archives as a complementary tool to text search interfaces and citation graphs.

Example of phylomemy generation workflow: (1) Transformation of scientific articles (title, summary) into sets of terms (2) Temporal separation of the transformed articles (corpus) into several subsets (3) Extraction of scientific topics (term vectors) for each subset (4) Similarity-based alignment of topics from different subsets (periods).



. **JPI CH funding:** 442 854 €
. **Year:** 2016
. **Partners:** Institut des Systèmes Complexes de Paris Ile de France ; Institut d'Histoire et de Philosophie des Sciences et Techniques ; Institut de Recherche en Informatique et Systèmes Aléatoires ; Institut des Systèmes Complexes de Paris Ile de France ; Institut d'Histoire et de Philosophie des Sciences et Techniques ; Laboratoire Informatique de Paris 6 (France)

https://iscpif.fr/epique/

ROUND TABLE

HOME

History of Medieval Europe

HOME develops a research environment on medieval historical sources by digitizing and then AI reading and analyzing over 2,000 registers and cartularies in order to identify people and their mobility.

A USER-CENTRED RESEARCH ENVIRONMENT

Capitalizing on the success of the JPI-CH Heritage Plus funded HIMANIS project, HOME associates Computer Science (UPVLC, Teklia), Humanities (IRHT) and Cultural Heritage (NACR) institutions (NACR). The partners aim at generating an automated transcript (HTR) and an index on thousands of medieval books in order to provide access to their contents and extract the information to analyse the medieval networks and make them searchable by historians and a broader audience.

To facilitate the access to sources in several languages (Latin, French, German, Czech), they have digitized the manuscripts, linked existing metadata, and aligned and structured text editions. They enhanced the technologies for handwritten text recognition and developed semantic analyses by combining image analysis and textual data mining. Hence, they can segment the resources into intellectual units ('acts'), recognize named entities, identify persons, and geolocate place names.

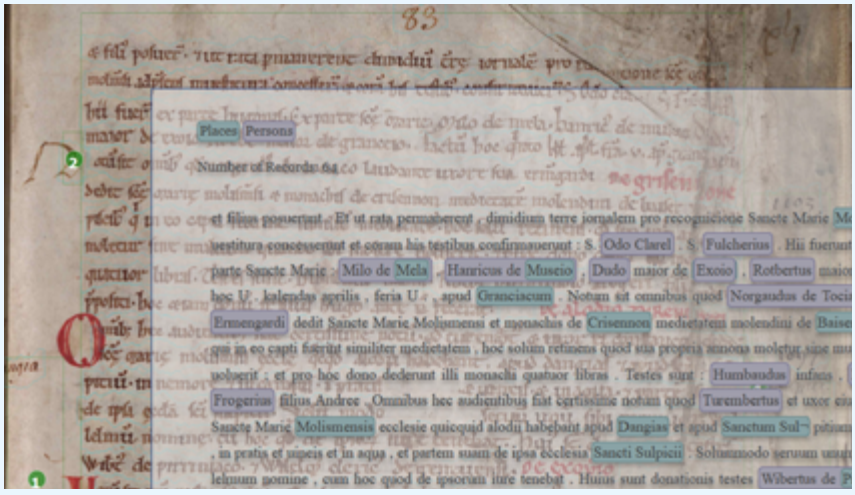
The user-centered and ergonomic environment is being developed in connection with members of the international ICARUS network, members of BeCore project and the Monasterium platform.

Boros, E., V. Romero, M. Maarand, K. Zenklová, D. Stutzmann, J. Křečková, E. Vidal, and Christopher Kermorvant. « A comparison of sequential and combined approaches for named entity recognition in a corpus of handwritten medieval charters ». In ICFHR 2020, 7984. https://doi.org/10.1109/ICFHR2020.2020.00025.

Prieto, J.R., V. Bosch, E. Vidal, and D. Stutzmann. « Text Content Based Layout Analysis ». In ICFHR 2020, 25863. https://doi.org/10.1109/ICFHR2020.2020.0005.

READ MOBILITY IN THE MIDDLE AGES WITH GREATER ACCURACY

HOME opens up a valuable Cultural Heritage and gives access to the wealth of its content. Technologies implemented by the company Teklia, particularly the identification of place and person names, have an important impact on local and genealogical research and communities. Partners converge in their research with the international Time Machine Organisation. Giving access to the full text and to structured information positively impacts all fields of historical research. For today's societies, the evidence of mobilities, diversity and networks in the Middle Ages helps fighting false narratives and ideological misuses of history.



Cartulary of Molesme (Dijon, Arch. dép. Côte d'Or, 7 H 6 [cart. 142], p. 83): manuscript, edition and automated named entity recognition for persons and places

. **JPI CH funding:** 278 185 €
. **Year:** 2018
. **Partners:** Narodni archiv České republiky (Czech Republic) ; Universitat Politècnica de València (Spain)

https://himanis.hypotheses.org/862

KAMOULOX

Online unmixing for large historical archives

The objectives of the ANR KAMoulox project was to provide audio restoration and demixing tools to be used by non specialists. This involved both basic research in signal processing / deep learning and on-the-edge processing for the end-user.

AUDIO RESTORATION AND DEMIXING TOOLS FOR NON-SPECIALISTS

- ✔ This project led us to propose impactful contributions in the theory of signal processing, notably through non-Gaussian (robust) probabilistic models for audio and especially alpha-stable processes. We introduced scalable methods involving such approaches.
- ✔ Thanks to this funding, we published what is now the de-facto reference corpus for music separation research : MUSDB18.
- ✔ We released open-unmix, which is the reference implementation for music separation, released under a MIT licence and that enjoys a strong impact.
- ✔ We did a strong effort in synthesizing current research and state of the art in music demixing, both for fellow scientists and for the wide audience.

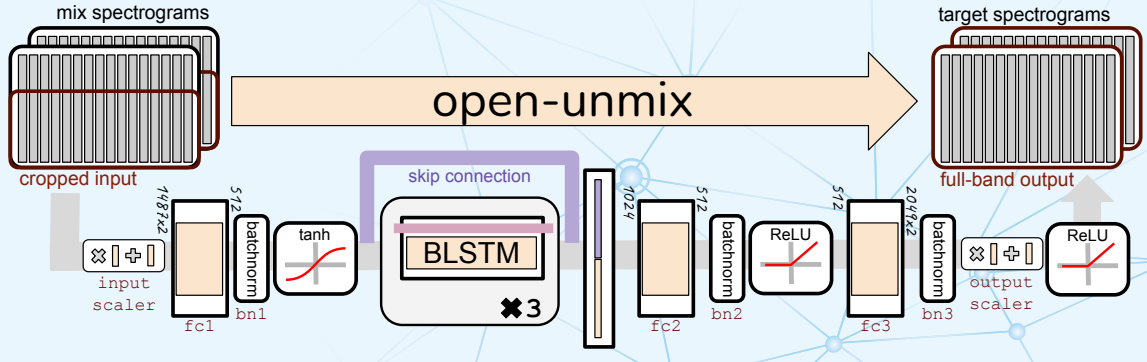
This project had an overall strong impact, with 6 journal papers, 19 conference papers, 3 book chapters, approximately 1000★ on github, 3 tutorials at conferences, article to the wide audience and one online mixing tool.

DEVELOP GENERATIVE MODELS

This project fell right within the deep learning tsunami, that swept over the whole field of signal processing. Whereas it was initially planned to exploit kernel methods (hence the name) within the project, we fully adopted the deep learning methodology right from the start, and actually published papers that are now considered among the first ones in the domain.

Thanks to a large scientific effort, and hence partially through this project, music separation can now be considered as a mature technology, and not so much as a risky research topic. For this reason, the natural continuation of this project is to delve into generative modeling, which goes beyond the filtering paradigm to reconstruct an information that was lost due to some degradations.

The initial foreseen applications regarding audio heritage remain very interesting and ambitious today. Efforts remain to be done in this direction.



Architecture of the Open-Unmix deep neural network

. **JPI CH funding:** 282 828 €
. **Year:** 2015
. **Partners:** Institut National de Recherche en Informatique et en Automatique (France)
. **More information:** https://www.youtube.com/watch?v=IxLnoy-Gzql / https://www.youtube.com/watch?v=MMLsDLF1Dfl
https://www.youtube.com/watch?v=AB-F2JmI9U4 / http://open.unmix.app

https://anr-kamoulox.github.io/

ROUND TABLE

MATERIAL

From digitization and visualization to study and exhibition of ancient textiles

Museum collections are inaccessible to the public for security and conservation reasons. New high-quality 3D scanning tools are needed to promote their dissemination and more participatory science.

A VIRTUAL MUSEUM FOR TEXTILE COLLECTIONS

The object of study is a national collection of Asian clothes collected in the 19th century and conserved at the Ethnographic Museum of the University of Bordeaux. It is composed of both beautiful costumes and everyday clothes. They are witnesses of techniques, customs and living conditions. It is necessary to proceed to the documentation, study and transmission of this heritage, but also to the dissemination of the corpus and associated knowledge while stimulating new studies and enriching knowledge.

From this follows the objectives in computer graphics and optical systems. The first is the acquisition of the appearance, with dense measures in viewing and light directions, as well as spatially. Procurement systems have been developed, including «the dome» (see the attached illustration). They are characterized by the desire to offer the same visual experience in front of the digitized object as in front of the real object, as well as by a metrological precision not available in existing devices. This massive data (up to 20 TB per clothe) must also be processed in order to be visualized. For such a goal, appearance models have been proposed.

The resulting publications in all the related fields (https://urlz.fr/epMw) as well as the digital corpus and an exhibition "Textile (s) 3D" were achieved through real interdisciplinary work and the construction of a common vocabulary.

Examples of digitised objects obtained for textiles (MEB)

A VISUAL EXPERIENCE CLOSE TO REALITY

An acquisition device (La Coupole) to digitize such objects has been developed. Its usage has been extended to capture alabasters and it can be used to measure the visual appearance of other objects as well. The next steps are to increase the spatial and spectral resolution of the device by leveraging between, the desired resolution, the object size, and the scientific goals in ethnography and also in art history.

The huge size of the acquired data (several Terabytes) raises the question on how to disseminate and make the data viable in the context of Open Science. Indeed, their storage has a strong societal and scientific impact but also induces a large economic and ecological cost.

La Coupole: an acquisition device to capture the appearance of objets.

Numerical reconstruction for an alabaster (Musée d'Aquitaine)

. **JPI CH funding:** 642 307 €
. **Year:** 2015
. **Partners:** Musée d'Ethnographie de l'Université de Bordeaux ; LP2N ; Oce Print Logic Technologies SA ; Institut National de Recherche en Informatique et en Automatique (France)

http://maverick.inria.fr/Projects/Materials/

MÉMOMINES

Converting memorial traces into numerical mediations: the case of mining memory

The issue concerns the conservation of endangered cultural heritage: how to build up corpora of digital archives and metalinguistic resources (thesaurus...) to ensure the media exposure of memory traces?

KNOWLEDGE ORGANIZATION SYSTEMS FOR THE MEDIATION OF MINING HERITAGE

1. development of an Okapi modeling tool for multimedia content
2. establishment of a thesaurus and an ontology on mining heritage (https://opentheso.huma-num.fr)
3. valorization of the human mediator in the dialogue with a Great Digital Witness.

Publications available on https://memomines.hypotheses.org/

Blondeau V. (2020), Vers un humanisme numérique. Du témoin vivant au Grand Témoin numérique, Thèse de doctorat en Sciences de l'Information et de la Communication, 3 décembre 2020, Université Polytechnique Hauts-de-France.

Blondeau V., Chaudiron S., Daloz A., Jacquemin B., Kergosien É, Leleu-Merviel S., Le Marquer J., Tardy C. (2020), « Préserver, valoriser et transmettre le patrimoine minier des Hauts-de-France : l'apport du projet ANR Mémo-Mines », Colloque international Le corpus audiovisuel : Quelles approches ? Quels usages ?, 12 juin 2019, Paris

Daloz A., Le Marquer J., Chaudiron S., Tardy C., Jacquemin B., Kergosien É. (2019), « Patrimoine, ontologie et savoirs pluriels : quelle place pour les mémoires minières des Hauts de France ? », 4èmes Journées scientifiques internationales du réseau MUSSI, Universidade Federal de Minas Gerais (Brésil), 27 et 28 juin 2019

Stockinger P. (2018), « Du modèle conceptuel des données à sa mise en scène multimodale. Réflexions sémiotiques sur le design d'information. Exemple : Memo-Mines – la mémoire du monde minier », Journée Sémiotique du design d'information, Université Bordeaux Montaigne – MICA, 21 Juin 2018 (conf. invitée)

RECONCILE REMOTE ACCESS AND HUMAN MEDIATION

At a time when the global health crisis has led to the complete closure of museums and cultural venues for many months and/or a ban on travel, access to culture at a distance has become a major issue, with a sharpness and topicality that was totally unexpected at the outset: digital mediation methods are thus at the heart of all heritage thinking. Blondeau (2020) having demonstrated the essential place of the human witness and the need for a guide/mediator when this repository of memory is digitized and mediated, it is advisable to think about bi or multimodal technical solutions allowing to reconcile the need for human mediation and 100% distanced access.

The mediations of the mining memory

. **JPI CH funding:** 748 758 €
. **Year:** 2017
. **Partners:** Université de Lille ; Université de Valenciennes et du Hainaut-Cambrésis - Laboratoire DeVisu ; Institut National des Langues et Civilisations Orientales/Pluralité des Langues et des Identités: Didactique, Acquisition et Médiations (France)

https://memomines.hypotheses.org/

READ-IT

Reading Europe Advanced Data Investigation Tool

READ-IT is a transnational, interdisciplinary R&D project building a unique large-scale, user-friendly, open access, semantically-enriched investigation tool to identify and share groundbreaking evidence on the cultural heritage of reading from the 18th to the 21st century.

AN ONTOLOGY OF EUROPEAN READING EXPERIENCES

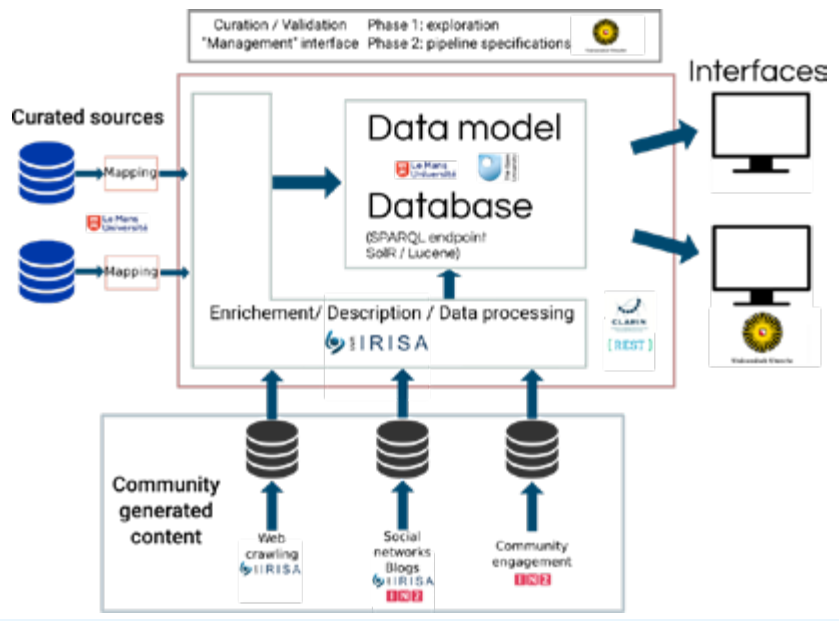
READ-IT ensures the sustainable and reusable aggregation of qualitative data allowing an in-depth analysis of the Cultural Heritage of reading. State-of-the art technology in linked data and information systems provides a versatile environment enabling to retrieve information from a vast amount of community-generated digital data.

The corpus encompassed is a rich 'human archive' in multiple media and languages depicting a transaction between reading subjects and reading material. Yet it is currently scattered and insufficiently labeled. The collaboration between digital humanists, human & social sciences scholars and computer researchers investigates innovative ways of gathering new resources through crowdsourcing and web-crawling as well as linking and reusing preexisting datasets. Extracting descriptors from a sample of multilingual textual sources contributes to a robust ontology of European reading experiences across times and cultures.

The choice of technologies and standards, such as RDF, combined with ontology formalisms and widespread vocabularies, allows READ-IT to publish its structured data with a universally understood data model. This facilitates flexible interfaces for search and exploration. Text mining is extensively exploited: natural language processing (NLP) plays a leading role in identifying new sources of information; entity detection and reading testimony detection in several languages (English, French, German) facilitates the description and curation of data.

NEW AVENUES FOR EXPLORING READERS' EMOTIONS

READ-IT maximizes research outputs through 'beyond the state of the art' smart APIs and user interfaces designed for the co-curation of personal collections and memories of reading. It sheds light on the societal impact of digitally mediated knowledge and of public engagement with the Cultural Heritage of European print culture. While the program could not fully conduct multimodal content analysis and image retrieval as initially contemplated, it does pave the way for future quantitative and qualitative research actions on the underexplored emotions of readers.



. **JPI CH funding:** 249 804 €
. **Year:** 2017
. **Partners:** Ustav proeskou literaturu AV R (Czech Republic) ; Laboratoire langues, littératures, linguistique des universités d'Angers et du Maine ; Centre National de la Recherche Scientifique (France) ; Universiteit Utrecht (The Netherlands) ; The Open University (United Kingdom)

https://readit-project.eu/

RESEED

Semantic reverse-engineering of digital heritage objects

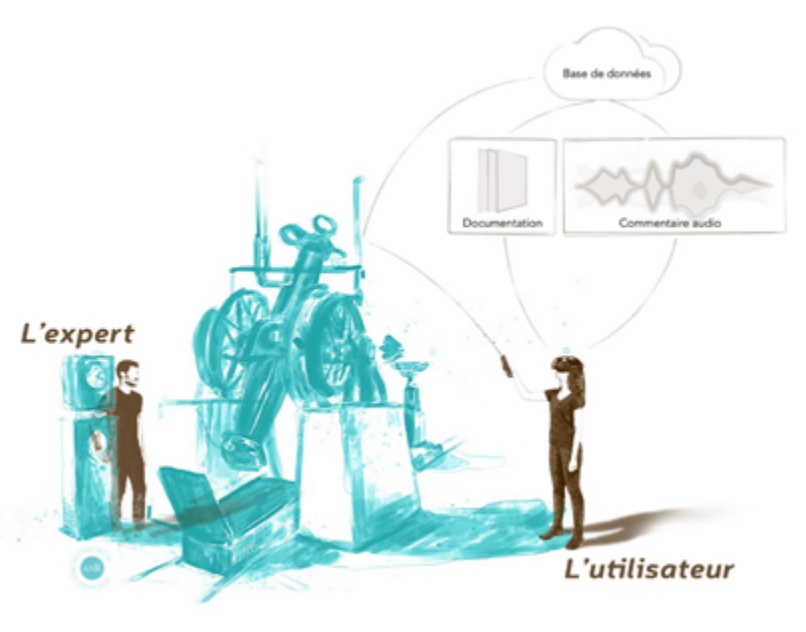
The ReSeed project aims to offer an alternative allowing both semantic (2D sources) and physical (3D) modeling for our scientific, technical and industrial heritage; while guaranteeing authenticity and integrity of knowledge.

A SELF-STRUCTURED DIGITAL CONTAINER OF KNOWLEDGE

The digital integration of heterogeneous knowledge is ambitious; the project team then demonstrated that designing a unique tool is not possible.
ReSeed's proposal is one digital container of self-structured knowledge created simultaneously with the digital double of the heritage object studied.
Considered as an «Augmented Historical Reality» defined by a virtual tool instead of the usual «paper» procedures, ReSeed nonetheless remains a tool for asset decision support.

TOWARDS AN SWISS HERITAGE KNIFE TOOL

With dedicated views for each profession, ReSeed becomes a toolbox available in "ReSeed App" with public version, pro version and several plugins: "ReSeed Eye", "ReSeed Snap"... while using "ReSeed Capture" to digitize in 3D the object and its historical sources thus certifying the integrity of the heritage data. In addition, in order to guarantee the authenticity of digital data, the concept of the blockchain can be adapted: it makes it possible to trace the use of a source and its modifications. The digital tool itself becomes the certificate of authenticity: it is «ReSeed Blockchain».
Several scientific prototypes have been developed for mediation purposes. They are applied on heritage objects and are based on augmented reality in smartphone mode and are also available in Virtual Reality on computer - go to the project website to test them.
Scientific perspectives are numerous and have shown that both for heritage communities and digital technologies, context and computer languages are not yet mature enough to allow total synergy of tools dedicated to heritage experts. The complexity of 2D and 3D digitization involves the convergence of models and meta-models with technical tools and software that do not yet exist. The major result of ReSeed project is the specifications towards an interdisciplinary world aimed at «the Swiss army knife tool of heritage».



ReSeed in-virtuo device

. **JPI CH funding:** 692 715 €
. **Year:** 2016
. **Partners:** LS2N - Ecole Centrale de Nantes ; Université de Technologie de Troyes ; Université de Nantes - Centre François Viète ; Université de Technologie de Compiègne ; DeltaCAD ; MCC-HERITAGE ; Musée des Arts-et-Métiers ; Ministère de la culture - Mission de l'Inventaire général du patrimoine culturel (France)

http://www.reseed.fr/

SCHEDAR

3D Capturing shape and motion to safeguard dance forms

We assume that safeguarding dance means worldwide dissemination and teaching remotely using VR/AR. SCHEDAR aims at designing new technological means to capture (motion, appearance, choreography...), model, annotate, store and disseminate dance.

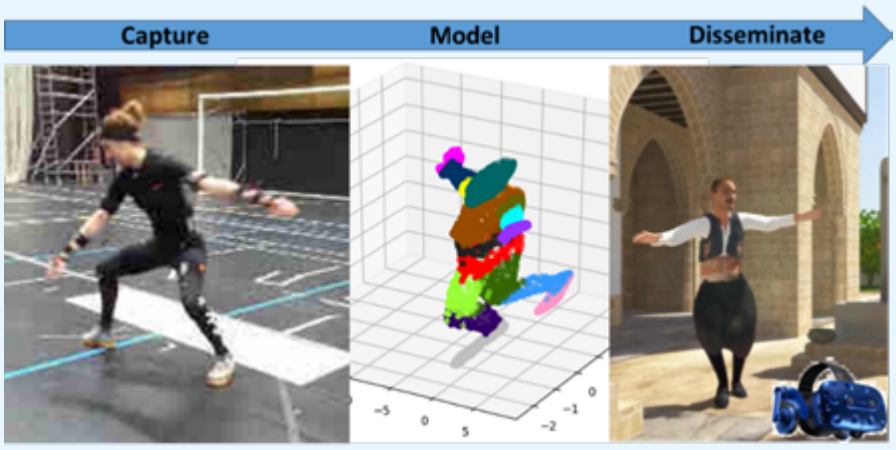
A PROTOTYPE USING VIRTUAL REALITY

UCY has designed a database to encode the knowledge required to model a dance form. To fill-in the database, URCA and UR2 have proposed a capture framework based on Microsoft Kinect Azur sensor to measure RGB images, depth images, sound and skeleton motion of the dancers. Based on this information, we reconstruct the motion and the shape of the dancer using a parametric representation (SMPL model). Hence, dance is not limited to joint motion, but important information is embedded in the relationship between the surface of several body parts which convey emotions or tell stories.. The result is saved in a standard fbx file that preserves the information of shape and motion. Algolisys partner in Cyprus developed the structure and tools of the database to store, search and visualize such type of data, for easy worldwide dissemination. University of Cyprus is also providing a system to enrich this motion data with meta-data that are useful to encode the other elements of the dance form. Concurrently, we have designed a joint protocol with URCA, UR2, UCY to evaluate the relevance of various motion capture systems in the context of dance capture. Moreover, UR2 with UoW are designing an original approach based on VR to train distant people to dance forms. To this end, a collaboration with the sports science department of UR2 enabled us to develop a prototype that benefits from the expertise of real professional dance teachers. The design of this system is under development.

NEW DIGITAL TOOLS TO COLLECT AND TEACH

Coupling shape and motion capture opens new avenue to measure and save the 3D deformation of garments all along the performance. It will clearly enrich the database with important information, not only skeleton motion. Working upstream with professional dancers will ensure to transfer the dance skills in AR/VR to facilitate their practice without the help of a real coach. However, we also explore how VR/AR support/complement traditional teaching of dance forms. This could help to disseminate rare dance forms worldwide, while taking advantage of the motivation of using VR/AR technologies.

All this research is developed to safeguard dance forms, but it could be easily applied to sports training, and to safeguard also traditional manual work.



SCHEDAR pipeline to safeguard dance forms: From left to right: data collection, dance modeling using shape, skeleton and meta-data, and dissemination based on VR/AR remote training.

. **JPI CH funding:** 249 861 €
. **Year:** 2017
. **Partners:** University of Warwick (United Kingdom) ; Algolysis LTD ; University of Cyprus (Cyprus) ; Centre de REcherche en STIC ; Laboratoire Mouvement Sport Santé (France)

https://www.schedar.eu/

Projects presented during the POSTER SESSION

POSTER

ALEGORIA

Advanced Linking and Exploitation of diGitized geOgRaphic Iconographic heritAge

ALEGORIA focuses on the valorization of iconographic institutional collections describing the French territory at different periods, by providing tools for multimodal indexing and visual restitution, evaluated for social sciences and humanities.

TWO PLATFORMS DEALING WITH ICONOGRAPHIC COLLECTIONS

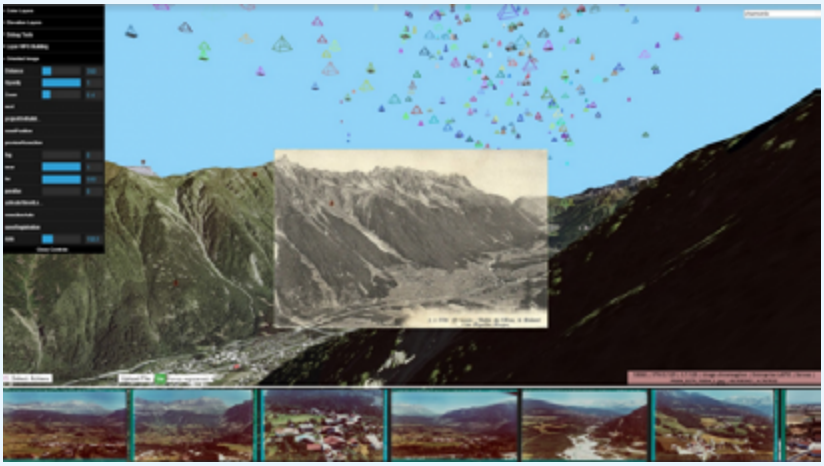
The work carried out has led to the development of two demonstration platforms dedicated to the valorization of digitized iconographic geographical heritage:

- ✔ A multimodal indexing and retrieval engine, combining content and metadata-based retrieval within and between collections, based on the consistency of metadata (international standard for archive description ICA-RiC) and on a visual retrieval using deep adversarial networks and multimodal siamese networks;
- ✔ A visualization engine (iTowns) offering several spatio-temporal restitution paradigms (including radiometric and geometric correction of distortions), immersive and interactive navigation in the 3D environment enriched with old photographic collections.

Currently, the project has resulted in 7 international and national publications (http://www.alegoria-project.fr/en/papers). Alegoria is an associated program of the European Time Machine Organisation initiative and supported the 2019 and 2020 editions of the SUMAC international workshop dedicated to the structuring and understanding of multimedia heritage contents (https://sumac2020.ec-lyon.fr). The achievements have led to two new collaborations: one with the Ville de Paris on the structuring of the city's iconographic collections (CIFRE contract) and the other with the «Digital Data» working group of the scientific project for the restoration of Notre-Dame de Paris (FSP funding).

INVESTIGATION TOOLS ACCESSIBLE TO ALL RESEARCHERS

Alegoria is at the heart of the problem of analyzing, structuring and reconstructing the Big Data of the past, for which the contents can evolve a lot over time and where the training databases are still poorly mastered. The project proposes solutions to these methodological obstacles.
The fallouts of the project cover a wide range of fields where multi-date geographical iconographic collections are valuable: historians and geographers modeling the evolution of the territory, sociologists investigating public spaces, tourism, heritage preservation, environmental mapping, urban planning (study of spatial and urban dynamics), etc.



3D spatio-temporal co-visualization of photographic archives
(J. J. 7770 Chamonix - Vallée de l'Arve, le Brévent et les Aiguilles Rouges Jullien frères, Phot. Editeurs, Genève)

. **ANR funding:** 507 398€
. **Year:** 2017
. **Partners:** Laboratoire Architecture Ville Urbanisme Environnement - Nanterre ; Laboratoire d'Informatique en Images et Systèmes d'Information - Écully ; Archives Nationales ; Laboratoire en Sciences et Technologies de l'Information Géographique - Saint-Mandé ; Musée Nicéphore Niépce

www.alegoria-project.fr

ANTRACT

Transdisciplinary Analysis of French Newsreels (1945-1969)

ANTRACT offers a historical and technological analysis of the images, texts and sounds produced by Les Actualités Françaises (1945-1969). Speech transcription, image and sound analysis, textometry, provide historians with a complete framework for study.

A SOUND, VISUAL AND TEXTUAL CORPUS TO EXPLORE HISTORY

The results of ANTRACT are three-fold:

1. A coherent corpus of images, sounds and texts built up with the help of image, text and sound analysis technologies
2. Technological domains:
   a. Autmatic speech transcription: unsupervised adaptation of the transcription system from documentation notes and OCRs of typescripts; integration of punctuation and capitalization into transcripts; identification of commentators.
   b. Personality recognition: library, API and graphical interface allowing the interactive creation of models for the detection and recognition of personalities present in French newreels.
   c. Textometry on multimedia corpus: links to video (synchronized to the nearest word), access with authentication to remote media, new possibilities for textual and statistical analysis by cross-referencing searches on different representations (transcribed audio, image descriptors, shot-by-shot sequences, etc.).
   d. Okapi platform: search, structuring, collaborative annotation of multimedia content with an online graphical interface; new tools for corpus building, assisted synchronization of subjects within videos, etc.
3. Historical studies based on the corpus enriched with automatic metadata, using targeted case studies relating to the history of France and the world on the one hand, and the «filmed news» form on the other hand, between 1945 and 1969.

AN OPEN SOURCE, ACCESSIBLE TO THE GENERAL PUBLIC

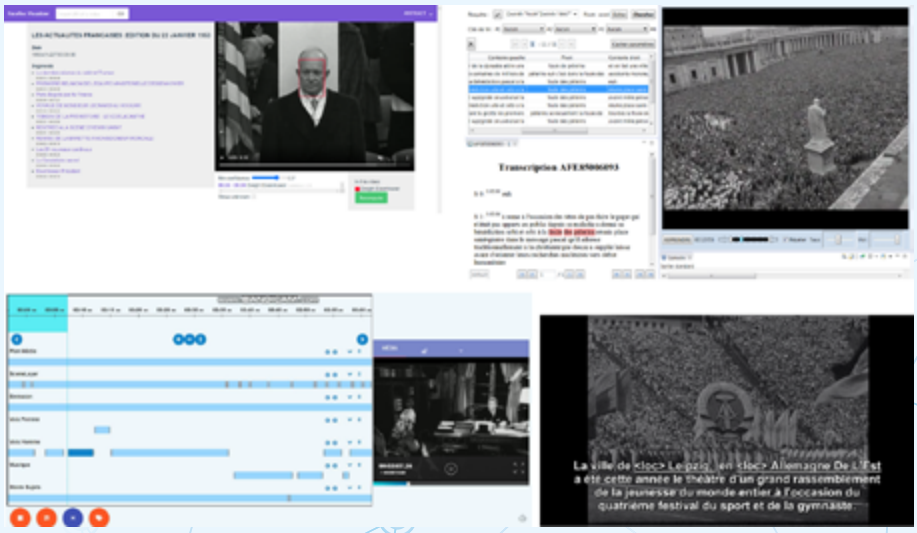
Perspectives

Demonstration for the general public via a web portal

Free availability of the corpus for public and private research

Open-source development: Okapi; TXM (GPLv2) including MediaPlayer extension; FaceRec

Exploitation of FaceRec by master's students



Automatic and automatically assisted analysis of audiovisual content for historical research

. ANR funding: 507 398 €
. Year: 2017
. Partners: Voxolab ; Institut d'Histoire des Représentations et des Idées dans les Modernités - Lyon ; EURECOM ; Institut National de l'Audiovisuel ; Laboratoire d'informatique de l'Université du Maine - LIUM ; Centre d'histoire sociale du XXe siècle - Paris (France)

https://antract.hypotheses.org/

POSTER

APPI

An online pan-Picard linguistic atlas

The APPI project aims to create a pan-Picard atlantographic corpus, bringing together dialectal materials from ALF (Atlas linguistique de la France), ALPic (Atlas linguistique picard) and ALW (Atlas linguistique de la Wallonie).

THREE HOMOGENIZED LINGUISTIC ATLASES

One of the challenges of the project is to fix linguistic atlases in the international movement of digitization of lexicographic resources. Our subject, Picard, deserves special attention given its geographical location between two national areas, France and Belgium, and its treatment in three linguistic atlases very differents: the ALF, the ALPic and the ALW.

We work on homogenizing the materials from a semantic and graphic point of view and making them accessible and searchable online (https://anr-appi.univ-lille.fr/).

The underlying computer model was developed in collaboration with the VerbaAlpina project team in Munich (https://www.verba-alpina.gwi.uni-muenchen.de/).

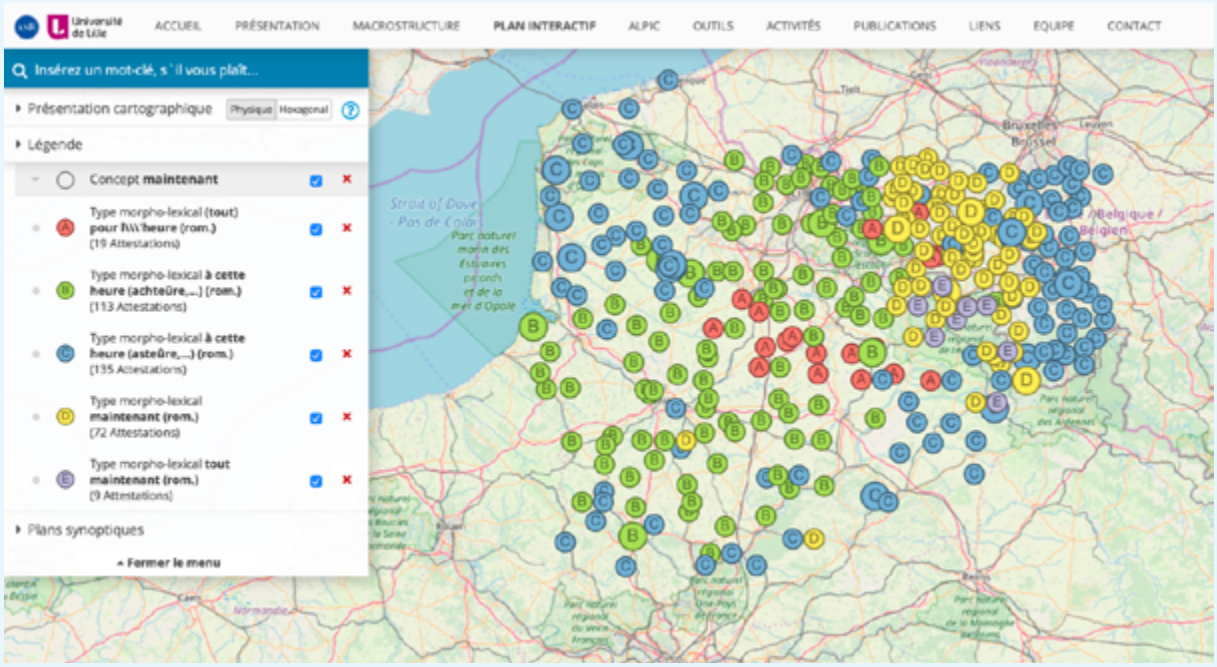
660 LANGUAGE MAPS ACCESSIBLE

The ALPic, the only one of our three atlases to exclusively study Picard, has been fully digitized; the 660 maps are accessible under the ←ALPic→ tab.

The encoded materials can be searched by concept under the ←plan interactif→ tab.

Integration of materials is still in progress. Some developments are also underway, such as interrogability by morphological type or phonetic type, or the enrichment of materials by adding etymological information and links to the computerized version of the FEW (Französisches Etymologisches Wörterbuch).

APPI map of materials naming the concept 'now'



. **ANR funding:** 342 666 €
. **Year:** 2017
. **Partners:** Analyses littéraires et histoire de la langue - Villeneuve-d'Ascq (France)

https://appi.univ-lille.fr/presentation.html

DAPHNE

Discovery in historical prosopographic knowledge databases

The DAPHNE project aims to create an open platform in the field of historical sciences to integrate a quality approach into the process of hypothesis checking and knowledge discovery.

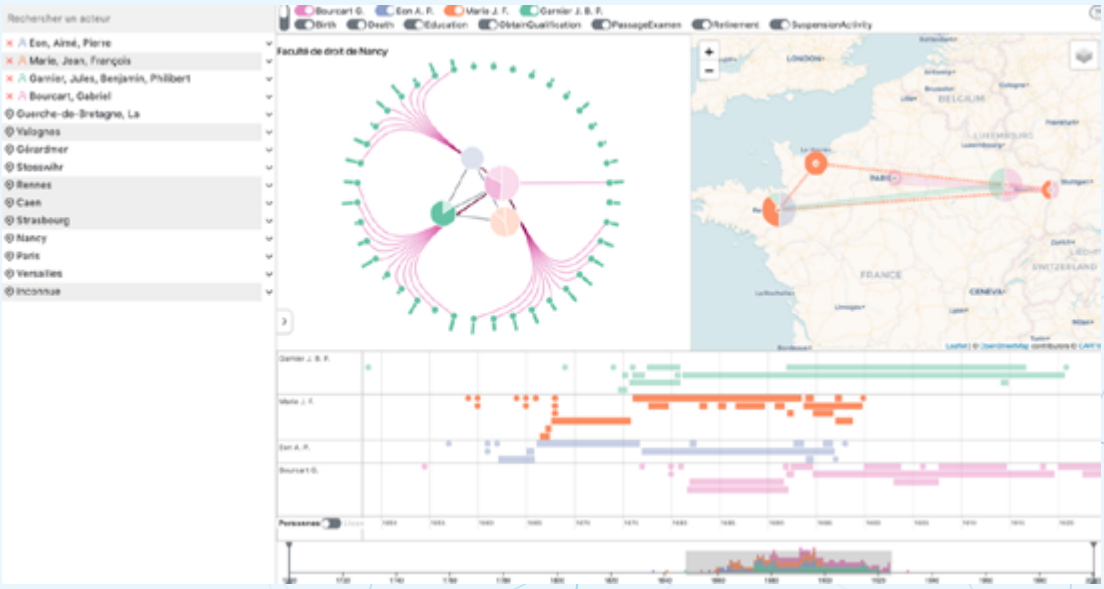
PROSOPROGRAPHY : AN OPEN PLATEFORM

The project has so far resulted in two major contributions. We thus proposed a conceptual approach for the design of a prosopographic database encompassing the notion of uncertainty [EGC18, HICSS19]. Unlike previous approaches, the developed design process allows for the integration of divergent views as expressed in the prosopography community. This work allowed us to model a process for creating knowledge in history [DESRITS19] as well as a model for developing historical facts and hypotheses [EGC20, ER20].
The second major contribution is the development of a platform (https://agorajs.github.io)) allowing to highlight and compare the different paths of individuals [GD19]. It allows through different views from the most global to the most precise and different interaction mechanisms, to select individuals, to display their journey over the years, to search for people they may have met as well. from a temporal and spatial point of view while taking into account the different types of events occurring during their life (eg birth, graduation, education, retirement, holidays, ...) [JGAA20].

COMPARE AND REASSESS THE CREDIBILITY OF SOURCES

It quickly appeared interesting to try to understand and to model the process of the researchers in history: how the facts are established (more or less certain), how hypotheses are developed, how the credibility of a source is estimated and possibly re-evaluated, the certainty of a fact ... Our initial work led to 2 publications but this work is crucial for the outcome of an ambitious project in digital humanities. This approach can then be extended to other areas of the human and social sciences.

Visualizing individuals paths thanks to Agorajs



. **ANR funding:** 464 000 €
. **Year:** 2017
. **Partners:** Laboratoire de Médiévistique occidentale de Paris UMR 8589 ; Laboratoire de recherche historique Rhônes-Alpes ; Technologies numériques pour l'éducation - Poitiers ; Laboratoire d'Informatique, de Robotique et de Microélectronique de Montpellier ; Centre d'études et de recherche en informatique et communications – Paris (France)

http://daphne.huma-num.fr/

POSTER

ECLATS

Automatic Extraction of Geolinguistic Atlas Content and Spatial Analysis: application to Dialectology

The ECLATS project proposes a geomatic processing workflow to extract, visualize, interpret and map the geolinguistic data contained in the Atlas Linguistique of France, an ancient cartographic heritage used as data source by dialectologists.

A SOFTWARE SUITE TO PROCESS GEOLINGUISTIC DATA

To study the linguistic features (phonetic, lexical, semantic ...) of languages with oral tradition, dialectology is based on the exploitation of phonetic data transcribed on the 1920 maps of the Atlas Linguistiques of France, an ancient cultural heritage published between 1902 and 1910. Each map has a heading (notion) representing an object or a concept and 639 localities (survey points) on which the phonetic form corresponding to the way the title of the map is pronounced in that specific location.

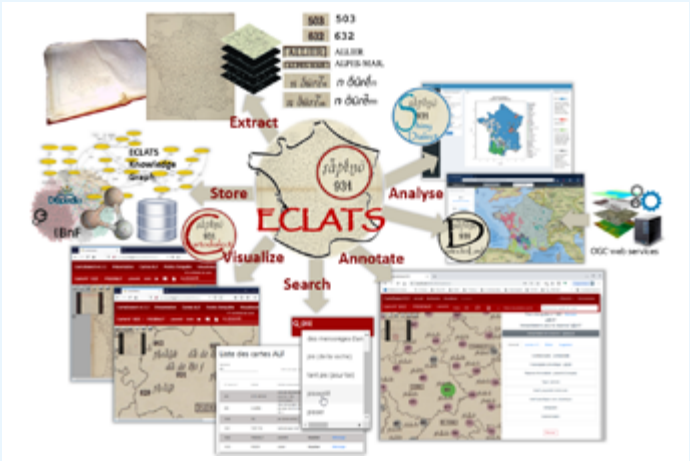
Interdisciplinary approach gathers research groups in Computer Science specialized in geomatics (LIG, Grenoble), in digitalization of ancient documents (LIRIS), in automatic content extraction (LIRIS & Li3) and in geolinguistics and dialectology (Gipsa-lab), and has allowed us to develop a set of software:

- ✔ Cartodialect, a web application for visualization, exploration of ALF maps and semantic enrichment of mapped phonetic forms.
- ✔ ShinyDialect and ShinyClass, interactive mapping applications in order to map the dispersion areas of linguistic phenomena associated with a lexical notion, and spatial analysis of recurrent dialectal pattern, using spatial clustering methods.
- ✔ DialectoLOD, a web-based data application to contextualize the analysis of geolinguistic phenomena by overlaying data from Cartodialect or Shinydialect with geographic data published via geographic web services.
- ✔ An algorithm for the extraction of cartographic components of the ALF (position of administrative boundaries, location of survey points and phonetic forms), from which, a dedicated system (development in progress) based on deep learning must ensure the recognition and automatic transcription of phonetic forms and their indexing to survey points.

PROSPECTS FOR PROMOTING AN INESTIMABLE HERITAGE

The software developments are the result of an active collaboration with dialectologists. Various linguistic studies have been published showing both the stakes of the software developments carried out, their operational characteristics, and the need to evolve the scientific approaches for digital humanities. The online CartoDialect application is the subject of numerous national and international consultations and contributes to the enhance an ancient cartographic heritage of an inestimable value.

The web-based data approach used allowed the ALF to be represented in the form of an RDF graph using a generic model defined by an OWL ontology, making it applicable to other atlases.



. **ANR funding:** 529 433 €
. **Year:** 2015
. **Partners:** Laboratoire Informatique, Image et Interaction – La Rochelle ; Laboratoire Grenoble Images Parole Signal Automatique ; Laboratoire d'Informatique de Grenoble ; Institut National des Sciences Appliquées de Lyon - Laboratoire d'Informatique en Image et Systèmes d'Information (France)

http://eclats.imag.fr/

E-ROMA

Expressive restoration of Gallo-Roman statues by virtual sculpture and animation

The e-Roma project focuses on the digital restoration of the remains of Gallo-Roman statues. It is a computer graphics project developing new anatomical approaches to help this reconstruction and its animation.

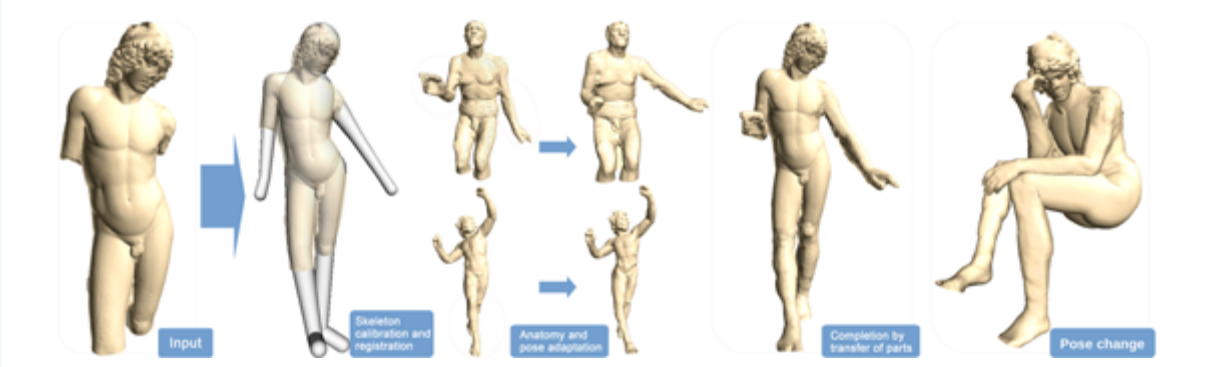
AN ARTICULATED ANATOMICAL MODEL TO RESTORE THE STATUES

e-Roma has developed FAKIR, a new algorithm to iteratively register an articulated anatomical model on a statue, which is essential for understanding the morphology of statues with sometimes unrealistic measurements. This algorithm can be used directly on the raw data provided by laser scanners (point clouds). It is then possible to bring back different statues in the morphology and pose of a statue to be restored, in order to add missing limbs to it, by harmonious combination. For this purpose of pose change, e-Roma offers a skinning algorithm based on the previous articulated model that is also usable on raw data. e-Roma is also interested in analyzing the anatomy of characters in bas-reliefs, with a new approach to extract a 3D model, the objective being to allow their animation constrained by a particular geometry. The animation of drapery is also under study. The work on understanding and modifying the morphology of a statue has been published in Computer Graphics Forum (issue dedicated to Pacific Graphics 2020) and at the Eurographics Workshop on Graphics and Cultural Heritage 2020. FAKIR was awarded the 3rd prize for best paper at the JFIG 2019. The works on bas-reliefs and drapery animation were published in the proceedings of the Eurographics Workshop on Graphics and Cultural Heritage 2019.

A PARTNERSHIP WITH THE LUGDUNUM MUSEUM

e-Roma now intends to select and digitize some artworks and remains from the Lugdunum Museum for which it will be possible to proceed with a virtual restoration, taking advantage of the advances made possible by the project, while respecting the historical knowledge brought by the project historian. An interaction with a professional restorer is also envisaged to discuss the advantages offered by digital technology to this profession. From a methodological point of view, the Origami and Anima computer graphics teams wish to study the possibility of integrating FAKIR and the skinning approach that accompanies it into a more automated understanding of bas-reliefs. One challenge also lies in the animation of these bas-reliefs.

Restoration process by combination of statues



. **ANR funding:** 410 874 €
. **Year:** 2016
. **Partners:** Laboratoire d'Informatique en Image et Systèmes d'Information – Villeurbanne ; Centre de recherche Inria Grenoble Rhône-Alpes – IMAGINE ; Musée Gallo-Romain de Lyon-Fourvière ; Université Paris-Sorbonne (France)

https://projet.liris.cnrs.fr/e_roma/index.html

POSTER

HBDEX

Exploitation of Historical Big Data for the Digital Social Sciences: application to financial data

The aim of HBDEX is to study the long term behaviour of the financial market. For this, we need to extract a large amount of data from the images of the documents. In this context we propose a strategy to recognize sequential collections of historical documents.

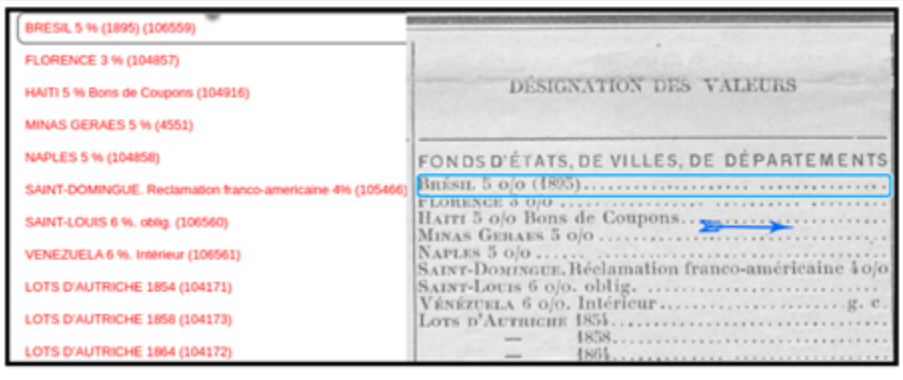
COLLECTION MODELISATION FOR THE RECOGNITION OF DOCUMENTS

Historical document recognition is a challenging task. Commercial solutions do not produce satisfactory results when they are applied on historical documents with noise and complex structures which is the case of the financial documents that we are interested in. Moreover to be exploitable such methods require a lot of manual checking.
Our contribution is to propose a recognition strategy that automatically exploits the sequentiality of collection to improve documents recognition.
The principle is to transform data that comes from image analysis into sequences of knowledge. We then analyze those sequences with tools like rupture detection in signal and sequence alignment. The results that we produce are then used to guide a second analysis of images.
To analyze images we use a grammatical description and an OCR with different language models. As a benchmark, we obtained a 20% CER using Omnipage, a commercial OCR. We created our own OCR, trained from hand-labeled data and reinforcing it with a grammar and lexicon module which helps correct the output following a list of rules or phrases. As a result, we can mitigate the irregularities and degradation from historical documents. This approach has made us obtain less than 1% CER.

Thanks to our strategy we obtained on the 1899 price lists, as intermediate results, already significant improvement compared to a "basic" method going from 91.4% up to 98.8% on stock recognition, while considerably reducing manual checking.

PROCESS 40 YEARS OF DOCUMENTS

In further work, we will first continue to improve the strategy and then test our system on larger scales by producing data for the whole collection of "La Coulisse". This collection is composed of 40 years of documents (more than 140 000 images).
Once the full data set obtained, a statistical and economic analysis will help to explain the functioning of markets at a micro level. In a first step, a times series analysis will furnish an overview of the dynamics of prices and quantities exchanged on the long term. In a second step, an analysis will be carried out on the basis of a complex system approach that models agents' behaviors. The hypotheses and the conditions of validation of an agent-based model will be discussed through the SHS partners.



Stock recognition results

. **ANR funding:** 660 960 €
. **Year:** 2017
. **Partners:** Centre d'analyses et de mathématiques sociales (CAMS) - Unité de recherche -Villejuif ; Institut de recherche en informatique et systèmes aléatoires – IRISA - Unité de recherche – Rennes ; Laboratoire d'informatique, de traitement de l'information et des systèmes - Saint-Étienne-du-Rouvray ; Ecole d'Economie de Paris (France)

http://hbdex.projets.litislab.fr/

HORAE

Hours - Recognition, Analysis, Editions

HORAE is an interdisciplinary research project that studies books of hours, improves the techniques of handwriting recognition by AI and the identification of texts by NLP in order to better undestand the circulation of texts and the religious history of the Middle Ages.

AUTOMATIC ANALYSIS OF BOOKS OF HOURS

Books of hours are the medieval bestsellers and often lavishly illuminated. They support the religious practices of the faithful, and comport several sections (calendars, offices, prayers) and text genres (chants, orations, readings, etc.). Too numerous and apparently standardized, their textual content has been neglected by scholars until now.

HORAE unlocks the books of hours' granularity and complexity and explains the interdependence of their different parts and the variety in the choice of pieces and prayers depending on the liturgical uses and devotion of the patron.

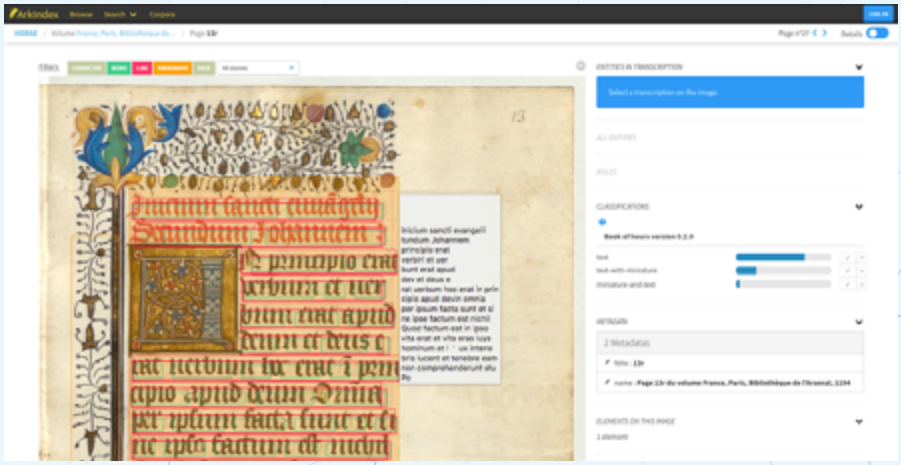
HORAE combines the partners' expertise in medieval history and palaeography (IRHT), in detection of plagiarism and text reuse identification (LS2N) and in machine learning and handwritten text recognition (Teklia) in order to characterize specific uses and textual transmission.

The partners have recorded more than 7000 manuscripts, including 1000 fully digitized and via IIIF available ones, and trained models for page classification, layout segmentation (illuminations, initials, rubrics, etc.), and text recognition. HORAE also developed technologies to identify texts in manuscripts and generate hierarchical tables of contents. Processes of textual circulation, hybridization and individualization are evidenced.

BETTER UNDERSTAND THE EVOLUTION OF EXPLORING AND UNDERSTANDING MEDIEVAL RELIGIOUS PRACTICES

IRHT publishes a database of books of hours worldwide, covering more than 300 liturgical uses and 15,000 records of works, as well as annotated data in order to train new models in AI. The Arkindex platform for document analysis allows the recognition of lines, graphic elements, and text beyond the HORAE project. NLP technologies, published in open source, allow to identify each textual unit as well as to reconstruct the internal structure of manuscript. Links with private owners and book collectors are being established. These technologies and workflow are extensible to all textual cultural heritage resources to facilitate their access to a broader audience as well as to understand the information flow and the individual conversion processes in religious communities.

Handwriting recognition interface
(Paris, Bibliothèque de l'Arsenal, MS. 1194, fol. 13r)



. **ANR funding:** 402 120 €
. **Year:** 2017
. **Partners:** TEKLIA ; Laboratoire des Sciences du Numérique de Nantes ; Institut de Recherche et d'Histoire des Textes - Paris (France)

https://horae.digital/

POSTER

HYPEROTLET

Documenting documentation: a European and Francophone tradition

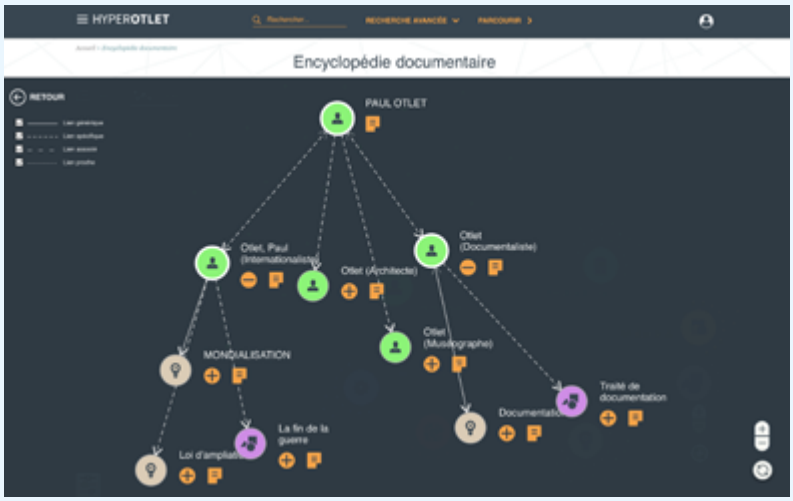
HyperOtlet is a pluri- and transdisciplinary project which deals with a major work in the history of documentation: the Traité de documentation (TD, 1934), by the Belgian jurist Paul Otlet († 1944).
A pacifist, convinced of the importance of knowledge as an instrument of peace, an internationalist involved in international associations, author of an essay on the League of Nations (1917), passionate about bibliography and classification, he was also an ardent activist in a new field: documentation.
The word is recent (circa 1870) as is the activity it refers to, articulated on the new «documentary» imperatives of industrial societies in the process of «democratisation».
Theory, methodology and pedagogy of documentation, the TD is a paradoxical object since the documentary project of its author is to go beyond the book, to unbind it from its boundaries, to disintegrate its contents on cards re-deployed in an encyclopedia-documentary. An hybrid object, a book by its binding and its boundaries, it is also an accumulation of pages/indexes, an agglomeration of files, a collection of folders, a directory and an encyclopaedia.

THE HYPERDOCUMENT, A NEW DIGITAL OBJECT

We have analysed the TD as a «hyperdocument», as the space of a device for regulating a new intellectual technology (Pascal Robert) and a new knowledge architecture: documentation.
As part of the social sciences and the development of the Digital Humanities, HyperOtlet has endeavoured to go beyond the now classic model of augmented publishing on the WEB (text, hyperlinks, multimedia) and proposes a new instrument around a new digital object, a new device: the hyperdocument (database, documents, data) and a documentary encyclopaedia structured by categories and whose entries are articulated by graphs. So we only have to reread the text in an augmented version, but above all recomposed into documents, likely to propose new enrichments, combinations, organisations, regularities, modelling, simulations and compose new encyclopaedic configurations.

A DEVICE THAT CAN BE TRANSPOSED TO OTHER EDITORIAL OBJECTS

The complex system developed within the framework of the project from the Omeka S platform is structured around new APIs which open up new editorial perspectives on the WEB, data structuring, visualisation, graphs. This system is likely to be developed and used for other editorial projects. This is already the case within the framework of the new project proposed to the ANR on the French Encyclopaedia (1935-1960), designed and directed by Lucien Febvre.



. **ANR funding:** 469 296 €
. **Year:** 2017
. **Partners:** Mundaneum ; Maison des sciences de l'Homme Paris Nord ; Ecole Nationale Supérieure des Sciences de l'Information et des Bibliothèques ; Mediations, Informations, Communication, Arts – Pessac ; Centre Maurice Halbwachs (France)

https://hyperotlet.hypotheses.org/

INTROSPECT

Introspection of archaeological material in the digital age

INTROSPECT aims to develop new uses and tools of digital introspection for access to new archaeological knowledge by combining computed tomography, Virtual Reality, tangible interactions and 3D printing.

AN UNPRECEDENTED COMBINATION OF INVESTIGATIVE TECHNIQUES

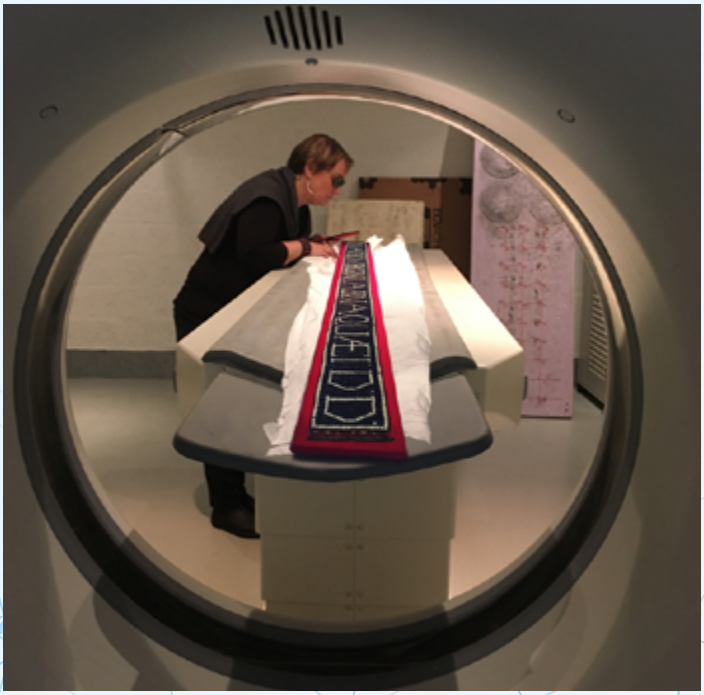
An important multidisciplinary collaboration allowed the development of a methodology applied to different study contexts for cultural heritage.
Among the project's achievements, three major contributions illustrate the results obtained:

1. The research work on the Egyptian cat mummy at the Musée des Beaux-Arts in Rennes, carried out through collaboration with the MAHES Egyptology project, revealed its unexpected content, testifying to little-known practices. Several achievements resulting from this work, including a transparent 3D printing at scale, have given rise to scientific communications.
2. A complete virtual excavation process was developed for the study of the Mesolithic site of Beg-Er-Vil. This novel methodology mixes advanced interaction techniques, in association with a VR database, and allowed the most scientifically reliable 3D reconstruction of the site.
3. Two wampums preserved in the treasure of the Cathedral of Chartres were studied following the method developed in the project, in collaboration with the Abenakis and Hurons-Wendat First Nations (Canada) in order to find the secrets of a lost craft.

INCREASED SCIENTIFIC RELIABILITY IN EXPLORATION

The project has resulted in scientific publications in archaeology and computer science, including a dedicated issue of the News of Archaeology (2020). A session at the GMPCA congress (Montreal 2019) and a scientific and technical seminar at Inrap and Inria (Rennes 2018) were organized. Actions for the general public were carried out at the JNA, JEP, in popular science programs (Xenius, Arte, Autour de la Question, RFI, Mag Science, Science & Vie TV) and in museums (British Museum, Musée du Quai Branly, Îlot des Palais, Musée Odanak). Joint CReAAH/Université Laval excavations, work on cremations with the University of Gent, IRISA, and Inrap, and an exhibition on Wampums are being organized.

Analysis of Abenakis wampum in tomodensitometry



. **ANR funding:** 249 990 €
. **Year:** 2016
. **Partners:** Université Laval ; Musée des Abénakis d'Odanak ; Société du patrimoine urbain de Québec ; Musée de la nature et des sciences de Sherbrooke (Canada) ; Image ET ; Institut National des Sciences Appliqués de Rennes ; Institut National de Recherche en Archéologie Préventive ; Université de Rennes 1 ; Ecole Normale Supérieure de Rennes ; Centre National de la Recherche Scientifique (CNRS) ; Institut National de la Recherche Scientifique (France)

https://sstinrap.hypotheses.org/474 et https://creaah.cnrs.fr/lieux/anr-introspect-canada/

POSTER

RESTAURE

Computational Resources and Processing for Regional Languages

The aim of the RESTAURE project was to provide digital resources (annotated corpora and lexicons) and natural language processing tools for three regional languages of France: Alsatian, Occitan and Picard.

ANNOTATED CORPORA AND LEXICONS FOR THREE REGIONAL LANGUAGES

Given the challenges of working with low-resource languages, which moreover present significant dialectal and graphical variation, our methodology was based on three main principles: collaboration between researchers, reuse and recycling of existing tools and use of standards (CONLL-U, Universal POS tags). These principles follow the recommendations given by Soria et al (2013).

The resources produced are associated with a persistent identifier (DOI), described by metadata, stored in a data repository (Zenodo: https://zenodo.org/communities/restaure) and reusable, following a Creative Commons CC-BY-SA licence. In addition, explicit links are made between the published articles (described on HAL) and the resources and tools published on Zenodo. The RESTAURE project thus allowed the development of 3 annotated corpora, 2 lexicons and dictionaries, 5 reports and annotation guidelines, 2 models for optical character recognition and 4 tokenization models and tools.

Claudia Soria, Joseph Mariani, & Carlo Zoli (2013) - Dwarfs Sitting on Giants' Shoulders: How LTs for Regional and Minority Languages Can Benefit from Piggy-backing on Major Languages. In Proceedings of the 17th Foundation for Endangered Languages Conference (pp. 73–79).

SYSTEMATIZE THE PRODUCTION OF TOOLS FOR REGIONAL LANGUAGES

Our work has highlighted a strong societal interest, corresponding to a growing need among speakers for tools that help them evolve in the digital world with their languages. Thus, the resources developed have been used to develop predictive keyboards. Low-resource languages, whether regional or minority languages, are still marginal in research projects, especially in natural language processing. It is therefore important to continue to encourage work on these languages. In particular, we plan to collaborate with other research teams to work on other regional languages of France.

. **ANR funding:** 394 674 €
. **Year:** 2014
. **Partners:** Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur - Orsay ; Centre d'études des relations et des contacts linguistiques et littéraires - Laboratoire Linguistique Et Sociolinguistique : Contacts, Lexique, Appropriations, Politiques - Amiens ; Cognition Langues Langage Ergonomie – Équipe de Recherche en Syntaxe et Sémantique – Toulouse ; Linguistique, Langues, Parole - Université de Strasbourg (France)

http://restaure.unistra.fr/

SCHOPPER

Simulating prehistoric human behaviours in their paleoenvironments for Research

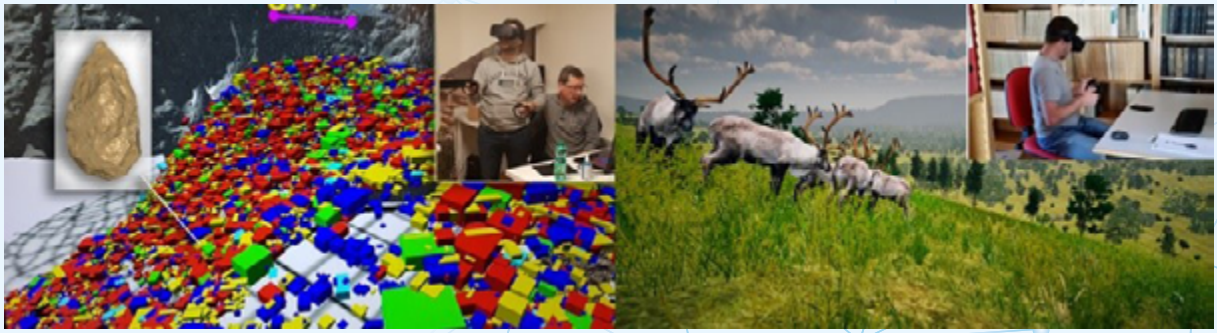
The aim of the SCHOPPER project was to design and develop a method for processing archaeological data, for the evaluation and validation of research hypotheses on palaeoenvironments and palaeolithic human behaviors.

PRODUCING PREDICTIVE MODELS OF THE PAST

This tool, using Machine Learning and immersive virtual environments scientifically reconstructed from procedural landscapes, works on multidisciplinary data collected during more than 50 years of excavations in the famous Caune de Arago palaeolithic site in the south of France and their analysis. Two 3D immersive environments: the cave of Caune de l'Arago and the surrounding Tautavel valley were created in order to collectively test research hypotheses in immersion. The system makes it possible to query the site's database and obtain predictive models on hypotheses, during the immersion, and to configure the environment according to the new models generated. The automatic processing of a large amount of multidisciplinary data by ML coupled with the reconstruction of 3D past environments and the use of VR make this new system a powerful research tool, plunging specialists into the heart of their hypotheses in order to check their validity. Concrete visualization of scenarios, immersion in reconstructions and disciplinary decompartmentalization of research on a prehistoric site are the main advances obtained thanks to the tool. The main research results concern the definition of prehistoric occupations and their contexts. The results obtained show the relevance of ML treatment for identifying the predominant characteristics of each occupation category or each type of climate or environment in the Caune de l'Arago quaternary archaeostratigraphic record. Significant results on Pleistocene paleoenvironments in South Korea and China have already shown that the system was transposable to other prehistoric sites, and even to other areas of research.

BETTER UNDERTAND PREHISTORIC CULTURES AND ENVIRONMENTS

The VR tools developed will have short-term museographic and educational benefits and prehistory students and museum audiences will be able to benefit from this device to understand the evolution of prehistoric cultures in connection with that of climates and environments during the Quaternary. Using the knowledge gained from this system, supplemented by new technologies, a project on prehistoric mobility aims to extend this research into the future on questions of geographical dispersion and organization of Paleolithic populations.



On the left, display and selection of archaeological items by a researcher in occupation level G (450 ka B.P.) of Caune de l'Arago. On the right: immersion of a researcher in the landscape of archaeological level L (550 ka B.P), reconstructed using palynological, paleontological and sedimentological data.

. **ANR funding:** 502 324€
. **Year:** 2016
. **Partners:** Immersion Tools ; Université Paris Ouest Nanterre La Défense / Centre d'études et de recherches sur les organisations et la stratégie ; Craft.ai ; UPVD CERP UMR 7194 HNHP – Tauvatel (France) ; Département d'Histoire de Yonsei University - Seoul (Republic of Korea) ; Institut catalan de Paléoecologie et d'évolution sociale (Spain)

http://www.schopper-anr.org/

POSTER

SUMUM

MUlti-scale, multi-modal documentation strategies for cultural heritage: acquisition, processing, study and dissemination

SUMUM proposes an innovative digital documentation methodology based on multiscale and multimodal imagery, guided by end-users around pertinent case studies, and providing a unified framework for data representation and processing.

WORK UNDERPINNED BY MAJOR ACQUISITION CAMPAIGNS

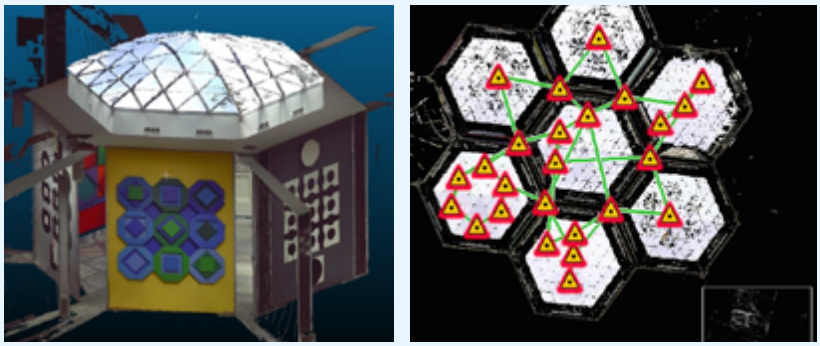
Progress has been made in both sides data acquisition and processing. As far as acquisition is concerned, we have organised 4 campaigns involving complex objects of different materials and sizes. Beforehand, a documentary work in order to define the needs and possibilities was carried out to elaborate the scenarios and to have references. Vasarely's works were the subject of two acquisition campaigns to study the change but also to confront the problems of registration and monitoring. These acquisition campaigns have enabled us to build a multi-modal, multi-scale and multi-temporal database that we share for the purpose of study between the partners and which will be made available to the community at a later date.

Regarding the processing, several investigations outcomes could be highlighted:

. Methods for calibrating the Free-Form RTI system
. Calibration-free 3D reconstruction of large objects by exploiting vague knowledge of camera movement.
. Registration and mosaicking of multimodal 2D/3D and RTI/3D data
. Development on graphs of useful tools for heritage applications (inpainting, colouring, filtering, etc.) for multimodal data (Library on GPU)
. Integration of the data from the different modalities to the AIOLI platform facilitating the annotation, the propagation of processing and also the valorisation of the data and the project.

DEVELOP MULTISCALE AND MULTIMODAL IMAGING

New research approaches non-initially envisaged have indeed been investigated. As examples, we can cite the work on modelling the appearance of surfaces using the RTI technique where approaches that bring rigor to the current use of this technique have been proposed. This involves considering variations in photometric quantities due to the lack of control of lighting (distance, intensity, direction, etc.) by local treatment (pixel-wise). Another original research direction introducing deeplearning in processing on graphs has been set-up: This is an approach where the solutions are parameterised by neural networks on graphs and the learning of weights is supervised by signals processed by EDP.



. **ANR funding:** 687 357 €
. **Year:** 2017
. **Partners:** Modélisation, Information & Systèmes –MIS – Amiens ; Centre interdisciplinaire de conservation et restauration du patrimoine – Marseille ; Groupe de Recherche en Informatique, Image, Automatique et Instrumentation de Caen ; ImViA – Auxerre (France)

https://anr-sumum.fr/

URBANIA

Digital valorization of historical models of cities dedicated to adaptive and innovative uses

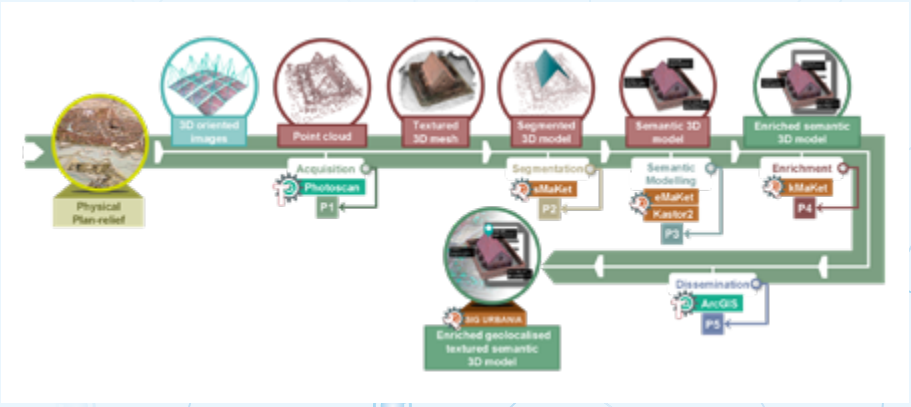
The collection of plan-reliefs is of great interest and is an emblematic entity of the collective memory. The objective is therefore to establish a digital continuum from the collection phases to the spatialized interpretation around the 3D digital model of the plan-relief.

TOWARDS A MULTI-USE GIS FOR VALORISATION AND DISSEMINATION

The ANR URBANIA project has made possible the implementation of a multipurpose geographic information system equipped with innovative types of interaction. A general public or technical user can navigate in the geolocalized 3D space and obtain information on the buildings in the digital plan-relief. A future objective would be to extend this method to the scale of the collection and to produce a visualization system capable of federating, analyzing and cross-referencing a large number of heterogeneous data describing these heritage objects and, if necessary, producing new knowledge. A first version of the digital continuum in the form of a BPMN (Business Process Model and Notation) model has been produced. Part of this continuum has been published: CIPA 2017, 3D Arch 2019, as well as in the French national journal In Situ. Several computer tools have been designed: sMaKet for the segmentation of the raw point cloud, eMaKet for the semantic modeling of buildings, KASTOR2 dedicated to the semantic 3D modeling of bastioned fortifications, kMaKet to elaborate descriptive sheets related to the identified major buildings. All the data, information and knowledge acquired through the digital continuum is capitalized within a GIS consultation platform dedicated to general public and technical uses. Finally, in order to understand the research work developed by the consortium, a dedicated website has been set up.

TOWARDS A SCIENTIFIC METHOD EXTENSIBLE TO THE COLLECTION OF PLANS-RELIEFS

The capitalization of knowledge has enabled the start of a new phase in a project to finalize Verdun's plan-relief digitization, in partnership with the city. The results obtained will also make it possible to optimize several modeling phases, thus making it possible to propose a 3D model that can be integrated into the GIS. Having acquired expertise in the development of a digital continuum dedicated to such objects, one our will is to extend this methodology to the scale of the collection. This is why we have started to build strong collaborations with the Museum of plan-reliefs (Paris), and the Palais des Beaux-Arts (Lille), emblematic national institutions for the conservation and enhancement of plan-reliefs.



Elaborated URBANIA digital and Informational continuum

. **ANR funding:** 272 421 €
. **Year:** 2015
. **Partners:** Région Alsace Champagne-Ardenne et Lorraine ; ARX IT – Paris ; Musée Historique de Strasbourg ; Service de l'inventaire du Patrimoine-Alsace ; INGEO – Lille ; Laboratoire des Sciences de l'ingénieur, de l'informatique et de l'imagerie – Strasbourg ; CNRS délégation Provence et Corse. UMR n°3495, MAP (France)

http://fujiyama.crai.archi.fr/wp-crai/Urbania/

Project valorization experience: Aïoli collaborative platform

AIOLI

A collaborative 3D annotation platform for the multidisciplinary documentation of heritage objects

Aïoli is an application that places the heritage object at the heart of the process in order to bring together the different actors in the documentation of cultural heritage around new practices for a better understanding of heritage objects.

AN EXPERIMENT FOR THE RESTORATION OF NOTRE DAME

Aïoli is a 2D/3D semantic annotation web platform allowing experts of cultural heritage documentation and conservation to establish a continuum of information between all phases of the process from image acquisition to the construction of semantically enriched 3D representations by integrating multi-support and multi-temporal aspects.

This service is based on two major technological evolutions: the democratisation of photogrammetry techniques which allow the processing of a 3D model by image correlation and the possibility of gathering, massively processing and sharing data. In addition to this computing potential, a specific development has been added for the multidimensional propagation of spatialized semantic annotations. This tool, anchored in the development of collaborative and participatory sciences, aims to introduce new multidisciplinary work methodologies at the crossroads of the gathered views around the study of heritage objects and to bring out new scenarios of comparative and cooperative analysis.

This platform has been experimented within several national and international projects and currently within the framework of digital documentation for the restoration of Notre Dame de Paris Cathedral.

An invention declaration was filed with the CNRS in 2017 and a support by CNRS INNOVATION, obtained in 2019 as part of the RISE programme, is currently underway in order to implement transfer trajectories.

A MILESTONE PASSED IN THE AUTOMATION OF DATA PROCESSING

The development of Aïoli opens up new perspectives concerning the automation of photogrammetric processing (TACO project), the interoperability of semantically enriched data (EU SSHOC project) and their integration into information systems for conservation and restoration purposes (Notre-Dame de Paris scientific site) but also real-virtual hybridization for in-situ documentation and finally the multidimensional correlation of large volumes of heterogeneous data, notably through graphical and automatic learning approaches. Moreover, the development of the platform is integrated into national and international initiatives in terms of infrastructures for digital humanities (TGIR HumaNum/Consortium 3DSHS) and heritage sciences (Equipex Patrimex+/E-RIHS).

Use of the Aioli platform on a mobile device

www.aioli.cloud

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