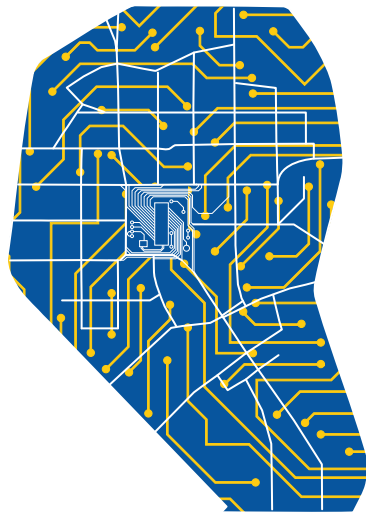


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**CAA
2019**

KRAKÓW

Institute of Archeology of the Jagiellonian University
Polish National CAA Chapter



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Session 01

Student and Early-Career researcher session

James Miles

Following the steering committee meeting for CAA2018, it was decided to create a session for all student and early-career researchers (up to three years post degree) who wish to present at CAA for the first time, aimed predominately for those who may not wish to present in alternate specialised thematic sessions. This session will only be open to students and early-career researchers, with all student papers being automatically considered for our annual Nick Ryan Bursary. Only those presenting in this session will be nominated for this prestige award and will allow for the best student paper to be identified, with the recipient receiving 1000 euros towards the costs of attending CAA-2020. The session will be actively publicised, and it is hoped that it will be well attended, acting as a way for students and early-career researchers to engage with the CAA community for the first time. All members of the reviewing panel for the Nick Ryan Bursary will be present and will be on hand to provide useful feedback around presentation style and the content discussed. The session will include all themes and topics. The aim of this session will be to introduce new members to the CAA community and to create a focussed session that allows CAA members to view all Nick Ryan Bursary nominated papers. In turn this will create a greater review process, with each paper being assessed against the others presented in the session.

Session 02

Progress in WebGIS and DB solutions for Archaeology

Mieko Matsumoto, Espen Uleberg, Volker Hochschild, Michael Märker, Christian Willmes

In this session we would like to bring together scientists presenting new ways to visualize and contextualize spatial data in archaeological databases. Digital field documentation is to varying degrees becoming more and more available as the significant analytical tool for archaeologists. This provides larger and far more complex datasets ever before that can be accessed and analysed. Detailed documentation of structures and contexts on the field can now be directly linked to artefact catalogues and results from digital data analyses. Authority lists and Linked Open Data will widen the range of potential utilities even more. Demands for data management plans, and the fact that many institutions move towards adhering to the FAIR data principles (that data should be Findable, Accessible, Interoperable, Reuseable), will also open new sphere of challenging, unforeseen areas of data exploitation.

The presentations could also include solutions that pass geographic, geodetic and 3D-data to visualization tools. Consideration should preferably be given to unconventional ways of combining georeferenced data from several open sources, and presenting them in unique and innovative ways.

Creating and providing context for archaeological databases, for example, by relating paleoenvironmental information or fresh ideas for spatial analysis, equally increases understanding of these databases and thus leads to progress. Presentations re-using or re-contextualizing existing archaeological datasets, as well as presentations of tools and interfaces like WebGIS (web based portal services and GIS-systems) that allow the visualization of such datasets, are also welcomed.

This session is a succession of nearly 10 years tradition at CAA. We have been presenting our own projects through this period, and invited many other researchers to discuss the most updated methods and theoretical background. We believe that work with digital field documentation for visualization and contextualization of archaeological spatial data is one of the most basic, hence fundamental issues in archaeological database research.

Session 03

Roundtable Scientific Scripting Languages in Archaeology – Limits and Opportunities of Open Research

Martin Hinz, Clemens Schmid, Sophie Schmidt

At last year's CAA, during the session on R in Archaeology, a suggestion was made to set up a Special Interest Group on Scientific Scripting Languages in Archaeology (SIG SSLA). We would like to comply with this proposal at this year's CAA. We would also like to take advantage of the forum to discuss the SIG's goals and agenda in a round table.

A scripting language is a programming language that allows interaction with a software interpreter to perform operations on data. It does usually not require compilation and is therefore associated with a rapid and agile development style that is particularly suitable for research, analysis and visualization of scientific data. Scripting languages may include but are not limited to R, Netlogo, Stan, OxCal, Bash or Python.

The use of scripting languages enables the user to document every necessary step in a research pipeline. Conversely, the resulting scripts can be used to reproduce analyses by other researchers if the input data is also available. Even the initial software environment can be emulated. Scripting languages are therefore ideal for reproducible research. But reproducibility can go even further: ideally it also documents the scientific production process with all inductive and deductive steps of hypothesis formation. A modern and powerful way to achieve this is version control.

There is a clear demand for dialogue in the community to broaden the impact of these improved methodological approaches, considering they still have a quite small number of users. We offer a draft Statement of Purpose for the SIG to discuss in this session. It is based on an internet survey following the last international CAA: (https://martinhinz.github.io/sig_sci_scripting_languages/statement.html).

We invite participants to prepare a two-minute statement or comment about this paper in order to start the discussion, which will be divided into two thematic sections. One section will focus on the general topics outlined in the position paper:

- What principles are essential for scientific programming?
- How should they be taught? How can quality control and sustainability be guaranteed?

The second section will begin to define more clearly the objectives of the proposed SIG:

- Which instruments and platforms can be established?
- What support can be provided for the growth of a more open, inclusive and reproducible research software landscape?

Session 04**Digital archaeology of modern conflict landscapes***Grzegorz Kiarszys, Mikolaj Kostyrko*

In this session we are looking to bring together case studies that apply digital archaeology to the research of modern post-conflict landscapes. Conflict archaeology of the recent past is a fast-growing field of knowledge. What 30 years ago would have been considered as new and quite peculiar kinds of archaeological studies have, in the last decade, become common. Today archaeologists study landscapes altered during recent conflicts (WWI, WWII, Cold War etc.) in the same way, as any other period. While doing so, they reach out to digital archaeology – computer aided or based techniques which provide them with a better insight into their study area. Tools that help them to explore (i.e. remote sensing), reveal and analyze (i.e. GIS analysis, modeling), share objects (i.e. online databases) of their interest with a wider audience.

What kind of contribution to the study of post-conflict landscapes can digital archaeology provide? How can digital archaeological tools change our (and other's) cognitive experience (enhance or cloud it?), and understanding of conflict sites? We are looking for qualitative and not quantitative case studies that will show the importance or irrelevance of digital archaeology methods in study of recent conflicts, both in its research, as well as in outreach and popularisation of archaeological study.

Session 05

R as an archaeological tool: current state and directions (vol. II)

Carolin Tietze, Sophie C. Schmidt, Nicole Grunert

The open source, platform-independent and community-driven software environment R has become one of the most important tools for quantitative archaeologists working on a reproducible research approach and developing new packages for their analyses. Following the success of this session at the last international CAA conference in Tübingen we want to encourage scientists using R to either return and show the progress of their work. We also warmly invite new colleagues to demonstrate their fresh and new approaches. As many colleagues have not yet realized the potential of the language and its easy access way to conduct high quality research with the readily available tools in R it is most important to explore its use for different archaeological research questions.

For this session we would like to continue to survey the state of the art and the potential application of R. We invite presentations for this session that focus on questions such as, but not limited to:

- What are the specific benefits of this statistical framework in the eyes of its users?
- What are the possibilities? What are the limits?
- What future directions might the usage of R in archaeology have?
- Which archaeological package has been developed, that might be useful for other researchers as well?
- Which package needs to be developed further to improve the usability of the software for archaeologists?
- What has to be considered to optimize the workflow with R?

We would especially like to attract colleagues who demonstrate their approach with live coding or present archaeological R packages that are ready or in the making. Presentations on works in progress are very welcome. We intend to maintain a productive and inclusive exchange between both young and experienced users of all backgrounds.

Session 06

Recent advances in spatial statistics for archaeology

Joe Roe, Francesco Carrer

Questions of space and place concern archaeologists from every branch of the discipline. There are many ways to approach such questions, but the application of quantitative spatial analysis to archaeology has long been an area of particular interest. This body of statistics originated in geography and ecology and was first adapted to archaeology over forty years ago by pioneering scholars such as Hodder and Orton. A “second wave” of renewed interest then came with the widespread adoption of geographic information systems (GIS) into archaeological methodology in the late 1990s and 2000s. In this session, we wish to explore advances in archaeological spatial statistics – from the intra-site to landscape scale – made in the last decade. In particular, we invite papers discussing the state of the art in spatial analysis; the application of new statistical techniques to archaeological contexts; new ways of thinking about spatial data in archaeology; advances in GIS technology; and the development of new statistical tools using scientific programming environments such as R and Python. Speakers are welcome to use archaeological case studies from their research, but the primary focus of papers should be methodological.

Session 07

Teaching 2.0: Show me how you teach!

Carolin Tietze, Sebastian Hageneuer

Nowadays, the necessity for a top-down hierarchy and presentation-discussion-style seminars are overdue for a remake as the class' content, used technologies and varieties of teaching methods have evolved. Additionally, many seminars now use more and more up-to-date technologies, including 3D, VR or AR applications, which foster an increasingly digital environment for archaeologists. This new digital movement even creates new fields of study like Computational Archaeology or Archaeoinformatics and Digital Humanities. The problem with these new fields is, that they cannot strictly be taught using the same methods as before, presenting lecturers with the need to adapt their teaching methods.

Concepts like inverted/flipped classrooms, MOOCs, blogs, simulations and even archaeogaming are starting to replace classical teaching methods gradually, although it is not quite clear in which ways these will prove to enhance the way we teach archaeology in academia.

This session wants to discuss exactly this problem. We would like to present and discuss modern ways of digital teaching in archaeology with a special interest in the evaluation of the used methods and the exchange of experiences and "lessons learned" from it. We therefore welcome contributors from all fields of archaeology (university, museum, excavation, cultural heritage) who want to share their experiences. Topics may include, but are not limited to:

- New digital approaches (blogs, films, exercises, games, simulations;)
- Evaluative field studies on new and old teaching methods;
- New applications that alleviate a steep learning curve.

This session aims to encourage discussion on the potential, problems and challenges of using new teaching methods that fit the needs of a future-oriented field of study. Participants will be asked to present their very own teaching methods within a 10-minute presentation, following a 10-minute individual discussion on their paper. The session will end with a full hour final discussion summarizing the different papers and debating the pros and cons as well as the general trend of digital teaching in archaeology. Special importance should be given to the implications that the methods presented may have for the students and in which way it might be supporting, enhancing or obstructing the learning process, and how it could inspire the student to creatively apply the new knowledge. We especially encourage presenters to evaluate their experience in order that we are able to compare different methods during the final discussion.

Session 08 Teaching Digital Archaeology

Till Sonnemann, Grzegorz Kiarszys, Arianna Traviglia

Courses teaching basic “digital” methods to archaeologists, from equipment to software use, have surged in recent years, particularly in Europe, with the goal to provide students with a bit of extra knowledge in digital techniques to survive in the market. Supported often only by university politics for its innovative character to help modernise archaeology, in many curricula the digital element is still fighting for a permanent position. While accepted by “real” archaeologist as a useful tool, digital topics nevertheless often are rare orchids in the vast field of archaeology. This seems particularly true in traditional archaeology courses, where students often choose their career path for very specific, sometimes utopian, reasons with one goal to become a field or dirt archaeologist.

Digital Archaeology offers the opportunity to include a great variety of courses and subjects. At the same time archaeology curricula can be very tightly specified and, in such cases, it becomes more difficult to fit in special topics because of BA restrictions. Additionally, students may question the value of adding such additional course elements: “Is the method being taught fully acknowledged? There can only be so many applied computer courses or introductions to digital techniques, software and programming, that could provide a new view on archaeological topics”.

In this session we ask: “What are the digital basics that all students should be equipped with at BA level? How much further should a MA Level course reach? What courses have been particularly successful, which ones failed, and for what reasons? How do students accept the challenge?” We want to bring together colleagues who focus on teaching and developing courses on digital archaeology and discuss openly our successes and the problems we can expect to meet. Our goal is to form collaborative networks and hopefully share methods and exercises. We will ask prospective participants, wishing to take part in the session, to fill out a questionnaire. Presentations should be no longer than 10 min with focus on the questions provided.

This session will feed into a Roundtable called “Thinking out of the classroom: developing a strategy for sharing knowledge and resources for education and training in digital archaeology”.

Session 09

Thinking out of the classroom: sharing knowledge and resources for education and training in digital archaeology

Philip Verhagen, Matthias Lang, Yasuhisa Kondo, Stephen Stead

In this roundtable, we invite participants to think with us on the future of education and training in digital archaeology. Despite the successes of digital approaches in archaeology, teaching to university students as well as post-graduate teaching is still suffering from a lack of resources. Dedicated curricula are scarce and definitions of best practices are largely absent, resulting in a highly variable proficiency of graduates in digital methods and techniques. We assume that much of this problem is related to the global system of university education, where sharing of educational resources and practices is not actively encouraged, while at the same time putting much burden on individual staff members to develop educational programmes with limited resources. We therefore feel that CAA, as a global organisation, could and should play a pivotal role in setting examples for good education and training and providing a shared knowledge base for its members that can lead to a higher quality of educational practice.

The question that we want to address in this roundtable is how we can profit from the experience of the CAA community to make sure that the available knowledge on education and training is better shared among its members and the wider archaeological community. Topics that could be discussed are the development of Open Access courses and training data sets, the development of specific learning goals and quality criteria for curricula, and the organisation of practical working sessions at CAA and other conferences. On the basis of this debate, we aim to establish focus groups to work on the issues identified.

Session 10 Urban Mobility: Analysing Movement within and between Cities

Katherine Crawford

The study of ancient mobility has seen a long tradition of scholarship. Until recently the predominant approach to studying past movement has been with either the application of GIS based analyses for studies of movement across landscapes or space syntax methodologies for urban focused research. The increased accessibility of GIS, network analysis, and simulation based methodologies have begun to allow researchers to more readily address various modes of human mobility within different urban and suburban landscapes. Likewise, the growing corpus of urban data resulting from the advancement of computational methodologies and interdisciplinary archaeological approaches, such as advanced geophysical methods, additionally presents a diverse set of urban data that can be used to study various forms of mobility. There is new potential to study a range of different mobility practices including but not limited to different types of pedestrian movement or vehicular traffic. The results of these studies can provide new insight into the ways in which cities structured different movement patterns as well as the different movement dynamics that occurred within or between cities. This session invites papers that discuss the use of various computational approaches for the study of urban mobility at various geographical and temporal scales. Especially welcome are papers that introduce innovative applications of computational methods for studying different forms of mobility at both the urban and suburban scale. This session aims to bring together researchers in order to share the different methodologies being applied to studies of past urban mobility as well as providing a venue to evaluate the methodological issues, theoretical foundations, and challenges posed by these current approaches.

Session 11

Cities and Complexity

Eleftheria Paliou, Georgios Artopoulos, Iza Romanowska

Some of the major challenges in the study of ancient urbanism concern change and evolution in cities and settlement structures. How did socio-political organisations move from simple to complex? What triggers urbanism in human societies through time? How do settlements grow and regional centres emerge? How do cities define and transform the local ecosystems and vice versa?

The idea that cities are highly complex systems tied together through interactions between various factors was introduced in urban studies and archaeology many years ago, but it is only in the last decade or so that there have been more consistent efforts to examine this complexity using quantitative and computational tools – the so-called “new science of cities”. This new synthesis of urban studies builds strongly on complexity science, social physics, urban economics, transportation theory, regional science, urban geography and network science. A number of computational tools and methods that have been used by archaeologists fall under this emerging interdisciplinary field, but there are also numerous underused techniques that show high potential for furthering our understanding of past cities.

This session invites papers that seek to examine past cities and urban life as complex phenomena by applying computational methods, for example:

- spatial interaction models;
- settlement scaling;
- space syntax;
- transportation network analysis;
- pedestrian simulation;
- analysis of urban morphology (fractals);
- agent-based modelling.

Or any other digital techniques designed to study interactions, flows, urban dynamics, morphology and scaling. We also welcome papers that use quantitative methods and spatial analysis to interpret urban data, as well theoretical papers that discuss the prospects and challenges of the science of cities in archaeology.

Session 12 Urban Transportation: Past and Future

Tuna Kalayci

According to a United Nations projection, 66% of the world population will be living in urban areas by 2050. By 2030 there will be at least 41 mega-cities with more than 10 million inhabitants each. These demographic changes will require cities to implement intelligent transportation systems which facilitate the “flawless” movement of pedestrians and vehicles. To this end, public policy makers (e.g. the European Commission) are already devising strategies for new “smart cities” and encouraging the broad implementation of transportation simulations and forecast algorithms.

In fact, the attraction to high-density areas is not a 21st century phenomenon, nor are the issues and problems associated with it. Waves of urbanization have taken place in various forms and magnitudes ever since prehistoric times. From South America to China, people have coalesced in specific places, and at times at a very rapid pace. Therefore, studies of past urban environments can and should provide alternative avenues for the development of modern cities, deliberately shifting the focus from the mobility of capital to the mobility of humans.

Thanks to long-term archaeological projects, targeted excavations, large-scale geophysical surveys, and detailed mapping efforts, researchers now have substantial cognition of urban layouts and how people might have moved within pre-modern cities. Furthermore, the use of information technologies – such as axial analyses, agent-based modeling, network analyses, pedestrian simulations, and cellular automata – opens up paths for understanding the dynamics of past urban transportation and provides researchers the opportunity to connect the past with the development of future cities.

This session invites historical, archaeological, and ethnographic studies of transportation in urban places from a computational perspective. Geographical region and time period is open, but diachronic studies that include modern cities are especially welcome.

Session 13

Ethics in Digital Archaeology: Concerns, Implementations and Successes

L. Meghan Dennis

An increase in digitally derived data and digitally situated methodologies has brought with it a new set of ethical concerns. CAA has attempted, as one intervention, to address these considerations with the creation of a code of ethics. This code was formally adopted by the membership at the 2018 Annual Conference. Though the contents of this code provide guidance to digital archaeologists, on-the-ground realities can prompt scenarios of ethical confrontation that require creative thinking and adaptations of practice.

This session aims to provide a venue for sharing experiences of ethical consideration in digital archaeology, both within the academic and private sectors. Papers will discuss the application of ethical theory and ethical guidelines to past and present projects. In addition, papers will examine initiatives for addressing ethical concerns within future projects. A synthesis of experiences over the first year of CAA's Code of Ethics and reflections on growth in ethical consideration within the sector will be made, and necessary adaptations and evolutionary changes in ethical decision making within the digital sphere will be discussed.

Session 14

Modelling Data Quality in archaeological Linked Open Data

Kai-Christian Bruhn, Allard Mees, Florian Thiery

Today, increasing quantities of data are published by archaeological institutions. At the same time, inter-connecting these data following the concept of “Linked Data” is becoming more and more popular. The current evolution from “Linked Data” via “Linked Open Data” (LOD) towards “Linked Open Usable Data” enables a wide array of archaeological applications. However, this development of an increasing LO(U)D-cloud implies challenges in handling complex facets of data quality. Therefore, modelling the handling of data quality becomes an increasingly important issue. This is especially valid for archaeological data, which are based on a complicated network of concepts from different knowledge domains.

Even very carefully compiled datasets can contain errors and ambiguities. Unrecognised errors multiply exponentially in scenarios of data reuse: not only incorrect data and conclusions are the result, but possibly also a loss of confidence in web-based resources. Moreover, modelling data quality to share knowledge about uncertainty is necessary to produce and publish transparent Linked Open Usable Data.

The success of the session “Guaranteeing data quality in archaeological Linked Open Data” at CAA2018 has raised awareness of many challenges related to this topic and encourages pursuing the debate.

For this session we invite contributions that addresses e.g. following issues:

- Identifying and strategies for correcting inconsistencies within the data;
- Identifying sources and dangers of incorrect or ambiguous data;
- Identifying duplicates across different LOD sources;
- Keeping track of the provenance of data as a means of solving errors and identifying their source;
- Defining metrics in order to rate data in respect to their quality;
- Setting up methodologies and tools in order to label or certify data sets based on their quality;
- Compiling trust levels based on various inputs such as provenance and quality level;
- Modelling uncertainty and vagueness in LOD (e.g. thesauri and CIDOC CRM);
- Dealing with ambiguities resulting from multiple links in the LOD cloud;

We encourage presenters to derive the problems from real-world datasets and to formulate proposals for solutions, preferably demonstrating (prototypes of) realised data driven web applications. As we target a broad and diverse audience because of the thematic relevance, the challenges described should also be integrated into their archaeological context (excavation, museum, archive, etc.).

Session 15

Issues of scale in archaeological computational modelling

Benjamin Davies, Colin D. Wren

Archaeology aims to interpret and explain patterns in the material record. That patterning may occur at a wide range of spatial scales, from microscopic traces in sediments and residues to global scale patterning in the distribution of technologies and material culture. These patterns may develop in an instant or accumulate over millennia, and are subject to change through time. The explanatory models that archaeologists develop must not only incorporate these spatial and temporal scales but must often operate across them to accommodate the emergence of wide scale patterning in the present from individual scale actions in the past. Whether represented using GIS, ABM, networks, equations, or otherwise, considerations of scale are fundamental to the venture of archaeological modelling, creating sources of frustration and inspiration for understanding the past. In this session, we aim to bring out some of the challenges of computational modelling in archaeology, particularly with respect to issues of scale. We interpret this broadly: scale can pertain to the behaviours under study, the analysis being undertaken, or representation as a model. Whether spatial, temporal, organisational, or even computational, we welcome papers that can provide insights into issues of scale in archaeological modelling.

Session 16

Where does global meet local? Finding common ground for multiscale analysis of settlement and land use dynamics*Philip Verhagen, Laure Nuninger*

Spatial modelling of regional settlement systems has made great strides since the introduction of GIS in the 1990s. Many regional datasets were created and completed, allowing for quantitative and spatial analysis of settlement patterns from a landscape perspective. Also, the study of settlement patterns has recently seen important advances with the introduction of statistical simulation methods to model and analyse chronological uncertainty.

However, the comparison of settlement systems between regions in order to understand long-term social, environmental, economical and political change at a national, continental or even global scale is a field where methodological progress has been slow. Current approaches seem to either favour a simulation modelling approach, trying to fill the gaps between sparse data points, for example using advanced diffusion models or agent-based modelling; or they rely on reducing the complexity of archaeological and palaeo-environmental data to produce standardized spatio-temporal analyses of large data sets.

In this roundtable, we invite participants to explore with us new and effective approaches to analyse and model settlement and land use trajectories within a multiscale context. In particular, we want to address the following questions:

- How can we exploit existing datasets, stemming from different scientific and heritage management traditions, for cross-border and cross-disciplinary studies? Current developments in data collection and curation, spurred on by the “linked open data revolution”, have led to an increasing availability of all kinds of data. However, the analysis of LOD for scientific research is still highly experimental and successful examples are dependent on the creation and maintenance of a common ontology.
- How can we develop common procedures for diachronic analysis, applicable to both large-scale questions and regional settings? Regional settlement data is fine-grained and needs local expertise to be exploited to full effect. What are the shared characteristics of local datasets that will allow for comparison on a larger scale, and are these useful for understanding questions of social, environmental, economical and political change? What ways are available to model and predict the characteristics of coarser-grained data sets, or even of zones where data is absent, and can these be combined in a common analytical framework?
- How can we build a bridge between different theoretical and conceptual frameworks? For example, to what extent can large-scale simulation modelling results be tested with regional archaeological data sets? And how can we connect settlement data to data sets that cover very different aspects of past land use and settlement, like palaeo-environmental data, transport and communication networks, or other off-site activities?

Session 17

Empowering Archaeology of the Senses through digital approaches

Giacomo Landeschi, Heather Richards-Rissetto

A major challenge of contemporary archaeology is to build formal-based narratives about the Past that allow for human perception and agency. Archaeologists are making use of digital tools and technologies to develop innovative approaches to take a situated perspective of human interactions in ancient landscapes. By “placing” human actors in specific physical and cultural contexts, we can explore the role of built and natural environments in structuring ancient experiences, which in turn, influence social, political, economic, and ideological interactions. While material culture together with other data sources provide the basis for bridging modern experiences with potential experiences of past peoples within landscapes, few formal methods exist to construct these narratives; however, recent advances in archaeological computing are affording new approaches.

In recent decades, archaeologists have begun to employ digital methods to simulate and quantitatively explore human experience in the past, or at least, to get some clues about the ways by which humans manipulated ancient spaces to convey symbolic messages, create identity, and structure interaction. Human senses, as defined by Aristotle, act as an important proxy to investigate the social dimensions of ancient spaces and places. Sight and hearing, but even smell, touch and taste can now be captured, analysed and reproduced in a digital environment through state-of-the-art technology that can contribute to deeper explorations of spaces and their relation to constructing a sense of past places.

The purpose of this session is to foster discourse on the way different digital tools and technologies such as Virtual Reality (VR), Augmented Reality (AR) Mixed Reality (MR), haptic devices, Geographic Information Systems (GIS), and more can lead to the development of formal methods that help create multi-sensory narratives to provide deeper insight into the study of ancient space and place. We invite all those specialists interested in applying advanced digital tools in the field of Cultural Heritage to present papers on the human sensorium as a possible gateway to the Past and as a way to foster discourse on methodological and interpretative challenges to building formal-based narratives that allow for human perception and agency. We solicit presentations on a range of issues such as, but not limited to, formal methods, research applications, technological challenges and affordances, and theoretical frameworks.

Session 18

Immersive Digital Media in Archaeology: Memory, Place and Performance

Gareth Beale, Julian Richards, Nicole Smith

The emergence of immersive digital media (including VR, AR and other forms of mixed reality) has created a wealth of new opportunities for archaeological storytelling and data representation. However, immersive media and mixed reality technology remain in a state of rapid flux.

Archaeologists are innovating and experimenting with these technologies and archaeological applications of immersive media have been quick to emerge. With a rich history of media innovation and non-digital immersive storytelling archaeology seems uniquely well placed to produce new and exciting immersive media forms. This session will ask:

- How do immersive experiences contribute to our ability to conduct and communicate archaeological research?
- How can archaeological expertise contribute to the innovation and development of rapidly evolving immersive media forms?

The goal of the session is to explore the diversity of immersive media practice within archaeology and to recognise the unique contribution which archaeology is currently making to the development of these media. We invite participants with experience of practical or theoretical research in the use of immersive media to contribute papers to this session. We welcome submissions from those working in areas outside of archaeology including media arts, heritage, human computer interaction, interactive media design, animation and games.

Our intention is to use this session as the basis for a co-authored publication on immersive media in archaeology, heritage and the arts.

Session 19

Our knowledge is all over the place!

Paul Reilly, Stead Stephen, John Pouncett

During CAA2018 Huggett *et al.* (2018) issued a grand disciplinary challenge to produce a consensus-based, end-to-end, digital archaeology knowledge map with which to locate evolving archaeological practices without stifling digitally creative disruptive developments. In a hugely complex and expanding knowledgescape, digitally-enabled knowledge maps will give practitioners a better chance to share our collective disciplinary knowledge (both by giving and receiving), while avoiding unnecessary duplication, exposing gaps, and fostering greater resilience in our knowledge sharing practices and knowledge bases. They are intended to digitally enhance questions of the generic form: “what do we already know about... where does it reside, and how can I gain access to this knowledge/tool/method/ insight/expertise/etc?”

This round-table seeks to seed a pan-archaeology forum to produce a preliminary high-level model of digitally-enabled archaeological knowledge practices (explicit and tacit) and capabilities and begin the process of mapping our assets, resources, communities, best practices, and gaps. Maps are not static entities and can be rendered in many different projections. They are contingent on need. We therefore fully expect a variety of (evolving) mapping approaches. In under 5 minutes each, participants will present a single-slide a map (model) which encapsulates the scope of knowledge practices and capabilities required to operate effectively within their competency/sector (inter alia, commercial unit, GLAM, research organisation, funding agency, government agency, etc). These maps will provide the initial inputs for a discussion aimed at developing a broader (e-2-e) composite model of the digitally enhanced archaeological enterprise that can be taken to the broader CAA community and beyond to be refined and expanded. Our ambition in this session is to provide a framework onto which digital methods and approaches for specific practices in different archaeological contexts can be mapped and then harnessed to support day-to-day work practices and research.

References:

Huggett, J., Reilly, P. & Lock, G., (2018). Whither Digital Archaeological Knowledge? The Challenge of Unstable Futures. *Journal of Computer Applications in Archaeology*. 1(1), pp.42–54. DOI: <http://doi.org/10.5334/jcaa.7>

Session 20

Recent Developments in Digital Numismatics – Breaking down barriers*Ethan Gruber, Karsten Tolle, David Wigg-Wolf*

Numismatics has seen significant advances in the digital sphere in recent years. Whereas initially computer applications were mainly restricted to statistical analysis and modelling (e.g. estimating the size of coin issues, or the analysis of coin finds), and recording collections or inventories of coin finds in stand-alone databases, the discipline has very much embraced the manifold possibilities that technical advances in the last decade have offered.

In particular, the nature of coins as mass-produced, serial objects with relatively standardised core data mean that with projects such as nomisma.org numismatics is very much at the forefront of the development of the application of Linked Open Data and the Semantic Web in the Digital Humanities. Other fields which have seen intense activity include the application of 3D-modelling as a means of documenting and presenting coins (the digital replacing the long-standing analogue practice of 3D-documentation with plaster casts), and of image recognition, not just for the automatic identification and classification of individual coins but, for example, also as a means of automatically identifying objects in the fight against the illegal trade in coins (e.g. the FP6 project, COINS: Combat on-line illegal numismatic sales).

The aim of the session is to present examples of recent work and advances in Digital Numismatics. In the past numismatics has often been seen as an isolated discipline with little (interest in) interaction with other fields. Therefore the session will place a particular emphasis on examining how the lessons learned from the various numismatic projects can be applied to other areas of the Digital Humanities, and how Digital Numismatics can be better integrated into the broader field of archaeology as a whole.

The session will take the form of a series of short presentations (c. 5 minutes), followed by a moderated discussion. Presentations are particularly invited from non-numismatic domain experts with a view to also examining what lessons numismatics can learn from the experience of those working in other fields.

Session 21

Challenges and opportunities of machine learning in archaeological research

Alex Brandsen, Iris C. Kramer, Wouter Baernd, Verschoof-van der Vaart

For over two decades there have been sporadic presentations of diverse machine learning (ML) applications to digital archaeology at the CAA. In recent years there is a notable increase of papers using ML in archaeology, which may be ascribed to the success of Deep learning and Convolution Neural Networks (CNNs) across various disciplines that were previously described as being too complex for using machine learning. Applications using deep learning now show high performance on challenging tasks ranging from computer vision to natural language processing. In digital archaeology we have seen and foresee applications of these techniques including automated object detection in remote sensing data, artefact image classification, use-wear analysis, text mining, paleography, predictive modeling, 3D shape analysis and recognition, and typology development.

Our aim for this session is to bring together the previously scattered ML research to discuss practical as well as theoretical approaches for ML in digital archaeology.

For practical approaches we would encourage a critical dialogue to identify individual and shared problems, opportunities, and solutions. We invite authors to provide a thorough explanation on their approach and engage on some of the following questions: How do you structure archaeological datasets which are often small, incomplete, and noisy? What considerations applied to your choice of ML technique and how did was this technique tuned to your particular research? Which threshold do you find appropriate to determine the success of your method? What was your desired outcome and how did your final results compare to this? If your outcome resulted in a lot of new data that needs further manual validation, how do you plan to verify this? Do you foresee other applications for your method within archaeology or in other fields?

Our request for theoretical approaches can be more broadly interpreted. Some examples include: creation of annotated benchmark datasets, sharing of developed methods, data (or data structure), and code, data science challenges, conventions for data structure and performance metrics, need for collaboration or special interest groups, insights from ML fields outside of archaeology, ethics of ML in archaeology, education of ML in archaeology, rapid publishing of new ideas, future gazing.

Session 22

Digital Infrastructures for Archaeology: Past, Present and Future directions

Julian Richards, Holly Wright, Franco Niccolucci

This session invites papers reflecting on the direction of development for research infrastructures in archaeology at the project, local, regional, national or international level. The successful completion in 2017 of the first phase of ARIADNE, an EC Infrastructures-funded project spanning 23 partners in 18 European countries, produced a greater understanding of how large-scale infrastructures can contribute to the development of archaeological knowledge (www.ariadne-infrastructure.eu). This spanned a variety of deliverables, and featured the ARIADNE Portal (portal.ariadne-infrastructure.eu). It also resulted in a better understanding of how project-based, local, regional and national infrastructures can work together to support and strengthen their own internal efforts, and participate in cross-border initiatives. The lessons learned within ARIADNE have informed the structure of the next phase of the ARIADNE infrastructure (ARIADNEplus), which will focus on broadening participation across Europe, and understanding best-practice worldwide. This session will be an opportunity to reflect on the results of the first phase of the ARIADNE project, to provide context with contributions from local, regional, national, or project-based infrastructures to discuss ongoing challenges, accomplishments, and wishes for the future. It will introduce the next phase of ARIADNE, and create a forum for ongoing discussion of the role, and direction of development of archaeological infrastructures in coming years.

Session 23

Taking your GIS onto the field. “How”-s and “Why”-s of future survey

Nazarij Buławka, Stefano Campana, Julia Chyla

Have you ever wondered if it is possible to create field documentation using only your mobile phone? Can you imagine that you have just one tool to measure coordinates, take photos, create 3D models, plan your drone path and fill in the artefact database? Well, it seems that we are on the edge of a technological revolution: in the next few years, we are going to face a breakthrough in the GNSS technologies.

In April 2018, India successfully launched its eighth satellite (IRNSS-1I), Galileo should have reached its full capability soon. The first GPS 3 satellite will be sent to the orbit. This next generation satellite is thought to introduce a fourth GPS signal (L1C). As David A. Turner – Deputy Director Office of OES/SAT – has pointed out, one of the key topics discussed in the modernization of GPS is to “encourage compatibility and interoperability among global and regional systems”. There is already a response to this in the smartphone industry as well: The BCM4775X is stated to be the first GNSS chip designed for smartphones to provide dual L1 and L5 frequency. Moreover, Android 7 OS has been equipped with tools to measure the carrier phase, which is a major ingredient in differential GPS. This capability is not available in every type of smartphone yet, but it is possible that future non-professional hardware could have better performance in GNSS.

We are facing changes in the professional hardware as well, as the current operating system used for most PDAs is being withdrawn from the market and replaced by others. GPS signals are going to change from codeless into a modernized civil-coded transmission, which is not going to be usable by all equipment currently used by archaeologists. A new era of modernized GNSS is approaching. We can face it when it is there in the 2020s or we can start preparing for it now. This is the question behind this session in which we will discuss both technical and methodological problems of field surveys which exists today and might occur tomorrow.

This session will consist of short (10-15 minute) case-study papers (10-15 minutes) and a longer, final discussion, in which we would like presenters to address the issue from their research point of view. The main goal of the session is to engage in a broad discussion on this topic involving international experts with the aim of establishing standards and guidelines that may serve as “good practice” for Mobile GIS usage in archaeology. By “good practice” we aim to discuss topics such as:

- Why is Mobile GIS necessary for archaeology?
- What can be studied via Mobile GIS and how?
- What types of efficient workflows exist for data collection of sites and other landscape elements?
- How best to use mobile GIS on different geographic scales of details: Intra-site and off-site?
- What can archaeologists expect from Mobile GIS’ cooperation with other tools, such as geodetic equipment, drones, and sensors?

- What is the ground truth of the collected data (precision, accuracy, and quality of crowdsourcing) and what is needed for the collection of archaeological datasets?
- Security of the archaeological data while using Mobile GIS applications (data loss and theft; access to data by the public; sharing of data);
- The problem of crowd data collection: how to check the quality of the collected data?

After discussing these questions through case studies and arguments we have to answer one last question: What is impeding the use of mobile GIS within archaeological community?

Session 24

New methods for stratigraphic modeling

Vasiliki Andreaki, Juan A. Barceló

Various ways have been developed through years showing the necessity to represent visually archaeological stratigraphic sequences. Starting from the classical two-dimensional Harris diagrams to modern three dimensional reconstructions based on photogrammetry and microtopographic data, computers are now the fundamental to process the huge quantity of field data necessary to understand time at the archaeological excavation.

This session has been created to integrate the most recent advances in using computer modelling for data acquisition, processing and presentation of stratigraphic units and sequences. We would like to invite papers presenting different ways to create analytic models of stratigraphic sequences, including:

- data capture and photogrammetry in the field,
- database recording of depositional events,
- extended Harris matrix methods,
- 4D Wheeler diagrams in geoarchaeology
- microtopographic modelling and surface interpolation,
- solid modeling of archaeological excavation
- geomorphology and advanced methods for structural geology
- models of “living floors”,
- Directed Acyclic Graphs (DAG) and Bayesian Networks,
- Allen’s Algebra and equivalent ontologies for temporal representation,
- Virtual reality systems, teleimmersive systems and cyberarchaeology.
- Ubiquitous computing and portable devices in the field

Especially important is the integration of relative chronology (stratigraphic ordering) and radiometric dates, as modern methods of bayesian chronology ask for stratigraphic data to define boundary events.

We think that stratigraphic modeling, in all its possible incarnations is a domain that needs a new theoretical background to allow the development of new techniques and technologies for understanding the formation processes of archaeological sites.

Session 25 “Real-time” archaeological data. Hyperreality, temporality and materiality of digital archaeological objects

Monika Stobiecka

From data-gathering, through computing and rendering, to simulations, the notion of “real-time” is widely present in digital and cyber archaeology. A term that originated in computer applications has analytical potential for digital archaeological theory.

“Real-time” simulations problematize the questions of reality, hyperreality, representation, subjectivism and objectivism. When digital archaeological objects are being rendered in real-time, they encourage us to investigate the actual character and status of obtained data. What does it mean for an artifact or an archaeological site to be recorded in the real-time? What is the relation between the referent and the referred in this case? How can we examine a disturbing rupture between real-in-reality and real-in-hyperreality?

“Real-time” inspires us to rethink the problem of time, temporalities, and events. Real-time objects, treated as events, have multiple temporalities. While using real-time, we are registering “events”. What is an “archaeological event” in this context? What kind of temporalities does it refer to? What is the relation between temporality and materiality of archaeological objects and sites? Assuming that archaeologists are working on vibrant matter (Bennett 2010) and/or performative materialities, we can investigate the relation between real-time technologies and materiality. Is real-time truly a form of registering unstable reality, or rather a form of capturing a temporal moment in time?

Another aspect of “real-time” has to do with objects themselves. Adopting Yuk Hui’s (2016) identification of digital objects as composed of data and metadata subjects matter of philosophy, we may pose specific questions in relation to archaeological digital artifacts and sites. We may reflect on their ontological status and consider bridging the gap between two apparently distant phenomena – digital turn and ontological turn.

Treating discussions about “real-time” as an interesting platform, I invite proposals that deal with the theoretical, methodological and practice based problems of reality and hyperreality, time and temporality, matter and materiality, epistemology and ontology of digital archaeological objects.

Session 26

Archaeological network research: formal network representation of archaeological theories

Paula Gheorghide, Tom Brughmans

In this session we aim to discuss and encourage the explicit representation of archaeological theories as network data, and the explicit theoretical motivation of network science method selection.

Formal network science methods are increasingly commonly applied in archaeological research to study diverse aspects of past human behaviour. The vast majority of these applications concern the use of exploratory network analysis techniques to study the structure of a network representation of an archaeological dataset, which often leads to a better insight into the structure of the dataset, help identify issues or missing data, and highlight interesting or surprising data patterning.

Less common is the explicitly formulated theoretical motivation of exploratory network analysis tool selection. What tools are appropriate representations of my theorized assumptions? What tools violate my theoretical framework? Equally uncommon is the formal representation of archaeological theories (rather than archaeological data) as network data. What network data pattern do I expect to see as the outcome of a theorized process? What does a theorized past relational phenomenon look like in network terms?

Taking explicitly formulated theories rather than datasets as the starting point of archaeological network research is useful for a number of reasons. It forces the researcher to specify the theory that will enable its formal representation, and possibly improve or modify it through this process. It allows for understanding the behaviour and data predictions of a theory: in exploring the structure of the theorized relationships, the implications for processes taking place on theorized networks, and the evolution of theorized network structure. It facilitates the selection of appropriate network analytical tools that best express the theory or that are appropriate in light of the assumptions inherent in the theory. Finally, it allows for comparisons of data patterns simulated as the outcome of a theorized network process with archaeological observations, to evaluate the plausibility of the theory.

This session welcomes presentations on the following topics:

- archaeological network research: applications, methods or theories;
- network representation of archaeological theories;
- testing archaeological theories with network science;
- using network configurations, motifs and graphlets for representing theories;
- exponential random graph modelling;
- agent-based network modelling;
- spatial network modelling.

Session 27

Chasing heritage thieves: digital methods and approaches to contrasting trafficking and looting of cultural property*Riccardo Giovanelli, Arianna Traviglia*

Looting and trafficking of cultural heritage, especially archaeological, is now a global scale phenomenon, the origins of which are rooted in history. Since the '70s, despite the 1970 UNESCO convention, plundering and illicit trade of cultural property has become an increasing trend with major consequences to internal security, economies and even loss of cultural identity, which exists without distinction at all latitudes, in the most advanced economies of the planet as well as in less wealthy countries. More recently, the phenomenon has been further exacerbated by conflict and turmoil in areas where political stability is compromised. Studies draw a firm connection between increased looting with the political destabilisation of the states.

The last decades have also witnessed several initiatives, promoted by a diverse set of actors engaged in the protection of endangered cultural heritage and halting illicit trade, that rely increasingly on technological and digital advances to combat such illegal activities. This session aims to take stock of ongoing initiatives and bring together emerging digital practices aimed at understanding the complexity of the phenomena of pillage and illicit trade in archaeological objects and evaluate them. We invite participants to discuss approaches and methods that are being adopted (or proposed) to foster remediation and resolution. This includes (but it is not limited to) established practices such as the use of remote sensing to detect looting activities, the role of network analysis to model illicit antiquities trade, the establishment of (local or global) databases of lootable or looted items, together with less explored (but highly promising) methods such as quantitative analysis, predictive modelling, data mining (especially on the dark web where looted properties are often traded), statistical analysis, deep learning, block chain technologies, and even apps and social media.

Session 28

Computational classification in archaeology

Oliver Nakoinz, Martin Hinz

To make inferences on archaeological material that goes beyond the individual object we always have to decide what is similar or equal and what is not. This reasoning is at the heart of the archaeological method since its beginning and describes what we understand as meaningful categories such as a type and what we try to achieve with a typology. We group and label objects on the basis of more or, in most cases, less defined criteria. Predominantly this is still done in an “impressionistic” or “intuitive” manner since more “objective” and “standardised” methods, combined with automated recording of the artefacts, have not found a wide reception within archaeology. The reason for this might be that most approaches are considered to be complicated, general or reductionistic.

According to the growing interest in pattern recognition, machine learning, and data mining, classification plays again a significant role in quantitative archaeology. This development could be seen in the classification session at the CAA2018. Now, we focus on two specific aspects of computational classification:

1. Automatic processing of considerable amounts of data. The production of local, regional and supra-regional data sets during the last decades left us with a big amount of data to analyse. Computational classification is an important approach for forwarding the acquired information into the process of archaeological reasoning. The given data, research questions, and theories in different case studies require specific classification methods which will be discussed in this session. Pattern recognition, machine learning and data mining approaches used on large data sets, heterogeneous data or used for supra-regional analysis are topics of this focus.
2. Method validation and reproducibility. Currently, there is not only a huge amount of data but there are also many classification algorithms and approaches available. This requires a much deeper understanding of the theoretical and methodological basics. In this session we will try connecting theory and method, evaluate different methods and estimate range, limitations and methodological constraints of different approaches. Furthermore, we hope to discuss standards of method description and reproducibility. We invite papers on new developments and methodological issues in computational classification.

The aim of the session is to provide a better understanding of classification methods and algorithms and of validation techniques since sound methodological knowledge is required to choose the right approaches among many competing approaches. In particular, a tight connection between method and theory which is essential for a valid interpretation of the results has to be based on this kind of knowledge rather than on methodological fashions.

Session 29

Our little minions, part 2: small tools with major impact*Ronald Visser, Florian Thiery, Moritz Mennenga*

In our daily work, small self-made scripts, home-grown small applications and little devices significantly help us to get work done. These little helpers often reduce our workload or optimize our workflows, although they are not often presented to the outside world. Instead, we generally focus on presenting the results of our research and silently use our small tools during our research. This session will focus on these small helpers (“little minions”) and we invite researchers to share their tools so that the scientific community may benefit and – perhaps – create spontaneously special interest groups. This session aims at short presentations – “minion talks” (max. 10 minutes including discussion) – of small software or hardware solutions, not only focusing on field work/excavation technology, associated evaluation or methodical approaches in data driven archaeology. Each “minion talk” should explain the innovative character and mode of operation of the digital tool. The only restriction is, that the software, code or building instructions are open and freely available (e.g. GitHub). Proprietary products cannot be presented (but tools designed for them). We invite “minion talks” that present small tools or hardware inventions related but not limited to the following subjects:

- data processing;
- measuring;
- digital documentation;
- GIS-Plugins;
- hands-on digital inventions (for excavations);
- Linked (Open) Data tools;
- ... etc.

We invite speakers to submit an abstract. But after last years spontaneous success of “Stand-up-Science”, there will also be an opportunity to spontaneously participate and demonstrate what you have on your stick or laptop. If you want to participate without an abstract in the spontaneous section of the session, please send an email to us (even shortly before the conference). This is however not obligatory.

Please come and spontaneously introduce your little minion!

Session 30

Palaeo-GIS: Scales, Sites, and Surroundings

Patrick Cuthbertson, Felix Henselowsky, Peny Tsakanikou, Emma Slayton

By focusing on the themes of Scales, Sites, and Surroundings, this session aims to address some of the challenging aspects that make Palaeolithic applications of GIS unique.

The spatio-temporal scale is a key part of what makes Palaeolithic GIS unique in the ways it impacts on our analyses and interpretations. How the issue of scale relates to the record itself, and what concepts already exist in Palaeolithic archaeology to cope with them, is still an open question. It should be asked what concepts and approaches exist in other disciplines that could be utilised within Palaeolithic GIS, especially in relation to the possible methods for reconstructing palaeoenvironments, inferring mobility patterns, and incorporating other forms of spatial data in the study of Palaeolithic behaviour.

Palaeolithic applications of GIS tend either to be very practical and fieldwork focused, or desk-based analyses focused primarily on site location versus environmental variables. How this dichotomy influences practice and outcomes in Palaeolithic GIS is also an open question. For instance, how do preliminary desk-based GIS analyses inform and affect the planning and execution of Palaeolithic fieldwork? Does the manner in which GIS are used in Palaeolithic research change our understanding of landscapes during fieldwork? How does the use of GIS affect the process and outcomes of interpretation in Palaeolithic contexts?

Furthermore, are these effects generally positive, such as enabling researchers to identify new kinds of sites and make better use of surface assemblages? And what might be the negatives, such as an over-reliance on environmental variables, or predicting only certain kinds of sites similar to those that have previously been identified and studied?

This session will aim to examine the challenges of Palaeolithic GIS, focusing on:

- the effects of the spatio-temporal scale, and the concepts currently in use to cope with them;
- GIS use in Palaeolithic fieldwork, especially on the effect this has on the discipline and on interpretation;
- the effects of GIS use of Palaeolithic contexts;
- the nature and availability of data sources, especially in palaeoenvironmental reconstruction;
- the current state and future prospects for interdisciplinary integration of Palaeolithic GIS with allied disciplines.

We encourage authors to submit papers presenting specific examples and case studies, as well as new developments in methodological GIS-approaches applied to Palaeolithic contexts.

Session 31

In pursuit of social space. Detecting activity areas in Palaeolithic contexts

*Gwénaëlle Moreau, Vincenzo Spagnolo, Noguera N. Morera,
Andrzej Wiśniewski, Irene Ortiz Nieto-Márquez*

The label “Palaeolithic site” encompasses a wide range of settlement organizational patterns, which are related to the mobility and economic strategies adopted by hunter-gatherer groups. The evidence of space management by hunter-gatherers constitutes a precious tool for the reconstruction of Palaeolithic settlement dynamics.

Usually, the only structuration elements of space that we can still see are zones with gradient densities of lithics and faunal remains. The introduction of GIS in Archaeology significantly increased our ability of detecting the structured components of space, reducing the subjectivity of the visual approaches, thanks to the parameterizing of data and application of the geostatistical methods.

In the intra-site scale of Palaeolithic sites, the Minimum Spatial Units represent the Activity Areas and their relations with possible features and structures in the site (both evident and latent). Detecting these Spatial Units requires a complex analytical protocol, including a taphonomic premise, as well as the palimpsest dissection (aimed to achieve a high-temporal-resolution) and the elimination of background noise (aimed to obtain a more refined reading of the evidence). In this regard, GIS is confirmed as the best analytical tool, due to its integrated structure and its scientific background in the field of spatial studies. Despite a wide variety of choices, in terms of analytical methods (e.g. KDE, Spatial autocorrelation, K-means, ...), we are still far from a common study protocol which can produce effectively comparable results from different sites. However, our analytical methods must be flexible and context-specific, and adapt to differences in preservation, variability and temporal meaning of Palaeolithic sites (e.g. palimpsest-effect, functionalities of sites, ...).

In this session, we would like to discuss activity area identification and interpretation processes. Our goal is to set up the basis required for the development of a common model of spatial-functional analysis within Palaeolithic contexts. We warmly invite papers in which integrated and multidisciplinary approaches are applied to gaining new meaningful data on Palaeolithic behaviour. Applications in different contexts, such as open-air, rock-shelter and cave sites, living floors, short-term or long-term palimpsests, will be welcome. The results must encourage a better integration and comparability of spatial studies in Palaeolithic research.

Session 32

Multiscalar and Multivariate Approaches to Digital Documentation of Archaeological Sites

Alfonso Ippolito, Dominique Rissolo

Specific research objectives or priorities as well as unanticipated opportunities and challenges in the field often dictate that each portion of an archaeological site might not be documented at the same level of detail or via the same documentation modality. Either by design or by circumstance, data can vary greatly in terms of scale and, consequently, density or resolution. With the widespread adoption of photogrammetric techniques, new issues of data quantity and quality have come to the fore.

This session explores topics related to massive data acquisition, scalar diversity, and creation of heterogeneous models. Digital images or image-derived data are commonly integrated into (and/or compared with) data acquired from laser scanning for the purpose of validation or texturing. However, imaging modalities need not be deployed in tandem to be considered complementary – as different objects, deposits, features, or structures (or components thereof) may call for the use of one technique versus another based on documentation objectives or situational realities. This session hopes to stimulate discussion on the potential benefits and limitations of integrative multiscalar approaches while evaluating the effectiveness and efficiency of practices currently in use.

Session 33

Digital Landscapes in Archaeology: From field recording to the reconstruction of human use of space

Eduardo Herrera Malatesta, Israel Hinojosa-Baliño, Moises Hernandez-Cordero

Since the early processualist approaches to the post-processual trend and the contemporary integration of disciplines, the study of landscapes in archaeology has been a long and fruitful sub-discipline. Within this development, the impact that Geographical Information Systems and spatial statistics have had on the contemporary advance of landscape research is undeniable. In particular, we have seen the creation of bridges between a wide range of disciplines such as cartography, environmental sciences, history, archaeology, geology, anthropology, computers sciences, among others. Computational methods have brought new avenues for research to the reconstructions of past landscapes, not only for the reconstructions of the ancient past but from contemporary landscapes and their (re)presentations in the context of community archaeology and heritage studies.

With this session, we aim to bring together researchers interested in reflecting on and debating the role of GIS-led research for the future of landscape archaeology, using cutting-edge methods for analysis of distributional patterns, understanding movement, digital reconstructions, etc. Contributions may deal with many aspects of this productive relationship, ranging from the collection of data in the field (small finds and landscape survey) and editing, processing, storing, sharing or visualizing it; to theoretically reflect the possibilities and scope for landscape reconstruction or analysis within GIS-led research.

We have no restrictions on the temporal or spatial contexts of case studies. However, we strongly encourage authors to reflect upon the session's issues using concrete case studies.

Session 34

Archaeological Data for Modern Problems. Modern Methods for Archaeological Questions

Stefani Crabtree, Iza Romanowska

Challenges faced by modern societies like climate change, epidemics, mass migration, or uneven wealth distribution may seem insurmountable, but they have their analogues in the past. The scale of the challenges may be different, yet the scope of the problems remains the same. Past peoples dealt with anthropogenic change, population shifts, disease, and famine, and the myriad other issues similar to the ones we face today. Some of them were successful in combating these challenges, some of them less so. With the onset of big data, robust computational analysis, scientific approaches to data collection, sampling and modelling, the notion that archaeology is a modern scientific discipline that can contribute useful insights to today's problems has gained momentum. With the technological shift it is no longer regarded as naive to suggest using archaeological and historical data to extend and calibrate our understanding of the present and to try to provide more informed predictions for the future. The question, though, is how do we do that?

In this session we welcome papers from archaeologists whose computational analyses have implications for understanding one of the following broad topics:

- climate change and resilience;
- migration;
- health science;
- wealth distribution;
- cultural identity.

The goal of this session is to encourage researchers to actively use their case studies to approach modern challenges and/or to use their data to bear on influencing public policy. Thus, each of the segments of the session will be followed by an invited discussant – a researcher outside the domain of archaeology who will comment on how data and models from past systems could help with modern challenges.

This session will be punctuated with several breaks for discussion, and the organizers will work as facilitators to bridge questions between practicing archaeologists and economists, climate scientists, public health experts, urban planners, and other scientists whose work could benefit from dialogue with archaeologists. It is the ultimate goal that this session will lead to constructive collaborations between archaeologists and scientists from other disciplines to solve the largest of today's problems.

Session 35

Extreme Data Processing in Archaeology

Sebastian Cuy, Benjamin Ducke, Reinhard Förtsch, Marco Block-Berlitz

Computational tractability (in practical terms: the question of whether it is possible to compute useful results within an acceptable time frame) is a decisive factor in many areas of archaeological data processing. Examples for this include high-resolution geophysical surveying, remote sensing, terrestrial and aerial laser scanning, image processing and image-based 3D reconstruction, high-detail simulation models and cost-distance based GIS analyses.

Obtaining the best possible results from the processing of extremely large volumes of data requires engineering skills, creativity and sound knowledge of optimization techniques: The limits of available resources define the possibilities of data analysis and scientific inquiry more often than would be desirable. Knowing how to push these limits becomes a hallmark of cutting edge research.

The predominant constraints of “practical computability” tend to fall into a relatively small but persistent number of categories:

1. The available resources are insufficient for the tasks at hand.
2. Automated solutions are not available for the entire processing chain.
3. Sensor speeds and resolutions advance faster than (affordable) processing and storage technologies.
4. Some processing tasks are of (presumably) intractable mathematical nature (“NP-hard” problems).

Frequently enough, such issues occur in concert and interact with each other to create technically challenging scenarios. The great efforts that the archaeological community invests into addressing and overcoming these challenges are often underrepresented (if not to say absent) from the forefront of academic discourse and publications. This session aims to make a contribution towards creating stronger awareness of the immense technical skill sets at work behind the scenes of many archaeological research projects and exposing their vital contributions to modern research.

We invite speakers willing to showcase working solutions to the challenges of extreme data processing in archaeology, including “brute force approaches” to hardware and software engineering (such as concurrent/parallel processing pipelines and GPU-based processing), “soft approaches” (employing smart heuristics, sampling strategies and divide-and-conquer approaches), but also creative and efficient solutions for automating time-consuming manual tasks.

Important notes on session format: This session is meant as an open forum for the immediate benefit of all participants. Contributors should be prepared to give full technical details and insight into their approaches and technical solutions. This includes (where applicable) granting looks into program and/or scripting code, as and if requested by the participants. Contributors are asked to reserve at least one

half of their time slot for impromptu technical discussion (with the participation of the audience), detailed showcasing and live demonstration. All accepted contributors are strongly encouraged to contact the session organizers well in advance to discuss the technical and procedural requirements of their contribution.

Session 36

User Experience Design in Archaeology and Cultural Heritage*Francesca Dolcetti, Sara Perry, Rachel Opitz*

Despite the widespread dissemination of digital tools and applications in both archaeology and heritage, relatively little is known about their real effectiveness and impact on diverse audiences (specialists and lay publics alike). A new iterative design workflow, involving end users and stakeholders from the outset, as well as an accompanying design evaluation methodology, may open new avenues for engagement while, at once, constructively influencing our research objectives and epistemologies.

In this Roundtable session, we seek to bring together a multidisciplinary group looking at different aspects of archaeological knowledge production to discuss theoretical and methodological issues in the field of participatory design and user experience, fostering a critical understanding of how this knowledge is used and its social impact. The aim is to convene researchers and practitioners in a dialogue that is focused on examples of interdisciplinary co-creation and user testing of Augmented, Virtual and Mixed Reality (AR, VR, and MR) and related digitally-mediated experiences for museums, archaeological and cultural heritage sites, and varied teaching and research contexts. We are particularly interested in practical experiences around how to integrate archaeological data, storytelling and digital platforms to create experiences truly tailored to the needs and expectations of users.

The format of this Roundtable is a series of flash position papers (10 minutes maximum) followed by periods of moderated discussion. The session concludes with an open floor discussion and a wrap-up report summarising the discussion and suggesting follow-up activities. Position papers will be submitted in advance to the session chairs and shared with all panelists. The session welcomes participants from different sectors including but not limited to digital humanities, archaeology, museology, design research and Human-Computer Interaction (HCI).

Session 37

3D Publishing and Sustainability: Taking Steps Forward

Elaine Sullivan, Heather Richards-Rissetto

3D technological innovations are being used successfully at varying scales of analysis in archaeology, cross-cutting regions, time periods, and theoretical frameworks. Historic reconstruction modeling, photogrammetry, LiDAR, procedural modeling virtual environments, and serious gaming are all now part of the archaeologist's toolkit. For example, museums are harnessing 3D data capture to record objects in their collections for public engagement and conservation analysis. Archaeological field work is transforming, with fully digital and 3D recording of excavation units as part of the daily workflow on sites all over the globe. Scholars are testing out theories relating to historic architecture, ancient landscapes, visibility, movement, and lighting in virtually (re)constructed "worlds."

While exciting, the adoption of 3D technologies for visualization, documentation, interpretation and analysis of material culture in Archaeology creates many new questions about the dissemination and curation of scholarly products. Can 3D scholarship be published and sustained in a robust and accessible way for the future? How can new platforms and technologies allow for more comprehensive forms of interactive publishing, allowing readers to query and critique the 3D content? What new formats could allow readers access to the decision-making processes of the author, so their interpretations can be peer reviewed? Can we push forward academic journal and monograph publishing to include 3D scholarly content in ways that bring it to the fore, not use it as fancy illustrations to a traditional textual argument? How can archaeologists promote the development of open-source platforms for sharing 3D content and contribute to its future preservation and sustainability? As web-browsers, software and hardware rapidly change, how will 3D information be archived into new formats for future access?

This session will ask archaeologists already working intensely with 3D content to reflect on the future of 3D publishing. Participants will make 10-minute presentations on their own work, showing how they have grappled with the question of disseminating archaeological 3D content in ways that allow for robust interaction by readers, promoting understanding through the integration of 3D with text, audio, imagery, etc. We encourage speakers to define 2-3 current challenges to 3D publication and dissemination of knowledge, and to offer suggestions to facing these challenges collectively as a field. After each group of speakers (3-5), we will break for group discussion and define clear "pain points" for the community. The last part of the session (45-60 min) will be directed to collectively define some next steps forward to concretely address how to improve 3D publishing and sustainability in order that the exciting content produced by archaeologists today is accessible to current and future generations

in meaningful ways. We ask speakers to particularly focus on issues of sustainability related to open-source vs. proprietary software, a major issue as the 3D industry is currently dominated by private sector corporations. We imagine the results from our group effort as taking the form of collaborative grant applications, coordinating professional groups across the traditional subject divides, and the sharing of resources and knowledge in this quickly shifting field.

Session 38

Artificial Intelligence in Archaeology and Cultural Heritage

George Pavlidis, Dimitris Kalles, Athos Agapiou, Chairi Kiourt

The advent of the deep learning era brings about an increasing interest for artificial intelligence applications in diverse domains. Artificial Intelligence (AI) and archaeology, or Cultural Heritage (CH) in general, have already crossed paths in a number of occasions. From scientific visualization and data representation, to knowledge management, empowerment of research, digital applications for museums, sites and tourism, AI is expected to be ubiquitous and game-changing in the following decades. AI has already successfully appeared in a diverse set of CH applications, including element/mineral identification, virtual museums, historical document analysis, natural language processing, semantics and knowledge extraction, automated processes in digitization, recommenders, storytelling and personalization. This session aims to attract researchers in this strongly cross-disciplinary domain and give floor to the dialogue between AI and CH, towards the digital heritage of the future.

Topics of interest in this session include, but are not limited to:

- AI in digital archaeology, digitization and on-site documentation;
- AI in digital cultural content/object analysis;
- AI in content-based classification and retrieval;
- AI in archaeometry and data analysis;
- AI in natural language processing and CH applications;
- AI in semantics and knowledge representation;
- AI in museums and cultural tourism;
- AI in virtual systems for education and tourism;
- computational archaeology;
- intelligent methods in spatial and temporal analysis;
- AI and simulations in archaeology and CH;
- intelligent crowdsourcing approaches.

Session 39

**The European Research Council (ERC): funding excellent
research in the field of Archaeological Science**

Efthymia Priki

Established in 2007, the European Research Council's mission is to encourage the highest quality research in Europe through competitive funding and to support investigator-driven frontier research across all scientific domains, on the basis of scientific excellence. For more than 10 years now, the ERC has been funding promising and/or top-notch researchers in all fields of science, including archaeology, becoming one of the most prominent funding bodies of frontier research worldwide.

The field of Archaeological Science, in particular, is represented in the ERC panel SH6 – “The Human Past: Archaeology and History”, and several ERC-funded archaeological projects have been incorporating computational and quantitative methods to the analysis of archaeological materials.

The aim of this session is to provide information to conference participants about research funded by the European Research Council in the field of Archaeological Science, as well as to bring together in dialogue ERC grantees with conference participants, which potentially will include prospective applicants.

The proposed session will feature a short presentation about the ERC, its funding schemes, and success stories of ERC-funded projects in the field of Archaeological Science, as well as presentations by ERC grantees about their ERC-funded research projects and their experience with the ERC both during the evaluation process and during the implementation phase of their project. The presentations will be followed by an open discussion.

Session-format: Short presentations – 10-15 min. – followed by open discussion.

Session 40

Argumentation and the Archaeological Record

Cesar Gonzalez-Perez, Patricia Martín-Rodilla, Martín Pereira-Fariña

Archaeological knowledge is constructed by making arguments based on material evidence. Interpretation, therefore, plays a central role in archaeological practice, and understanding how it works will help us improve our capacity to value other people's conclusions, revise our own, and overall produce better results. For this to happen, two aspects must be developed in conjunction. On the one hand, we need robust models of the archaeological record, which allow us to reason about the corresponding physical artefacts. On the other hand, we need to understand how argumentation takes place, and how new knowledge is constructed from smaller pieces. Thus, ontology and discourse must be treated in relation to one another; if we treat ontological issues without argumentation, we obtain only a static and fossilized view of the world; if we study argumentation without ontology, we obtain only propositions about unknown entities.

Furthermore, a wide array of computational techniques has been used to model, store and process both ontologies and argumentation as separate artefacts, but none exists that can tackle both aspects at the same time.

This session aims to address the joint modelling of the archaeological record and the argumentations applied to it, and the joint processing of the ensuing data.

Major research areas that are welcome in the session include the following:

- What conceptual models or ontologies of the archaeological record exist, and how useful and robust are they?
- What computational conceptual models of the archaeological argumentation processes exist, and how useful and robust are they?
- How can we successfully trace interpretative conclusions to the original evidence, and how can this be supported by computational approaches?
- How can archaeological conceptual models help us to understand and check the integrity of the associated discourse, and vice versa?
- How can archaeological interpretations and argumentations be formally and computationally analysed for a better understanding?
- How do archaeological models or ontologies evolve during multi-agent argumentation? How can this temporal dimension be captured in databases, corpora, or other computer tools?
- How can we build databases, ontologies, or corpora that support interpretative and argumentative processes about the archaeological record?
- What computing techniques, such as data-to-text, data mining or natural language processing, should we use to support multivocal argumentation in archaeology?

Session 41

From Micro to Macro: computer-based approaches for the analysis of big data in the study of artefacts and societies

Marta Lorenzon, Agnieszka Kaliszewska

We see steady progress in computational modelling and its application to the detection of patterns in complex datasets. This approach finds application in archaeology, such as in modeling of the settlement patterns, and in the analysis of material culture (e.g. pottery typology). Nevertheless, these applications are still relatively new in the field of archaeology, although their potential to improve our analysis of past societies, in both micro and macro scale, is undeniable.

Archaeological research often deals with large amounts of data of different types. Such datasets are often too complex to be analysed in a traditional way. However, the application of formal computer-based modelling approaches can uncover underlying patterns in large and diverse datasets. These models allow us to combine a multitude of factors that impact the archaeological record (e.g. climate, topography and resources in the case of settlement location), or various characteristics of material culture objects (e.g. shape, material, colour).

Most methodologies, whether they are dealing with the micro or the macro scale, combine the use of model-based approaches with tools such as CAD (2D and 3D), GIS and/or Space Syntax, methods of image recognition, and clustering or classification. The application of such methodologies allows for new lines of investigation, testing of new theories, and the combination of data on multilayered registers passing from the micro (artefact) to the macro (society behaviour and spatial pattern of occupation) scale. Thus, the utility of formal-based computer-generated models becomes of paramount importance, providing a new venue for archaeologists to discuss hypotheses before empirical testing and the development such technologies may help to bridge different approaches and help establish the field of formal methods in archaeology.

In this session we invite contributions using a model-based approach to analyse the archaeological built environment and its material culture, creating a deeper and multilayered understanding of past societies. We also seek case studies showcasing innovative approaches to qualitative and quantitative computer modelling in archaeology, presenting new techniques and expanding the use of computer-based modeling, or providing new forms of investigation of material culture.

Session 42

New technologies in woodland archaeology: problems and limitations

Kamil Niedziółka, Paweł Konczewski, Michał Jakubczak

A vast part of Europe is covered with woods (esp. Central, Eastern and Northern Europe), however, research within woodlands has often been neglected by archaeologists, mainly due to limited accessibility to these areas and the difficult conditions encountered during field investigations. Nevertheless, many forested areas offer unique opportunities to explore well-preserved remains of earlier human activities, traces of which have not been erased or transformed by modern agriculture, industrialisation or urbanisation. For some chronological horizons, there are regions that preserve complete accumulations of deserted cultural landscapes (economic, domestic and funerary) despite the succession of forestation processes. Unfortunately, the presence of dense vegetation has until recently meant that the application of standard archaeological techniques in forested environments, such as surface surveys and excavations, was problematic. However, the development of new technologies can significantly support archaeological investigations in wooded landscapes (e.g. the introduction of ALS data, GPS tools, GIS software, modern geophysics, photogrammetry etc.).

Alas, these new approaches are not without their own problems. For example the frequent lack of GSM/GPS signal caused by the wood cover makes it difficult to properly locate and georeference surface surveys, excavations and other investigations. The woodlands also restrict the deployment of drones and the preparation of photogrammetric plans. Furthermore, the application of geophysics is much more difficult, both from the point of view of conducting field work and the subsequent interpretation of survey data. Of course, these are just a few examples of problems related to woodland archaeology, the full list is much longer.

In this session, we will address topics ranging from non-invasive remote sensing to more invasive ways of archaeological investigations, performed with the use of high-tech methods of documentation and geodetic measurements. We would like to focus especially on specific problems and limitations related to utilisation of concrete modern technologies in woodlands as well as possible solutions. Interdisciplinary approaches are also welcome.

Session 43

Remote sensing in archaeology of forested areas

Rafał Zapłata, Krzysztof Stereńczak, Michał Pisz

Forested areas provide a distinctive opportunity for recognising, researching and protecting cultural – including archaeological – heritage. Specific conditions characterising such areas necessitate the use of a different methodology and approach to cultural heritage. Forested areas require the implementation of a holistic approach, which takes into consideration not only the protection of heritage but also of the natural environment. Currently, we witness significant developments in technologies and remote sensing techniques. Therefore, it is timely to analyse these developments, especially non-invasive research methods, within the context of forested areas and in the fields of recognising, researching and protecting as well as promoting archaeological heritage.

The main aim of the session is to foster discussion around the implementation of interdisciplinary methods and tools for gathering and analysing data associated with heritage structures in this unique – forested – environment.

We encourage participation on the following topics:

- The use on non-invasive methods in researching cultural (archaeological) heritage in forested areas;
- Processing, visualising, archiving and providing access to databases that collect information about sites and monuments in forested areas;
- Analysis and interpretation of digital data gathered on forest land – problems, challenges and good practices;
- Digital data in the promotion and popularisation of cultural heritage on forested areas;
- Various fields of studies and common data sets – how to use, adjust and process various sets of data for the use in research and protection of archaeological heritage;
- Can “archaeological data” be used outside our field of study and if so, how?

We invite paper proposals which tackle the topic of creating and popularising good practice, present outcomes of research conducted in forested areas, or discuss the development of procedures and methodology of recognising, researching and protecting cultural heritage in forested areas.

Session 44

Analysing Shape in the Digital Age: Current Considerations in Archaeological Application of Geometric Morphometrics

Christian Hoggard, Sarah Stark, Georg Roth, Katrien Janin

Ordering and analysing objects according to their morphology has been at the heart of archaeology since its very construction as a discipline. And over the last thirty years a new methodology for the quantitative analysis of digitised shapes, Geometric Morphometrics (GMM), has become increasingly popular, leading to case studies around the world. GMM characterises and analyses morphological data directly, resulting in representations of shape (differences) as numeric variables open to combinations with other forms of data, including spatial or chronological frameworks. Additionally, powerful visualisations that partition shape differences into independent components (by PCA for example) allow for hitherto impossible separate interpretations of these differences. Yet curiously, despite positive feedback in its application, GMM still has not reached the attention in archaeology its potential achievements deserve.

This session illustrates the various aspects which GMM offers for the archaeological study of physical object forms, while aiming to highlight current issues in the field of archaeological shape analysis. It aims to provide a forum for debate on how archaeologists apply GMM technologies for research in the physical shape of objects, and how GMM can be further integrated into archaeological analyses.

We are particularly interested in presentations which discuss:

- The current state-of-knowledge of GMM in the discipline;
- Methodological developments (including software, frameworks and recording);
- The innovative application of GMM to object classes beyond lithic, osteological and zooarchaeological data;
- The consideration of GMM with alternative data types and frameworks (including Bayesian modelling);
- Theoretical considerations e.g. bridging the gap between statistical GMM and archaeological significance.

Note: in the interest of transparency, and in aiding discussion and learning, we encourage authors to distribute scripts used in their presentations prior and immediately following the session. Following the conference participants will be invited to collaborate on a review article on GMM for the CAA Journal.

Session 45

Virtual Reality and 3D modeling: Where are we now?

Mantha Zarmakoupi

Over the past 20 years virtual reality and 3D modeling technologies have expanded the range of research tools used in the study of the history of architecture. They have enabled researchers to explore multifaceted themes of design and restoration, as well as sensory experience of historic buildings and spaces in virtual space. The excess of 3D and virtual reality representations asks for methodological approaches that will further facilitate their instrumental integration in research. This session invites papers that tackle the use of 3D modeling representations and virtual reality simulations, especially in the fields of ancient Greek and Roman art and architecture, that attempt on the one hand to challenge their limitations and, on the other, to address the ways in which they can be used to develop research questions. Papers can address the challenges that virtual Reality and 3D modeling technologies pose for research today by focusing on specific case studies or addressing broader methodological questions.

Session 46

Spatial Analysis of 3D Archaeological Information: Method and Theory

Gary Nobles, Joerg Raether

Archaeologists and Heritage professionals continue to capture 3D data through photographic and optical methods. While the methods of data collection are well documented, the theoretical and practical aspects of using these relatively new datasets within archaeological practice are in the initial stages. Point cloud processing, web visualisation, spatial thinking, volumetric analysis are a few of the related themes to this broadening topic. This session aims to bring together researchers working with a variety of 3D spatial data. The key aim of this session is to move the discussion beyond purely data capture towards the analytical applications which have been, and continue to be, developed. Papers can take various forms: narratives considering the current and future archaeological requirements for 3D data; analytical applications applied to 3D data with archaeological contextualisation; theoretical conceptual papers which question how we understand the 3D spaces we record; technological developments and innovation applied to 3D archaeological data; or purely 3D spatial analytical applications. The session will conclude with a general discussion indicate the hurdles, technological or theoretical, which limit the use of these kinds of datasets.



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