

# CAA2014 PARIS

**CAA2014 : Computers Applications & Quantitative  
Methods in Archaeology**

22-25 Apr 2014 Paris, 75006 (France)

**SESSION, ROUNDTABLE & WORKSHOP ACCEPTED**

03/09/2013



## SESSIONS

## **S01 Towards a History of Archaeological Computing**

Chairs : Paola Moscati 1, François Djindjian 2

1 : Istituto di Studi sul Mediterraneo Antico (ISMA) - Italy - [Website](#)

2 : Université Paris 1 Panthéon Sorbonne & UMR 7041 Arscan - France

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The session will focus on the reconstruction of the main progressive steps of a boundary discipline, archaeological computing, which set its roots in the 1950s, in order to shed light on the theoretical implications arising from the meeting between computer science and the humanities and the role played by information technologies for the development of archaeology.

The main topics of the session will contribute to achieve a scientific definition of “archaeological computing” as an autonomous discipline, with its chronological evolution and its own methods and procedures.

Particular emphasis will be given to the role played by computer techniques not just as a tool supporting the investigation, but rather as a methodology affecting the entire cycle of archaeological research, in order to enucleate and debate the following main evolutionary steps:

- The first attempts to automate archaeological data processing
- The pioneering work by Jean-Claude Gardin in France
- The rising movement of the New Archaeology
- The introduction of databases
- The breakthrough of PCs
- The impact of the Internet
- The development of Geographical Information Systems
- The introduction of Virtual Reality techniques
- Towards a “global archaeology”
- Integration, multimedia and Open Science

During the session, the international project on the “Virtual Museum of Archaeological Computing” will be officially presented to the public.

Subject : : Paper session

Topics : : Historiography

## **S02 Archaeological prospection, geophysics and remote sensing**

Lena Kuehne 1, 2 , Jörg Fassbinder 1, 3,

1 : Bavarian State Dept. for Monument and Site Preservation, Archaeological Prospection (BLfD) Germany

2 : Institute of Classical Archaeology (LMU Munich) Germany - [Website](#)

3 : Dept. Earth and Environmental Sciences, Section Geophysics (LMU Munich) - [Website](#)  
- Germany

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Physical prospection methods have a great potential for the discovery but also for detailed non-destructive mapping and interpretation of buried archaeological sites worldwide. The application of remote sensing and non-invasive geophysical measurement methods has on many occasions been proven to have resulted in considerable new archaeological knowledge about the layout, organisation and extent of archaeological sites ranging from the oldest era of mankind to present day. This includes items like Palaeolithic fire places but even miscellaneous structures in urban sites, rural settlements, grave yards or defensive fortifications.

Recent progress in the development and application of new instruments and interpretation techniques enables the generation of detailed maps of archaeological structures hidden beneath the surface with unprecedented quality. Combinations of airborne and terrestrial laser scanning, hyper-spectral scanning and aerial photography with high-definition ground penetrating radar measurements, large scale magnetic surveys or resistivity measurements permit the detection and investigation of individual sites and their surrounding archaeological landscapes.

Integrative GIS based archaeological interpretation of the prospection data can be used for the generation of maps and, in some cases, even for the creation of digital models of ancient buildings and constructions, forming the basis for the understanding of sites and its archaeological analysis.

The purpose of the session is the communication and presentation of latest methodological and technological developments and concepts in the field of archaeological prospecting and geophysics.

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Subject : : Paper session  
Topics : : Field and laboratory data recording  
: : GIS & Spatial Analysis  
: : 3D Archaeology  
: : Virtual Archaeology

## **S03 Archaeology in the Woods: New Technologies, New Perspectives**

Chairs : [Rachel Opitz](#) 1, [Kasper Hanus](#), Clement Laplaige, Benjamin Stular,

1 : Center for Advanced Spatial Technologies, University of Arkansas (CAST) - [Website](#)

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Abstract: In this session, we hope to bring together papers on a range of technologies, prospection methods, and analyses applied in the contemporary study of forested environments. We define forests broadly, encompassing everything from the temperate deciduous woodland, to the mediterranean scrublands, to the tropical rainforest, from organized and intensively exploited plantations to regenerated and unmanaged mixed woodland, to 'ancient' forests which have been exploited continuously or episodically over an extended period. The technologies and methods of interest include ALS (airborne laser scanning / LiDAR), which has been rapidly changing the large scale picture of archaeology preserved under woodland for the past decade, geophysical survey in woodlands, where important advances are being made in the detailed description of little studied types of sites, new applications of geochemistry and geochemically-oriented spectral surveys e.g. XRF/XRD which could complement both geophysical and ALS surveys, and the ever growing importance of digital databases and ontologies which make trans-regional comparisons and research increasingly feasible.

In this session we are taking inspiration from the work of researchers like A. Groves and O. Rackham, and asking ourselves how the big archaeological picture about woodlands and forests is changing as the result of the deployment of all these new technologies, which are producing enormous amounts of new evidence about past landscapes preserved under woodland canopy. We would like to address both our understanding of the past state(s) of these now-forested areas, our knowledge of activities and experiences of landscape specific to woodlands, and the implications of past activities in forest and the remains of these activities for the landscapes which exist today.

The implications of the technological and methodological leap which has been taking place for the past decade for the study of forests as an theme/concept/aspect of the landscape/aspect of past societies and economies are not always immediately evident. It is easy enough to say that the advent of these new technologies is changing our understanding of the archaeology of forests, but the nature of this change, the new ideas and understandings, are still in gestation. The creation of a bridge between archaeologists working directly with new technologies, the enormous data generated by these technologies, and the 'data wrangling' tools and methods needed to extract information from these data, and archaeologists and researchers in related disciplines studying forests and woodlands from various other perspectives requires that all concerned consider the broader implications of their work. This session aims to draw out expressions of the broader aims, implications, and new perspectives and understandings from the archaeologists working directly with the new technologies and the big datasets they often generate which, we argue, should be leading us to reconsider many aspects of past and present woodlands. The emphasis will be on the chaine operatoire between the technologies, the methodologies, and the archaeological knowledge they create.

Subject : : Paper session

Topics : : Field and laboratory data recording

: : GIS & Spatial Analysis & 3D Archaeology

## **S04 Integrated and multidisciplinary approaches for digital documentation and research in Archaeology**

Chairs : Carlo Bianchini 1, Alfonso Ippolito 1,

1 : Dipartimento di Storia, Disegno e Restauro dell'Architettura - "Sapienza" Università di Roma (DSDRA) - [Website](#)

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Since the early 1990s, researchers started to apply the potential of digital numeric models to the representation of “real” phenomena also in apparently far disciplines like Archaeology. Nowadays this approach has become common practice also in archaeological research: nevertheless the possibility of exploiting increasingly large amounts of data often imply more complex procedure for investigation and categorization of phenomena. The whole process it's clearly connected to the quality of the conceptual and real models adopted to gather, organise and process this information thanks to detailed and accurate 3D numeric models that are becoming widely available after the diffusion of several “new technologies” for automatic 3D acquisition, digitalization and real time browsing.

These new technologies are substantially changing the approach to the workflow:

- 1) Creating interactive and dynamic graphical models for the analysis and investigation of the documentation produced on-time with the excavation;
- 2) New possibilities for data sharing, with the creation of GIS and AIS platforms and visual databases, including digital models;
- 3) Development of detailed analysis of the artefacts and the archaeological architectures for the interpretation of sites, carried out with interactive models (2d and 3d) which can be easily web-shared.

The session will focus on different approaches, techniques and methodologies based on the non-contact 3D acquisition of data and their following elaboration into 2D-3D digital models at a large and small scale, from archaeological sites to small objects.

Contributions to this session will discuss the use of integrated and multidisciplinary approaches in archaeological research, highlight their benefits during both the acquisition and the interpretation of data from the fieldwork, and examine the potential problems associated/not associated with their application.

The session aims at outlining theoretical foundations, as a starting point for further debate about the changing approach to Cultural Heritage.

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Subject : : Paper session

Topics : : Field and laboratory data recording

: Multi-agent systems & complex system modelling

: 3D Archaeology

## S06 Modelling the Archaeological Process

Chairs : [Cesar Gonzalez-Perez](#) 1, Patricia Martín-Rodilla 1,

1 : Institute of Heritage Sciences, Spanish National Research Council (Incipit, CSIC) - [Website](#)

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Most of the efforts that are made in the realm of information technologies and archaeology are directly related to data, or information. However, information technologies have been also successful in organising and improving processes as well as data. Recent debates in the field of archaeology suggest that the formal treatment of process, often neglected, is becoming more and more present in the research arena. European initiatives such as DARIAH and ARIADNE, as well as numerous academic works in recent CAA conferences and other venues, recommend that we start paying serious attention to the systematic study of how people do things in archaeology.

This session aims to address this by, precisely, analyzing how people do things in archaeology, i.e. by studying the processes, products, actors and related aspects of archaeological practice from an abstract viewpoint.

Major research areas that are welcome in the session include (but are not limited to) the following:

- What are the key “products” of archaeological work? What models, documents, ideas, artefacts, etc. are used, changed or generated, and how?
- What is the relationship between the “primary” material evidences and the “secondary” information records that are derived from them? How are the latter constructed from the former?
- Who are the key actors in the process of archaeological practice? What individuals, roles and groups act upon the material evidence and the information, and how?
- What kinds of processes, tasks and techniques are employed in archaeology? Who uses them and why?
- What kinds of tools are used in archaeology, and how do they mediate in the interaction between actors and things?
- What kind of workflow takes place within an archaeological project? What tasks occur before what others, and why? What products are used by whom? Who participates and who does not? What tools are used?
- Do we use methodologies in a prescriptive manner, in order to guide the work? Or do we use them descriptively, to report on what was done?
- What kinds of reasoning processes take place that use archaeological information as input and/or output?
- Do we improve our archaeological practices over time? How do we measure this “progress”?
- How do we build consensus decisions on top of archaeological evidence?

Please bear in mind that the session is intended to focus on the theoretical and analytical study of archaeological practice, rather than on the detailed account of specific case studies.

The session will be of interest to people who:

- Design documents, models and other deliverables or products of the archaeological work.
- Are highly specialized in the use of a particular archaeological tool or technique.
- Need to assess the impact of tool or technique adoption on the overall results of their work.
- Make decisions about methodological choices, either small- or large-scale.
- Are responsible for archaeological or inter-disciplinary teams who will need to work together in complex projects sharing a common methodology.
- Are interested in the mechanisms by which meaning is constructed in archaeology, either individually or collectively.

Subject : : Paper session

Topics : : Ontologies & standards

## **S07 Ontologies and standards for improving interoperability of archaeological data: from models towards practical experiences in various contexts**

Chairs : Anne-Violaine Szabados 1, 2, Katell Briatte 3, Maria Emilia Masci 4, Christophe Tufféry 5, 6,

1 : Archéologies et Sciences de l'Antiquité (ArScAn) - [Website](#)

CNRS : UMR7041, MAE-Maison René Ginouvès. NANTERRE - France

2 : Fondation internationale pour le Lexicon Iconographicum Mythologiae Classicae (LIMC) MAE-Maison René Ginouvès. NANTERRE - France [Website](#)

3 : DGP – DSIP Ministère de la Culture et de la Communication

4 : Scuola Normale Superiore di Pisa (SNS) - [Website](#)

5 : Institut National de Recherches Archéologiques Préventives (INRAP) - [Website](#)  
INRAP

6 : Cités, Territoires, Environnement et Sociétés (CITERES) CNRS : UMR7324  
, Université François Rabelais - Tours - [Website](#)

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The documentation and data of archaeology - planned or preventive - and of cultural heritage, lead to the need for technical and semantic interoperability. The development and the use of ontologies, standards and languages devoted to archaeology intend to facilitate the integration, exchange and sustainability of cultural information. Some researchers have explored these approaches during the previous CAA (Perth 2013 sessions 4, 5 and 6 ). Archaeology, and its documentation and data, are multidisciplinary and heterogeneous. In order to make the best use of conceptual reference models and their implementation in standards, a balance must be found between general approaches, which allow promote interdisciplinary exchanges, and specialized ones that preserve the unique aspects of archaeological research (contextualization, uncertainty, incompleteness, evolution analysis, review of dating, different spatial scales, subjectivity methods, observation and / or interpretation, allocation, etc.). The use of ontologies and standards for treatment of cultural heritage information (CIDOC-CRM / ISO 21127; Europeana Data Model ...), spatial information (INSPIRE, ISO 19115, GML, GeoSPARQL ...) or languages and thesauri (OWL, SKOS ...) already has a proven basis but it may be insufficient. During their implementation in recording, study and management applications using archaeological data, various standards and conceptual models should ensure that archaeologists can choose the level of representation of information, from operational to continental scales. To encourage the use by cultural heritage specialists of languages and construction principles of ontologies, works specific to their domains have to be shown. This will involve presenting standards, and models, but also tools developed on recognized standards already adopted by the scientific community and cultural institutions. The use and reuse of archaeological data encoded in a standardized way, and metadata widely available also raises several points of discussion: the integrity of archaeological data, the risk of misinterpretation, the quality of recorded data, the need for labeling data, the level of specialization in data description and levels of generality imposed by interoperability, etc. The purpose of using ontologies and standards is to enable interoperability and a large but controlled diffusion of archaeological and cultural heritage data in the general context of wide diffusion of big and open data.

The session's goal is to provide practical use cases of ontologies and standards to address these issues. Theoretical aspects too difficult to be transposed will be avoided. Papers may focus on the more practical issues in the construction of ontologies, models and applications, from experience feedback analyzed, and available tools built on such approaches. Finally, communications will enable the various actors of archaeological research and cultural heritage to identify and evaluate, what can be used if they wish to engage in the use of standards for interoperability and wide dissemination of their data.

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Subject : : Paper session  
Topics : : Ontologies & standards

## S08 The third and fourth dimension in archaeological data modelling

Chairs : [Eric Desjardin](#) 1, [Berdien De Roo](#) 2, [Robert Vergnieux](#) 3,

1 : Centre de Recherche en Sciences et Technologies de l'Information et de la Communication (CRESTIC) - [Website](#)

Université de Reims - Champagne Ardenne : EA3804 UFR Sciences Exactes et Naturelles

2 : cartogis - [Website](#)

Department of Geography, Ghent University,

3 : ARCHEOVISION UPS SHS 3D PESSAC - France

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Archaeological data are fundamentally linked with the vertical and temporal dimension, although many data models in archaeology do not fully incorporate these aspects. Analysing archaeological data in their spatio-temporal context requires an adequate data modelling. The last few years, the number of 3D models intended for visualization is increased significantly; however, this session will focus on the geometrical modelling of the data in regard to data exchange and storage. Nevertheless, not all archaeological findings can be located in space via their coordinates, e.g. because of their limited shape. Therefore, topological relations are of importance as well. Moreover, topological relations not only occur with regard to spatial locations, but also concern the temporal dimension. In addition, data imperfection is linked to the temporal dimension as to all other facets of archaeology. Incorporating all these issues and other not-mentioned data particularities makes the development of an archaeological information model a challenging thought process.

This becomes further complicated due to the variety of research questions, site objects, time periods and scale levels. Therefore, archaeological standardization is currently mostly defined by local organizations and rather consists of formats than real standards. Developing a single data model to standardize all archaeological data might not be feasible. Nevertheless, a standard data model which is suitable for part of archaeological data may facilitate the data exchange among various parties. During the development of such a standard, issues such as subjectivity and multivocality may be tackled as well. In this context, integrating the third (spatial) and the fourth (temporal) dimension in archaeological data modelling is inevitable.

Consequently, this session attempts to bring together innovative research in the discipline of archaeological information modeling and archaeological data exchange. This way, the state of the art about the 3D or even 4D data modeling in archaeology is questioned. At the same time, this session could be a forum for the exchange of knowledge and ideas or stimulate further collaboration on this topic.

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Subject : : Paper session

Topics : : Ontologies & standards

## **S09 Strategy, Practice & Trends in Online Archaeology**

Chairs : Virginie Fromageot-Lanièce 1, Judith Winters 2,

1 : CNRS (CNRS - UMR ARSCAN) MAE NANTERRE - France

2 : University of York - United Kingdom

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### *Session abstract*

There is always more to learn about where the key challenges and opportunities lie for archaeology in terms of the internet, its technology and its applications. Institutional and cultural change alongside experimentation, testing and consultation are all required. This session will explore how archaeologists are collaborating, implementing and using web-based technologies (databases, WebGIS, journals, blogs etc) and will try to address questions such as:

- How do we build, implement, and sustain online archaeological resources?
  - What are the important digital archive / preservation issues we need to consider?
  - How do we integrate and re-use digital data in heritage resources?
  - Where is the development and application of open data leading us?
  - How do we use the web to promote awareness and monitor usage and reach a wider public?
  - What are the current web-based applications for archaeological fieldwork, studies, publishing, conservation and site management?
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Subject : : Paper session

Topics : : Internet & Archaeology

## **S10 Archaeology at large: embracing massive audiences for online applications**

Chairs : J. Andrew Duffon 1, Müge Durusu-Tanrıöver 1, Susan Alcock 1

1 : Joukowsky Institute for Archaeology and the Ancient World, Brown University (JIAAW) United States- [Website](#)

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As we reach over 20 years since the Internet truly arrived to a wider public, it is no longer a mere tool for the dissemination of information. Online applications are now also easily used for the active engagement of massive audiences. Although archaeologists have long relied on the web for the spread of archaeological data, have we been as successful in creating a sphere of online interaction for the general public? To achieve the democratic potential available online, archaeologists need to not only present information to a passive audience but also to encourage the direct involvement of this audience with archaeological materials.

As online technologies continue to develop, some new phenomena have emerged aimed particularly at fostering this type of direct involvement. For example, Massive Open Online Courses - or MOOCs - have the potential to drastically alter the way in which previously 'academic' information is conveyed. What ethical questions does the spread of 'MOOC fever' raise about the impact of opening up the academy to an unpaying audience? Crowdsourcing and crowdfunding initiatives similarly look to existing public interest to support archaeological projects. Yet how can we maintain professional standards or legitimacy when archaeological work is undertaken by the general public? Interactive museums open collections to a global community, but how can we structure the archaeological narrative to such a varied audience? With the positive trend toward greater and greater engagement, we must also take time to ask the hard questions about the potential impact of our choices to embrace these new online tools.

This session invites contributions from projects using digital media specifically to actively engage larger groups. Of particular interest are discussions of successful - and also unsuccessful - techniques for harnessing global communities or untapped potential. This may include examples of online teaching, crowdsourcing initiatives, interactive museums, or other approaches. We ultimately hope to open a timely dialogue on the potentials and pitfalls of these new online tools for a truly interactive online archaeology.

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Subject : : Paper session  
Topics : : Internet & Archaeology

## S12 Community Archaeology and Technology

Chairs : [Eleonora Gandolfi](#) 1, [Nicole Beale](#) 1, 2,

1 : Archaeological Computing Research Group, University of Southampton (ACRG)

2 : Web Science Doctoral Training Centre, University of Southampton

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Our purpose in this session is to estimate the viability and applicability of advanced technologies (in recording, management and/or communication of cultural heritage) for archaeology in a collaborative environment working together with communities.

Hi-specification technologies are increasingly becoming an essential element of archaeological recording, interpretation and dissemination, with previously expensive equipment such as laser scanners becoming cheaper. In addition to this, there has been a rapid development in low-cost technological solutions, with tools such as photogrammetry, Reflectance Transformation Imaging, 3D printing, and mobile device apps becoming popular amongst archaeologists. These technologies offer substantial improvements to the ways that archaeologists and communities can work together.

In light of these new opportunities for affordable technologies, the relationship between communities, cultural heritage organisations and universities has become increasingly pertinent. Budgetary constraints are becoming increasingly significant, and we are reminded on an almost daily basis of the importance of incorporating successful collaborations into the management of archaeology. These projects often use technologies for the recording of material culture and landscapes, the interpretation of data, and the communication of ideas. Methodologies for technology use are often decided along the way, and most projects have an emphasis on expertise remaining with those providing the equipment. There is an opportunity, with new technologies that adapt and adopt existing equipment, such as computational photography methods with open source software options, to transfer knowledge of highly sophisticated technologies over to communities.

Many in academia are calling for increasing forms of engagement between researchers and communities, and this session is an opportunity to discuss this move towards long-lasting relationships between communities and archaeologists within which technology is a central factor. Examples might include projects that have used web-based communication to maintain contact with a community, or projects that have relied heavily on open source solutions for recording.

Although the use of new technologies such as non-intrusive recording techniques, social media, can facilitate this type of engagement, this session welcomes submissions addressing legal, ethical and communication issues. We encourage participants to critically reflect upon their projects' use of technological solutions, the many forms of engagement, and the impact of these approaches on our vision of the past.

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Subject : : Paper session

Topics : : Internet & Archaeology

: : Field and laboratory data recording

## S13 Databases on cultural heritage and their geographic visualization

Chairs : Michael Maerker 1, 2, Espen Uleberg 3, Volker Hochschild 4

1 : Heidelberg Academy of Sciences & Humanities (HAW) Germany- [Website](#)

2 : Department of Earth Sciences (DST) Firenze, Italy - [Website](#)

3 : Kulturhistorisk Museum, Dokumentasjonsseksjonen OSLO - Norway  
- [Website](#)

4 : Eberhard Karls University of Tübingen, Institute for Geography (EKUT) - Germany

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As a follow up of the last CAA we would in this session like to bring together scientists working on different issues of visualization of data stored in Databases that are related to archaeology and cultural heritage. This comprises the technical prerequisites of DB-systems such as interface solutions that pass geographic, geodetic and 3D data to visualization tools (e.g. Postgis) as well as tools and interfaces that allow the visualization of these data like web based portrayal services, GIS systems, etc.. In addition, we want to discuss visualization issues related to metadata and data formats like vector, raster and voxel formats and also geographic data projections.

Moreover we will focus on open source solutions and would like to show some application examples in order to give an overview on state of the art solutions. Finally we will also discuss how user requirements can be considered already in the design of these systems to guarantee sustainability and acceptability of the targeted user. Here questions of visualization versus interaction might be focused.

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Subject : : Paper session  
Topics : Internet & Archaeology  
: AIS (Archaeological Information System)  
: GIS & Spatial Analysis

## S14 Practising Digital Cartography in Archaeology: What is at Stake?

Chairs : Piraye Hacigüzeller 1, 2 , Gary Lock 1

1 : University of Oxford

2 : Univeristy of Leuven

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There has been a rapid proliferation and popularisation of digital mapping technologies and related practices over the last two decades mainly thanks to the advances in GIS and in internet mapping (Haklay et al. 2008). The implications of digital mapping technologies are certainly far-reaching in terms of sharing and creating spatial knowledge. These technologies are likely to have brought changes to cartography which are as profound and broad as the popularisation of printing in the fifteenth century (cf. Pickles 2004).

Various types of digital mapping practices ubiquitously take place in archaeology today. With the introduction of geographical information systems (GIS) to the discipline in the 1990s, digital mapping has quickly proliferated and replaced traditional pen-and-paper mapping within research contexts. Yet, scrutinizing the implications of digital cartographic practices for the discipline is a pending challenge as the topic is so vast. Related technological developments show no sign of slowing down thus enabling new digital mapping practices to develop continuously. Moreover, coming to terms with the theory-laden nature of digital technology has historically and notoriously been a slow process in archaeology and there is certainly a large unexplored terrain there for future research. Specifically, while archaeological GIS has received some degree of attention for its epistemological implications, this attention has almost exclusively been paid to the analytical component of GIS and rarely the technology's cartographic capabilities (i.e. the way in which it displays spatial information). Also, it has often been overlooked that there are other, non-GIS, agents routinely involved in the digital mapping of archaeological information which also significantly shape the processes of carrying out archaeological research (e.g. image editing software, tablet computers, GPS). Indeed, if we are to accept the insight from science-technology-studies that technologies shapes us and effect what we (want to) do (cf. Pickering 1995), there is still a detailed discussion to be had on the ways in which this happens within the context of archaeological digital mapping.

Accordingly, this session aims to focus on two main issues:

- how various digital cartographic technologies and practices shape the way in which we do archaeology (in comparison to pen-and-paper mapping), to what extent are the ways we think spatially and represent spatial relationships controlled and constrained by these technologies,
- what theoretical approaches would enable the archaeological implications of these technologies and practices to be opened to critical scrutiny.

As such, the session welcomes contributions that address possible social theoretic approaches (e.g. science-technology-studies) which can be employed to critically reflect upon digital mapping phenomena in archaeological contexts. The session also welcomes case studies that aim to critically re-think the impact of digital mapping technologies on the ways in which we do archaeology.

### References Cited

Haklay, M., Singleton, A. & Parker, C., 2008. Web Mapping 2.0: The Neogeography of the GeoWeb. *Geography Compass*, 2(6), pp.2011–2039.

Pickering, A., 1995. *The mangle of practice: Time, agency and science*, Chicago: Chicago University Press.

Pickles, J., 2004. *A history of spaces: cartographic reason, mapping and the geo-coded world*, London and New York: Routledge.

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Subject : : Paper session  
Topics : : GIS & Spatial Analysis  
          : : AIS (Archaeological Information System)

## S15 Transportation Network analysis

Chairs : Robert Sandrine 1, Mermet Eric

1 : École des hautes études en sciences sociales (EHESS) - [Website](#)

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In Archaeology, transport is a subject of research since the 17th century (Bergier 1622) and an extensive bibliography has been produced on land routes and waterways. In recent years, this research has benefited from the use of geographic information systems, facilitating archaeologists and historian's location of qualitative information with precision. Another field which has developed with GIS is the modeling of transport networks, deduced from the diffusion of artifacts or the location of archaeological settlements (Verhagen et al. 1999, Zaksek et al. 2007, etc. for example).

In this session, we will focus on a lesser-known aspect: analysis of structural properties of transportation networks. These were developed in the 1960s and applied in geography and archaeology.

Exploring the structural properties of infrastructure networks lies across several domains: graph theory for modeling and using different data structures, computer science to build effective graph analysis algorithms or conceptual models and finally geovisualization to observe the behavior or phenomena on a network (Haggett et al. 1969, Chapelon 1997, Dykes et al. 2005). Structural analysis consists of crossing edges and node attributes from different map layers of a network in order to reveal network features including the strengths and weaknesses of its components (Gleyze 2005 et 2007). Achievement of a structural study of a network consists of exploring the networks relational potential. To do this, it is necessary to measure how the network reacts to different stimuli by computing indicators. Most of the latter are called relational indicators and need a collection of paths on the network as inputs. This kind of study focuses on an Origine-Destination-space where origin and destination nodes are connected by their shortest path (SP).

This approach has been tested on historical data since the 1960's on medieval oecumene in Serbia or medieval space trade networks in Russia (Carter 1969, Pitts 1979). In archaeology, graphs were used to understand the centrality of prehistoric places and their role in innovation, (Irwin 1978; Peregrine 1991 for example). For a decade, exchanges have grown between physicists, mathematicians, geographers, archaeologists and historians, especially on social network (Terrell 2013), plots of lands (ANR GraphCom, F. Hautefeuille dir.), transport or street network (Mathis 2003; Gleyze 2009; Bretagnolle et al, 2010; Strano et al. 2012, Barthelemy et al. 2013; Scheidel 2013).

In spatial archaeology, the interest of this kind of analysis is to characterize the nodes from the network properties. New centralities can be deduced from the network and the evolution of a settlement can be deduced by its ability to control the flow. The focus of research is on topology of connections rather than on the attributes of nodes.

The session is open to applications on transportation network analysis from graph theory, implementing historical and archaeological data.

The workshop “Exploring network structural properties with GeoGraphLab” will complement the session.

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Subject : : Paper session  
Topics : GIS & Spatial Analysis  
: Mathematics & Statistics in Archaeology  
: Multi-agent systems & complex system modelling

## **S16 GIS, a new trowel for archaeologists? The challenges of using GIS in preventive archaeology**

Chairs : Anne Moreau 1, Xavier Rodier 2, Anthony Corns 3

1 : Institut National de Recherches Archéologiques Préventives (INRAP) - [Website](#)  
INRAP

2 : Centre National de la Recherche Scientifique (CNRS)  
Université François Rabelais - Tours

3 : the Discovery Programm

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The current context of preventive archaeology leads to the introduction of GIS and its widespread use. Indeed, GIS can be seen as an efficient tool for both research and legal obligations of data's conservation and restitution. GIS are nowadays one of the common tools that archaeologists use to manage, analyse and explore the archaeological data as shown by many communications at previous CAA conferences. Most experiments and special developments, more or less integrated into the research process, have been led in selected archaeological operations. However, most of these experiments were carried out in the course of operations with high financial support, which strengthened the idea that only big or important operations deserved using GIS.

The French National Institute for Preventive Archaeological Research– which carries out more than 2000 operations a year – began considering the use of GIS in preventive archaeology in 2006, in collaboration with the French association ISA (spatial information in archaeology). Since then, the institute has launched an unprecedented programme to promote the use of GIS and to train archaeologists in the new practices involved. Indeed, getting from local experiments to a massive use in thousands of operations has brought up several questions such as :

- the consequences of the data digitalisation form the start of the process
- the changes raised by GIS in the ways of working, the organisation of work, the occupations...
- relationships between the scientific problematic and the system contrived and used
- the new graphic representations of archaeological data in the GIS compared with the traditional habits
- the exploitation of stratigraphy with GIS
- the tools used
- the aims of the systems used (management of the operation, data exploration, cartographic results...)
- the development and use of GIS by the different organisations of preventive archaeology in the world ...

The session aims at concentrating case studies dealing with the questions above. The communications will focus on the operation's scale without excluding the questions raised by the exploitation of archaeological data in multiscale approaches.

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Subject : : Paper session

Topics : : GIS & Spatial Analysis

## **S17 From stats to storylines: computational approaches to archaeological spatial data and its interpretation**

Chairs : [Phil Riris](#) 1, [Patricia Murrieta-Flores](#) 2

1 : Archaeological Computing Research Group (ACRG) University of Southampton - United Kingdom - [Website](#)

2 : Lancaster University Bowland College - United Kingdom - [Website](#)

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All archaeological information has an intrinsic spatial component, a fact which has been appreciated for as long as the discipline has existed. The significance of this property of our data has greatly increased in step with the general availability of powerful computing and specialized software packages in recent decades. In the drive to adopt, adapt, or invent techniques that directly address the spatial dimension of the material record, archaeologists have looked towards other fields as diverse as epidemiology, astronomy and landscape ecology for inspiration.

While many commonalities exist in data structure, vocabulary and toolkits, it remains the case that archaeologists mostly employ spatial methods which were not developed with the explicit intention to pursue questions meaningful on a cultural or human scale. As such, this crucial element in the study of past societies can easily be lost in the transition from analysis to interpretation. This is to the detriment of our objects of study, to the broader dissemination of spatial analysis within archaeology, and to the effective communication of results to a wider audience.

This session aims to bring together scholars who are actively seeking answers to social questions through spatial analysis of archaeological, historical or environmental information. The focus of our interests is how to articulate the relationship between the fabric of space as a culturally-constituted, socially experienced entity, and our understanding of these properties using quantitative analytical methods. To this end, the interface between analytical scale, data resolution and the unfolding of fields of social action in the past may provide a backdrop for answering critical questions about how to approach the human factor in spatial analysis. Additionally, explorations of these topics may be considered from a theoretical perspective, provided the emphasis is on applied spatial analysis with archaeological information.

Papers likely to be accepted may draw from an exhaustive variety of spatial approaches (including spatial statistics, data mining, simulation and numerical modelling), employing such methods to explore and create interpretations that generate a narrative on a past society. Researchers developing new platforms, environments or techniques are particularly encouraged to present. Overall, we seek the recognition of dynamism and variability in human culture, and hence the strengthening of our interpretations through rigorous analysis and interpretation of the broad range of data that we as archaeologists are capable of leveraging in our research.

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Subject : : Paper session

Topics : : GIS & Spatial Analysis

: Mathematics & Statistics in Archaeology

: Multi-agent systems & complex system modelling

## **S18 How to deal with time in order to understand the dynamics of societies?**

Chairs : Xavier Rodier 1, Ian Johnson , Alfredo Maximiano Castillejo , Laure Saligny  
1 : Centre National de la Recherche Scientifique (CNRS)  
Université François Rabelais - Tours

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By nature the archaeologist comes to terms with the temporal dimension of the data he manipulates. During the excavation, the temporal links between the basic units are studied by relative chronology. Items of dating are then used to set up a continuous time. When moving towards a territorial scale, archaeological structures get clustered into time ranges, more or less wide according to the nature of the study. This results into either snapshots, with waves time limits, or into regular time spans, similar to like temporal pixels.

At best, time contributes to the analysis and explanation of the spatial phenomena investigated – in that case time is as neutral space where historical objects can be set up – although it is necessary to have a conception of space including time. When phenomena are discussed in a spatio-temporal perspective, time is one of the elements that structures space. In short time studies, this approach is used to explain processes, trajectories, or dynamics. The consideration of time is so closely linked to space that the question of its own modeling does not arise. The omnipresence of time into the phenomena under investigation even hinders its formalization and its modeling in historical sciences. Moreover, archaeologists have little formalized their temporal approach beyond the scale of the excavation and dating issues.

The aim of moving from a neutral space in the first place, to spatial interactions, then to the study of spatial dynamics, has largely contributed to the formalization of spatio-temporal processes and their method of analysis. Archaeologists, who have naturally based their understanding of space on the work of geographers, have also addressed in the same way the question of spatial dynamics. The results represents significant progress from a methodological point of view. It also offers an understanding of archaeological phenomena. However, systematically subordinating time to space does not allow to account for multiple temporalities historical objects. The objective of this session is to discuss how to approach time in the archaeological information systems, in order to observe the dynamics of transformation of societies.

This session is in line with those previously organized at CAA2009 "Why Did It Take So Long? Spatio-Temporal Modeling and GIS" at CAA2013 "Is there time for archeology? Understanding time through modeling and representation" and at EAA2013 "Towards a real representation and interpretation of spatio-temporal data in Archaeological Record". It is supported by the MoDyS group of research investigating challenges raised by the modelling and representation of time, through interdisciplinary contributions encompassing various scientific communities (archaeology, but also architecture, geography and geosciences, computer science).

The proposals expected will focus on: spatio-temporal analysis, dynamic mapping, graphical modeling, statistical models, descriptive models of dynamics, dynamic models, simulation tools.

Subject : : Paper session  
Topics : : GIS & Spatial Analysis  
: : AIS (Archaeological Information System)

## S19 GIS methodologies, applications and regional Case studies

Chairs : Claira Lietar 1, Julie Boudry 1, Laurent Aubry 1

1 : CNRS-Université Paris 1 UMR TRAJECTOIRES Nanterre France - [Website](#)

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Archaeologists are increasingly asked to use their data within a geographic information system to cross examine and analyze multivariate data. The aim is to answer specific archaeological issues and also to advance understanding about the spatial and territorial organization systems, and socio-cultural organizations.

An archaeological study in a macro-regional or regional level often integrates multidisciplinary GIS data (archaeological, geological, geomorphological, etc..). It is more difficult, or at least less accurate at a smaller scale. At the site level, the structural organization of the territory is of course not graspable. Querying and analyzing data collected in simultaneous ways, georeferenced and integrated into the GIS will provide a comprehensive approach to modeling societies and their settlement. In order to examine and address the issues of different axes of research (relationship between site and environment, reliability of distribution sites, site's function, distribution of artefacts, socio-cultural organization), a multitude of analyzes are available to us, from the simpler (Kernel density for example) to the more complex (reconstruction of agricultural potential, etc..). Yet one must still use pertinent analysis based on the data and address issues raised in archaeological research.

We propose here to provide an overview of the different spatial analysis useful in archeology, covering all periods, through specific applications to regional case studies. The presentation will be focused on methodological processes arising from such studies. Examples of specific spatial analysis will be presented as well as "chaînes opératoires" or chains of thoughts, in other words global processes used to answer spatial and territorial organization issues (data, tools and analysis and their concomitant use). The question of interchangeability of "chaînes opératoires" and of the limits in understanding archaeological settlement systems lies at the heart of this session.

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Subject : : Paper session

Topics : : GIS & Spatial Analysis

## **S20 (Re)building past networks: archaeological science, GIS and network analysis**

Chairs : Thomas Huet 1, Craig Alexander 2

1 : Culture et Environnements, Préhistoire, Antiquité, Moyen-Age (CEPAM) Université Nice Sophia Antipolis – France - [Website](#)

2 Department of archaeology, University of Cambridge – United Kingdom

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How can archaeologists – and other social scientists such as historians – best (re)create the networks that constituted past societies? Networks of relationships – social, political, economic and biological – are now recognised as a key mode of description and analysis of societies both past and present. By bringing together researchers in these fields we will advance the state of both cooperation and knowledge.

### **Key issues include:**

- Integration of diverse strands of evidence
- Synchronic and diachronic aspects
- The possibility of interdisciplinary research/collaboration

GIS approaches are now commonplace in archaeology and methods based in the physical and biological sciences (XRF/pXRF, LA-ICP-MS, ancient DNA etc.) are becoming ever more widely used. GIS is a tool well suited to the integration of the inherently spatial data that underpin many networks – e.g., palæo-environmental variables, soil types, settlements, find-spots, chemical composition of ceramic samples, sources of clay, minerals or metals, pathways, rivers, landforms – across a variety of spatial scales. Combined with network approaches, such GIS-unified data offer us the potential to understand the synchronic and diachronic nature of past network phenomena such as sourcing, trade & exchange and even, perhaps, endogamy and exogamy.

GIS is, perhaps, less strong in dealing with time, tending to treat it as a series of snapshots: the diachronic reduced to a series of synchronic views. Simulation methods may offer one way to bring time more directly and appropriately into a GIS framework. A Multi-Agent Simulation, for example, can be seen to develop across both the spatial and temporal dimensions. Of course, the temporal dimension is still captured as a series of synchronic images but there are now formal mathematical/algorithmic links between the successive snapshots: this is not the case in more traditional GIS approaches to time.

GIS applications thus come in a variety of forms:

- Simple map-making
- Georeferenced databases
- Integration of spatial information of diverse forms as a prelude to analysis, probably with a network focus
- Serious attempts to treat change through time as a phenomenon in some ways distinct from variation across space.

This session welcomes papers in the third and fourth of the above categories with any geographic or temporal focus: our aim is to bring together those who are trying to unify archaeological science, GIS (particularly but not exclusively applications where intertemporal change is modelled explicitly) and network approaches to the past. We welcome contributions focussed on both the empirical (e.g. case studies, applications and algorithms) and the theoretical (e.g., analysis of the relationships between well-established approaches like “taskscape” and what can be achieved through the combination of scientific and spatial methodologies).

Subject : : Paper session

Topics : : Multi-agent systems & complex system modelling

## S21 Data mining in archaeology and historical sciences : new trends and developments

Chairs : [François Giligny](#) 1, [Stéphane Lamassé](#) 2, [Marie Cottrell](#) 3

1 : Université Paris 1, Panthéon-Sorbonne - UMR Trajectoires (TRAJECTOIRES) - [Website](#)

1 Université Paris 1 Panthéon-Sorbonne TRAJECTOIRES - France

2 : Université Paris1, Panthéon-Sorbonne LAMOP (LAMOP) - [Website](#)

3 : Université Paris1, Panthéon-Sorbonne SAMM (SAMM) - [Website](#)

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Archaeology and History are disciplines in which the interdisciplinarity plays a large part and possess one very large number of interfaces with other disciplines: geography, sciences of the environment, the physical and chemical sciences, the linguistics, the philology etc. The data used in Archaeology and the History present besides peculiarities which have to lead(drive) to precise reflections on the methods and the used protocols. These data are registered first of all in a more or less long time, the absolute, even relative chronology of which is not still insured. They are sometimes indistinct, even incomplete.

The applications of the data analysis are anchored in the history and epistemology of each of our disciplines and are a part from now on of current methodologies. They allow methodological transfers between disciplines and to create also spaces of dialogue. We shall be interested in the recent developments of data analysis in terms of applications which favor the disciplinary footbridges.

Case studies will concern mainly the following themes :

- Complex serial models by data analysis,
- Regional spatial analysis, temporal spatial dynamics,
- Intrasite Spatial analysis (Artefacts and Contexts),
- Connections between graph modelling and statistical processing (Harris matrix, "operational sequence", social networks etc.).

Genet J.-P., Zorzi A. (ed.), Les Historiens et l'informatique. Un métier à réinventer, Rome, Ecole Française de Rome, 2011.

Djindjian F., Manuel d'archéologie. Méthodes, objets et concepts, Paris, 2011.

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Subject : : Paper session

Topics : : Mathematics & Statistics in Archaeology

: : Computing in Epigraphy & History

## S22 Reading between the lines: Computing applications for the analysis of archaeological and historical texts

Chairs : [Patricia Murrieta-Flores](#) 1, [Christopher Donaldson](#) 1, [C. j. Rupp](#) 1, [Ian Gregory](#) 1  
1 : Lancaster University - United Kingdom - [Website](#)

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Over the past twenty years, the adoption of digital technologies within the humanities has revolutionized scholarly practice in disciplines that traditionally deal with textual sources such as History, Archaeology and Anthropology. From experimental methods for manuscript conservation to automated techniques for handling 'Big Data', this budding field of research offers many promising areas for further exploration. These include visualization and conservation technologies (such as Reflectance Transformation Imaging), data-extraction, management, and analysis tools (such as Text Encoding, Text Mining, Geoparsing and Geographic Information Systems). These approaches have been used by a number of research projects in both Europe and the United States. Examples include Lancaster University's Spatial Humanities Project (<http://www.lancs.ac.uk/spatialhum>), the Quijote Interactivo Project (<http://quijote.bne.es/libro.html>), Stanford University's Mapping the Republic of Letters (<http://republicofletters.stanford.edu>), Sheffield University's London Lives (<http://www.londonlives.org>), the Pelagios Project (<http://pelagios-project.blogspot.co.uk>), A vision of Britain Project (<http://www.visionofbritain.org.uk>), Locating London's Past Project (<http://www.locatinglondon.org>) and Google Ancient Places (<http://googleancientplaces.wordpress.com>), among many others. These projects are marked by their unique methods and aims, and by the fact that they work with texts and documents from different historical periods. Yet, when viewed collectively, they can each be understood as participating in a common scholarly agenda.

The aim of this session is to put this agenda into focus by bringing together the multiple theoretical and methodological digital perspectives established in the last years for the research of documents of archaeological and historical concern. By providing a wide platform for researchers with interest in the study of past texts, we aim not only to explore the achievements of present research projects, but also to examine potential lines of collaboration on this topic between fields such as (but not limited to) archaeology, history, literature, heritage management and computer science.

We welcome papers from projects and/or individuals at any stage of research that are implementing computing approaches to preserve, explore and analyse documents and texts of archaeological and historical interest.

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Subject :                   : Paper session  
Topics                     : Field and laboratory data recording  
                              : Internet & Archaeology  
                              : GIS & Spatial Analysis  
                              : Computing in Epigraphy & History

## **S23 Modelling approaches to investigate population dynamics and settlement patterns over the long term**

Chairs : Laure Nuninger 1, Philip Verhagen 2, Tim Kohler 3,

1 : CNRS : UMR6249, Université de Franche-Comté Laboratoire Chrono-environnement / MSHE C.N. Ledoux UMR 3124, / GdR MoDys (LCE) - France - [Website](#)

2 : Research institute for the heritage and history of the Cultural Landscape and Urban Environment (CLUE) VU University Amsterdam - Netherlands - [Website](#)

3 : Washington State University/Santa Fe Institute/Crow Canyon Archaeological Center - United States - [Website](#)

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Understanding population dynamics and ancient settlement patterns has been one of the main goals of numerous spatial studies in archaeology since the 1970s. Questions addressed typically include the overall density, locations, and inferred interactions among sites, as well as the degree of hierarchical organization and the use of space.

Whatever the region or the period considered, or even the approach used, the results of the analysis provided by different cases of study over the world often show considerable regularity of spatial patterns and/or chronological series of sites sizes or inferred populations.

A typical regularity in Neolithic or protohistorical sequences for example is a tendency towards more aggregated settlement, which may often later be reversed before even larger aggregates appear. Another one, observed in European protohistory or Antiquity, is the trend of a rapid increase of scattered settlement quickly followed by a strong decrease. Reasons for these changes may be difficult to discover, especially in cases where some clustered settlements lasted only a few hundred of years while others grew and remained in place up to today. The various approaches that archaeologists apply to these questions focus on different aspects and take into account specific geographical, cultural and archaeological contexts. This makes it difficult to compare cases and to extract the causative factors for any possible regularities. Building process models (deductive models), for example based on palaeodemographical, anthropological, economical and geographical theory, is a promising path towards connecting the patterns recognized and the factors causing them.

Building models of this kind however remains a great challenge for archaeologists. Shared protocols, explicit concepts and common variables have to be defined in order to analyse different regional cases, to safeguard interpretation of analogies and to increase understanding of variation and change in ancient complex societies while striving for a common framework of analysis and explanation.

The aim of this session is to share experiences, concepts and methods for a normative analysis of ancient settlement patterns and population dynamics from various geographical areas in the world and different periods. Presentations may focus on agent-based or other types of deductive models, scaling studies, or comparative analysis of cases from different regions.

Of special interest will be papers which generate or analyze :

- population estimates from various proxies
- typical population growth rates and constraints on growth in various economic contexts/organizations
- settlement dynamics and ranking (rank-size curves, spatial distribution, network...)

- the role of the social and environmental factors in the success (durability or/and increase) or collapse of settlements and the impact on population growth or decline

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Subject : : Paper session

Topics : : Multi-agent systems & complex system modelling

## **S24 Modelling approaches to study early humans in space and time**

Chairs : Michael Maerker 1, 2, Yasuhisa Kondo, Christine Hertler,

1 : Heidelberg Academy of Sciences & Humanities (HAW) University of Tübingen - Germany - [Website](#)

2 : Department of Earth Sciences (DST) Firenze - Italy - [Website](#)

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At the last CAA in Perth, Australia, we have launched a session on the geospatial characteristics of early humans like Ardipithecus, Australopithecus, Homo erectus, Homo heidelbergensis, the Neandertals (Homo neanderthalensis), and early modern humans (Homo sapiens). Focus of this session was the spatio-temporal distribution, migration, cultural behaviour, and environmental niches of these early humans. Recently, an increasing number of papers have been published to discuss the spatio-temporal distribution and migration of early humans taking into account different types of environmental information such as paleoclimate, paleotopography, stratigraphy, lithology, paleofauna and -flora, and/or ecological niches. However, there are some problems to apply spatio-temporal analyses to early human archaeology. Firstly, in general, the older type of human species the fewer the archaeological assemblages. Thus, spatial and temporal resolutions of the data are often too coarse to extract any significant patterns at a reliable standard. Secondly, since early humans are truly interdisciplinary research topics, a great variety of approaches are employed. Therefore, data and results of projects are often managed and stored in large database systems of different origin and different technical background. It requires a common working platform (such as a common metadata format). Moreover we have to deal with different modelling approaches ranging from passive geo-statistics to active, actor based methodologies.

In this session we would like to continue the discussions initiated in Perth about techniques and methodologies to understand the spatio-temporal distribution of early humans, taking into account the current technical problems and constraints. Major topics of our session will include (but not limited to) i) the provision of spatial data in large-scale databases, ii) techniques to assess the spatial distribution of early humans, iii) techniques to deal with small statistical samples, and iv) theories and methods to generate meaningful information for spatio-temporal modelling by means of GIS, Remote Sensing and statistical modelling; v) different modelling concepts to assess expansions and niches. We welcome a wide variety of papers relevant to any of the above mentioned topics and are looking forward to fruitful further discussions on the technical issues of early human research.

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Subject : : Paper session

Topics : : AIS (Archaeological Information System)

: : GIS & Spatial Analysis

: : Multi-agent systems & complex system modelling

## **S25 Agents, Networks, Equations and Complexity: the potential and challenges of complex systems simulation**

Chairs : Benjamin Davies 1, Iza Romanowska 2, Enrico Crema 3, Tom Brughmans 2

1 : The University of Auckland - [Website](#)

2 : University of Southampton - [Website](#)

3 : University College London - [Website](#)

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Simulation is not new in archaeology. However, the last decade knew an increased focus among archaeologists in the use of simple computational models used to evaluate processes which may have operated in the past. Rather than all-encompassing reconstructions of the prehistoric world, models have been used as 'virtual labs' or 'tools to think with', permitting archaeologists to explore hypothetical processes that give rise to archaeologically attested structures. Computational modelling techniques such as equation-based, statistical, agent-based and network-based modelling are becoming popular for quickly testing conceptual models, creating new research questions and better understand the workings of complex systems. Complexity science perspectives offer archaeology a wide set of modelling and analytical approaches which recognise the actions of individual agents on different scales who collectively and continually create new cultural properties.

This session aims to bring together complex systems simulation applications in archaeology. We invite innovative and critical applications in analytical and statistical modelling, ABM, network analysis and other methods performed under the broad umbrella of complexity science. We hope this session will spark creative and insightful discussion on the potentials and limitations of complexity science, its many simulation techniques and the future of modelling in archaeology.

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Subject : : Paper session

Topics : : Multi-agent systems & complex system modelling

## S26 The 3rd dimension in use-wear studies

Chairs : Hugues Plisson 1, Jesús Emilio González Urquijo , Bruno Dutailly

1 : CNRS : PACEA (UMR 5199) Université Bordeaux 1 - France

- [Website](#)

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The session is open to any methodological work or archaeological case studies in which the visualization and quantification of the third dimension contribute to a better characterization of use-wear features on tools, ornaments, rock art, bones, etc., involving technics as different as photogrammetry, multifocus, reflectance transformation imaging, lasergrammetry, computerized tomography, confocal microscopy, etc.

“We have in mind stereo-photogrammetry, which forms an important branch of metro-photography and plays a large part in strict scientific methods of measurement, especially in geodesy and astronomy. From what has been said above it follows that stereoscopic photography is of great value whenever precise and full documentation of the objects being studied is required in their natural three-dimensional aspect.” pointed out S.A. Semenov, the father of functional studies (1957 p.4, 1964 p.29), long time before personal computers and digital photography.

More than half a century later various firms propose to scientists sophisticated instruments for 3D recording and analysis at various scales; in the same time 3D technology is becoming available in consumer devices. However, very few use-wear studies have taken profit of the third dimension, even in the cases where it could improve the understanding of tools function, such as with the very variable deformation of the active surfaces of grinding tools, the microtopography of the use-wear polishes, the volume of impact scars on lithic weapons, the morphology of grooved surfaces on mobile and parietal art to cite only a few examples.

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Subject : : Paper session  
Topics : : 3D Archaeology

## S27 New trends in virtual reconstructions of cultural heritage

Chairs : [Andres Bustillo](#) 1, [Pedro Martin-Lerones](#) 2

1 : University of Burgos (UBU) - Spain - [Website](#)

2 : CARTIF Research Centre (CARTIF) - Spain - [Website](#)

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Virtual reconstructions of Cultural Heritage, whether small artefacts or entire cities, are powerful tools, both for research and educational purposes, as well as for the divulgation of our past. Different techniques have been developed over recent decades to create virtual reconstructions using CAD, photogrammetry, laser scanning and photoscanning, as well as hybrid combinations of these techniques. Special effort has gone into creating low-density 3D Models that allow real time interaction with the final user. Moreover, new ways of presenting these 3D Models have been tested: Internet, 3D caves, mobile devices, etc. The target user who will interact with a 3D Model also determines the best technique for its creation, because a virtual environment aspiring to be a learning process for young students hardly requires the same approach as a museum exhibition open to the general public. This special session will be used to gather experiences from around the world on the following topics:

- Improvements in CAD techniques, photoscanning, laser scanning, and hybrid techniques to create virtual reconstructions,
  - New ways of interacting with virtual reconstructions (Internet, games, etc)
  - Applied experiences of virtual reconstructions of Cultural Heritage for different target populations (students, general public, etc.)
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Subject : : Paper session  
Topics : : 3D Archaeology  
: : Virtual Archaeology

## S28 Digitization, visualisation and interpretation of ancient sculpture

Chairs : [Bernard Frischer](#) 1, [András Patay-Horváth](#) 2, [Roberto Scopigno](#) 3

1 : Indiana University, School of Informatics- United States - [Website](#)

2 : University Eötvös Loránd Budapest (ELTE BTK) - Hungary - [Website](#)

3 : Visual Computing Laboratory Istituto di Scienza e Tecnologie dell'Informazione (ISTI CNR) Pisa - Italy - [Website](#)

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There are many possibilities offered by the latest technological innovations, which are variously used in different projects to document, to visualize, to reconstruct and to analyze ancient sculpture in 3D. Despite the spreading of knowledge among specialists, there are only isolated efforts in this field and there was certainly no conference or session devoted to this topic during the past decades.

The session would like to bridge the gap between classical studies / classical archaeology / history of art on the one hand and information and communications technology applied to archaeology and cultural heritage on the other: specialists from both fields are therefore invited to present their ongoing projects, problems, preliminary or final results (theoretical considerations as well as case studies) concerning innovative technologies, which are somehow related to the visualization, reconstruction and interpretation of ancient Greek, Etruscan and Roman pieces of sculpture. Case studies might include papers dealing with single statues or entire sculptural groups of any material (stone, metal, terracotta) and size (from jewellery to monumental sculpture) coming from the whole Mediterranean. The presentation of papers concerning plastic arts of prehistoric or later (medieval, renaissance, etc.) periods is also welcome, if they contribute to general methodological issues (e.g. analysis of tool-marks, identification of individual master-hands or workshops). On the other hand, we would like to avoid presenting a collection of papers, which merely describe new digitization projects of some statues with standard technologies. Instead, we are mainly looking for contributions offering technological improvements (concerning e.g. the accuracy, the costs, the workflow or the pipeline) and novel computer-aided approaches to the study of the artworks, e.g. new insights concerning or the computation of shape characteristics.

The session will thus focus on different approaches and methodologies to record, to process, to store, to organize and to make use of the information (often recorded by different projects using various kinds of equipment and standards) and would like to create a platform where experiences with different hardware and software solutions, expectations and possibilities concerning the accuracy, reliability, etc. of the different tools can be exchanged.

Special emphasis will be given to the discussion about virtual reconstructions and virtual repatriation of cultural heritage objects, which now are in various museums around the world and belong to a particular site/country. The creation and usage of digital libraries and virtual museums may be discussed as well.

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Subject : : Paper session  
Topics : : 3D Archaeology  
: : Virtual Archaeology

## S29 Virtual Reconstruction in Archaeology

Chairs : [Philippe Fleury](#) 1, [Robert Vergnieux](#) 2, [Sophie Madeleine](#) 1, [Bernard Frischer](#) 3

1 : Université de Caen, Centre Interdisciplinaire de Réalité Virtuelle (UCBN / CIREVE) - France - [Website](#)

2 : CNRS ARchéovision Bordeaux- France

3 : University of Virginia – United States

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Today digital techniques offer new possibilities for reconstructing the past. For several years, the number of virtual reconstructions of archeological sites increased, especially on Internet. Nevertheless, all this pictures haven't the same level of authenticity. We would like to highlight some questions of methodology: why are we doing these reconstructions and for who? How distinguishing scientific productions from imaginary ones? When the work preliminary to the reconstruction itself is performed by a research team (we mean the analysis of ancient source materials), how giving validity to this analysis from the academic point of view? Is it possible to connect a database with the virtual environment to provide the visitor with the possibility to have a good idea of the degree of reliability of the model?

Then, this session will focus on the future of the scientific reconstructions: how the virtual model are used? It cannot exclude scientific commentary: the researcher must be in input and in output of the model. The model needs a scientific mediator but in the same time, it's interesting to provide access to the recent research to the public at large. How both aspects can run together? When we speak about the future, an important issue is the archiving of the virtual environment. There are a lot of software to reconstruct archaeological sites in virtual reality and so many digital formats. The challenge is the preservation of the digital formats. How the virtual reconstructions of archaeological sites will be accessible in the next few years?

Finally, virtual reconstruction can be enhanced by virtual reality. The advent of what we usually call virtual reality took place in the 1980s at the same time as the development of computer graphics. Two fundamental notions are associated with it: immersion and interactivity. Immersion is the operation which consists in going to the other side of the "mirror," seemingly entering into the image. The immersion is physical when an interface is used, but it can also be simply mental. Interactivity is the operation which consists in the real-time manipulation or transformation of the image. What are the interests of these technologies for virtual reconstruction in Archeology? Is it just attractive for the public at large or is there a scientific interest?

The papers of this session will have to answer to these questions in showing their methods, applied to their virtual reconstruction of archeological sites.

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Subject : : Paper session

Topics : : Virtual Archaeology

### **S30 JIAP contribution to the CAA**

Chairs : Laurent Costa 1, @ , François Djindjian 2, \*, @ , Giligny François 3, \*, @

1 : CNRS : UMR7041 Archéologie et Sciences de l'Antiquité (ArScAn) - France

2 : Université Paris 1 Panthéon Sorbonne & UMR 7041 Arscan - France

3 : Université Paris 1 Panthéon Sorbonne & TRAJECTOIRES - France [Website](#)

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A general paper session corresponding to the JIAP" Journées Informatique et Archéologie de Paris" - "Computing and Archaeology Days of Paris" will be organised during the CAA. This session is a contribution to CAA and gives the opportunity to create a CAA France during the 42th CAA Conference.

The JIAP are organized in Paris every two years, during two days in June. This conference gives the opportunity to researchers (University, CNRS, Ministry of Culture, INRAP, local authorities, engineering consulting firms, etc.) to present current research and innovative IT and statistical applications in Archaeology an history.

The proceedings of the previous conference are published in an International scientific journal. The proceedings of 2008, 2010 conferences have been published in the journal "Archaeologia E Calcolatori", which is the worldwide reference in computing Archaeology. 2012 proceedings are being published this year.

<http://jiap2012.sciencesconf.org/myspace>

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Subject : : Paper session

Topics : : ALL

# CAA2014 ROUNDTABLES

## **R1 What do you want from Digital Archaeology?**

Chairs : Jeremy Huggett 1, Gary Lock 2, Paul Reilly 3,

1 : University of Glasgow

2 : University of Oxford

3 : University of Southampton

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In a time of financial crisis and disciplinary anxiety, when impact and value are demanded, subjects – and humanities subjects in particular – are searching for relevance. In a keynote at CAA 2012, Huggett argued that archaeological computing needed to seek grand challenges if it was to continue to transform the practice of archaeology and contribute to the development of theories and methods. The immediate challenge is for archaeological computing to confront the task of constructing and pursuing grand challenges in the first place, and this round table discussion is intended to be a first step in this direction.

What are these grand challenges? A range of different criteria can be defined but they have in common some general characteristics. They should focus on the needs and values of archaeology, but at the same time be of interest and relevance to other disciplines, organisations, and the general public. They should have transformative potential, creating something that is novel and innovative, pushing boundaries and going beyond what is currently possible. They should be international and interdisciplinary in scope, involving the whole community rather than just the academic sector. Although challenges should be capable of being implemented, at least insofar as they can be broken down into intermediate benefits and goals, success is not measured solely in terms of the final outcome but in relation to what is learned as a consequence of making the journey. And, at the risk of stating the obvious, they should be difficult to achieve and represent a considerable degree of effort.

Such criteria set grand challenges apart from what might be characterised as a 'typical' research project. What may be adequate and sufficient for a research project will not necessarily constitute a grand challenge. For instance, archaeologists will frequently use concepts, techniques and technologies borrowed from another discipline, but such an approach would not be enough for a grand challenge unless it is significantly offset by meeting other criteria. A grand challenge may not need to meet all the defining criteria: the extent to which it does or does not remains a matter for debate. It does mean, however, that grand challenges cannot simply be 'more of the same' – they need to go beyond relatively straightforward applications of existing software, beyond areas such as resource discovery and finding aids, beyond applying what may be relatively commonplace in other disciplines, etc. and generate genuinely novel approaches and methodologies that may also find application beyond archaeology. Most challengingly, they should represent a radical paradigm shift and hence unlikely to be met from evolutionary professional/commercial development.

In an environment increasingly characterised in terms of 'big data', cloud processing, crowd sourcing, social media, intelligent computing, etc., this roundtable seeks to begin the debate about the future contributions of archaeological computing to the discipline and, in doing so, to identify the next big research challenges for the subject. How can the expertise represented at CAA be best harnessed in pursuit of these objectives?



### **R3 Virtual Archaeology - the first 25 years**

Chairs : Hookk Daria 1 , Sorin Hermon 2, Franco Niccolucci 3, Susan Hazan 4

1 : The State Hermitage Museum - [Website](#)

2 : The Cyprus Institute (CyI) - [Website](#)

3 : University of Florence (UNIFI) - [Website](#)

4 : Israel Museum (IMJ) - [Website](#)

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Virtual reality in archaeology, or virtual archaeology, was “officially” introduced to the archaeological scientific community more than two decades ago, by the work of P. Reilly (1990). Since then, additional terms were added (e.g. virtual environments, cyber-archaeology) and application areas extended from reconstructions of buildings, simulation of construction / destruction of monuments and sites or virtual reconstruction of ancient landscapes. We find today “virtual archaeology” in many museum installations, online web pages and recently in the “apps” world. As an apparently natural course of development, virtual archaeology followed trends in technological developments, the archaeological scientific community seeing applications using haptic devices, cave systems and recently augmented reality environments. Measuring devices improved as well, nowadays including total stations, GPS, 3D scanners or image-based 3D documentation systems. As pointed out in many scientific papers, virtual archaeology is a term that has the potential to cover the entire archaeological research pipeline – from field data acquisition, archiving, analyzing and interpreting the results, to the final publication and dissemination. A digital model produced during an archaeological research becomes object of study and education that means digital heritage by itself. What is then the relation between the original and the digital surrogate?

Virtual archaeology and its digital outcomes can be powerful tools for the archaeological investigation, but also as excellent communicators of the embedded (and sometimes not so visible) information cultural heritage assets possess, and, as such, are widely implemented in museum environments. However, even after almost 25 years of “virtual archaeology”, the term is still under scrutiny of definition within the archaeological scientific community (as recently expressed in the the First International Conference on Virtual Archaeology, organized by the Department of Eastern Europe and Siberian Archaeology of the State Hermitage Museum) as well as the museology (and virtual museums) community (see discussions in the Automation directions in Museums and Information Technologies – ADIT conferences in the Russian Federation, NODEM, Museums and the Web conferences, etc.).

The aim of the session is to create a meeting point between scholars of Eastern and Western scientific traditions, experts in virtual archaeology and related fields, with experiences which sometimes developed in parallel paths but eventually converge, since sharing similar goals. Moreover, the session aims at bringing together scholars that expertise in all or specific steps of the scientific pipeline: data acquisition (recording), archiving, interpreting and publication, the ultimate scope being the definition of the term “virtual archaeology”, its research methodology, techniques and technologies to be adopted. We are inviting therefore scientist to present papers that will contribute to the goals described above, in particular (but not exclusively) topics such as data provenance, data reliability and transparency, virtual paradigms in archaeology or ontologies of virtual archaeology.

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Subject : : Roundtable

Topics : : Virtual Archaeology

## **R4 Bringing closer together different scientific communities around the question of historical geographic data**

Laurent Costa 1, Eric Grosso 2

1 : CNRS : UMR7041 Archéologies et Sciences de l'Antiquité (ArScAn) Nanterre - France - [Website](#)

2 : IGN laboratoire COGIT Saint-Mandé - France

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Over the last decade, the use of historical geographic data (old maps, globes, etc.) has been in constant progression. This evolution has been accompanied by the multiplication of online resources and by the possibilities of access to information previously difficult to obtain.

The particular nature of this data, as well as its multiple uses within the context of archaeology, history or geography also allow us to analyse the use of and integration of this kind of data within infrastructures of exchange and of collaboration from a methodological perspective. These developments also raise questions regarding the capacity of researchers to gain the specific data and tools necessary to put into place the potentialities of the study and its necessary collaborations.

Therefore, today the question that is raised is no longer linked to the pertinence of the dispositives in place for the mutualisation of historical geographic data but on what objectives we base these mutualisations. For whom are they produced and for what purpose? From a dispositive where everyone retrieves data from each other in order to work individually to a dispositive which allows us to gather data in a shared tool (download server, extranet, intranet, web GIS, etc.), there is a qualitative step which is currently being crossed. Developing a geographical and collaborative platform that efficiently responds to users needs with varied profiles requires a particular reflection which has to be brought before having archaeological and historical results.

Indeed, these transformations in the way of doing research, conjointly due to the massive numerisation of this type of data and the development of sharing tools on the internet, open up research potential that gives an important place to the idea of geographical referentiality as well as raising possibilities of offering a new materiality to interdisciplinary users. This renews the notion of maps and is a fundamental basis for data sharing for the research programs which include a territorial dimension. Along with the data diffusion and processing methods this becomes a real infrastructure in the sense that it is placed at the same time before and after the projects.

Several scientific communities have examined these tools and tried to offer solutions to this questioning. Among them, several works from CAA and the commission “Digital technologies in cartographic heritage” of the International Cartographic Association began to explore several different solutions.

In order to bring the communities of archaeologists, historians, geographers and geomaticians closer together, the aims of this session are:

- to disclose to the different actors and/or members of these communities the existence of other communities via short introductory presentations,
- to see what are the common issues of these communities and what could be the possible solutions,

- to share the knowledge and the new and future issues,
- to find the means to collaborate or a minima to exchange information,
- etc.

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Subject : : Roundtable  
Topics : : Internet & Archaeology

# CAA2014 WORKSHOPS

## **W01 Hands-on structured light scanning workshop with discussion**

Chair : Dirk Rieke-Zapp 1,

1 : Breuckmann GmbH Meersburg - Germany - [Website](#)

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Structured light scanning has a long tradition in digitization of artefacts from arts and cultural heritage domain. Recent advances in 3D printing and inexpensive sensors based on computer vision technology have increased the awareness and availability of 3D digitization tools even for non-experts in 3D metrology. In this workshop we will highlight 3D scanning technology with special emphasis on Breuckmann structured light scanning systems.

The workshop will be divided in three parts

- Overview of current digitization technology with theoretical background
- Hands-on practise using structured light scanners
- Discussion on pressing challenges in the digitization of cultural heritage artefacts

The workshop is directed to novice users of structured light scanning technology as well as experts in this field. Hand-on experience will be important to grasp the process of data acquisition and to understand current research questions.

Members of the EU funded COST action on Colour and Space in Cultural Heritage (COSCH) are especially invited to join this workshop for hands-on experience.

Breuckmann Company has a long standing record in structured light scanning technology as well as its application to arts and cultural heritage. This workshop will offer an opportunity to all people interested in this field to exchange ideas, get a hands-on experience of the hardware and software far beyond the typical presentations available in the exhibition area of the conference.

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Subject :               : Workshop  
Topics                 : Field and laboratory data recording  
                             : 3D Archaeology  
                             : Virtual Archaeology

## **W02 Digital Documentation of Cultural Heritage Structures and Objects with Terrestrial Close Range and Medium Range Laserscanning**

Chair : Philipp Kresser 1, Christoph Held 1, Daniel Blersch 1

1 : Zoller + Fröhlich GmbH (Z+F) Wangen im Allgäu - Germany - [Website](#)

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The focus of the workshop will be the documentation of Cultural Heritage Sites with terrestrial laser scanners. This includes the data acquisition and data processing.

Laser Scanning of cultural heritage differs greatly from scanning in the industry. For example, while in industry often it is necessary to cover an object only with a few points to be able to model it with geometric primitives, in cultural heritage, every single point can be of significance. Thus, many more setups are necessary. As cultural heritage sites are also much more fragile, the use of targets for the alignment of scans is not always possible. Hence, different solutions for data processing are necessary. The workshop will focus on these issues and provide the attendees with solutions for their needs.

Inside Z+F, there is a lot of experience with organizing events, such as workshops and seminars, but also with documenting cultural heritage sites. Daniel Blersch, for example, has gained experience during his time at the DIAPReM institute at the faculty of Architecture, University of Ferrara in Italy where he spent a lot of time with recording and processing data of various Italian sites. He was also in the team for the documentation of the Nativity Church, Bethlehem. Christoph Held was a long-term member of the Zamani Project, South Africa, which is documenting cultural heritage sites all over Africa. Christoph Held, was also part of the documentation project in Petra, Jordan.

The proposed workshop is conceptualized as a joint session between the two technology developers and manufacturers Breuckmann and Z+F. While Breuckmann is focusing on close-range instruments, Z+F will address the topic with medium range laserscanners. Both technologies do have their pros and cons and their field of application and attendees of the workshop will benefit of the combined knowledge.

For the entire workshop we estimate 1.5 days. It will cover the theory of laserscanning with each technology, reports of and advice for scanning in the field, as well as practical hands-on sessions for the attendees to familiarize themselves with the technology.

The organizers of the CAA should receive a separate proposal from Breuckmann GmbH, which will be part of this workshop.

The workshop will be held in English.

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Subject :               : Workshop  
Topics                 : Field and laboratory data recording  
                              : 3D Archaeology  
                              : Virtual Archaeology

## W03 Hands-On Archaeological Conceptual Modelling 2

Chair : [Cesar Gonzalez-Perez](#) 1, [Charlotte Hug](#) 2

1 : Institute of Heritage Sciences, Spanish National Research Council (Incipit, CSIC) - Spain [Website](#)

2 : Centre de Recherche en Informatique, Université Paris 1 Panthéon-Sorbonne (CRI), Paris France - [Website](#)

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Research and practice in archaeology often generates, and needs to manage, a large amount of information, which exhibits complex relationships and categorisation phenomena. The quality of the conceptual models that we use when gathering, organising, processing and reporting this information determines, to a large extent, the quality of our work. Creating explicit, high-quality conceptual models is a crucial task in any information-intensive endeavour, and especially in those where the complexity of the information means that intuition alone is not sufficient.

This workshop will be divided in two parts. During the first half, the workshop will introduce the discipline of conceptual modelling, often seen as pertaining to the engineering world, to archaeologists and related professionals. This introduction will be achieved by hands-on work, i.e. doing and experimenting with ConML ([www.conml.org](http://www.conml.org)) rather than through theoretical explanations. ConML is a simple, high-level, affordable, powerful modelling language specifically designed with the humanities and social sciences in mind. In addition to supporting most of the object-oriented structural modelling constructs, ConML extends them with concerns that are rarely seen in industry-standard approaches but which are extremely important in archaeology, such as the ability to express temporality and subjectivity in conceptual models.

During the second half, the workshop will introduce CHARM (Cultural Heritage Abstract Reference Model, [www.charminfo.org](http://www.charminfo.org)), an abstract and wide representation of the basic concepts that we can use to compose models of the archaeological record and related information. CHARM will be used to create particular models that are useful to attendees' needs, using their own terminology and conceptualizations, but without losing the ability to interoperate and share information with one another. Special attention will be paid to issues such as how to model material and performative entities as well as agents, valorizations and representations.

The workshop will assume no previous knowledge of conceptual modelling, although it will assume familiarity with archaeological concepts and practice. It will begin by teaching the basic tenets of object-oriented modelling, followed by a comprehensive presentation of CHARM and its applications. Participants will be asked to undertake an extensive array of exercises and practical cases in the archaeological domain, either individually or in small groups, throughout the workshop. The maximum number of participants is estimated at 20.

Similar experiences have been carried out internally at Incipit, in the form of postgraduate courses at CSIC, and as workshops at various editions of the CAA conference, with excellent results in all cases; archaeologists, historians and architects with no previous exposure to conceptual modelling were capable of creating good-quality models after a few hours of practice. The organizers have extensive experience in using conceptual modelling in archaeological domains for over 15 years.

Subject : : Workshop  
Topics : : Ontologies & standards



## W05 Online Resources for Archaeological Research

Chair : Holly Wright 1,

1 : Archaeology Data Service (ADS) University of York - United Kingdom - [Website](#)

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This workshop will introduce archaeological researchers to a variety of online data resources, including those held by the three partners providing online access to their data as part of the new EC Infrastructures funded Advanced Research Infrastructure for Archaeological Dataset Networking (ARIADNE) project. The partners are the Archaeology Data Service (ADS), ARACHNE at the German Archaeological Institute (DAI), and Fasti Online at the International Association of Classical Archaeology (AIAC). Each partner has a different focus. The ADS is based in the UK and supports research, learning and teaching with freely available, high quality and dependable digital resources in English, derived from UK archaeology, or UK-based (or funded) archaeology abroad. ARACHNE is based in Germany and provides archaeologists and Classicists with a free internet research tool for quickly searching hundreds of thousands of records on objects and their attributes, in both English and German. Fasti Online provides a database of excavations carried out in countries throughout the Roman Empire since 2000, providing a record in English and in the local language for each season. The workshop will also feature resources from several other online data providers, representing data held in different languages, and from countries outside of Europe. All of the data providers will showcase the resources they have available and discuss how to use them, also illustrating the benefit to archaeology of making data openly available.

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Subject : : Workshop  
Topics : : Internet & Archaeology

## **W06 Belling the Cat: Making CIDOC Conceptual Reference Model (CRM) data available as Linked Open Data (LOD): A practical hands-on workshop of a complete solution using freeware**

Chair : Stephen Stead 1, 2 , Michael Charno 3,

1 : University of Southampton (Southampton, UK) (ACRG) - United Kingdom

2 : Paveprime Ltd (PPL) - United Kingdom

3 : Archaeological Data Service, University of York (ADS) - United Kingdom

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The mice meet in council to debate the problem of the new cat in the district. One suggests that a bell should be attached to the cat to give a warning. This is greeted with universal approval until someone asks “How?” Cultural Heritage Informatics specialists are often heard to say “just publish your CRM data as linked open data so that others can use it”, but how do we actually do that? This workshop aims to lead attendees through the process of taking an export of delimited text (ie. comma separated values) from their database, converting it to CRM compatible RDF triples and then making them available via a triple store for consumption by humans or machines as linked open data. The course will provide an introduction to linked open data and then will lead users through a cookbook of simple to follow techniques for creating and publishing it. All software used in the workshop will be freeware and runs on the free and open source operating system Linux. The software and operating system are uniquely capable of running on underpowered hardware, making deploying it simple even with limited support from an IT department or support services. The full set of software and guidelines will be available to attendees (if you bring a USB stick)

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Subject : : Workshop

Topics : : Internet & Archaeology

## W07 Manage stratigraphic data with Le Stratifiant

Chair : Bruno Desachy 1,

1 : CNRS UMR 7041 équipe archéologies environnementales Nanterre - France

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"Le Stratifiant" is a software of stratigraphical and chronological data processing, developed since a few years (Desachy 2008, 2010). It allows the automated realization of Harris matrix-like graphic representation of stratigraphic relationships, including elements of quantified dating (TPQ-TAQ). It has for peculiarity to authorize processing of not sure data (uncertain stratigraphical relations or estimated dates). It is designed in a purpose of simplicity, ease of use, and integration to the existing recording systems. It exists at present in the form of a (free) additive to the software Excel. It is usually used by several archaeological teams in France in INRAP, university and CNRS, and local archéological units.

Demonstrations will present the features and use of "Le Stratifiant" :

- stratigraphical data processing and stratigraphical graph realization ;
- logical errors detection and processing ;
- uncertain data processing ;
- stratigraphical groupings processing;
- elements of quantified dating processing and stratigraphical sequence inscription in the absolute chronology;
- communication with archaeological recording databases and information systems ;

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Subject :               : Workshop  
Topics                 : Field and laboratory data recording  
                          : AIS

## **W08 Exploring network structural properties with the GeoGraphLab GIS solution**

Chair : Robert Sandrine 1, Mermet Eric

1 : École des hautes études en sciences sociales (EHESS) PARIS - France - [Website](#)

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This workshop proposition is linked with the “transportation network analysis” session (S. Robert and E. Mermet dir.). GIS solutions are growing with the emergence of open source software. These tools offer analysis methods in various domains involving geolocalised data. On a network, data are nodes and edges. These data structures can be studied simply, some might say too simply, by graph theory (Berge 1973) developed in the late 1950's.

It is interesting to notice that first studies using graph theory and very beginning of GIS were focused on an historical view of the medieval river trade network of Russia (Pitts 1965; 1979). In such a study, it is highlighted, with various network measures like (accessibility, centrality, proximity) that the special position of the city of Moscow in the river system led to affirm its economic dominance and became capital.

Other methods of analysis of networks add a relational dimension to the simple graph theory (Freeman 1978, Sheffi 1985, Bollobás 1998). If this dimension adds a combinatorial complexity, the most interest is that it becomes possible to understand phenomena underpinned by the only network effect (Gleyze 2005) without the need to integrate thematic data. While at present it is becoming easier to acquire, to access and to integrate data in GIS tools (travel surveys, GPS mapping and tracking, etc.), obtaining reliable historical data can take many years of research.

In this workshop, we propose to introduce a tool for analyzing relational phenomena on networks. GeoGraphLab (Mermet et Ruas 2010) is a GIS solution that allows to analyse and to map networks without thematic data based only on its structural properties. Indeed, a network due to its intrinsic properties reacts in its own and unique way to different stimuli. These reactions are dictated by the arrangement of the network components and how these components are activated by relationship: that's what we call the potential relational network (Mermet 2011).

This approach is based on the geometric aspect of components nodes (positions) and edges (geometries), topological aspect (edges connect nodes), metrics aspect (length, time, costs, etc.) and finally relational aspect (all the relations on the network have to be considered). Then relations are reflected by paths (shortest paths, random paths, etc.) for which it is possible to measure properties to obtain indicators on the network (like betweenness or proximity centrality, average distance, distal or proximal radius, etc.). These indicators, once mapped, offer a particular view of the network status in the study.

Different pretreatments are integrated to correct topology, induce a metric, check the connection. It is also possible to filter relations, to take an interest in specific phenomena involving a set of relations of interest. Finally, an integrated tool for crossing created maps will be presented as a complete graphical language in order to speed up studies and network analysis.

Subject : : Workshop  
Topics : : GIS & Spatial Analysis  
: : Mathematics & Statistics in Archaeology  
: : Multi-agent systems & complex system modelling

## **W09 Data analysis for human and social sciences : a multidisciplinary interface**

Chair : [François Giligny](#) 1, [Stéphane Lamassé](#) 2

1 : Université Paris 1, Panthéon-Sorbonne - UMR Trajectoires (TRAJECTOIRES) - Paris - France [Website](#)

2 : Université Paris 1, Panthéon-Sorbonne (UP1 UFR09 LAMOP) Paris - France - [Website](#)

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Data analysis is a part of standard tools of data processing in numerous disciplines of human and social sciences. The nature of the handled data and the used procedures allow to define recurring needs and processing chains by means of tools such as the factorial analyses, the automatic classifications etc.

These recurring needs are performed by diverse software, free or not, or can be scheduled in languages as R.

An interdisciplinary reflection on the used methods and the formalization of the procedures in various human and social sciences, history, archaeology, sociology, was undertaken between various laboratories of the university Paris 1 to define needs, formalize the procedures used in the various disciplines and to produce an appropriate software.

This software (<http://analyse.univ-paris1.fr>) was designed free under R and put on-line, so that researchers and students have a tool adapted to the educational needs and research.

This workshop will allow to discuss about usual procedure, from the needs for the users, to criticize them and to illustrate them with case studies.

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Subject :           : Workshop

Topics             : Mathematics & Statistics in Archaeology

                      : Open Source & Archaeology

                      : Computing in Epigraphy & History

## **W10 Hands-on Workshop- Using Free and Open Source GIS tools: QGIS and GRASS for Archaeology and Cultural Resource Applications**

Chair : Scott Madry 1,

1 : University of North Carolina at Chapel Hill (UNC-CH) - United States - [Website](#)

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This full-day, hands-on workshop (or half day, if you prefer) will present a general overview of the archaeological and cultural resources applications of Free and Open Source (FOSS) GIS Software tools, specifically the QGIS and GRASS GIS packages. Open Source tools have advanced significantly in recent years, and now provide a viable, no-cost alternative to expensive and proprietary GIS systems. Several of these tools make up the 'OSGEO stack', providing a full range of GIS, GPS, remote sensing, database, visualization, networking, and spatial analysis capabilities. This workshop will provide a full day's hands-on exposure to the QGIS and GRASS GIS systems. Participants will be encouraged to bring their own laptops so that they can leave the workshop with a full set of open source GIS tools for future use.

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Subject : : Workshop

Topics : : Open Source & Archaeology

## W11 Introduction to network analysis for archaeologists

Chair : [Tom Brughmans](#) 1 , [Ursula Brosseder](#) 2, [Bryan Miller](#) 2,

1 : Archaeological Computing Research Group, University of Southampton - [Website](#)

2 : Vor- und Frühgeschichtliche Archäologie, Rheinische Friedrich-Wilhelms-Universität

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Recently, an increasing number of archaeologists are turning to network analysis in their attempts to understand past phenomena. But what is this network perspective exactly, and what are its advantages? Most importantly, how can archaeologists critically select and perform a network analysis in their own research?

This workshop will introduce the basic principles of network science as well as some of the most commonly used analytical techniques and visualization methods. It will draw on archaeological examples throughout to illustrate these topics. It will include a discussion of some of the most crucial benefits and issues with network science in archaeology. This practical workshop will guide you through completing a network visualization and analysis of an archaeological and geographical dataset using the user-friendly network analysis software platform Cytoscape. It will be followed by a brief discussion of the advantages and disadvantages of other free-to-use network analysis software. Finally, the workshop will close with a creative exploration of another archaeological dataset from Late Iron Age Eurasia. The aim is to discuss connectivity along the Silk Roads from a network perspective, and how this might lead to new hypotheses.

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Subject : : Workshop

Topics : : Mathematics & Statistics in Archaeology

: Multi-agent systems & complex system modelling

## W12 One hour, one model: Agent-based Modelling on-the-fly

Chair : Iza Romanowska 1, Benjamin Davies 2 , Enrico Crema 3, Tom Brughmans 1,

1 : University of Southampton - United Kingdom

2 : University of Auckland - Australia

3 : University College London (UCL) - United Kingdom - [Website](#)

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The number of archaeological applications of complex systems simulation using equation-based, statistical, network and especially agent-based modelling has increased significantly in recent years. The modelling techniques are becoming easier to use and faster to build (Kohler and van der Leeuw 2007; Robertson 2005). Large, detailed datasets are becoming effortless to obtain and work with (Gruber 1993; Snijders et al. 2012; Watts 2011). Sharing data and models between colleagues across the globe has become quick and seamless. However, computational modelling is often conceived of as a painstaking process limited to focused research programs. Partially because it still lacks the standardized simulation tools, good-practice guidelines and libraries of coded examples that are commonly used in other disciplines. This can make coding models a time consuming process, limiting the use of simulation modelling as an on the fly experimental process. Processes such as social interaction, diffusion, population growth or communication are common to many ABM applications, in a wide range of disciplines. The aim of this workshop is to compare and contrast different approaches to such recurring research themes in archaeological simulation used by modelling and to challenge the notion that simulation building is a painstaking process involving high levels of expertise. We hope to bring the simulation method into the realm of "tools to think with" (Epstein 2008; Fencott et al. 2012; O'Sullivan and Perry 2013) and promote the use of ABMs as experimental laboratories in archaeological practice.

This workshop is aimed at modellers of all stripes: from qualitative/conceptual modelling to networks and agent-based models and on through to statisticians. The workshop participants will be divided into 3 to 4 groups and will be given programming tasks which have to be solved in approximately 1 hour each.. We'll begin with a discussion of the concept, then a problem will be introduced, and we'll break into groups to begin model building. Groups will go from model conception to construction and on through to analysis multiple times during the day. A comparison and discussion of the different coded solutions to the same research topic will follow each module. As an immediate result of the workshop we hope to produce a library of documented code snippets that can be used in a wide variety of (archaeological) models.

We suggest that participants familiarise themselves with NetLogo before joining the workshop (a short NetLogo tutorial is available here:

<http://ccl.northwestern.edu/netlogo/docs/> ).

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Subject :       : Workshop

Topics         : Multi-agent systems & complex system modeling