AHRC ICT Methods Network Seminar

THEORETICAL APPROACHES TO VISUAL REPRESENTATIONS OF PAST ENVIRONMENTS

GOLDSMITHS COLLEGE, UNIVERSITY OF LONDON, 7 MARCH 2007

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Introduction

Computer graphics has become a popular way of interpreting past environments, for educational and entertainment value, and also as an aid to research. The use of three-dimensional computer modelling to create an image of a site or artefact has become an accepted means of communicating cultural heritage information.

Although computer graphics have been used in archaeology for about 20 or so years, and despite an early awareness that this is an area strongly in need of critique and a theoretical basis, to date cohesive discussion has been limited. It seems to be only recently that we have seen representations of past environments being treated as a distinct research subject. A community is being forged with these historical and archaeological representations as the focus. We have moved away from creating virtual heritage merely because we can, from the idea that such representations are a way of depicting something for illustrative purposes, or for showing off new graphics techniques, or generating publicity for a site, for example. Nowadays we are working on the representations because they give us new information; they are research tools in their own right.

Computer generated images are not subject to the same scrutiny that text invites, and given the selectivity of a dataset, the motivation behind the work and the inclusion of inference, the possibility of misinterpretation is likely to be high. However, a neutral virtual representation is unlikely, if not impossible. Without any indication of the underlying motivation, we are left with images that are merely one subjective picture of the past.

Something that proves particularly difficult is how to provide context of an intangible nature, such as a social, temporal or even emotional interaction with - or reaction to - the representation. For example, many reconstructions are sterile, empty spaces, devoid of the people who would have built and used them. We need to look at ways that allow us to convey information outside of the physical depiction of a scene.

The seminar was proposed because of several topics that seemed likely to benefit from a collaborative framework of specialists. These include:

- The Need for a Virtual Past - Why are virtual representations being created? Are they really being used, and if so, in what way? How do virtual images aid understanding of past environments? How do we choose which aspects of a multifaceted site to represent?

- Establishing Interdisciplinarity - How do we reconcile the work of computer scientists with the work of archaeologists? What are the goals of the participants in terms of their own subject areas? How do we go about creating awareness of the issues for both computer scientists and archaeologists?

- Conveying the Intangible - How do we introduce non-visual and intangible elements to our representations? Is it desirable, or even possible, to recreate a 'true' sense of the past? Can we establish an agenda for advancing research in this field?

The principal aim of the seminar was therefore to bring together specialists in the Arts and Humanities and Computer Science to speak for 5-10 minutes each about their own research, followed by collective, open discussions on five areas:

- Discussion 1: The need for a virtual past
- Discussion 2: The state of the art
- Discussion 3: Conveying the intangible
- Discussion 4: Misrepresentation
- Discussion 5: Establishing interdisciplinarity

Following the discussions, time was set aside for "research speed dating" where participants could circulate and meet others in the seminar for short periods of time in order to facilitate networking and collaboration. The seminar concluded with a summation of the day's deliberations.

Participants' Research

The seminar begin with a presentation from each participant on their research in the field of virtual heritage:

Richard Beacham spoke of unreal structures such as scenery paintings where the original artist had a mind's eye image that we try to reconstitute in our own mind's eye. He explained how we try to make visible the unseen.

Hugh Denard talked about the relationship between conjecture and fact in what we create and how we might go about evaluating this. He gave an account of the London Charter and the work being carried out to create technology-independent standards for visualisation.

David Humphrey's research concerns late medieval jewellery and he has been focusing on the problems with determining how such items were sited and worn on the body and how, ideally, the currently limited virtual environment should be extended into a much bigger environment.

Babak Davarpanah discussed the trans-disciplinary nature of his research in regard to heritage and urban planning. Heritage is of importance to others outside of the heritage sector such as planners, engineers and the public, and thus we should be seeking community cohesion.

David Webster considered how archaeologists use images, describing it as an old job with new media. He asked us to consider what role these images played and what exactly the archaeologists want from them.

Maria Gabriella Micale's research deals with the influence of prior reconstructions on virtual reconstructions and the influence of reconstructions and drawings on national identity. She also suggested analysing our virtual reconstructions with the same method as archaeological illustrations.

Frederic Fol Leymarie's area of research is computer vision and he is interested in what use virtual heritage can be to an archaeologist actually working on a site, including how best to interface with large amounts of data.

Melina Giannakis works in four dimensions – three-dimensional space plus time. She is concerned with representing how the world has changed over time: how did people in the past represent their own world? Did they represent it as we did? She highlighted the dichotomy of the subjective (perceptual) experience of time and the objective (measured units) experience of time.

Carl Smith described his work with very accurate (millimetre), very detailed models, working from two-dimensional elevations and extruding them into three dimensions. This involves deconstructing objects into their units of construction.

Damian Murphy spoke about his research in acoustic rendering, the sonic equivalent to visualisations. His work crosses the disciplines of music and engineering.

Stuart Jeffrey explained the work of the Archaeology Data Service and talked about the problems faced regarding the melding of models into much larger landscapes.

Tim Holmes applies Darwinian theory to optimisation techniques, bringing together visual perception and evolutionary computing in the design process. He is concerned with the essence of objects, and of representing contextual information visually.

Eleftheria Paliou is analysing visibility in visually complex spaces, creating cumulative visibility maps. She is also using autonomous agents to examine how visibility is related to patterns of movement.

Maria Sifniotis is determining how to visualise the amount of knowledge and confidence we have about a reconstruction, including the factors that influence the archaeologists' knowledge. This ties into community-based contributions to archaeology.

Sorin Hermon talked about the virtual reality (VR) pipeline from research to acquisition and through to communication. He asked how we might go about documenting the process, and how data mining might be used with VR. He suggests that we need to move away from an Aristotelian view in archaeology towards a more fuzzy view.

Janette Bonar-Law is working towards engaging children with their local cultural heritage through the use of a VRML toolset that they can use to create models of local buildings. She has also been working on mapping projects and spoke of the difficulty in establishing narratives to sit alongside the geospatiotemporal data.

Kate Devlin spoke about her interest in conveying social aspects of the past, in particular how to convey human presence in virtual representations of heritage.

The need for a virtual past and the state of the art

This topic of discussion focused on questions raised by several of the participants during their presentations – are we working towards providing a service for archaeologists, or have we begun to create representations that stand on their own? From that, how does the state of the art reflect this?

It was noted that virtual reality opens a completely new way of thinking, allowing us to explore vague hypotheses. Often, we think in two dimensions in archaeology when dealing with representation (e.g. site plans), neglecting the concept of space. However, space is part of our actual experience in our day-to-day existence. Sorin Herman described this as *modelling of* and *modelling for*, where the former is an attempt to recreate the sense of space at the time and the latter is a way of examining how space is structured.

The discussion then moved to the uptake of virtual models from the heritage sector. There was a general consensus that feedback from the heritage sector suggested there were beliefs that one needed to be an expert to create such models, that there was a lack of standards leading to a lack of confidence in the resulting model, and that copyright, sharing of data and cost were hindering factors. It was suggested that explaining the process to the end user might go some way to reducing scepticism.

Digital preservation was flagged as an area of great importance, without which the virtual models become what Melina Giannakis described as 'digital dust'. Digital ephemerality is a subject about which everyone is concerned. Stuart Jeffrey commented on the fact that information is meaningless without metadata, and that it requires a huge infrastructure of the sort provided by the Arts and Humanities Data Service (AHDS) and the Archaeology Data Service (ADS) to maintain and preserve digital information. Without guaranteed preservation of the data we gather and the models we create we have no way of future proofing the work we have carried out.

Conveying the intangible

We can build and represent structures from the past with comparative ease but are limited when we try to portray aspects of the past that are not immediate and visible. For Richard Beacham, this includes theories of deportment and posture. For Kate Devlin, it is the difficulty in showing humans and signs of human habitation and portraying emotive aspects. David Webster described how we are never simply in 'space' – we create a 'place' instead. Stuart Jeffrey asked why, when we move into a different media such as VR, do we begin to question 'reality'?

This led in to a discussion about Second Life and virtual worlds, including the idea that Second Life can lead to two versions of reality, the physical and the mental. Second Life was considered to be a good example of an easy acceptance of virtual worlds with excellent potential for sharing information. Hugh Denard called for a shared environment to break down barriers between experts and interested users, providing a set of tools for collaborative work. This was welcomed by the other participants.

Misrepresentation

The possibility that our reconstructions may be misleading is of great concern to those working in virtual heritage. Archaeology by its very nature is selective: the archaeological record survives according to the conditions in which it resides, its discovery often depends upon sampling, excavation is carried out on only a part of what survives, the way in which a site is excavated is further limiting, and finally this fraction of the whole is subject to the interpretation of whoever excavated it. We must then base our representation on the fragmentary evidence that has come through this process. Here we face multiple problems, not least: how do we deal with conjecture, and how do we make it clear that we are providing our interpretation - an interpretation that may be one of many?

Sorin Herman described concepts from fuzzy set theory to address the problem. The modeller can establish a reliability index and the user can change parameters. The indices are based on primary data. Fading, ghosting and colour can be used to suggest conjecture, and a possible method of visualising alternatives is to use split viewing windows.

David Humphrey asked how one establishes the granularity of truth – are we expected to provide stereovision, for example? Damian Murphy responded from an audio perspective: a telephone is appalling audio quality but is perfectly acceptable, so we can easily get by with something that is perceptually pleasing.

It was generally agreed that this is potentially a problem for any medium in any discipline and that explaining and exposing the processes involved in the creation of the virtual model reduces the possibility of misrepresentation.

Interdisciplinarity

As with research in any two seemingly disparate disciplines, problems arise when trying to negotiate the middle ground between Archaeology and Computer Science. The verifiable logic of Computer Science

does not always sit well with the abstract theorising of the Arts and Humanities. How, therefore, do we make each other - each side – aware of the issues?

Many participants cited examples of being asked to provide the impossible from clients with no technical background, or of anachronisms from technological experts with no grounding in archaeology. Many also had personal experience of their interdisciplinary research being perceived as weak in both of the fields in which they worked. Damian Murphy remarked that this was not unusual in the fields of music and engineering also, but that networking and large European Union projects have helped forge a stronger community.

All of those present commented on the need for a common language between disciplines that would allow better communication and permit us to define the research questions with more clarity. This discussion also highlighted the need for the correct toolset and software for the creation of virtual models.

Conclusions

The main goal of this seminar was to bring together researchers from both the Arts and Humanities and Computer Science to discuss the problems they face in their work and how best these might be addressed. Many of those involved found the experience useful, gaining a wider view of what was happening in this and related fields, and in meeting new acquaintances with similar interests to their own.

Several themes emerged over the day's discussions. First, that we all face similar problems when determining what aspects of a site to portray. This includes establishing methods to deal with the potential of misrepresentation. Mathematical approaches and documentation of the processes involved can aid this, and the emerging London Charter (http://www.londoncharter.org/) is a step towards transparency of information. Second, that data preservation is a key concern, and that digital information must be preserved, especially if the data is to be reused. Finally, that we must establish a common language to share ideas and formulate research questions between the diverse disciplines of the Arts and Humanities and Computer Science.

Acknowledgements

The author would like to thank the seminar participants and the AHRC Methods Network team, in particular Neil Grindley and Hazel Gardiner.