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COMPUTER APPLICATIONS
AND QUANTITATIVE
METHODS IN ARCHAEOLOGY
UK CHAPTER

BOOK OF ABSTRACTS

Papers and posters

**Computer Applications and Quantitative Methods in
Archaeology Conference**

UK Chapter

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Hosted by the Department of Archaeology, the Archaeology Data Service and
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ARCHAEOLOGY
DATA SERVICE

THE UNIVERSITY *of York*



Abstracts for papers

Friday 1st February

Session 1

Janet E. Davis (University of York) and **John Cowles** (altcom)

A kitchen garden by any other name: building semantic bridges for historic parks and gardens records

The Parks & Gardens UK project is creating a new web resource about historic parks, gardens and designed landscapes in the United Kingdom. It is led by Parks and Gardens Data Services, supported by the Heritage Lottery Fund, and uses a database and Content Management System built by Altcom Ltd. The project involves volunteers and professionals working together to create around 6,000 site records by August 2008.

Creating a new web resource and database for historic parks and gardens records that will be used by a broad audience has raised some interesting challenges. Two of our key challenges are usability and intellectual accessibility. We need to make the content of the records comprehensible to the non-expert audience, including schoolchildren, lifelong learners, casual browsers, whilst not being too simplistic for the expert audience. A further issue is that the people involved professionally with historic parks and gardens are from diverse disciplines, each of which has its own specialist vocabulary.

This paper focuses on solutions to these semantic and accessibility challenges: the Parks & Gardens 'Thesaurus,' a hierarchical controlled list of terms that is embedded in the database; and the related Parks & Gardens UK Illustrated Glossary that is created within the web site content management system. It looks at the accessibility issues of incorporating word lists within a database with a web interface for both expert and non-expert data entry users; and how sustainability of the Thesaurus has been built into the system.

Rebecca Jones (RCAHMS) and **Jim Devine** (Hunterian Museum, University of Glasgow)

Linking records to enable wider access to the UK's next World Heritage Site?

In 2007 the UK government, through Historic Scotland, nominated the Antonine Wall for World Heritage Site status, and it is hoped that the monument will be inscribed on the list in Summer 2008, joining Hadrian's Wall and the German *Limes* in the trans-national 'Frontiers of the Roman Empire' World Heritage Site. RCAHMS and the Hunterian Museum have been working closely with Historic Scotland to support the nomination process. RCAHMS have undertaken a digital mapping exercise, prepared the nomination maps and upgraded some of the information available in the online database, Canmore. The Hunterian Museum are working towards a new Antonine Wall visitor centre and are leading various education projects, including the construction of a website for the Wall.

Both organisations contain a wealth of collections relating to the Antonine Wall and Roman Scotland in general. The Hunterian Museum holds most of the distance slabs and the major collection of artefacts found on the Wall, and RCAHMS has a large archive relating to its survey and research. The speakers are currently exploring projects to link these geographically separate

collections, to re-establish the link between 'artefact' and 'site' and use current and emerging technologies to present these to the user in both the real and virtual environments. Computer interactives are being developed to allow scholars to access information and images from the respective collections.

An Antonine Wall Centre is being established to provide a showcase for these resources. This will allow any fort site on the Wall to be visited through QuickTime Virtual Reality, taking visitors along the sites of the Wall where the objects on display in the Centre originally came from, and using the partners' collections resources to place the artefacts in context. A computer-generated virtual Roman Fort model will allow visitors to explore the outside and inside of an Antonine Wall fort reconstructed accurately from excavation plans and incorporating finds from the excavation into the virtual discovery experience. The Antonine Wall Centre will also provide audio-guides for use within the Centre, along with downloadable pod-casts of site information and travel routes etc. and updated information provided via RSS (Really Simple Syndication) feeds. Mobile phone downloads will be employed in a similar fashion.

Michael Charno (University of York)

A Futile Attempt at using SVG in Archaeology?

This paper explores the concepts of Scalable Vector Graphics (SVG) and their use in archaeology. SVG is a W3C standard but yet lacks widespread support from mainstream developers and vendors. Additionally, Adobe has announced it will discontinue support for its very popular SVG viewer in 2009, a date which has been moved back from previous announcements. The current situation and future of SVG in general will be discussed, in hopes of putting fears of its potential demise to rest.

A simple tool associated with the Sikyon project will be presented to show the potential applications of SVG within an archaeological context. Because SVG is a data-driven format, many interesting techniques can be employed to present visual data which are not possible with other formats. Eventually the SVG elements of the Sikyon project will be integrated into the existing project database to enable a dynamic and sophisticated presentation of the entire data set.

Leif Isaksen (University of Southampton)

Faceted Geodata: A proposal for improving low-grade geospatial data interoperability

The ubiquity of GIS in modern archaeology and the rise of 'Neogeography' have led to huge growth in the amount of spatial data available for analysis. Much of this is derived from sources, both historical and contemporary, for which traditional metadata is either impossible or very difficult to acquire. Rather than consigning such information to the epistemic dustbin, this paper will argue that much of it can be broadly classified along a number of binary axes, and that in so doing, potential for use (and misuse) can be made more readily apparent to users. The second part of the paper will look at some of the practical issues that would be necessary to implement such a scheme. At the level of technology it will explore mechanisms by which third-parties can formally classify legacy datasets according to the weakest 'assertions' that they may be deemed to make. Such a schema would not only make the integration of legacy data a simpler task, but could also provide the foundation for 'intelligent' semi-automated GIS functions. At a behavioural level the primary issue raised will be the nature of data 'ownership' and the rights of third parties to make formalised public statements about the structure and quality of spatial information.

Session 2

Nicola Schiavottiello (University of Southampton)

The megalithic building of St.Erasmo di Cesi: architecture, astronomy and landscape

The site of St. Erasmo in central Italy is one of the most enigmatic structures of its kind. It is a complex enclosing an area of around 8000 square meters and surrounded by refined polygonal walls, also called “Cyclopean” walls. All in all an introduction of previous studies pursued on the area will be presented, followed by the results of GIS landscape visibility analysis and archaeoastronomy interpretation, thus carrying out a multi-disciplinary approach for the study of this complex and its related structures, this is in order to clarify the function and possibly the dating of this interesting site. Hypothesising the historical function of the site is important in order to create educational material for public dissemination, moreover submitting the final results of the analysis to future generation of archaeologists is important in order to sensitise the scholars that excavation work must be considered in the near future. The complex is in fact often misunderstood by the general public that numerous visit the site for leisure and outdoors activities, however there are no explanation panel and people often mistake polygonal walls with rocks natural formation. Recently graffiti have been found in different parts of the complex and collapses are clearly visible in many parts of its perimeter. Full documentation must be pursued in order to outline a strategic plan for its conservation. Discussion of whatever conservation and reconstruction of the site must be pursued is beyond the scope of this project however information must be given to the public that need full historical and archaeological appreciation of this extraordinary place in the central Italy.

Anthony Masinton (University of York)

Separating Fact from Fiction: Clarifying the difference between data and conjecture in archaeological virtual realities

Complex interpretations of archaeological spatial data can be, and frequently are, delivered almost instantaneously in the form of 3D or VR visualisations. The more 'realistic' the image or VR, the less critically the argument or interpretation of the data behind it is received. This is a well-known problem in archaeology, but is frequently ignored in the final presentation and publication of the data. This has the twofold affect of opening wide possibilities for the publication of misleading or erroneous interpretations and also relegates 3D/VR techniques to mere 'window-dressing'. This paper will explore several possibilities of providing visually compelling interpretations of archaeological data while also making the difference between the known data and conjecture or interpretation evident to the users. In this way the 3D/VR image is rescued from a purely aesthetic role and is rehabilitated as a useful, informative and flexible research tool.

Andy Curtis, David Tuck, David Jones, Joe Gibson, Richard Stroud (Northumberland & Durham Rock Art Project) and **Paul Bryan** (English Heritage)

Photogrammetric Recording of Rock Art with Digital Consumer Cameras

The work of amateur enthusiasts, and Stan Beckensall in particular, has made the prehistoric rock art legacy of Northumberland and Durham some of the best known in the world. About 1500 carved panels mainly of the symbolic 'cup and ring' type and attributed to Neolithic or Bronze Age periods are known. The Northumberland & Durham Rock Art Project (NDRAP) funded by English Heritage (EH) was set up to standardise recording of these panels using teams of trained volunteers. A key aspect of the project was to investigate the practicality of capturing low-cost photogrammetric data with the use of 'off-the-shelf' digital consumer cameras. With the

assistance of Paul Bryan of EH's Metric Survey Team, volunteers were trained in stereo-photographic procedures and the processing of resultant images into three dimensional (3D) models using Topcon's PI-3000 software. Techniques were developed using multiple image sequences in order to capture data across large rock panels. Manipulation of these models enables the carvings to be examined under different lighting conditions and for accurate ortho-images and other metric data to be obtained. The data collected is now being incorporated with the University of Newcastle Beckensall Archive into a new archive and web site designed by the Archaeology Data Service. This is expected to allow public access to both interactive 3D models and raw photogrammetric imagery. Assuming the availability of processing software, we will show that photogrammetry techniques can be used effectively by volunteers with consumer-grade equipment as an effective observational and recording tool.

Gareth Beale (University of Southampton)

An Archaeology of the Mundane: Interpretation and reconstruction of the Grandi Magazzini di Settimio Severo at Portus, Italy

Portus was the principle harbour of Rome for more than three hundred years from its initial construction during the reign the Emperor Claudius in 42AD. Development was undertaken by the Emperor Trajan in the mid second century; it was during this phase of development that the Grandi Magazzini di Settimio Severo was built. The building is situated at the centre of the port and standing remains indicate that it was a very substantial structure.

The primary goal of this project has been to explore the form and function of the Grandi Magazzini di Settimio Severo. It explores the implications of using these terms for architectural archaeology and explains how they might be of use in the analysis of Roman urban space.

Through the use of 3D modelling, a series of virtual reconstructions have been developed. Each represents a differing interpretation of the appearance and function of the building. These have allowed data collected at the site to be consolidated and interpreted in a way which has not, until recently, been possible. It has also allowed the data to be interpreted from a unique perspective.

One of the goals of this project was to bring virtual reconstruction into the research process in a meaningful way. The reconstructions did not only act as illustrative tools, they have also played a functional role in the interpretive process. Using web technologies I have been able to engage in a critical discourse throughout the developmental process, the models have formed a visual focus for this discussion.

Session 3

Gary Nobles (University College London)

Hermeneutic GIS: The Circularity of Horizons around Stone Circles

This paper is a result of a Masters Dissertation which was completed towards the end of 2007; it investigated the circularity of the far horizon surrounding the Recumbent Stone Circles of North East Scotland and South West Ireland. It was largely based upon the previous works of Richard Bradley and Colin Richards, as well as building upon the recommendations suggested by Mark Lake and Patricia Woodman. It aspired to utilise Geographical Information Systems (GIS) technology in an amalgamation with phenomenological techniques in addition to developing a further methodology for this type of analysis. Both statistical and heuristic analyses were applied in an attempt to quantify an impression of circularity. It is these methodologies which are used to illustrate the potential of hermeneutic or phenomenological GIS.

Paul Cripps (Wessex Archaeology)

Building bridges; intradisciplinarity in archaeology

The use of computer based technologies within archaeology has blossomed over the past decade with databases, GIS, 3D applications and survey and statistical tools all being regularly deployed on archaeological projects. Over the same period, the internet has come of age as a platform offering many opportunities. Meanwhile, the trend in mainstream archaeological theory has been away from so-called reductionist, scientific approaches, including computational ones, and towards multi-vocal narrative modes of description, with much less emphasis on rigorous scientific analytical methods. This has resulted in a divide whereby theoreticians have criticised computational or scientific approaches per se and yet regularly apply them: At the same time the archaeological computing fraternity often fail to tackle adequately the philosophical nature of their work, preferring instead to concentrate on technical aspects. As such, we as archaeologists generally go to TAG or special interest group conferences to talk about theoretical issues and CAA to discuss technological aspects with little cross-talking between the two constituencies. Using examples including the nature of data itself and (structured) approaches to it, phenomenological approaches to landscape studies using computational methods and also the nature of cartography and map reading, this paper will propose that increased engagement between computer specialists and non-computer specialists is vital for the propagation of meaningful interpretations of the past in this age of technology and that any barriers, real or imagined, are detrimental to archaeological discourse.

This paper follows on from one given at TAG (York, December 2007) which aimed to explore this issue and the possibility of a middle way, encompassing the strengths of each whilst minimising potential issues arising.

Damian Murphy (Department of Electronics, University of York)

Acoustics, Archaeology and Heritage

Virtual interactive environments, especially in online gaming and similar applications, are now a highly popular sector in the entertainment industry, and offer high quality graphical rendering of virtual worlds and user interaction and immersion. Such graphical virtualization techniques have long been used in the fields of archaeology, history, and heritage as a means to better understand, interact and experience past environments. However, sound design is usually perfunctory at best in such applications and makes little use of recent similar creative and technological developments in the field of acoustics and audio processing. It is generally agreed that good and considered use of high quality sound design can work with the imagination to evoke powerful images or memories, or provide important auditory cues to the nature of events in the virtual environment, either in support of or parallel to the visual stimulus.

This work discusses a number of aspects relating to the use of sound in archaeology and heritage applications. A recent acoustic survey of sites around the UK is reviewed, where sites have been selected based on features of specific acoustic interest, leading to insights as to their characteristics and construction. Computer based acoustic modelling techniques have been used to reconstruct the sound of Old Coventry Cathedral, based on available architectural data. Finally, A Sense of Place was a sound/light installation that used these techniques to explore the 2000 year old link between two of the oldest buildings in York - York Minster, originally the site of the Roman Legionary Headquarters and the symbolic heart of the City, and Bootham Bar, one of the four main gates of the Roman legionary fortress and still used as an entrance to the city today.

Saturday 2nd February

Session 4

Bill Wilcox (University of East Anglia)

Archaeological Settlement Predictive Modelling

A talk highlighting a few issues relating to my research to formulate archaeological settlement predictive models for the Anglo-Saxon colonization of East Anglia;

An introduction of why some countries invest heavily in archaeological predictive modelling and why this can be a potentially dangerous thing.

Discussion on the suitability, scale and variance of different environmental parameters available for modelling. The virtual lack of social parameters for modelling, leading to accusations of 'environmentally determined' models. Problems with different archaeological datasets used to model – exactly what is the HER and NMR? What do field walking results say about past settlement patterns?

Discussion on multi-co linearity problems within the logistic binary regression analysis caused by environmental parameters with similar properties. Problems with too many variables within a parameter. When it comes to predictive modelling, does the size of input data matter?

What does a predictive model actually tell you? The general lack of independent testing procedures for archaeological predictive models and one suggested independent procedure for testing an Anglo-Saxon predictive model.

How well does archaeological predictive modelling work and how do you rate a model's success? Why do my archaeological settlement predictive models of East Anglia have lower predictive capabilities compared to other predictive models? Is the difference due to the modifiable areal unit problem? What effect does geography have on the success of predictive models?

Giacomo Landeschi (IMT Institute for Advanced Studies Lucca)

The archaeological risk evaluation in the Pisa Coastal Plain

In this paper will be presented the results obtained in the course of a research project regarding the archaeological-topographical study of a portion of the coastal plain of Pisa, anciently known as the *Portus Pisanus* area and occupied by an extended lagoon, where a predictive model was tested in order to map the archaeological risk from an inductive approach, that considered the relationship between some environmental parameters and some archaeological sites that have been already studied in the last twenty years. The aim is to integrate the values of risk obtained through the spatial analyses managed within a GIS with the previous knowledge of the topographic context, gathered in a multidisciplinary perspective, in order to have a complete perception of the archaeological potential of the area, so that the environmental variables used to build the model are linked to an assessment of the cultural aspects involved in the determination of the human settlement distribution.

For this purpose, five maps are produced, (lithological, land use, aspect, slope, altimetry) and used as predictors after a significative correlation between them and the sites distribution has been demonstrated. So the final predictive model is the result of a raster overlay in which each

cell represents the mean value of all the values contained in each predictor at the same spatial coordinate. The map obtained could be a useful tool in helping the archaeologist to monitor and preserve a wide area (that nowadays is interested by many public works), by establishing priority criteria on which he could have an immediate vision of the high-risk areas, that anyway has to be associated with a good knowledge of the cultural factors, that is essential in the interpretation of a such non-deterministic thing as the development of the human settlement in a diachronical perspective is.

George Daghli (Independent Analysis and Computation)

Semblance, “Uniform Gain” and Similarity: Discovering pattern in archaeological remains

At Lightwater in Surrey, an Iron Age - Roman site has been revealed by recent excavations. Roman Industrial Sites together with Iron Age smelting activity have been unearthed. Slag and Kiln Bases to a total of 4 tonnes were found across the area.

The Roman activity has destroyed the integrity of the pattern of the Iron Age remains. To rediscover some order, the following Mathematical Methods are invoked.

The Semblance Function, S , is defined for the comparison of a set of Profiles, $a_{i,j}$, as:

$$S = \frac{\sum_{i=0}^{n-1} \left(\sum_{j=0}^{m-1} a_{i,j} \right)^2 - \sum_{i=0}^{n-1} \sum_{j=0}^{m-1} a_{i,j}^2}{\sum_{i=0}^{n-1} \sum_{j=0}^{m-1} a_{i,j}^2}; \quad \text{For normalised pairs of profiles, } S \in [0,1].$$

The “Uniform Gain”, N , is defined as:

$$N = \frac{1}{S} \left(1 \pm \sqrt{1 - S^2} \right); \quad S \in [0,1],$$

$$N = \sqrt{\frac{\chi^2}{\sum_{i=0}^{n-1} T_i}} + \text{Unity}; \quad \chi^2 = \sum_{i=0}^{n-1} \frac{(O_i - T_i)^2}{T_i}.$$

O_i and T_i are the “Observed” and “Theoretical” Profiles.

Their properties are then discussed:

- **“Uniform Gain”.**
[This section displays derivations of N , above, and defines the implications of values that N assumes. $N \in [1, \infty]$, where Unity implies Similarity. Increasing values indicate divergence.]
- **Semblance as an Equivalence Relation.**

[Separating information into classes with minimal overlap can be achieved using the Semblance Function.]

- **Comparing Groups of Profiles with the Semblance Function.**
[Values of S , comparing groups of normalised Profiles, are scaled as $S \in [0,1]$. *Zero* implies Dissimilarity. *Unity* implies Similarity.]
- **The Limiting Values of S , for general cases of two Profiles.**
[The range is from Antithetical to Similar, i.e. $S \in [-1,+1]$.]
- **Calculation of Degrees of Similarity associated with Threshold Values.**
[Objective measures for comparing “Similarity” and “Congruency” are determined.]
- **The Relation between Semblance Thresholds and the “Uniform Gain”.**
[The “Uniform Gain” concept is explored and generalised:

$$N(S, \Theta) = \frac{1}{S} \left(\cos \Theta \pm \sqrt{\cos^2 \Theta - S^2} \right).$$

Θ is the angular divergence between Profiles.]

Session 5

Mike Rains (York Archaeological Trust)

Enhancing the Stratigraphic Matrix Diagram - recent developments in the IADB

Whether working with digital or paper based records, archaeologists make use a variety of different approaches to their excavation data and the process of post-excavation analysis. Some will take a catalogue based approach, starting from the individual written Context records, others will use the plan record as their starting point, whilst some will see the stratigraphic matrix diagram as being at the heart of the post-excavation process. The choice of approach may be determined by the nature of the excavation, combined with personal preference. Although the Integrated Archaeological Database (IADB) has included support for all these elements for many years, this paper will describe significant recent developments which have taken the stratigraphic matrix diagram in the IADB beyond the simple graphical representation of stratigraphic units (contexts) and the relationships between them, to become a general purpose visualisation tool capable of representing and encapsulating a wide range of archaeological records and relationships both stratigraphic and non-stratigraphic. At the heart of this is the ability to add non-stratigraphic units such as images, plans, other matrix diagrams, artefact records, etc to a diagram and establish links between them. The ability to add and link other matrix diagrams opens up the possibility of a matrix of matrix diagrams - one possible approach to the problem of dealing with the stratigraphy (and stratigraphy diagrams) of large excavations.

Graeme Earl (University of Southampton)

Digital recording strategies at Portus

This paper will provide a case study for some initial attempts at digital recording at the site of Portus, Italy. It will concentrate on object and architectural recording methodologies including polynomial texture mapping and laser scanning.

Emma Jane O'Riordan and Matthew Grove (University of Reading)

Virtual Environments for Research in Archaeology Project (VERA)

During the summer of 2007, the Roman town of Silchester was dragged into the 21st century as the trench went wireless. During the six-week training excavation for the University of Reading, the JISC funded Virtual Environments for Research in Archaeology project (VERA) trialled the use of handheld technologies for on site data acquisition.

This paper presents the results of these field trials and describes how the lessons learnt during the excavation, as well as interaction with the Silchester specialists, have been used by VERA to further develop the existing Integrated Archaeological Database system (IADB) into a fully-fledged virtual research environment. The paper also discusses the future aims of the project and how VERA will continue to develop tools and utilities that help encapsulate the working practices of current research archaeologists unfamiliar with Virtual Research Environments (VREs).

The aim of the VERA project is to provide archaeologists with a means to share their research and results before, during and after excavation. In order to do this, VERA will create advanced computer-based tools for data acquisition and management, as well as producing a standards compliant web portal with integrated tools for the user community. VERA is also working towards creating an ontology for describing Roman excavations, to enable more efficient cross-database searching between VREs.

VERA is a collaboration between the Department of Archaeology and the School of Systems Engineering at the University of Reading and the School of Library, Archive and Information Studies, UCL, this combination of expertise allows VERA to pursue a user driven approach which is sensitive to the existing archaeological processes and procedures.

Joseph Reeves (Oxford Archaeology)

One laptop per archaeologist: Oxford's open archaeology

Oxford Archaeology is committed to a policy of Open Archaeology, a theoretical and technical approach to the process of Archaeological practice, archival and dissemination. A key element of the Open Archaeology paradigm is the belief that data should be born digital; to this end, pens and paper will be removed from our sites and each field archaeologist given the tools to interact with digital data in the field from their own mobile device. Social networking becomes embedded within the recording process; the devices people are equipped with connect them with both the material evidence of the past and their present day colleagues.

This is, at least, the plan. This paper will briefly outline the importance of the Open Archaeology approach to the discipline and the key technical points that support it. Oxford Archaeology's research into Digital field recording will be discussed more fully, highlighting the various approaches under review, as well as the technical and theoretical successes and challenges encountered so far.

Digital field recording is the future of archaeological practice and Oxford Archaeology aims to become one of the leaders of this approach. The technology required is within reach, and the associated mindset is present in many of those involved. Most importantly is the realisation that a paper-free excavation is a worthwhile goal, that can enrich and inform the archaeological process, and one that should be achieved in a relatively short period of time.

Kayt Armstrong (Bournemouth University)

Archaeological Prospection in Peatland Environments: Thinking in 3D

This paper presents my current research project, which started in January 2007. My overall aim is to develop a geophysical 'toolkit' of field techniques and data processing routines for use in archaeological prospection in peatland environments. A non invasive prospection method for these environments is badly needed because of their great potential and the threats they face. The waterlogged and anaerobic nature of peat deposits often preserves organic remains and valuable paleoenvironmental information. This is in contrast to other soil types, which almost invariably leave only those items with a mineral component. Waterlogged sites offer priceless insights into how organic materials were used by past cultures, and have preserved wide ranging finds, from immense trackways through the fens to personal items of clothing, tiny yew wood pins and traces of cordage and fabrics.

This particular discussion will focus on the problems these environments pose in terms of visualising the 'third dimension'- conventional geophysical techniques in the UK usually deal in two dimensions, conflating the third. GPR data is the exception to this rule, and I will consider how approaches to this type of data might be adapted to other techniques. Potential data processing solutions to this issue will be considered, and some preliminary results will be presented from two of my case study sites. The use of GIS in analysing, displaying, and interpreting geophysical data will be explored, as will issues surrounding the meaningful comparison and integration of data gathered by different instruments.

Stephen Malone (Archaeological Project Services/Witham Valley Archaeological Research Committee)

Exploring the micro-topography of the Witham Valley: Applications of lidar-derived surface modelling

The use of airborne laser altimetry (Lidar) as an archaeological tool has become increasingly established, both for prospection and mapping of archaeological earthwork features and for placing those features in a wider landscape context. Within the marginal landscapes of the Lincolnshire fenland this landscape context is crucial and lidar survey is providing new insights into past human use of the landscape.

The 35km reach of the Witham Valley between Lincoln and Tattershall preserves a rare landscape where the fenland edge interfaces with a true river valley environment. It is also a rich cultural environment with widespread evidence of human activity from the Mesolithic period to the present day. Desiccation and gradual shrinkage of former peat cover within the valley has exposed remnants of the creek and channel systems of the prehistoric estuarine drainage network along with features of the contemporary archaeological landscape.

Using Environment Agency data a series of detailed plans and digital terrain models of the valley have been prepared allowing the identification and characterisation of palaeodrainage features over a wide area and with considerable chronological depth. This represents a significant advance in the understanding of the relationships of past human activity to the micro-topography of the valley.

The subtle topography of this landscape responds particularly well to Lidar and the approaches used in this survey programme will have wider applications within the Fenland of eastern England.

Chris Green (University of Leicester)

It's about time: temporality and intra-site GIS

Archaeology is fundamentally temporal, and thus GIS approaches that ignore time are limiting. Attempts have been made to address this, but they have been case-specific or avoided the concerns of everyday archaeological enquiry. Further, they have not fully engaged with theoretical developments regarding the nature of archaeological time.

Archaeological time takes two forms: the constructed temporality of chronology; and the perceived temporality of past persons. The former is complex: multi-linear, topological and uncertain. As such, existing temporal-GIS (T-GIS) are insufficient, being based around temporally precise data. This research seeks to bring T-GIS functionality to existing GIS (ArcGIS), but based upon explicitly archaeological data and questions.

The software deals firstly with the fundamental uncertainty of archaeological dates, by comparison of the date range intrinsic to each date to the date range selected by the user, using several different methods. The temporal topological relationship is also recorded between each date and the time-frame selected.

The output can then normalise any spatial analysis undertaken, according to the likelihood of each date falling within the period of interest. As such, the software takes forward spatial analysis into the time dimension and forms a foundation for introducing further temporal models into analyses. It also provides a tool for moving beyond conventional chronology through weighted timelines produced from the uncertainty profiles for each date.

This software takes forward the agenda of archaeological T-GIS, by dealing with the fundamental uncertainty of archaeological dates whilst remaining within the "software horizons" of the average archaeologist. The next stage would be to produce a solution that also took account of the stratigraphic relationships between the dates plotted.

Nicola Schiavottello (University of Southampton)

The Magic Tour

The aim of this project is to provide to the medieval town of Southampton (UK) a new information system that could serve for tour guides as an augmented and enhancement set of visualization tools delivered to the public on tablet pc. The research and implementation will be restricted to the part of the town that is included in the ancient medieval walls. However because of the maritime nature of the site, sometimes the boundaries will have to be crossed in order to present the original seascape that once surrounded this beautiful medieval port. This will be achieved for example by installing some significant information points near the main gates in order to represent what was the ancient view from that particular point at a certain time in the past.

The research project will propose a presentation of augmentation in situ with the use of mobile computing to acquire presentation material. It will be assumed that the reader will have some basic familiarity with augmented reality systems. Even if some technical advice will be given, it is not the aim of this paper to explain the functionality and technicality of augmented reality itself as the reader could refer to the number of papers, books and web references provided in the bibliography, but rather to exploit their potential as it is applied to cultural heritage and archaeology.

It is hoped that in the future, techniques of augmented information systems will be exploited more often and that this proposed design project would be considered as possible solution to offer to

the visitors of Southampton a new way to visualize the ancient elements of this town and the events that characterized it during any historic periods.

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ArToolkit Plus

<http://studierstube.icg.tu-graz.ac.at/> [last accessed 21/01/08]

Augmented reality for 3dsMAX

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Ordnance Survey UK

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Abstracts for posters

Sarah Croker, Warren Reed, Denise Donlon (University of Sydney)

Can cortical bone thickness measurements be used to distinguish human from non-human bone? A preliminary study of the tibia

The swift identification of a bone as human or non-human is an important first step when skeletal material is encountered. Yet if the bone is fragmented, identification based on morphology may not be possible. There is a need for a simple straightforward method of fragment identification, and the thickness of the bone cortex in long bone shafts has been suggested. This study aimed to explore this method using digital radiographs of the tibiae of humans and several similar-sized non-human mammals common in Australia – kangaroos, sheep, pigs, large dogs and cattle. Measurements of whole bone length, and shaft diameter, medulla diameter and cortical thickness at the midshaft were made on two radiographic projections (antero-posterior and medio-lateral) of each tibia. A range of statistical tests helped describe the data. ANOVA determined that differences existed between some of the groups, and Newman-Keuls tests were used to show where these differences lie. Unfortunately, for the tibial midshaft, there was no clear difference in cortical bone thickness between humans and all the non-human groups; the human group clustering with different non-human groups depending on which side of the bone was being examined. Correlation statistics were used to help explain the observations; for example, the close relationship observed between cortical bone thickness and total shaft diameter.

Mark Dover (Bournemouth University)

Detailed 3D recording of the Durrington Walls Neolithic Houses: Point cloud Synergies

The Stonehenge Riverside project is a major collaborative research project conducted by five UK universities, and aimed at unravelling the prehistoric development of the Stonehenge landscape. In 2004, the first Neolithic Houses were recorded at Durrington Walls; subsequent excavations have identified 7 in total.

In 2007 the excavations of the houses was accompanied by a program of Laser Scanning of the living surfaces, as a detailed record of their topography. To overcome a perceived lack of data from negative features, this data was combined with information derived from Differential Geographic Positioning System (DGPS) equipment, producing accurate topographic models.

The initial laser scanning was undertaken with a Leica Scanstation, with scans taken from different positions, to provide adequate coverage. These scans were then combined, in Leica's Cyclone Software, using common HDS targets. However, the Leica Scanstation can be geospatially referenced in the field, using known coordinates. This meant that each Point position was recorded in Ordnance Survey (OS) 6 figure x, y and z, rather than a local grid.

The scanner footprint and lack of tilt meant that negative features could not be sampled. This was overcome by using DGPS, to gather the required point information, in 6 figure OS x,y,z. Combined with exported 'cleaned' point cloud data, in Esri ArcGIS, it led to an accurate representation of the excavated houses.

This innovative synergy of different surveying solutions produced TIN frameworks and raster representations of the house that could not have been achieved by one method alone within the excavation timeframe.

Patricia Murrieta Flores (University of Southampton)

Mobility, Transhumance and Prehistoric Landscape: A GIS Approach to the Archaeological Landscape of Almaden de la Plata in Andalucia, Spain

This poster shows some of the results obtained from the investigation of diverse hypotheses that have been proposed between the relationship of megalithic monuments as markers in the landscape and transhumance routes in the Sierra Morena Occidental, especially in the Almaden de la Plata area. Through the implementation of statistical methods, the spatial correlation between the archaeological elements was explored. A Geographic Information System was also used to create a spatial model using mobility and least cost path analysis with the purpose of understanding the trace of pathways as the product of social and historical processes.

Nicola Schiavottiello (University of Southampton)

Archaeological practice, dissemination and education through the technologies of VR and AR

After more than a century of archaeological practice, archaeologists are still struggling to find the right balance between public dissemination and conservation of the cultural heritage, mainly “in situ”. Also museums are struggling to find the right tools for education, preservation, as well as dissemination of the history of the artefacts.

In many countries, virtual realities have long entered our day-to-day life in research and education, but sometimes have struggled to represent natural models with easy understandable applications and at the same time with descriptions of uncertainties. This is mostly due to the fact of the technological limitations at the expense of the content.

This poster presentation discusses the advantages and the disadvantages of using virtual and augmented realities for the dissemination of cultural heritage and education, by presenting a personal experience of a virtual reality museum display projects undertaken under “The Virtual Landscape Centre” at the University of Stirling in Scotland. This subject will be further presented throughout a museum design project undertaken at the University of Southampton, which includes the exploration of augmented reality for tourist guides as an enhancement set of tools as well as digital displays in museums. Some of the themes that will be addressed during this discussion will include:

- The need of preserving and presenting artefacts.
- Archaeological interpretation and reconstruction in situ.
- Storytelling and oral culture through visual technologies.
- The real cost and the accessibility to this type of technologies.

It is hoped that after this discussion the audience will be more sensitised to the need of different visualisation technologies as a way of learning process, its positive and negative consequences.

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Ladislav Smejda (University of York)

Aerial photographic and GIS recording of a prehistoric hillfort

A prominent multi-period hillfort, Zahorice-Vladar (Karlovy Vary district, the Czech Republic) has been subject to substantial archaeological investigation since 2000. In addition to some older chance finds, such as the small bronze figurine of a warrior (probably imported from the East-Alpine Hallstatt circle), new discoveries include a wooden structure of yet unknown purpose (probably of the Early Iron Age), an iron sword and other small metal finds of the Late La-Tene period and a water cistern filled by sediments containing rich environmental record, spanning from the Early La-Tene up to the present. A wide range of digital spatial technologies have been used to record diverse features of this intriguing site: aerial photography and photogrammetry, GPS survey, 3D positioning of small finds in excavation trenches, GIS mapping and analysis.

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