

Sessions CAA Tübingen 2018

S1 Creative Disruption in Archaeological Theory and Practice	3
S2 Islamic History and Archaeology: Linking Data and Ontologies	3
S3 Digital Archaeology Scholars in a Changing World: Problems, Perspectives, and Challenges	4
S4 Close range 3D data acquisition, processing and querying in cultural heritage	4
S5 Exploring Digital Interpretation, Argumentation, Conflict	5
S6 Our little minions: small tools with major impact	6
S7 What is the Value of Digitally Mediated Archaeology?	6
S8 Untapping the potential of 3D Quantitative Analysis	7
S9 Show your code: task streamlining, reproducibility and replicability in archaeological computing..	7
S10 Expanding horizons: confronting issues of scale, resolution, and representation in the study of human expansions.....	8
S11 Untapping the value of old fieldwork records.....	9
S12 Making the most of film and video in archaeology	9
S13 Digital Documentation Archaeological Ships. What do we do and what do we need?	10
S14 Setting the automation agenda for Remote sensing: learning to see through a computer?	11
S15 Analysing Historical Transportation Systems from new applications and methodologies	12
S16 Play, Process, and Procedure: An Experiential Digital Archaeology.....	12
S17 Early human land use strategies during Middle and Late Pleistocene glacial and interglacial times in Europe	13
S18 Women in CAA: Continuing the Dialogue.....	13
S19 Agents, networks and models: formal approaches to systems, relationships and change in archaeology	14
S20 Palaeo-GIS.....	15
S21 Structural Analysis for Cultural Heritage: Tools and Methods for Assessing Heritage Monuments and Structures	15
S22 Social theory after the spatial turn.....	16
S23 New Directions in Archaeological Aerial and Satellite Remote Sensing.....	17
S24 Computational classification in archaeology	17
S25 Do we have a heading? Ah! A heading. Set sail in a... uh... for Mobile GIS direction!	18
S26 Sensory GIS: towards a deeper engagement?.....	18
S27 Map management and Webgis applications for archaeological data base solutions.....	19
S28 Cities of Data: computational and quantitative advances to urban research.....	19

S29 Digital Innovation & Experimentation in Archaeology & Cultural Heritage Collections	20
S30 Open Digital Infrastructures for Archaeology and Cultural Heritage	20
S31 The Third Dimension: Beyond Visualisation	21
S32 Automation, combination and calibration: consolidating the framework for archaeological geophysics	22
S33 Guaranteeing data quality in archaeological Linked Open Data	22
S34 R as an archaeological tool: current state and directions	23
S35 Ancient Near Eastern and Neighboring Regions: Enlarging Research Horizons through Digital and Computational Practices	24
S36 Advantages and Limitations of Spatial Applications in Archaeology.....	24
S37 Connectivity: linking and interpreting the archaeological record	25
S38 Applicability of Digital Archaeology Tools	25
S39 Heritage Beyond Boundaries: Developing Standards and Storefronts for Immersive Technologies in Archaeology.....	26
S40 Science and Technology (S&T) for Archaeology and Cultural Heritage in the Eastern Mediterranean	26
S41 Immersive Techniques in Archaeological Practice and Publication	27
S42 Archeology Heritage Information Modeling. Models construction for documentation and analysis	28

S1 Creative Disruption in Archaeological Theory and Practice

This paper session will explore the use of digital technologies as a means of “creative disruption”, in the construction of new meaning and archaeological knowledge. Archaeologists creatively engage in the archaeological record in their daily practice, but it is the “creative innovation”, that experiential, raw, impactful application of creative thought, tools and techniques, which empowers and enriches archaeological meaning-making, that needs further exploration. Transcending beyond the mere fetishization of digital applications to visualize archaeological data, the proximal goal is to explore and discuss the exemplary applications of creative innovation to disrupt and communicate new ways of archaeological knowledge translation and mobilization through the novel use of archaeological theory, method and practice by creative digital means. Whether it is the application of robotics and drones, the auralization of excavations, the virtual (re)imagination of known and unknown archaeological data or the statistical networking of digital data through closed and open digital networks, this session will aim to engage in near-term and future-proofing discussions to enable theoretical and methodological considerations alongside the practical in-field and post-excavation application of digital techniques through creative means.

William Michael Carter

S2 Islamic History and Archaeology: Linking Data and Ontologies

While Islamic Archaeology is intensively making use of computer applications and quantitative methods, especially with regard to spatial information, these so far play a much lesser role in the study of Islamic history, which is by and large based on texts and qualitative interrogation. Islamic History and Archaeology, however, have a huge potential to interact since their perfect chronological and geographical intersection outright calls for relating their diverse evidences to each other. This already happens on the level of individual projects, but still the Islamic Middle East could be much more fruitfully conceived as a common field of interdisciplinary study. As concerns computer applications in particular, not so many intersections have so far been tested, and even less are accessible to the research communities or visible to the public. Part of the issue is the dearth of open-access data platforms that are specific to, or appropriately include, the Islamic Middle East. Aiming at more collaboration and future visibility, this session wants to stimulate interdisciplinary exchange and the discussion of how data can be shared and bridging ontologies can be built. Some basic questions concern: – Methods and interdisciplinary relevance of current IT-based projects – Different evidences and potential ontological interfaces – Uses of mapping, gazetteers, and other databases for collaboration – Present and future platforms for shared and linked (open) data – Dynamic data publication formats and the issue of crediting – Digital Humanities, a common ground?

Kurt Franz, Mathias Piana

S3 Digital Archaeology Scholars in a Changing World: Problems, Perspectives, and Challenges

Advances in the use of digital and computational methods in archaeology have encouraged great hope among archaeological computing practitioners regarding the potential of digital archaeology to transform archaeology as a discipline. Such an optimism was apparent in the diverse response received at the “Challenging Digital Archaeology” sessions organised in CAA 2014 and CAA 2015 (Hugget 2015 <https://www.degruyter.com/view/j/opar.2014.1.issue-1/opar-2015-0003/opar-2015-0003.xml>). Nonetheless, positive views on the future of digital archaeology often come into contrast with the reality in academia for most archaeological computing practitioners, who sometimes face significant challenges in making their work accepted as genuine archaeological research and are often considered as “hybrid scholars”. Digital archaeology specialists often find themselves into an in-between space comprised of two or more disciplines, trying to create their own distinct identity, demonstrate their value, and get credit for their contributions to these fields. Academic hierarchies, conservatism, and established processes and practices are only a few of the challenges that hinder digital archaeologists from securing their status in academia. At the same time, digital and computational approaches to archaeology have created continuous needs for new modes of research, evaluation, collaboration, teaching, and publication that don’t always conform well with traditional academic practices. The focus of this session is on the role of digital archaeology scholars in a changing world with constant transformations in the academic ecosystem. Participants in the session are expected to contribute short papers of no more than 10 minutes. A ten-minute discussion will follow after each talk, while the session will conclude with a general discussion (30 minutes). Contributions that discuss philosophical and theoretical aspects of digital practice and scholarship are especially encouraged, as well as reflective works drawing from personal experience in distinct digital archaeology fields. Some relevant topics include but are not limited to: -What is the value or potential of digital archaeology research and how this is reflected in or contrasted with perceptions of digital scholarship in the wider discipline of archaeology? -To what extent are digital outputs and digital creations (e.g agent-based models, virtual worlds etc.) accepted as genuine archaeological research? -What is the contribution of digital archaeology to new forms of research (e.g. crowdsourcing) and teaching practices (e.g. MOOCs, SPOCs, serious games etc)? -In what ways trends in computational archaeology for open data and open software policies, as well as reproducible research, could transform archaeological scholarship and publication practices? -To what degree the role of Digital Archaeology practitioners ties in with the concepts of hybrid-scholars and alt-academics discussed in Digital Humanities?

Eleftheria Paliou, Jeremy Huggett, Konstantinos Papadopoulos

S4 Close range 3D data acquisition, processing and querying in cultural heritage

This session collects contributions concerned with 3D data in cultural heritage and how they are employed to tackle research questions or for proficient presentation to stakeholders. While much attention has been paid in recent years to evaluate different methodologies of data acquisition, compare algorithm for data processing or querying of 3D data, much less attention was given to

provide information on metric data quality required to solve specific questions like: What resolution is required or useful to display data in a 3D viewer? What precision is needed for comparative study of gypsum casts? What do we learn from comparative studies with regards to required data quality? This session particularly invites presenters working with 3D data that can provide feedback towards the process of acquisition to optimize data collection and to identify best data collection procedure for a given project. At the same time we welcome contributions that are predominantly application based or based on acquisition methodology. Close range 3D data includes mostly, but not exclusively triangulation based acquisition techniques, i.e. structured light scanning, close range photogrammetry, triangulation laser scanning. Works based on 3D data from CT-scan, digital microscopy, and the like, are also welcome.

Dirk Rieke-Zapp, Diego Jiménez-Badillo, Vero Moitinho de Almeida, Mona Hess

S5 Exploring Digital Interpretation, Argumentation, Conflict

Archaeological knowledge is usually constructed through interpretation from material evidence and today is increasingly mediated by computers and quantitative methods. Interpretation, therefore, plays a central role in digital archaeological practice, and understanding how it works and how it can be computationally assisted may help us improve our capacity to value other people's conclusions, revise our own, and produce better results overall. Also, archaeological interpretation usually occurs in scenarios where multiple agents have a voice, such as multiple researchers working on the same site, managers and professionals negotiating how to excavate and when, mediators working to reconcile the interests of local communities and government agencies, or professionals employing different computing approaches and techniques. In situations like these, argumentation is crucial to the generation of solid and reliable interpretations. Sometimes however when conflict arises, the clashing views of different agents must be reconciled. This session aims to address the interpretation, argumentation and conflict phenomena that occur within archaeological practice as mediated by computing approaches, analysing the cognitive, linguistic, philosophical and archaeological factors that may influence them. Papers that address combinations of theoretical and applied issues are welcome. Major research areas that are welcome in the session include (but are not limited to) the following: • What theories exist to explain digitally mediated interpretation, argumentation, and conflict? • What connections exist between discourse and their underlying ontologies? • How can interpretations and argumentations be computationally analysed to obtain a better understanding of them? • How can we build databases, ontologies or data repositories that support interpretative and argumentative processes? • What natural language processing techniques can be applied to the analysis of interpretation and argumentation, and what can they offer? • What computing techniques, such as data-to-text or data mining, can be used to support multivocal argumentation in archaeology? • What real-life scenarios exist where discrepancies and resolution have been exemplified with regard to digitalised archaeological knowledge and entities? • How can digital mediation techniques help in reconciling arguments from different agents regarding archaeological heritage?

Cesar Gonzalez-Perez, Patricia Martín-Rodilla, Ruth Varela

S6 Our little minions: small tools with major impact

In our daily work the scripts, small applications and little devices help us the most to get the work done. These little helpers often reduce our workload or optimize our workflows, although they are not often presented. Instead we generally focus on presenting the results of our research and happily use our small tools during our research under and above water. This session will focus on these small helpers and we invite researchers to share their tools so that we all may benefit. This session aims at short presentations (10 minutes) of small software or hardware solutions, focusing on field work / excavation technology and the associated evaluation. The fields of application are not further restricted. Each presentation should explain the innovative character and mode of operation of the digital tool. The only restriction is, that there are open source or open access tools or the building instructions are freely available. Proprietary products can not be presented. We invite papers that present small tools or hardware inventions with the focus on application before, during and after fieldwork, for example • data processing • measuring • digital documentation • GIS-Plugins • Hands-on digital inventions (for excavations) • ...

Moritz Mennenga, Ronald Visser

S7 What is the Value of Digitally Mediated Archaeology?

For more than six decades archaeologists have been exploring the power of computer-based methods and digital technologies to advance archaeological inquiry and practice. Successive cohorts of CAA members have been, quite rightly, anxious to articulate the relevance and impact of their work to archaeology in general. However, Costopoulos in 'Digital Archeology Is Here (and Has Been for a While)' *Frontiers in Digital Humanities* 3:4 (2016) <http://dx.doi.org/10.3389/fdigh.2016.00004> suggests that there has been too great a focus on debating digital approaches and tools as objects of study and argues that far more emphasis should be placed on articulating the practical benefits of deploying digital tools in archaeology. In this Round Table session we ask "what is the value of digitally mediated archaeological practice?" We will question whether digital archaeology is merely the latest ephemeral fashion - just another technological fetishism, a significant upgrade to traditional methods, or an important new paradigm for archaeological practice. This round table welcomes participants from all segments of archaeological practice including but not limited to university-, state-, museum-, commercial unit-, and public-archaeology. This format of this Round Table will be a series of pairs or triplets of presenters offering short points of view (c.15 minutes or less) followed by periods of moderated discussion, chaired in rotation by the organisers. We also welcome 'flash statements' (less than five minutes). The session will be concluded with an open dialogue based on the accumulated discussion and a wrap-up report by one of the organisers, summarising the discussion and suggesting follow-ups. Some potential discussion points: What benefits does digital archaeology offer? How do we evaluate it? How should we evaluate effectiveness and impact compared with traditional techniques? How might we best monitor and track progress? What new benefits could we propose to archaeology more generally? How does digital archaeology better connect us to other disciplines, the

heritage sector and the public? Please contact the organisers if you wish to offer a point of view or flash statement.

Daria Hookk, Paul Reilly, Jeremy Huggett, Irina Grevtsova, Sorin Hermon, Franco Niccolucci

S8 Untapping the potential of 3D Quantitative Analysis

The increasing availability of 3D datasets produced by photogrammetry, laser scanning, and procedural modelling in the last decade have offered new opportunities for the recording, documentation and visualisation of archaeological environments and artefacts in three dimensions. Although these developments have greatly enriched the archaeological record and have encouraged new types of public engagement with archaeological data, the potential of 3D datasets to be subjected to formal quantitative analyses aiming at better supporting archaeological interpretations still remains largely untapped. Works on three-dimensional computational simulations and analyses that explicitly aim to produce new research outputs remain few and far between, despite often producing promising results. This session would like to invite scholars with an interest in archaeology, architecture, material culture, cultural heritage and computer graphics to present works that demonstrate the potential of formal analyses of 3D datasets to contribute to advances and new directions in archaeological research. It welcomes presentations on quantitative analysis of SFM and scanned models of archaeological artefacts and spaces, formal visibility, acoustic and lighting analysis of archaeological environments, analyses of immersive VR experiences (e.g. via the use of eye tracking devices etc), 3D GIS analysis, volumetric, structural and statistical analysis of 3D data. Besides presenting their work on 3D quantitative analyses, participants are encouraged to critically evaluate any methodological and theoretical issues posed by these approaches.

Konstantinos Papadopoulos, Eleftheria Paliou

S9 Show your code: task streamlining, reproducibility and replicability in archaeological computing

Once a fringe component of archaeology, digital data and methods are rapidly becoming commonplace, changing how we learn about and discuss the past (Bevan 2015). This presents many technical challenges, but also an opportunity to reshape archaeological science by automating many of the most tedious tasks while encouraging reproducibility and replicability of computer applications. This session will be part seminar and part live-coding demonstration to which we invite anyone with a working piece of code that automates or streamlines any task that may be undertaken by an archaeological practitioner. We ask participants to show their code, explaining what the code does and how it works to make it easier for others to use it (Eglen et al. 2017). In doing so the session will showcase the principles and benefits of open science (sensu Nosek et al. 2015). We invite

demonstrations from all points in the production of knowledge, from building and using archaeological databases, to statistical analyses and modelling (simulation, GIS, etc), to dissemination and public engagement. We also welcome more traditional papers that can bear on the following issues: - Improving usability and discoverability of code; -Communicating coding results with non-experts; - Managing concerns regarding intellectual property and data ownership; -Maintaining code and data in the long term; -Using code examples for teaching archaeology. Whether you are producing grand-scale syntheses of big data or those bits of programming that make life just a little easier, we want to see your code! All programming languages welcome. References: Bevan, Andrew. 2015. "The Data Deluge." *Antiquity* 89 (348): 1473–84. doi:doi:10.15184/aqy.2015.102. Eglén, Stephen J., Ben Marwick, Yaroslav O. Halchenko, Michael Hanke, Shoaib Sufi, Padraig Gleeson, R. Angus Silver, et al. 2017. "Toward Standard Practices for Sharing Computer Code and Programs in Neuroscience." *Nature Neuroscience* 20 (6): 770–73. doi:10.1038/nn.4550. Nosek, B. A., G. Alter, G. C. Banks, D. Borsboom, S. D. Bowman, S. J. Breckler, S. Buck, et al. 2015. "Promoting an Open Research Culture." *Science* 348 (6242): 1422–25. doi:10.1126/science.aab2374.

Benjamin Davies, Iza Romanowska

S10 Expanding horizons: confronting issues of scale, resolution, and representation in the study of human expansions

Panelists of this roundtable session will discuss theoretical and methodological issues associated with the study of prehistoric human expansions and computational methods used to represent them. From the earliest hominin expansions in Africa and Eurasia, to the settlement of Australia and the New World, to explorations of the world's oceans: the historical record of humanity is structured by the movements of people over the earth. Human expansions have been facilitated by changing environmental conditions, technological innovations, and shifts in the social relationships between different human groups, all of which have consequences for patterning observed in the archaeological record. Many major human movements occurred at spatial and temporal scales that differ from that of both archaeological investigations and many conceptions of human culture, leaving room for a good deal of uncertainty and presenting challenges to the construction of prehistoric narratives. Computational modelling approaches like GIS, network analyses, and agent-based models, offer opportunities to place these narratives in a framework where different potential historical processes can be assessed and uncertainty can be quantified. How we represent our ideas about the past in computational form involves trade-offs between realism and generality, as well as negotiations between different areas of expertise. This roundtable will include panelists from a range of research specialisations in order to expose common issues in the field of modeling human expansions and generate ideas about how best to bring together these areas of expertise.

Benjamin Davies, Nicholas Conard

S11 Untapping the value of old fieldwork records

In recent years an increasing number of new discoveries have taken place due to the re-examination of previous archaeological finds and documentation. The purpose of this session is to examine how, with new technologies and methodologies, archival data (including photographs and drawings), artifacts and other materials from past excavations and fieldwork in general can be analysed in order to glean information that was either not recorded or was unavailable due to previous limitations in the technologies and knowledge of the time. Because some excavations and/or structures are either not available now (backfilled/collapsed etc.) or have degraded severely through time, the ability to examine them and their materials as they were when excavated can breath new life into old digs. Approaches such as photogrammetric 3D modelling of past excavation data, geophysical prospection, archaeometric analysis and crowd sourcing based solutions can serve to "virtually restore" the excavation, the monuments and the context of artifacts. Presenters are invited to reflect on the use of these technologies, what are their benefits and implications and whether they enhance the overall archaeological process with a more holistic record. The session will follow a standard format for the first half with papers being presented on. The second half of the session will involve four 15 minute flash discussions on ideas and approaches to prepared questions. Each discussion is open to audience input and finishes with a panel summary. Discussion One: What purposes can revisited materials be used for? This discussion will revolve around possible uses and benefits of new data produced from legacy data and materials. What is currently being done in the reexamination of materials as well as proposals of other possibilities for newer technologies or the repurposing of existing methods? How can their application benefit both archaeological research and its presentation and promotion to the public? Discussion Two: Crowdsourcing based solutions Unfortunately many archaeological sites have not been adequately documented either at the time of their excavation or prior to changes or even their destruction. While "Virtual restoration" can be augmented using internet sourced materials, crowd sourcing may yield a greater selection and quality of materials as in the example of the NewPalmyra project. The discussion will focus on what kind of results can be achieved through this method as well as ways to maximize public input. Discussion Three: Digital preservation and curation of legacy datasets Digital preservation and curation of legacy datasets in archaeological archives such as ADS are aimed at maintaining such datasets in a form amenable for further access, analysis and research. Discussion will include how to make such datasets (and artefact databases) amenable to information integration, i.e. to consolidate such data across different excavations and the possibilities of using NLP and semantic technologies. Discussion Four: Solutions in Using Archival data This discussion will focus on the problems involved using archival photos, plans and data and what solutions participants have succeeded with or suggest in order to achieve best results in "virtual reconstructions" of past excavations.

Dorina Moullou, Isto Huvila, Costis Dallas, Arianna Traviglia, Antonia Davidovic, Rimvydas Lauzikas, Henriette Roued-Cunliffe, Colin Wallace

S12 Making the most of film and video in archaeology

Despite the fact that archaeologists have experimented with various forms of filmmaking for a century we are still yet to develop a pragmatic approach to how best to integrate actuality film and video recording, editing, and archiving into our research project designs. As mediums merge and digital platforms multiply, as coders begin to replace film editors, as media technologies, standards, laws, and conventions shift – now is a timely moment to take stock and consider how we can make better use of actuality film and video in archaeological contexts. Key challenges include how to address the disconnected digital archives of historical archaeological film footage increasingly available online; how to better integrate drone, underwater, and site videography into archaeological research design and dissemination strategies; and how to better foster media literacy and skills among archaeologists tasked with researching, designing, recording, editing, managing, distributing, and digitally archiving film and video material. This session seeks to cross industry and disciplinary boundaries by inviting archaeological scholars and computing specialists to problematise and bring fresh perspectives to the above issues by suggesting future directions for how we can make the most of digital actuality film and video in archaeology. Suggested themes and topics include but are not restricted to: o Approaching film and video as archaeological data. o The challenges of digital archiving, database management, and accessibility for archaeological films and videos. o Working with video files – what archaeologists need to know. o Using film and video in academic publishing. o The pros and cons of vlogging, social media, and online video platforms for archaeology. o Merging the mediums: approaches to combining actuality footage with animation, VR, AR, and more. o Coding: the future of film editing? How can we futureproof digital archaeological storytelling? Please note: the term ‘actuality’ is borrowed from the documentary industry and used here to describe non-fiction films and videos of actual people, places, and events - as differentiated from animated or fiction films and videos.

Kathryn Rogers, James Miles

S13 Digital Documentation Archaeological Ships. What do we do and what do we need?

Ship Archaeology is by essence international and ships have always been the medium of goods and knowledge. Over the last 15 years, projects using different methods flourished all over the world to document and monitor digitally archaeological ships. The oversize of these kind of artefacts justifies the use of modern technologies for the documentation and long-term monitoring. In fact, digital methods enable on the one hand new assessments that are not possible with traditional methods, but also a higher precision (Jones; 2015). Several initiatives show the path using coordinate measurement machines (Jones; 2015) or Total Station Theodolite (van Dijk; 2016), and Laser Scanners (Tanner; 2012) but also Photogrammetry (Wiggenhagen; 2004). Nevertheless, these different initiatives were not looked at globally from a technical stand point. Our aim with this session is to get an overview from the current state of digital documentation and long-term monitoring of ships in Archaeology. We like to think that the data collected is usable in other context by other disciplines. However, given the variety of methodology applied as well as mind-sets, is this goal achievable? Is it realistic to believe that the data collected by an archaeologist will serve the needs of a conservator? Is it realistic to believe that the data collected by a conservator will serve the needs of an engineer? We should be looking at

the issue from a broader distance and realise that guidelines and standards are necessary to structure the knowledge collected. Guidelines are needed to provide a common ground for effective interdisciplinary discussion. A framework for the digital documentation and monitoring of ships in Archaeology shall be discussed with the session participants. References: Jones, T., 2015. Three-Dimensional Digital Recording and Modelling Methodologies for Documentation and Reconstruction of the Newport Medieval Ship. PhD Thesis submitted at University of Wales Trinity Saint David, Great-Britain. Tanner, P., 2012. 3D Laser Scanning in Boat Recording. Nautical Archaeological Society Newsletter. Van Dijk, N., et al., 2016. Monitoring archaeological wooden structures: Non-contact measurement systems and interpretation as average strain fields. *Journal of Cultural Heritage*, 17, pp. 102-113. Wiggenhagen, M., et al., 2004. Repeated Object Reconstruction of the Bremen Hanse Cog. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences (IntArchPhRs)*, pp. 54-58.

Amandine Colson, Kristofer Gamstedt, Pat Tanner, Toby Jones, Heidi Hastedt, Thomas Luhmann

S14 Setting the automation agenda for Remote sensing: learning to see through a computer?

The application of automated procedures in Remote Sensing archaeology is entering a new phase of widespread acceptance and adoption, as made evident by a number of research projects focused on the development of computational approaches to streamline the processing and examination of RS data. Technical or theoretical drawbacks (such as the great variation in the morphological and spectral expressions of archaeological features) are being overcome by adopting approaches successfully implemented in other fields (such as medical imaging, face recognition, surveillance, social media) where automated image processing and classification is routine. In particular methods involving deep convolutional neural networks (e.g. CNN), cognitive reasoning, self-learning algorithms, adaptive template matching, feature extraction, pattern recognition, and pattern matching (to name just the most effective) are showing great potential in dealing with the variability in the manner in which of archaeological objects are expressed in RS data. These approaches directly address previous limitations of spectral and object-based methods and enable recognition of landscape objects and patterns produced by a variety of natural and artificial elements. This session aims to further the discussion of applications of automation methods to identify landscape features and/or patterns in remote sensing data. This dialogue will include exploring the interfaces between traditional methods, such as observer-directed survey, observer-driven aerial photo and remote sensing data interpretation, and the potential of automated processing and object detection. Here, the explicitness of archaeological understandings of objects and their component parts is absolutely fundamental, and an area where automated approaches present a direct challenge to archaeologists to unambiguously define how they see what they see. Such processes are key to choosing the most productive trajectories for development, built on a shared and clear understanding of founding principles and therefore of what outputs mean in 'real world' terms. The session has also a specific interest in exploring ways of building infrastructures and base layer datasets that are at the foundation of future discipline developments. Central to this agenda is how we generate datasets that can be used for machine learning (that is to fit the parameters of the classifier), how crowd-sourcing might be developed and how transferable, flexible toolkits might be developed.

Arianna Traviglia, Dave Cowley

S15 Analysing Historical Transportation Systems from new applications and methodologies

In the last years there has been a growing interest in the development of new methodologies to model and recreate the mobility and transport in historical periods. The use of GIS, but most important, the increase of Network analysis applications, has allowed several researchers to deal with the study of transportation networks from different perspectives and frames. In this context, it is important to apply all kind of new approaches to the analysis of historical infrastructures in order to understand the transportation systems and the territorial organisation of different territories in diverse timeframes. The use of new methodologies and approaches to these analyses is offering brand new data that seems to be very useful to obtain better reconstructions of the historical transport conditions and network morphologies. Between these new approaches we can find the modelling of travel costs and times or the analysis of the road networks structures in order to obtain new knowledge about the territorial configuration. The results of such applications provide us with new information to understand the distribution of commodities, product competition and the role of the ancient economies, such as Rome or Medieval Kingdoms, in the configuration of historical territories. The ability to see graphically and quantitatively those results which until now they could only be guessed, can open new perspectives and justifications to the speeches made about the Ancient world up to now. At the same time, it is possible to observe how the construction of a complex communication network meant an important element for the integration of new territories into a bigger domain. For a better understanding of the morphology of these infrastructures, Network Analyses and other approaches are applied to understand the configuration and performance of the Roman networks in these territories. In this research context, with this session we want to offer a public space where researchers can share their experiences with the use of this new methodologies and approaches applied to historical transport and create a positive debate about their optimal application and generation of results.

Pau de Soto

S16 Play, Process, and Procedure: An Experiential Digital Archaeology

Videogames and virtual worlds have increasingly become areas in which archaeological research is situated. These emerging venues straddle the divide between analogue past and digital present, asking the archaeologist to consider where that divide exists in their own archaeology, or whether it exists at all. Through this session, researchers are asked to look towards these new settings for how process, procedure, and play are being incorporated into digital archaeology, and what challenges to traditional archaeological practice can be overcome by embracing spaces of play as research arenas. Designed as an experiential exercise, each participant is asked to condense their presentation into 15 minutes, and one digital slide. Immediately following the presentation of papers, a working session to incorporate the themes of the session into prototype archaeological experiences of play will see participants creating together, and making the results of their collaboration available for further comment and discussion during the conference.

L. Meghan Dennis, Lennart Linde, Megan von Ackermann, Tara Copplestone

S17 Early human land use strategies during Middle and Late Pleistocene glacial and interglacial times in Europe

The transition from the Middle to the Late Pleistocene is characterised by the transition from a distinct glacial cold phase (MIS 6) to a distinct interglacial warm phase (MIS 5e; Eemian sensu stricto). While changes in climate, environment, vegetation and fauna are obvious, this session aims at identifying possible differences or continuities in Neanderthal hominin performances, resource space and range between MIS 6 and MIS 5e. Several research questions have been addressed by researchers of the project 'The Role of Culture in Early Expansions of Humans (ROCEEH) and will be discussed during the session. What did climate, environment and vegetation look like during a distinct cold phase and a distinct warm phase? Did corridors and barriers change? Are resource space and dietary breadth greater during a warm phase? Did changes between glacial and interglacial times have any impact on Neanderthal lifestyles and behaviours? Is there a relationship between changing climatic and environmental conditions and the distribution of Neanderthal sites? Can we observe different site preferences in Middle and Late Pleistocene Neanderthals? Did human land use strategies change? Are tool diversity and mobility different between MIS 6 and MIS 5e? Does an interglacial - or rather a glacial with stronger challenges - trigger an expansion of cultural capacities and/or performances? Do glacial or interglacial phases lead to specific cultural adaptations? Several computer-assisted methods from different scientific fields that have been (or might be) applied to answer such questions shall be discussed. They include, among others, measurements of tool diversity, tool-flake-core ratios and artifact density; agent based modelling; modelling of climate and vegetation; GIS-based analyses and modelling of geographic parameters. Colleagues from all scientific fields are invited to contribute to the session.

Michael Bolus, Angela Bruch

S18 Women in CAA: Continuing the Dialogue

This follow-up to the inaugural "Women in CAA" session held at CAA2017 seeks to continue the conversation about positive solutions for how to equalize opportunities for women in the field of digital archaeology. Women are generally underrepresented in both archaeology and computer science, especially in leadership roles. The first session brought together a range of panelists to discuss the challenges that female digital archaeologists often must confront in academia to CRM. Suggested solutions included such ideas as enhanced mentoring and networking opportunities to workshops on how to handle harassment. Many people felt that CAA as an organization offers an open environment to begin implementing some of these solutions. However expanding the dialogue to involve more participants is still needed to ensure a variety of perspectives and ideas for moving forward. This panel session, through the presentations and conversations, will provide a platform for continuing the discussion of constructive solutions. Topics may include, but are not limited to, the process of professionalization for women, continuing education to address access to resources, the power of

increasing visibility of female role models and developing mentoring opportunities for students, actions for improving retention and promotion of women, the importance of creating a formal network of CAA members with the shared interest of developing women in the field, or lessons from how other professional organizations have handled these disparities (looking both within and outside of Anthropology). Position papers should identify issues, but also focus on concrete solutions for enhancing women's roles within the discipline. The format will be the same as the initial CAA2017 session. Panelists, grouped by topic, will each give a 5-8 minute flash position paper. Each group of speakers will then participate in a panel discussion to allow time for conversation about the issues and suggested solutions. Audience members will also be encouraged to participate in the discussions to create as wide a dialogue as possible. The session will conclude with a general discussion section focusing on creating a list of constructive steps to be undertaken moving forward. Speakers will be asked to submit draft papers or summaries of key points they will address in their talks, which will be circulated among the panelists, approximately two weeks before the conference in order to help facilitate the discussions. Note: Presenting a position paper in this format does not count as full paper, so speakers in this session may also present a full paper in another session at the conference.

Lisa E. Fischer, Katie Simon

S19 Agents, networks and models: formal approaches to systems, relationships and change in archaeology

Even if much ink has already been spilled on the need to use formal, computational methods to represent theories, compare alternative hypotheses and develop more complex narratives, the idea is still far from being firmly established in archaeology. Complexity Science provides a useful framework for formalising social and socio-natural models and it is often under this umbrella term that formal models are presented in archaeology. It has a particular appeal for researchers concerned with humans, thanks to its bottom-up focus, which stresses the importance of individual actions and interactions as well as relations between system elements. Equally, archaeology is a discipline where long-term, large-scale shifts in social change, human evolution, or interactions with the environment are at the heart of our interests. Complexity Science offers an arsenal of methods that were developed specifically to tackle these kind of research questions. This session will provide a forum for archaeological case studies developed using Complexity Science toolkits as well as for more methodological papers. We invite submissions of models at any stage of development from the first formalisation of the conceptual model to presenting final results. Possible topics include but are not limited to applications or discussions of the following approaches: - Agent-based and equation-based modelling, - Network science, - System dynamics, - Game theory, - Long-term change in social systems, - Evolutionary systems, - Social simulation in geographical space, - Complex urban systems, space syntax, gravity models.

Iza Romanowska, Tom Brughmans, Benjamin Davies

S20 Palaeo-GIS

The use of Geographic Information Systems (GIS) in Palaeolithic research is growing rapidly. A wide variety of innovative applications, published in recent years, offer new and alternative ways of conceptualising the Palaeolithic landscape and exploring several aspects of landscape use by early humans. The nature of the Palaeolithic record, however, requires unique consideration within geospatial archaeology due to the vast spatio-temporal scales involved in its formation as well as the fragmentation and paucity of available data, especially for the earlier periods of the Palaeolithic. These records are often time-aggregated, and deal with scales of behaviour that have little or no meaningful corollary in other prehistoric or historic periods. Typical Palaeolithic contexts such as river terrace palimpsests, multi-context cave sites, and deflated surface assemblages provide unique challenges to archaeological interpretation and geospatial analysis. Despite the frequent and multiple use of GIS in Palaeolithic contexts, it is our contention that there have been only limited attempts to identify or integrate the specific concerns of Palaeolithic researchers within geospatial archaeology generally, or even to account for the breadth and variety of Palaeolithic work currently being undertaken using GIS. A presentation session focused specifically on Palaeolithic applications of GIS would be beneficial in bringing together practitioners to consider the methodological and interpretive challenges that are unique to this topic area, and also exchange ideas and experiences. The CAA International 2018 conference in Tübingen could provide a survey of current work in the field, and form a basis for furthering the topic area of Palaeolithic GIS at future CAA events.

Patrick Cuthbertson, Peny Tsakanikou

S21 Structural Analysis for Cultural Heritage: Tools and Methods for Assessing Heritage Monuments and Structures

Ever present in the world of cultural heritage are the challenges associated with assessment, diagnosis, and preservation of as-built infrastructure with potentially unknown materials, techniques, or damage. Historical buildings, monuments and sculptures require delicate handling. Therefore, the techniques used to capture the existing conditions must be non-destructive, though at the same time must acquire accurate information at the surface, subsurface and volumetric levels. Interdisciplinary collaboration between engineers, scientists, historians, and other stakeholders can reach beyond documentation and visualization towards the production of actionable data on the current “state of health” of buildings, monuments, and artworks as well as predict how structures or their constituent elements might respond to theoretical stresses in the future. Presentations concerning new tools, methods and treatments being researched and developed for understanding and diagnosing heritage buildings, monuments and sculptures are encouraged. Potential topics include novel approaches for translating laser scanning or photogrammetry data into 3D models for structural analysis, new methods for robust investigation of structural systems, as well as recent updates in structural monitoring and lifecycle management. Technology must be leveraged to aid in modeling and simulating problematic aspects

such as heterogeneous materials, existing damage patterns, seismic vulnerability, and unknown construction techniques. Structural engineering methods and software tools better enable cultural heritage practitioners to make informed decisions through understanding how the built environment responds to the always present forces that shape it.

Michael Hess, Rebecca Napolitano, Dominique Rissolo

S22 Social theory after the spatial turn

The past has always offered new and interesting insights that could be simulated, modelled and evaluated with computational approaches. In recent years the applications of advanced geospatial statistics, as well as modelling have become a central methodological framework to analyse past human behaviour and societies in general. However, often archaeological applications falls short on the capacities of these methods or massively overestimate their potential. On the one hand it is clearly related to the pursuit of model and test assumptions. On the other hand causal expectations are strongly simplified and in general more basic statistics are used. Predominantly, this leads to rather simple, purely environmentally constraint versions of reality, neglecting the presence of more than a topographical landscape with certain resources. Other factors, such as a “landscape of ancestors”, differing perception of space, or unknown human factors are mostly ignored in the models. The social sciences have constantly stressed the complexity of human decision making and have successfully implemented complex statistical procedures, such as sophisticated self-learning algorithms in order to achieve a better representation of reality. However, societies modelled in archaeology are often devoid of this cognitive human factor, which cannot be represented in the predominantly deterministic, almost Darwinian models. Furthermore – if at all – theoretical frameworks which were long since updated in social sciences are used to retrospectively interpret the model’s outcome. In this session we wish to address and discuss this problem in current archaeological human behavioural research with an interdisciplinary approach of archaeology and sociology. We welcome theoretical as well as practical contributions on the inclusion of social theory in geospatial analyses and predictive modelling, new ideas for a theoretical framework, and how archaeology can deal with the fuzziness of human decision making, which is never purely environmentally driven.

Chiara G. M. Girotto, Lennart Linde

S23 New Directions in Archaeological Aerial and Satellite Remote Sensing

While archaeologists have long relied on aerial and satellite remote imagery to aid in investigations, a new and ever growing array of technologies, sensors, and analytic tools are rapidly changing how we use these methods to discover, map, and interpret sites and landscapes. This session seeks to highlight recent technological developments and emerging applications in archaeological aerial and satellite remote sensing. We encourage papers that present on the deployment of innovative analyses using new sensor technologies in aerial, drone-based, or satellite imagery for remote sensing of ancient cultural landscape features.

Jesse Casana, Elise J Laugier

S24 Computational classification in archaeology

To make inferences on the archaeological material that go 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 wider reception within archaeology. The reason for this might be that most approaches are considered to be complicated, general or reductionistic. What is a classification good for if it can not inter-subjectively evaluate how similarity and dissimilarity are defined, if the typology can not be duplicated by other studies due to imprecise specification, and a new object can not easily be integrated into the original classification? These issues are perfectly well handled when a statistical, computer based classification is applied. Especially the growing interest in pattern recognition, machine learning and the classification of information emerged within the last years, led by major information processing companies (eg. search engines and social networks). Many new and interesting approaches to this topic were developed that hopefully find their way into archaeological reasoning. In our session we would like to survey the current state-of-the-art research for the classification of archaeological datasets. The aim of the session is to provide a better understanding of classification methods and algorithms and of validation techniques since a sound methodological knowledge is required 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. We would like to welcome presentations on recent applications of machine learning, clustering approaches, and related regression methods in the field of archaeology. Presentations will explore methods for evaluating the accuracy of classifications, and investigating the implications of different classification methods for archaeological interpretation and understanding. Reports on how to deal with the challenges of applying modern computational methods to sparse and problematic archaeological datasets will also be included in this session. The session is organized by the ISAAKiel group ((Initiative for Statistical Analysis in Archaeology Kiel: <https://isaakiel.github.io/>))

Oliver Nakoinz, Martin Hinz, Benjamin Serbe, Caroline Tietze, Ben Marwick, Christoph Rinne, Clemens Schmid, Daniel Knitter, Franziska Faupel, Karin Kumar, Moritz Mennenga, Nicole Grunert, Nils Müller-Scheeßel, Wolfgang Hamer, Camille Butruille, Dirk Seidensticker, Joana Seguin

S25 Do we have a heading? Ah! A heading. Set sail in a... uh... for Mobile GIS direction!

The current trends in Geographic Information Systems hardware and applications suggest that Mobile GIS will be the main mapping tool for future surveying in different fields. Will it be also true for archaeology? Taking into account that the discipline has always followed technological trends, the answer is easy. We would like to discuss how the introduction of Geographic Information System and GNSS mobile applications available on gadgets of everyday use opened a new chapter in archaeological field survey techniques. The most valuable will be case studies and research projects. Thus, we would like to invite topics presenting not only possibilities, but also obstacles encountered during research. The goal of this session is to discuss not only problems which can occur in the field while working, but also to take a step back, and consider methodological approaches that are or should be used while using any type of device with any type of GIS application from a wide spectrum available nowadays. Encouraged by the success of last year's session „Mobile GIS and field survey – current possibilities, future needs“, we would like to continue the discussion on the topic of possibilities in mobile GIS use on the field. We kindly invite all papers exploring the broad question “what is beyond the horizon” of Mobile GIS. Where does it lead us? How does it influence the methodology and field survey strategies? Are there common technical problems and methodological issues and if yes – what kind of solutions are available, or to ask if we are simply trying to approach old problems for which new technology is not a solution?

Nazarij Buławka, Julia Maria Chyla

S26 Sensory GIS: towards a deeper engagement?

Significant improvements recently occurred in the realm of GIS: advanced software solutions along with efficient field acquisition techniques dramatically increased the accuracy of data representation, which was complemented by the introduction of high-performing fully-three-dimensional platforms. This opened up for new ways of representing more exhaustively the complexity of the landscape, in a multi-scalar and multi-temporal perspective. As a consequence, it is now possible to investigate the perceptual dimension of space by taking advantage of reliable datasets that provide a more refined representation of the landscape as it was (presumably) perceived by its ancient inhabitants. Today geometrically-complex 3D models, high-resolution DEMs, together with improved analytical tools let archaeologists to experiment more sophisticated solutions to simulate the perception of space, which takes into account of multiple senses (visual, acoustic etc.). Purpose of this session is to raise a discussion on the way GIS today can facilitate an experiential approach to the ancient space, either the single site or the whole landscape. Contributors are therefore invited to present their papers on theoretical and practical aspects of using GIS as a framework to develop a more ‘humanized’ form of analysis of the ancient space.

Giacomo Landeschi

S27 Map management and Webgis applications for archaeological data base solutions

As a follow up of the last CAA in this session we would like to bring together scientists working on different issues of spatial data visualization and management in archaeological data bases. This comprises the technical prerequisites of DB-systems such as interface solutions that pass geographic, geodetic, and 3D data to visualization tools (e.g. Postgis) as well as tools and interfaces that allow the visualization of these data like web based portrayal services, GIS systems, etc.. On the other hand we want to discuss visualization issues related to the data formats and metadata like, vector, raster and voxel formats and geographic data projections. Especially we will focus on open source solutions and would like to invite presentatiuons on application examples in order to give an overview on state of the art solutions. Finally, we will also discuss how user requirements can be already considered in the design of these systems to guarantee sustainability and acceptability of the targeted user.

Michael Märker, Espen Uleberg, Mieko Matsumoto, Christian Sommer

S28 Cities of Data: computational and quantitative advances to urban research

The use of digital and quantitative methods for studying the evolution of ancient cities and their environments at multiple spatial scales has steadily been increasing in recent years. Large volumes of data on ancient settlements and settlement systems have become more and more accessible as a result of advances in computational methodology and archaeological interdisciplinarity. These datasets are often remarkable in their diversity. Spatial data, often acquired by means of advanced geophysical and remote sensing methods, have not only offered a more comprehensive picture of settlement systems at the regional level, but also detailed data indicating the extent and form of urban and suburban areas. Environmental data (sediment cores, geomorphological data, etc.) have increasingly been used to reveal a finer-scale patterning in the archaeological record. Archaeological publications, national archives, online databases and on-going excavations have provided scholars with an abundance of material culture evidence that are suggestive of social, economic and political change in human settlements over time. At the same time, archaeologists have been using a multitude of quantitative methods to assess and analyse this evidence so as to reach a better understanding of socio-economic and cognitive aspects of past cities and settlements, including: Building Information Modelling (BIM), Space Syntax, 2D and 3D GIS based analysis, spatial interaction models, network analysis, mobility studies, fractal analysis, and urban scaling. This session invites papers that discuss the use of computational methods for the acquisition and analysis of settlement data at various geographical, spatial, or temporal scales. We especially welcome papers on the innovative applications of 2D and 3D spatial analyses to the built environment, works that adopt a comparative and diachronic perspective, “big data” approaches, and projects that aim to bring together diverse sources of

evidence, as well as studies that seek to evaluate the theoretical contributions and challenges associated with the use of these computational methods to the study of ancient cities and settlements.

Hanna Stöger, Eleftheria Paliou, Katherine Crawford

S29 Digital Innovation & Experimentation in Archaeology & Cultural Heritage Collections

This session aims to look at the impact that emerging digital technology and innovative engagement tools are increasingly playing in how we approach and present cultural heritage data. Digitisation, 3D modeling, 3D printing, and AR/VR experiences have become key working practices in archaeology, increasing accessibility to cultural heritage data, archaeological archives, and museum collections. What are the key challenges in using digital experimentation, digital inclusion, and open access tools in cultural heritage projects? How can use digital innovation democratise access to archaeological and museum collections? How does digital technology impact cultural institutions and their understanding of intellectual property (IP), digital capture, curation and dissemination? This session welcomes papers exploring these themes, aiming to look broadly at digital working practices across the cultural heritage, archaeological, and museum sectors.

Jennifer Wexler, Dan Pett

S30 Open Digital Infrastructures for Archaeology and Cultural Heritage

In general, infrastructures encompass "all long-lived facilities or services of a material or institutional nature". The current transformation toward open science, open source software and open data infrastructures is a challenge that must be addressed in archaeology and cultural heritage. Open and sustainable, digital infrastructures do not only have to be open in themselves, but also have to consist of open ingredients. They should be built from open source software, rely on open formats and protocols and promote open science. They also need to handle data access in a difficult compromise between intellectual property protection, heritage protection and the right of the public to access data and analysis results that belong to the common worldwide portfolio of science and heritage information (and, in many cases, have been funded by public money). The term "open", after more than a decade of its web-based reinvention, has gathered its own history of use and abuse. But one could argue that short-term software platforms that die with their funding cycle should not be called "open". The same applies to implementations that use open source software but (due to sheer technological complexity and cost) create asymmetric relationships and dependencies for communities with lesser capacities. From a technical point of view, data-centric infrastructures and workflows mean

that monolithic end-user applications become interchangeable and lose their dominance over the workspace. Instead, open data repositories, standardized documentation/metadata and sharing solutions become essential for the long-term survival of research and cultural heritage data. As the bottleneck nature of proprietary data formats, short-lived project cycles and slow, restrictive publication practices becomes ever more apparent, the long-term advantages of open source software, open formats and protocols begin to outweigh any functionality edge that closed source, proprietary software may retain. At the same time, open data repositories open up new possibilities to interact with research results and stimulate innovative interchange with actors from the public as well as the economic sector. Yet, the heterogeneous nature of archaeological data and software applications complicate the development of open standards and tools that can lead to truly open infrastructures. We invite contributions with a focus on the challenges, prerequisites and ingredients of open digital infrastructures, such as: - long-term data survival using open formats and protocols - "Big Data" and data-centric workflows - long-term sustainability and the commercialization of open source software - centralized versus distributed concepts of open infrastructures - issues of accessibility and re-usability of data - computational reproducibility of data - further technological, economic, academic and social aspects of the "open everything turn"

Kai-Christian Bruhn, Sebastian Cuy, Benjamin Ducke, Reinhard Förtsch, Felix Schäfer

S31 The Third Dimension: Beyond Visualisation

This session is designed to bring together researchers who are pushing the boundaries of 3D data in terms of analysis, interpretation and management. As 3D recording becomes increasingly applied in both commercial and research orientated archaeology the already captured data sets are varied in terms of their quality and purpose. What effect does this variation have on archaeological interpretation? How can 3D datasets collected for a specific research question be repurposed? More generally, as a discipline, we face important questions: What types of 3D data do we want to analyse, and how can we get to a better understand the spaces we record? Topics could be orientated around, but not restricted to: Appropriate data structures: Voxels or Vectors and forms of quantitative space 3D GIS Embodiment in 3D digital spaces (e.g. digital phenomenology, perception of digital space) Spatial databases (do we need GIS?) Non-geographical spaces: other ways to represent space We especially welcome papers which explore how archaeologists work with 3D datasets particularly those that go beyond the process of data capture and simple visualisation. Papers can be can be theoretical in terms of the perception and understanding of space, analytical, or discuss the management of 3D datasets, or a synergy of topics. Papers which discuss the embodiment of spatial research are also welcome.

Gary Robert Nobles

S32 Automation, combination and calibration: consolidating the framework for archaeological geophysics

Geophysical survey methods have become a standard part of many archaeological research programmes. Technological advances over the past two decades have not only allowed for a broader range of instrumentation that can be applied, but have increased the speed at which resultant data can be collected and processed considerably. While a first gap may have been bridged through the efficient application of geophysical methods in archaeological field methodology, a remaining challenge lies in fully addressing the interpretive potential of increasingly multidimensional, often larger, and more complex geophysical datasets. Recently, more research effort is being directed towards advanced approaches to collect, process, interpret and communicate geophysical survey data. Researchers are therefore addressing the need to automate steps in data analysis and interpretation, and to render this process more reliable and objective, in order to obtain ever more robust data sets that facilitate archaeological research. For this session we invite contributions that present and discuss new technological and methodological advancements in geophysical archaeological prospection. Proposed topics include: - automation in collecting, processing and interpreting geophysical data; - data fusion and geophysical inversion; - quantifying archaeological feedback. We encourage presenters to underline the interpretive potential and efficiency these advanced methods add to the streamlining of geophysical data into archaeological research. As we target a broad and diverse audience, concluding remarks should go beyond technical aspects, but focus on the relevance of the presented research in resolving fundamental archaeological and anthropological questions. Lastly, conclusions should focus on issues that remain to be addressed in order to further consolidate and streamline the practice of archaeological geophysics.

Eileen Gloria Ernenwein, Philippe De Smedt, Immo Trinks

S33 Guaranteeing data quality in archaeological Linked Open Data

In the age of open access, increasing quantities of data are becoming available for re-use. While this development is generally to be greeted, it brings with it significant dangers. Just as with all information, source criticism is vital, since even the most carefully assembled data will include errors and ambiguities. If they go unrecognised such errors can, when re-used, multiply exponentially with dramatic effects: not just erroneous data and conclusions are the result, but potentially also a loss of confidence in web-based resources. This session will focus on aspects of data quality, with particular reference to Linked Open Data (LOD), where data is currently often re-used without any form of quality control. Problems and challenges we see include: - Identifying inconsistencies and errors within the data. - Identifying the sources and dangers of erroneous or ambiguous data. - Strategies for correction of inconsistencies and errors. - Identifying duplicates, especially across different LOD sources (objects or concepts represented in different sources by different URIs might represent the same entity). - 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. At the solution level: - To what extent are (semi-

Automated solutions to such problems feasible, or even desirable, and what new dangers might they bring? - How can social and management aspects be addressed, incorporating control of data quality at a permanent, process level? - Can community mechanisms be set up to identify and rectify erroneous data, and how could such mechanisms function? Contributions are invited which address these and similar questions; experience of them in different projects and areas, and their solution; as well as the identification of additional risks. These are not problems that are unique to archaeological LOD, and lessons are to be learned from other fields of data management and control.

David Wigg-Wolf, Karsten Tolle

S34 R as an archaeological tool: current state and directions

In recent years, R has silently become the workhorse for many quantitative archaeologists. It's open source, platform-independent and can be linked very well with other programming languages. As an interpreted language with simple and flexible syntax it is easy to learn but hard to master. Due to its huge community, spanning from hobbyist to commercial data scientists and researchers from scientific fields like statistics, ecology or linguistics, the catalogue for freely available packages is enormous and continuously growing. The foundation of the R-Consortium, a group of corporations highly invested in R, including Microsoft, IBM and Google, pushed the language and its abilities further ahead. Nevertheless, there are still many colleagues who have not yet realised the potential of the language and how easy it is today to conduct high quality research with the available tools. This is reflected by the fact that the workflow of many students of archaeology is at best still limited to Excel or SPSS. The solutions for archaeological problems in R are already manifold -- although maybe developed for a different purpose. For example spatial analysis, multivariate statistics and scientific visualisation are well reflected within popular R packages, which makes it a very useful tool for archaeological research, teaching and publication. R also provides an advanced environment to produce truly reproducible research, which will be of growing importance in the future of scientific dialogue. Within this session we would like to explore the state of the art and the potential application of R in archaeology. We invite presentations for this session that explore questions like (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, and which package still has to be developed to improve the usability of the software for archaeologists? * What has to be considered to optimise the workflow with R? We especially would like to attract colleagues who might present archaeological R packages that are ready or in the making and demonstrate their relevance for archaeological analysis. Also we would like to encourage potential presenters to demonstrate their research approaches via live coding, for which we would support them in ensuring that their presentations will work offline and on foreign hardware. If desired, we would like to publish the session and the code in an open online book embedded with runnable code. We hope to foster a productive and inclusive exchange between both young and experienced users from all backgrounds.

Clemens Schmid, Ben Marwick, Benjamin Serbe, Camille Butruille, Carolin Tietze, Christoph Rinne, Daniel Knitter, Dirk Seidensticker, Franziska Faupel, Joana Seguin, Manuel Broich, Martin Hinz, Moritz Mennenga, Nicole Grunert, Nils Müller-Scheeßel, Oliver Nakoinz, Wolfgang Hamer, Karin Kumar, Kay Schmütz

S35 Ancient Near Eastern and Neighboring Regions: Enlarging Research Horizons through Digital and Computational Practices

In the latest years, the use of quantitative and qualitative methods in ancient Near Eastern studies is experiencing an impressive expansion. This is partly due to the situation of the increasing endangerment of the heritage in Western Asiatic and Eastern Mediterranean regions. But this results in two separate profiles of Humanities scholars who hardly work together: some use “traditional” methods, while the others — mostly “young” researchers — digital and computational practices. Thus, the question arises of how to build bridges in order to facilitate dialogue with colleagues who are not accustomed to these “new” practices? This is especially important, since the digital and computational approaches in Humanities are not a field, but methods, and as such their goals are sometimes to optimise the available funds (digitized or not) or the acquirement of information from the available materials and field recordings. Among other answers, one could be to develop open archives and open linked data projects in order to focus on the specific nature of the challenges of ancient Near Eastern and neighboring regions’ studies, e.g.: the particular issues related to Sumerian studies; the specific features of ancient languages and writing systems; the consequences on the archaeological record of the continuous cultural contacts and exchanges in regions like Syria and northern Mesopotamia; the movements of materials and people through differently structured societies, including the (semi-)nomadic ones. To pursue the aims expressed here, it is essential that the contributions that will be presented are able to show the actual progress potential that the application of digital and computational methods and tools can bring. This requires a clear explanation of the theory and performing processes of the systems used in Digital Humanities, but also an explicit comparison between the “new” Humanities' processes and results and those of other methods. This session is open to all scholars — including non-digital researchers who look to enhance cooperation — of Prehistory through Late Antiquity, whose proposals are related to the adoption of digital tools and theories in any sector of the mentioned fields of study (epigraphy, archaeometry, philology, historical geography, ceramic studies, art history, etc.). The presentation of in progress projects, experimental proposals, and theoretical explanations are also welcome.

Vanessa Juloux, Alessandro di Ludovico

S36 Advantages and Limitations of Spatial Applications in Archaeology

In this session, we want to incorporate the dynamic scale of landscape analysis with traditional archaeological practices. Landscape analyses solve different kinds of former archaeological problems in isolation. Landscapes enables us to perceive and comprehend interdependencies among people’s interactions with their environment. GIS is a very powerful tool to study landscapes because of its ability to simultaneously analyse space, time, and form. Geophysics, remote sensing analyses as well as unmanned aircraft systems (UAS) approaches lead to a fast way of spatial analyses of surfaces as well as paleosurfaces. A powerful technique is the use of big data and geostatistics in archaeological

research. This session welcomes presentations on theory, experiences and projects related to the theme of landscape pattern analysis. We welcome disciplinary studies such as geophysics, soil analysis, coring, dating, pollen and faunal analyses, laboratory methods etc. Equally, we invite work that links environmental conditions and data with archaeological structures and structures of the paleo-landscape.

Geraldine Queneherve, Michael Maerker, Felix Bachofer

S37 Connectivity: linking and interpreting the archaeological record

Connectivity, broadly construed, has long played a role in archaeological thinking. Recent, influential volumes such as *Entangled* (Hodder, 2012) and *An Archaeology of Interaction* (Knappett, 2011) provided new theoretical frameworks centring connectedness. The adoption by archaeologists of more formal theoretical and methodological frameworks based on connectivity, such as actor network theory, assemblage theory, graph theory and social network analysis have broadened the influence of the idea to directly affect practice. At the same time, linked open data initiatives in archaeology have brought attention to the importance of shared standards and ontologies in ensuring interoperability between archaeological data produced across the world, and interoperability between active and legacy datasets - another, more contemporary and social form of connectivity. The session aims to bring together a broad range of contributions including, but not limited to, the challenges in creating ontologies of connectivity, the opportunities afforded by linked data, and theoretical implications of centring connections between things in the archaeological record. We are particularly interested in the practical applications of connecting archaeological datasets to datasets within and outside the discipline, and case studies showing of research emerging from such applications.

Gisli Palsson, Colleen Strawhacker, Rachel Opitz

S38 Applicability of Digital Archaeology Tools

More and more apps for archaeology appear on the market, more scientific tools are used for data analysis, network analysis etc. and finally more and more databases offer "the" solution to host all records and archaeological data. Frequently enough these solutions are however not really applicable and provide results that may be wrong - this session focuses specifically on discussing the scope of applicability of such tools and where they fail, respectively how to interpret their results. This session is aligned to the SIG on Digital Archaeology Standards and Practices. The results of the discussions will be used in an online database about which tools can be used when, where and how. Authors are expected to submit and present papers on specific tools and methods and an analysis of their applicability, such as e.g. different types of network analysis algorithms for different research

questions. Authors should ideally provide a comparison of different tools for one or more application field (era, region) and research question.

Lutz Schubert, Gill Hunt, Stephanie Metz, Keith Jeffery

S39 Heritage Beyond Boundaries: Developing Standards and Storefronts for Immersive Technologies in Archaeology

In only a decade the technological advancements associated with immersive capture of first person experience in archaeological sites and settings, has transformed how quickly and efficiently we can present visualizations of landscapes, sites, and artifacts. This session collects contributions concerned with developing processes and standards for not only the acquisition of immersive archaeological experience, but also best practices for producing, presenting, and archiving these data in accessible formats. Ideally the session will be presented in two sessions with adequate discussion time each. First, narratives and case studies about data acquisition challenges and standards will be presented alongside papers discussing best standards for processing and producing visualizations from these case studies. Papers should be prepared for a technical audience interested in applying these technologies in a variety of archaeological and ecological contexts. In the second session, papers should focus on how a combination of technologies can be best leveraged to produce and present an immersive archaeological experience. Papers in this session that focus on particular efforts to communicate archaeological science are particularly encouraged to contribute to this session. Combined, the session hopes to attract a global community of scientists and heritage managers looking to expand, apply, or refine the application of these technologies in diverse archaeological contexts.

Timothy Murtha, Alex Klippel

S40 Science and Technology (S&T) for Archaeology and Cultural Heritage in the Eastern Mediterranean

This special session aims at promoting the establishment of an Eastern Mediterranean Centre of excellence for Archaeology and Cultural Heritage in Eastern Mediterranean that seeks to advance in a systematic way archaeological research and practice, as well as enhance sustainable growth through the preservation and valorisation of cultural heritage in the wider region. Based on the initiative of the recent successful Teaming for Excellence Phase 1 WIDESPREAD project MedSTACH (Eastern Mediterranean Science and Technology Centre of Excellence for Archaeology and Cultural Heritage), this session will showcase the need for such a regional entity that will capitalise on scientific excellence and multidisciplinary research. Apart from excellent science and technological innovation, the particular centre will provide best practices and guidelines to local and regional stakeholders, while bridging existing gaps “on the ground” that often hinder the valorisation of cultural heritage. The session will seek papers dealing with current and future prospects of projects and activities in the wider area of the Eastern Mediterranean (including the Balkans, Middle East, Anatolia, NE Africa, etc.); the objective being to illustrate the current activities and needs in the wider spectrum of technologies

applied in archaeological research and cultural resources management, spanning from ground-based, aerial and satellite remote sensing, geoinformatics, spatial technologies, modelling, climatic reconstructions, protection and conservation of monuments, etc. Some key questions arising within this context include: How is sustainability of such centres achieved and maintained? Which are potential, current or future, services that are of need and can be integrated and supported by such centres? What is the potential involvement of the private/business sector and what are the links with the tourism industry? The proposed special session will provide the forum for advocating the long-term need for a regional, science and technology centre of excellence in archaeology and cultural heritage, while presenting current relevant initiatives, thus offering a unique opportunity for networking the development of new synergies.

Athos Agapiou, Phaedon Kyriakidis, Vasiliki Lysandrou, Apostolos Sarris

S41 Immersive Techniques in Archaeological Practice and Publication

This session focuses on the thoughtful integration of digital methods into the processes of gathering, recording, interrogating, and publishing archaeological data. Digital publications, geospatial datasets, and three-dimensional presentation are examples of interactive approaches to what has been called “digital archaeology.” This interactivity can be taken a step further, as approaches like Augmented, Virtual, and Mixed Reality (AR, VR, and MR) allow for the fostering of immersive experiences around the reconstruction, visualization, and presentation of archaeological data. This session highlights all aspects of digital innovation in the survey, excavation, interrogation, and publication process, with particular emphasis on 3D modeling and printing, data interoperability, and VR, AR, and MR. It is intended both to serve as a follow-up to the CAA 2017 session on 3D modeling, AR/VR, and immersion (chaired by the session proposer), and to foster further discussion about the uses of interactive and immersive technologies both in the field, and in the presentation and analysis of objects and datasets. The format of this session will be a combination of interactive presentation and discussion, with a specific emphasis on demonstrations of 3D reconstruction, Virtual/Augmented and Mixed Reality experiences, online presentation, and other interactive and immersive approaches to excavation, recording, and dissemination. Our goal is to cultivate a needed community of practice and shared knowledge around these techniques and approaches, while working together to support the highest quality of digital methods and processes in archaeological practice.

Jeffrey Emanuel

S42 Archeology Heritage Information Modeling. Models construction for documentation and analysis

Any comprehensive knowledge concerning Archaeological Heritage can be reached only through the development of different investigation activities belonging to a very wide range of disciplines: archaeology, of course, but also history, chemistry, physics, architecture, and so on.

An enquiry into a work of Archaeology Architecture means investigating a physical space constructed and experienced by man ever since his appearance on earth as well as analyzing elements, from structures of great dimensions to the smallest objects. Corresponding to this dimensional variety is a series of problems connected with the instruments, which enable us to acquire knowledge – conceived in terms of the synthesis of surveying and the survey – about these objects.

Nowadays, the whole research field has experienced (like the majority of human activities) a massive transition from analogic to digital tools, data and information. As this transition can be considered by now almost concluded, the research must now work especially on archaeological documentation procedures and protocols. The core of this activity concern the way Archaeology is digitally documented, how this information is elaborated and finally how it is communicated. For instance, digital surveying technologies have produced important changes in the study, analysis, and interpretation of archaeological elements. The growing demand for realistic 3D models enabling the cognition and popularization of archaeology represents one of the clearest consequences of this process. Furthermore, the opportunities disclosed by the digital revolution are deeply influencing even the management and preservation of Archaeological Heritage, by now inextricably connected with the innovative processes of acquiring, organising and using digital information.

Hence, the documentation of Archaeological Heritage must be subjected to a multidisciplinary approach that enables analysis and interpretation capable to combine different expertise. The representation of the archaeological survey represents a monumental change in capabilities thanks to the acquisition and alignment of massive survey data describing the geometry, appearance and context of the target environments. The construction of 2D/3D models is the starting point for essential activities – from cataloguing to preservation, from design to restoration and valorization – linked to the knowledge of Archaeological Heritage.

Is then Archaeological Heritage also ready also to identify a path called AHIM (Archeology Heritage Information Modeling) and determine the elements of such a procedure?

What data can be entered into AHIM - resulting from excavations, searches and procedures where the common denominator is archeology or paleontology?

Undoubtedly, one of the main problems to deal with is the BIM Modeler, that is, the 3D modeler used to represent the objects found and surveyed; in many respects, it presents a rigid parametric modeling structure. For example, if I need to describe a Roman colonnade, can all the elements that make up an individual column (base, column and capital) be covered by a single parametric matrix or are they a "unicum"?

Contributions to this session will discuss the use of integrated and multidisciplinary approaches in archaeology, use of digital data acquisition technologies, data processing and communication. The

focus will be on 3D data capture methodologies and tools; data processing in archaeology; issue in construction of 2D/3D archaeological models; use of digital models for archaeological and historical research; standards, metadata, ontologies and semantic processing in model construction for archaeological heritage; data management, archiving and presentation of archaeological content; innovative topics related to the current and future implementation in use and development of archaeological models; digital archives in archaeology; diagnoses and monitoring for the preventive conservation and maintenance of archaeology; information management systems in archaeology.

The "session" is also aimed at encouraging a widespread debate to identify, where applicable, the guidelines or operating modes shared by archaeologists, surveyors and historians.

Michele Calvano, Tommaso Emler, Carlo Inglese, Alfonso Ippolito, Luca J. Senatore