Bournemouth 2019

Abstract Book & Programme

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▪ Aims

The 2019 annual meeting of the UK Chapter of *Computer Applications and Quantitative Methods in Archaeology* (CAA-UK) will be held in Bournemouth on the 4th and 5th October 2019 at the *Bournemouth International Centre*. CAA-UK aims to encourage communication between UK-based archaeologists, mathematicians and computer scientists in order to stimulate research and promote best practice in computational and mathematical approaches to the past.

This year's meeting will focus on what lies ahead for digital and computational approaches to archaeology, discuss future horizons for the field and how state-of-the-art and upcoming technologies and approaches will continue to revolutionise how archaeology is done, what questions it addresses, how the past is thought about and how heritage is presented to the public.

The meeting will feature a number of keynotes to discuss new horizons for digital archaeology. CAA-UK 2019 will be held in conjunction with *BFX festival*, the UK's largest visual effects, computer games and animation festival. Papers will be delivered on topics at the cutting edge of computer applications in archaeology whereas, in addition, there will also be some software/serious gaming demos and showcases and posters.

▪ Location

The meeting is at the *Bournemouth International Centre*. Delegates travelling by train or public transport will normally arrive in Bournemouth at the Transport Interchange. There are regular bus services from here to the BIC via Yellowbuses, Morebus and Plusbus. Alternatively, it is a 30-minute walk to the BIC and there is a taxi rank outside the railway station. Parking is available at the venue, more information can be found here.

The University has preferential rates with a number of local hotels, including Carlton Hotel, East Cliff Court Hotel, Miramar Hotel, The Green House Hotel, and Ramada Encore. Please quote *Bournemouth University* when booking to access these rates. Note that preferential rates are subject to availability and will be advised by the hotel at the time of booking.

▪ Code of Conduct

Wherever possible we wish to make this event accessible and collegiate; we are committed to making reasonable accommodations to facilitate the full participation of all attendees. Please contact us with any questions or requests that will facilitate your attendance.

We will be based in *Bournemouth International Centre* for the event; details regarding accessibility are available here. There are no gender-neutral toilets on site, venue staff encourage anyone who does not feel comfortable using the male or female facilities to use the disabled toilets.

We encourage attendees of all ages, levels of experience/qualification, and across all disciplines. We are adopting an "opt out" policy regarding sharing scholarly activities associated with the conference. Presenters are requested to communicate any restrictions

on sharing their conference activities in advance to the conference team and again during conference activities.

Discrimination on the basis of age, race, ethnicity, gender, sexual orientation, ability, nationality, religion or any other basis are not tolerated.

We do not tolerate harassment of any form, in person or via digital media. Harassment includes any unwelcome conduct toward an individual that creates an intimidating, hostile, or offensive professional environment. This includes, but is not limited to, comments or jokes, non-verbal conduct, physical conduct, and exposure to visual image.

If you have any concerns or questions in advance, during or after the event please contact Fabio Silva (fsilva@bournemouth.ac.uk) or Catriona Cooper (catriona.cooper@york.ac.uk) via email or in person.

▪ Social Events

❖ CentreVR Experience

For one-and-a-half hour on Friday evening CAA-UK will take over the entire CentreVR in Richmond Gardens Shopping Centre, just a short walk away from the CAA-UK venue. This Vr experience centre has more than 30 virtual reality stations including: 16 tower tag (6 players per game), 8 flying simulators, 16 VR “your choice” stations where you can choose from over 100 games, and 30 stations for education.

Click here for details on the location, and here for details on the games that are available.

❖ Cosy Club Icebreaker

We will then head out to Cosy Club for an icebreaker party. Venue details here.

▪ Keynotes

Andrew Bevan

Professor of Spatial and Comparative Archaeology (Institute of Archaeology, University College London)

Title **Recent trends in computational archaeology… and why we should be excited**

Abstract Digital and computational methods have transformed the way we collect and understand archaeological evidence, and have matured into a well-known range of sub-fields, each with their own strengths and weaknesses in terms of how they achieve that awkward balancing act between data, theory and method. I will try to sketch out some key ways in which our horizons are being altered for the better, as well as some of the key challenges that still remain.

Friday October 4th, 1.20pm - 2.20pm

Sara Perry

Senior Lecturer in Cultural Heritage Management (Department of Archaeology, University of York)

Title **Designing care into (digital) archaeology**

Abstract In this lecture, I explore what it looks like to design care into archaeological practice. With reference to affective and social justice-oriented methodologies, I argue that our long-standing approaches to recording, interpreting, publicising and archiving archaeology perpetuate systemic power imbalances and, hence, demand revision. I outline the components of an more contextual and dynamic 'affective' model of practice, and I consider the essential role that digital media have in its success. Currently these media are heavily implicated in the discipline's structural divides, yet they also offer means to break free in order to design a more responsive and responsible discipline.

Saturday October 5th, 9.20am - 10.20am

Mark Gillings

Professor of Archaeology (School of Archaeology and Ancient History, University of Leicester)

Closing Discussant
Saturday October 5th, 4pm

▪ Programme

	FRIDAY	SATURDAY
9:00		*Opening*
9:20		**Keynote Sara Perry**
9:40		
10:00		
10:20		Lawrence Shaw
10:40		Lukasz Banaszek
11:00		Liz Falconer
11:20		Discussion
11:40		*Break*
12:00		Samantha de Simone
12:20		Catriona Cooper et al
12:40		Heather Tamminen
13:00	*Opening*	Discussion
13:20	**Keynote Andrew Bevan**	*Lunch & AGM*
13:40		
14:00		
14:20	Joana Valdez-Tullett	Eike Anderson et al
14:40	Philip Riris	Robert Peter Barratt
15:00	Marta Kryzanska	Gary Nobles
15:20	Discussion	Discussion
15:40	*Break*	*Break*
16:00	Kirsty Ackland et al	**Keynote Discussant Mark Gillings**
16:20	Martina Trognitz et al	
16:40	Leo Sucharyna Thomas	
17:00	Discussion	*Closing*
17:20	*Closing*	
17:40		
18:00	***CentreVR Experience***	
19:30	***Icebreaker at Cosy Club***	

▪ Abstracts

Friday Afternoon

2.30pm Joana Valdez-Tullett (Historic Environment Scotland)

Title **"But grandmother, what big eyes you have!...All the better to see you with". Computer modelling and sensorial experiences in the exploration of Atlantic Rock Art**

Abstract Since early times rock art has aroused curiosity, mostly due to the enigmatic character of its representations on rocks and stone walls. The main focus of early approaches was on the iconography and extensive typologies were created with the aim to understand rock art. A number of quite invasive techniques were used to record carvings and paintings. In the 1990s the intersection of rock art with landscape archaeology refocused research interests on the landscape and the relationship between rock art and its environment. New methodologies were carried out, and variables such as visibility gained importance due to the premise that wide vistas were paramount for rock art location. Landscape archaeology prompted the widespread use of GIS, driving archaeologists away from the field.

Although less extensively, these techniques have also been applied to the study of Atlantic Rock Art, the main focus of this paper. Mostly known for its cup-marks and cup-and-rings, this tradition of prehistoric carvings is distributed across the landscapes of a number of modern countries in the Atlantic seaboard. This paper will discuss the results obtained in a recent project focused on a re-assessment of Atlantic Rock Art, in which the rock art's context was approached with a two-fold methodology based on GIS analyses contrasted with a sensorial and experiential perspective of the landscape. It will argue that although GIS is a useful tool to investigate the affordances of the landscape, human experience is also fundamental in the way we perceive and interact with rock art sites.

2.40pm Philip Riris (UCL Institute of Archaeology)

Title **Connected Communities: computational approaches to artistic traditions in prehistory**

Abstract This paper employs network visualisation and modelling techniques to understand how artistic traditions articulate, through the lens of prehistoric rock art. The concept of an artistic tradition often hinges on a common set of characteristics, frequently scaffolded by exploration of continuities and discontinuities in the material, linguistic, and ethnographic records across time and space. Breaking from exclusively interpretative focuses, this paper proposes the application of network methods to understand how artistic communities form and interact.

Mapping rock art sites in topological space offers the opportunity to characterise prehistoric art on an unprecedented scale. Employing a combination of geographical, iconographic, and archaeological data, I focus on some key questions: do stylistic networks mirror prehistoric social structures or flow beyond known cultural and ethnolinguistic boundaries? How does the distribution of nodes and links compare with the stylistic content and diversity of sites?

Are sites highly inter-connected or do networks they centre on few hubs with numerous satellites? What influence does geography have?

This paper reports on the analysis of a growing dataset collected in northern South America, a hotspot of biological and cultural diversity. An especial challenge is translating between highly particular local patterns and mature archaeological models of diffusion, migration, and down-the-line trade that form an intricate and ever-present backdrop. Centring this study on the Orinoco River and its affluents, which have long been conceptualised as mediators of cultural interaction and syncretism, I will trace the structure and variability of rock art networks and discuss future directions for formalized modelling approaches.

3.00pm Marta Kryzanska (University of Cambridge)

Title **Integrating past and present data to model limits on the cultivation of buckwheat across time: application of Species Distribution Modelling**

Abstract This paper will discuss the results of Species Distribution Models (SDMs) used to estimate the environmental constraints on the domesticated buckwheat and its potential distribution in Mid-Holocene, constructed as part of the interdisciplinary project 'Crops pollinators and people: the long-term dynamics of critical symbiosis'. Buckwheat has been cultivated from at least 3500 BC, with its origins identified in southwestern China on the basis of genetic and biogeographic data. However, the archaeological evidence remains scarce and the exact timing and its routes of dispersal both within China and across Eurasia remain obscure. In this paper we will evaluate the two approaches used to estimate the potential distribution of buckwheat in China after its domestication: one based on the past occurrence records, and the other based on the data on present abundance of buckwheat. With reference to ecological theory, we will discuss how the nature of available data affected the choice of modelling methods as well as the resulting implications for the interpretation of models' predictions. Furthermore, will demonstrate how the potential uncertainties in relation to preservation, taphonomy, identification and chronology of the past occurrence records could have affected the models' results. Finally, we will assess the validity of the models with reference to the archaeobotanical and archaeogenetic evidence and we will discuss the implications for the identification of the geographical areas suitable for buckwheat's cultivation and the key constraints on its dispersal.

4.00pm Kirsty Ackland, D Stump, HM Griffiths, L Barker, S Davies, T Driver, D Hunt and P Robson (University of York, Aberystwyth University and RCAHMW)

Title **A GIS-based Investigation of Coastal Erosion and its Effect on the Historic Environment of Bardsey Island**

Abstract Climate change and coastal erosion is currently a major concern for governments and heritage agencies. In 2017 the CHERISH (Climate, Heritage and Environments of Reefs, Islands and Headlands) Project was established to investigate the effects of climate change and coastal erosion on key archaeological sites on the Irish Sea coast in Wales and Ireland. Data are currently being collected from 17 key heritage locations in both countries, including

high resolution LiDAR, UAS and differential GPS surveys, which will be used to assess recent coastal change. One such key site in Wales is Bardsey Island which was chosen by the project because of its exposed location and archaeological and cultural significance as an early Christian monastic settlement.
This paper presents the findings of MSc research in collaboration with CHERISH in which Bardsey was used as a pilot study to analyse CHERISH's survey data with currently developing GIS methodologies for studying erosion susceptibility. The project used ESRI's ArcGIS 10.5 and the U.S. Geological Survey's Digital Shoreline Analysis System (DSAS) to first determine the extent of historic erosion on the island and second, assess where erosion can occur. This was achieved by combining pre-existing geological datasets (Soil parent type and distance from open coast) with the data collected by CHERISH (used to create slope and elevation models). Finally, by combining these results with spatial data from Gwynedd's HER, the effects of coastal change on Bardsey's heritage assets were assessed. This determined that although most of Bardsey's heritage was not in immediate danger within the next 50 years, the rate of erosion around the island's isthmus is cause for concern. The results will therefore be shared with the managers of Bardsey's heritage in order to mitigate the effects of erosion on the island.

4.20pm Martina Trognitz (ACDH-ÖAW) and Florian Thiery (Mainzed)

Title **Wikidata: A SPARQL(ing) Unicorn?**

Abstract In archaeological research and documentation, databases recording finds, sites and analyses, play a central role. Some of these databases are available as online resources, few of them are made openly available and accessible and even less are linked into the Linked Open Data Cloud. This hinders comparative analyses of records across multiple datasets. But there is one database that has been around since 2012 and recently gained momentum: Wikidata.

Wikidata is a secondary database for structured data. Data in it is also enriched with source information, i.e. references about where the information came from. Additionally, connections to other databases, like the Getty AAT, are provided by inclusion of their IDs. In this way, Wikidata not only contains information about e.g. specific archaeological objects, but also helps in providing links to other datasets with further information. Wikidata can be accessed via a dedicated SPARQL endpoint.

We are working towards a little minion: the SPARQL UNICORN. Its aim is to help researchers in using the community driven data from Wikidata and make it accessible to them without expertise in LOD or SPARQL. As a first step, we are currently exploring the already existing tools, as well as the archaeological content in Wikidata and will present our findings along an introduction to Wikidata and its data model.

4.40pm Leo Sucharyna Thomas (University of Edinburgh)

Title **Combining agent-based modelling and geographical information systems to create a new tool for modelling movement dynamics: A case-study of Mesolithic Orkney**

Abstract The earliest Holocene occupation of Orkney is still poorly understood. A lack of obvious sites means that it has, to date, undergone inadequate representation in the wider research agenda. This proof-of-concept study explored the development of a ground-up environment-based site-prediction model; a realistic mobility-resistive prehistoric landscape; and a dynamic human exploratory approach, using advanced computational techniques to place Mesolithic activity within a realistic landscape setting. Constrained variables pertaining to the base physical character produce initial insights into site placement and exploratory movement. This lifts topography and terrain from a passive backdrop to play an active role within Mesolithic studies, moving away from the static frameworks of previous analyses. The promotion of a complex physical environment can be used to test hypotheses and allows the development and layering of more complex input factors, and progresses research by addressing further questions. The approach promotes understanding of post-glacial Orkney and is widely applicable to other situations around the globe.

Saturday Morning

10.20am Lawrence Shaw (New Forest National Park Authority)

Title **Computer Applications in Archaeology and Protected Landscapes: a review of the New Forest Higher Level Stewardship scheme**

Abstract In 2010, the New Forest National Park entered Europe's largest Higher Level Stewardship scheme. With an overarching remit to protect and enhance the natural habitats found in the National Park, the scheme also commissioned a 30,000 hectare remote sensing survey of the open Crown lands. The purpose of this was to improve upon an archaeological record that was considered to be incomplete. Whilst proving successful in its aims, the project has also resulted in a number of additional digital heritage projects which were born out of the base line data gathered by the remote sensing survey. This paper will review how the projects has influenced a number of projects and outputs around archaeological recording, public engagement, virtual environments, citizen science and dissemination. The paper will also review the pivotal role that external collaboration can play in advancing archaeological knowledge and engagement when developing digital archaeology projects.

10.40am Łukasz Banaszek, Dave Cowley, George Geddes, Alison McCaig (Historic Environment Scotland)

Title **Which way archaeological earthwork survey? Some perspectives on illustrating the understanding of archaeological topography in a digital world**

Abstract Earthwork survey, a distinctive and well-established element of British field archaeology, has incorporated techniques including taped-offsets, plane-tables and global navigation satellite systems used to collect surveyed points that are interpolated to produce interpretative plans and drawings. The analytical exploration and understandings of features in the field are expressed through scale-dependent conventions used to represent earthworks and landforms in the produced outputs.

With the increasing application of airborne laser scanning and image-based modelling in archaeological survey, dense point data, which offers 'total coverage' of the study area, is collected and rendered in a proliferating range of visualisations. These are commonly presented as an expression of the monument or landscape without reference to common conventions or explicit mechanisms including *para-* and *metadata* to convey to third parties analytical understanding of the topographic features.

While traditional plans are increasingly regarded as difficult to read by non-specialists, the same is true of many digital outputs, presenting a challenge to the depiction of earthworks, especially so when the survey process seeks an analytical understanding of the remains (e.g. phasing). This paper presents some of the challenges to developing conventions for the outputs of analytical earthwork survey. In this approach we seek to generate illustrative outputs that take advantage of the 'total coverage' of 3D data, at the same time exploring the continued utility of the conventions. In this context, we hope to address the challenge of

merging old and new techniques and methodology to better present understandings of archaeological sites in a digital world.

11.00am Liz Falconer (Bournemouth University)

Title **Cyber Archaeology in Virtual Environments**

Abstract This presentation explores notions of space, place and digital being in virtual worlds and 3D environments, and their applicability to the practice of cyber archaeology. The phenomenological approach to archaeology tends to stress the importance of the archaeologist's senses, drawing on responses from their physical presence in a landscape to enable an appreciation of a sense of place through understanding the materiality of an environment. This presentation discusses the findings from 2 projects that have simulated Avebury Henge and Stone Circle in Wiltshire, UK; one in a virtual world and one in a fully immersive, 3D virtual reality simulation. The phenomenological approach that was applied to experiences in these virtual environments, where sight and hearing senses are restricted and the senses of touch and smell are deprived altogether, is explored. Findings show evidence that experiencing a landscape from an archaeological point of view can be achieved in virtual environments, but that the nature of the experiences is different to those in the physical world. The ability to experiment with designing landscapes, to change environmental aspects in simulations of places that could not otherwise be experienced, and to meet with others in those places to discuss, explore and experience them together has the potential to offer a new practice of phenomenology in archaeology.

12.00pm Samantha De Simone, Andrew Ford, Ellen Hambleton, Paul Cheetham, Martin Smith (Bournemouth University)

Title **Capturing Complexity: evaluation of the applicability of three-dimensional point cloud data for recording the excavation of mass graves**

Abstract Remains of multiple individuals buried in mass graves pose challenges for the recording process. The current study focuses on creating a permanent record of such burials in three-dimensions (3D). It explores the applicability and limitations of 3D point cloud data, generated through multi-view-stereo structure-from-motion (MVS-SfM) photogrammetry, for recording complex deposits of human remains. This technology is applied for recording single burials *in situ*. However, no attempt has been made to assess the accuracy and precision of different parameters on the generation of a single point cloud from a complex assemblage.

The material for this study comprises replica human skeletons, deposited in a simulated mass grave. The grave has been photographed twice. The first set, when digging, depositing the casts and re-filling. The second, during excavation and lifting of the bones. The photographs were acquired with a digital single reflex (DSLR) camera and then used to generate point clouds. In order to acquire metric data, to analyse the multiple layers, measurements were taken with coded targets and a robotic total station theodolite (TST).

This paper presents the preliminary results of the 3D recording of the multiple excavation layers. Among the factors evaluated are the choice of the photographic strategy, the equipment and environmental effects during data capture. With the technology to create 3D models becoming increasingly accessible, there is a need to test the validity and reliability of such models. Moreover, such digital recording permanently stores the excavation sequence in a form inaccessible using conventional techniques.

12.20pm Dr Catriona Cooper, Dr Abi Glen, Daniel Pett, Dr Melanie Pitkin, Dr Jo Vine and Dr Jennifer Wexler (Fitzwilliam Museum, University of Cambridge)

Title **Creative Out-Petts: 3D technologies at the Fitzwilliam Museum**

Abstract 3D printing and 3D technologies have been rapidly adopted by museums and heritage institutions for public engagement and alongside this creative economy industries have boomed to keep up with the market. While there is much anecdotal evidence for the use of these technologies there has been limited investigation into how they can be effectively adopted. In this short presentation we will discuss four projects which combine expertise from three key actors in the heritage ecosystem: a university, a museum and industrial collaborators, to explore the use of 3D prints and technology of public engagement.

Each project explores different opportunities for the sector but also highlights the importance of careful consideration over the most appropriate technology prior to deployment.

These case studies will provide an evidence base for how 3D prints can be applied successfully, and unsuccessfully, within a heritage setting while also allowing our small industry partners Museum in a Box (MIAB) and ThinkSee3D (TS3D) to guide our research from a consumer based perspective and develop their products by working with their target audience.

12.40pm Heather M. Tamminen, Andrew Ford, Kate Welham, and Martin J. Smith (Faculty of Science and Technology, Bournemouth University)

Title **Exploring New Dimensions: Investigating the use of Multi-View Stereo Structure-from-Motion Photogrammetry in Skeletal Sharp Force Trauma Analysis**

Abstract Developments in technology are changing the way that human remains can be analysed and presented to the public. Multi-View Stereo Structure-from-Motion (MVS-SfM) photogrammetry is a fast, accessible, and relatively easy way to create 3D models using overlapping images produced from multiple angles around a stationary object. This process is currently underexploited in osteological research and curation. When studying skeletal trauma such as sharp force trauma, MVS-SfM can potentially provide advantages in accuracy, precision, and repeatability over conventional physical measurements. Whilst methods like laser scanning and digital microscopy can also create 3D models, they are relatively expensive, time consuming, and less available for many researchers. Thus, a method that allows for models to be made with the accuracy and precision of these techniques but with the ease of using calipers would be advantageous. Currently, the influences of the geometry of image capture, 3D control, and photogrammetric variables on the quality of measurements from

MVS-SfM models of this nature have not been fully investigated. Therefore, this paper presents initial results demonstrating how best to use MVS-SfM to create detailed 3D models of sharp force trauma on human remains. Additionally, this technique may present an invaluable resource for digitising, preserving, and studying more detailed aspects of human skeletal remains, also allowing for data sharing between institutions or researchers. MVS-SfM ultimately provides a straightforward method of recording, analysing, and presenting traumatic defects to a variety of audiences.

Saturday Afternoon

2.20pm Eike Falk Anderson and Tom Cousins (Bournemouth University)

Title **Interactive Presentation of Archaeology in the Historical Context and the Present - Virtual Heritage Experiences that Blend Tangible and Intangible Cultural Heritage**

Abstract Improvements in virtual environment infrastructure over the past two decades have ensured that the presentation of tangible cultural heritage using virtual-, augmented- or mixed-reality is no longer an exception. The presentation of intangible cultural heritage, on the other hand, is lagging behind although interactive virtual environments are ideal for this purpose. We have developed a mode of public presentation of cultural heritage that creates a synthesis of both tangible and intangible cultural heritage, providing audiences with a virtual experience that allows the interactive exploration of archaeological remains and also presents these archaeological artefacts in their historical context in form of a serious game allowing audiences to travel back in time to take part in and experience the historical event that resulted in the archaeological remains. A demonstrator to prove the concept is our "Exercise Smash" virtual heritage experience, an interactive virtual environment that allows the audience to take part in a historical second world war training exercise. During the titular "Exercise Smash", conducted in Studland Bay in preparation of the 1944 D-Day landings, several amphibious tanks sank, the wrecks of which have been surveyed by the BU Maritime Archaeology department and recently been listed as scheduled monuments. In the serious game the audience experiences a snapshot in time where they are tasked to land a swimming tank on the beach during the exercise, after which they explore the present-day wrecks in a virtual dive, extending the concept of conventional "Virtual Dive Trails" by incorporating interaction modes of entertainment games.

2.40pm Robert Peter Barratt (Queen's University, Belfast)

Title **3D simulations, hyperrealities and the scientific method: a theoretical and practical approach to calculating astronomical alignments in Neolithic Malta**

Abstract 3D simulations – the use of virtual environments for the interpretation of archaeological sites – are flexible tools that can answer many complex archaeological queries. By providing a non-destructive and malleable venue for experimentation, simulations can create new data quickly and efficiently. However, issues of imprecision and subjectivity have drawn many criticisms from the archaeological community. This is partly due to a mistrust of the 'new' methodologies, but it is rooted in a real lack of theoretical background within Visualisation, which can lead to misinterpretation and bad research.

This paper will focus on core concepts in the scientific method to demonstrate that with a more conscious approach it is possible to confer scientific legitimacy to 3D simulations, minimising inaccuracies and subjectivity. By addressing issues such as hyperrealities, imprecision and the lack of concrete past realities, this paper aims to compare 3D simulations to archaeological theory building and wider scientific methodologies.

The theoretical discussion is supplemented with a test case that attempt to answer questions of cosmological alignments in Neolithic Malta. Extensive work has been carried out on the topic previously, but this paper presents a new approach based on 3D simulation in Unity3D, which aims to focus on issues of intentionality in Maltese temple orientation.

3D simulations are seen not as mere presentation tools, but a collection of hypotheses and experiments with a visual component. With a firm grasp on the scientific method, a more theory-conscious approach can lead to high quality results and overall better research.

3.00pm Gary Nobles

Title **Archaeological Practice in the 21st Century: perfecting the 3D workflow**

Abstract Since 2014, the Kaymakci Archaeological Project (KAP) has been innovating new archaeological workflows for the recording and analysis of the archaeological excavation and its materials. Work is ongoing, however this paper presents the state-of-the-art in terms of archaeological recording methodology and digital recording techniques within a methodological framework. On the international stage a few pioneering researchers are investigating the limits of current technology (3D modelling, GIS, Web presentation, etc.), others (like KAP) are actively developing new technological solutions in line with the archaeological method. While this paper presents the ongoing developments in the creation of 3D Volumetric geometries of archaeologically excavated contexts, it also questions whether the archaeological method itself is fit for purpose in a 3D world? Such exploration and self-critique is crucial for the ongoing technological and theoretical development of the discipline which last peaked (in relation to spatial technology) within the context of the GIS revolution (For instance Lake et al. 1998, Wheatley & Gillings 2000).

▪ Posters

Robert Peter Barratt (Queen's University, Belfast)

Title **3D simulations in practice: a Unity3D script for the analysis of astronomical alignments in Neolithic Malta**

Abstract In the 1980s-90s, Agius and Ventura published a series of seminal articles regarding astronomical alignments in the temples of Neolithic Malta. By calculating equinoxes and solstices, and using a chi square test, they concluded that although there is a high probability that the temples are oriented towards something, there is not enough evidence to suggest a single astronomical event. Yet, later authors have published extensive calculations showing that individual temples align to the sun, the moon or various other stars and constellations. While these results are true for individual sites at specific times, it is impossible to determine intentionality without a clear pattern throughout all the Maltese temples.

Here we use TarxienCore, a specifically coded script in Unity3D to create new data regarding temple orientations. TarxienCore can calculate the position of the major celestial bodies at a specified time and date (up to 4000 BC) and simulate the alignment within the 3D model of each temple. More importantly, the script can calculate the alignment over the entire year or over many years, providing a much wider insight into alignments. The results obtained can then be used for statistical analysis, which show the mathematical significance of each astronomical event. While previous research has focused on individual temples and times, TarxienCore uses 3D simulations to provide a much larger picture. Patterns between sites can be identified, and changed through time become clearer thanks to the newly produced data. And the results are not just significant for Neolithic Malta, as the tools and techniques can be applied to any site or area, allowing for more comprehensive and accurate alignment calculations.

Sarah Hodge (Bournemouth University)

Title **Supporting virtual heritage experiences with Cyberpsychology**

Abstract Cyberpsychology is a new branch of psychology which focuses on applying psychology theory to understand human interactions with technology. Recent exciting developments in technology, have enabled history and virtual heritage to become interactive experiences that can recreate history. One such example includes Virtual Reality (VR) which can recreate historical sites through simulation. Therefore, Cyberpsychology can be used to further support and understand these experiences with history and virtual heritage. This includes understanding and measuring the interaction between human and technology; which is especially important for the role of learning, gamification, flow state (e.g. engagement), and feeling emotions (e.g. awe). These technologies have also enabled for these experiences to measure, recorded and feedback provided, such as users making choices in VR. The poster aims to highlight the psychological concepts, theories, and measures that can applied to the virtual heritage; to support considerations and reflections regarding the human-computer-interaction in virtual heritage. Through incorporating Cyberpsychology it can support adding rigor to virtual heritage through the added value from the psychological perspective to enhance multidisciplinary approaches.

David John and Glyn Hadley (Bournemouth University)

Title **Are Photogrammetry and 3D Scanning a real alternative to 3D modelling for Virtual Heritage applications?**

Abstract Photogrammetry is promoted as a quick way to create realistic 3D models, while handheld 3D scanners are advertised for projects that require greater accuracy. Both technologies are increasingly being targeted for virtual Heritage applications. This paper presents the initial findings of a project that compares both methods for creating assets to be used in game engines to make interactive presentations. A range of test objects were chosen from small artefacts of about 10 cm up to ground features of about 8m in length. Hardware included the Faro Freestyle handset, while photographs were taken using a Nikon digital camera. An iPhone was also found to take adequate images and had an advantage in confined spaces. The time it takes to capture data was equivalent for both methods. More photographs and data points improve the accuracy of models. Bright sunshine was a problem for both methods: the 3D scanner was unable to pick up any data, while hard shadows in photographs produced artefacts in the resulting model. Processing software included Scene, Meshlab and ReCap. The scanner software was quicker to process but stitching together multiple scans can lead to inaccuracies. The polygon count of the resulting models is too high to use in UE4 so further manipulation was required using Maya and Z-Brush. The creation of Normal maps can help preserve detail, but the accuracy of textures is diminished. To modify the models to enable them to be used within interactive game engines still requires a high degree of 3D modelling expertise.

S. de Simone, M. Smith, E. Hambleton, A. Ford and P. Cheetham (Bournemouth University)

Title **Keeping it real: testing the validity of three-dimensional (MVS-SfM) constructs for recording and interpretation of mass burials**

H. M. Tamminen, A. Ford, K. Welham and M.J. Smith (Bournemouth University)

Title **Digital futures for the physical past: investigating the use of photogrammetric modelling in the analysis and preservation of sharp force trauma**

… and a few others TBC.

▪ Showcases/Demos

"Exercise Smash" is a virtual heritage project conducted at Bournemouth University by members of the National Centre for Computer Animation in collaboration with the university's Maritime Archaeology department who over the past few years located a number of amphibious tanks in Studland Bay (outside Poole, UK) that sank during a training exercise in preparation of the D-Day landings in 1944. Extending the limited concept of conventional "Virtual Dive Trails" and incorporating interaction modes of entertainment games, this project provides audiences with a virtual experience that allows the interactive exploration of archaeological remains – diving to the wrecks – and also presents the archaeological artefacts in their historical context in form of a serious game allowing the audience to take part in the military training exercise and experiencing the event - a snapshot in time - that resulted in the archaeological remains. The resulting virtual heritage experience was unveiled during Tankfest 2019 at "The Tank Museum" (Bovington, Dorset, UK) at the end of June 2019.

"Virtual Avebury" is an AHRC/EPSRC funded project under the 2017 Immersive Partnerships call. It is a partnership between BU, National Trust, virtual reality developers Daden Ltd and soundscape specialists Satsymph. We have created a 3D, fully immersive simulation of Avebury Stone Circle, as it may have appeared circa 2,300 BCE. The project has been funded for 9 months during 2018, running from mid-February to mid-November. During this period we created a visual simulation in Unity 3D and embedded a layered soundscape, after which the simulation was evaluated through public engagement.

▪ Organizers and Sponsors

Professor Kate Welham
Dr Fiona Coward
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