MOTION IN PLACE PLATFORM: VIRTUAL (RE)PRESENTATIONS OF IRON AGE MOVEMENT

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Over centuries, societies have built up a wealth of written knowledge of human behaviour and emotion in response to specific sites. Such narratives are, however, subjective and not necessarily quantifiable. At the same time, the physical study of a site or the cataloguing of material objects falls short of capturing the human experience of a site. MiPP is developing technologies and research strategies to understand a site by moving through it.

Figure 1: Capturing Archeologists working on site in Silchester.

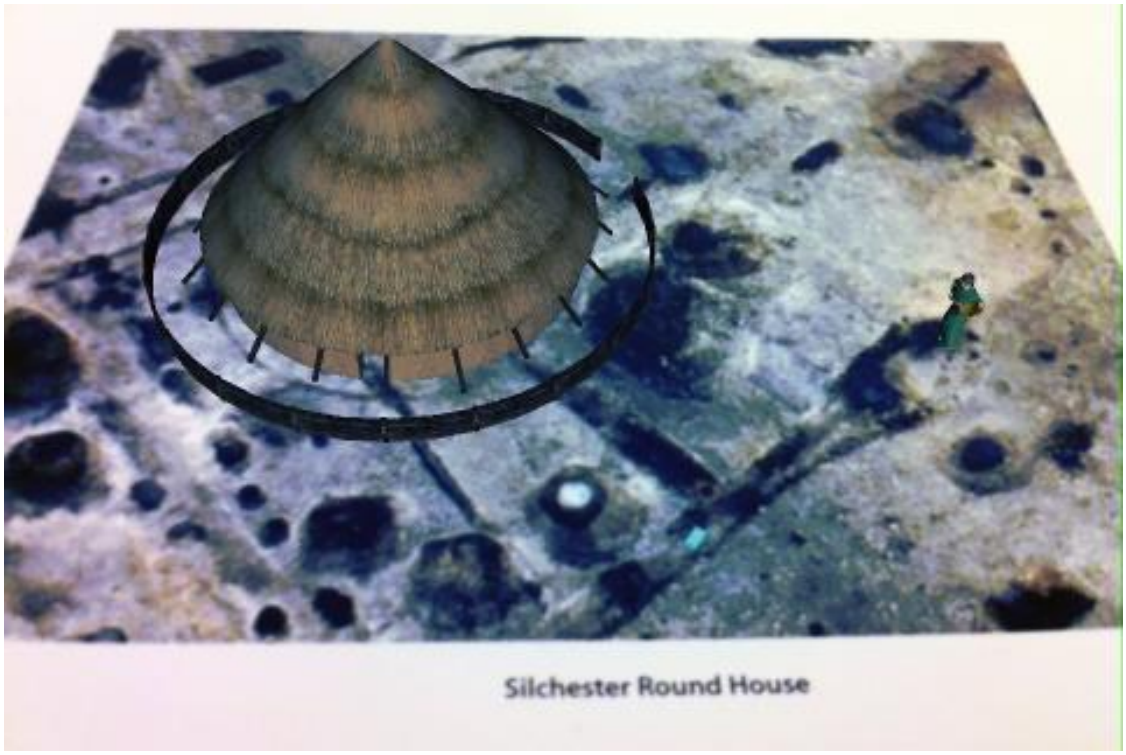

Figure 2: Live, Augmented Reality rendering of Silchester Roundhouse and Iron Age inhabitant.

Figure 3: Live capture in a re-constructed roundhouse at Butser.

Understanding Human Movement

Explorations of relationships between human movement and places, sites, or locations, are frequent components of research in archeology and anthropology. However, as ever more of our culture is digitised, disciplines including architecture, cultural studies, natural and built environment studies, performance, and others, are re-discovering transdisciplinary notions of site and embodied experience of place. They are broadening their research from studies of purely material cultures of roads, paths, and buildings to encompass the experiences and social relationships for which these were constructed. When members of UNESCO developed their definition of Intangible Cultural Heritage they looked at Rangihiroa Panoho's example of the marae, as simultaneously a building and a cultural meeting space for the Maori. It functioned along the lines of what Joseph Roach calls "vortices of behaviour": churches, marketplaces, theatres, schools, and kitchens in which certain kinds of behaviours and values are learned and certain memories are transmitted. [1] These sites are often documented by researchers using traditional research tools including cameras, GPS loggers, etc, but the behaviour, the embodied experience of the place is lost.

Architects long ago realised that it is not possible to get a proper understanding of a location by simply looking at drawings or images; that we need to move around a building in order to understand it. Traditionally, they would build 3D models to allow people to look at places from different viewpoints. Recently, many have turned to digital models and techniques enabling virtual fly-throughs, yet these digital resources cannot replace embodied understanding of place. Architects continue to "walk the site" or, rather, plot out the site on the ground and walk through it with an understanding that movement alone allows them to comprehend scales, orientations, and relationships. Similarly, the importance of an explorer's bodily involvement with the objects of scientific investigation is increasingly, explicitly, acknowledged in current archaeological theory. With the steady growth of interactive virtual environments, architects, geographers, anthropologists, performing and visual artists, and human-computer interface specialists are increasingly dealing with Mashiro Mori's "uncanny valley" where as depictions of motion come closer to human, emotional responses become increasingly positive and empathic, until a point is reached beyond which the response quickly becomes that of strong repulsion. [2]

The interdisciplinary Motion in Place Platform (MiPP) consortium aims to move beyond traditional studio-bound motion capture to ask how capturing humans' movements through sites can lead to new forms of research data to reinforce understandings of how places were/are used rather than focusing primarily on how they are constructed.

Case Study: 3D Movement (Re)Presentation in Iron Age Briton

It is paradoxical that the one thing which most visual 3D representations of the human past lack is humans. The most obvious reason for this is that buildings, features and artefacts can be reconstructed (whether digitally or not) from empirical archaeological remains, whereas there is far less direct evidence for how people would have looked and moved. Clothing, of course, can be reconstructed from historical or art-historical evidence, but such indications are lacking for many periods and cultures. This is surely a limitation on the application of 3D reconstruction, both as a tool for archaeological research and as means of presenting cultural heritage to the public. In a footnote Mark Gillings states: '[I]t is worth noting that one of the most striking things about archaeological Virtual-models is the lack of people in them. As a result, wandering around re-creations such as Virtual-Stonehenge can be a ghostly and unsettling experience.' [3] It should also be noted that such previous research as has been done on this

area has typically focused on what might be termed ‘extra-ordinary’ activities, such as ritual. [4] There remains a lack of consideration and theory of how day-to-day practices can be visualized and presented as products of human activity.

Archaeological evidence is, and always has been, primarily about material, and about what the process of human existence has left in the ground for us to find and document empirically. Experimental archaeology seeks to evaluate the methods (although not necessarily the tools) used to create features such as buildings and artefacts, such as arrowheads, with the evaluations derived from empirical evidence. [5] Careful observation and recording of the construction and creation processes can lead to new insights in to how buildings and artefacts were created, and in some cases can help explain anomalous or unusual features in the material record.

In its initial development phase of the project, the MiPP researchers worked directly with Michael Fulford’s team from the University of Reading during their Summer 2010 excavation of the Silchester Roman Town. [6] The Reading team at Silchester has a strong history of acting as a testbed for digital technologies in the field through it’s hosting of the Virtual Environments for Research in Arts (VERA) project. As such, the Silchester team provided infra-structural support for the first on-site motion capture trials. In order to obtain initial test data, the MiPP team captured the movement of the archeologists as they worked on the site (see figure 1), and has made this data available to archeologists at Reading, Southampton and other universities. At this phase of excavation, evidence was emerging of an earlier Iron Age town on the Silchester site including a clear circular impression which hypothesised to have been the wall of a roundhouse. As more evidence of an Iron Age town arose, the MiPP team focused on how their systems could be used to understand the daily life in an Iron Age roundhouse, what were the movements of Iron Age people on the same location and how could an understanding of their motions help to understand the emerging archeological evidence. In collaboration with the Silchester archeological team, a model of the roundhouse and was illustrated, modeled and textured using Autodesk Maya. These models were imported into the Unity3D game engine to allow them to be animated and explored.

Given that round houses were domestic settings, we determined that the actions to be generated to populate this virtual roundhouse should be day-to-day activities, with the actions, themselves, being based as far as possible on available evidence from archeological records. The first step in this process was to develop 3D character models to simulate the activities of human agents. Utilising Zbrush and Maya, characters were modelled and rigged. In order to correctly constrain these activities spatially, an area of floor space in a studio at the University of Bedford was taped out with dimensions equivalent to the Silchester round house. Two dancers and a choreographer were then asked to explore and participate in the type of tasks that might have been performed during the daily activities of inhabitants while wearing Animazoo IGS190 inertial motion capture suits. Motion from the suits was mapped, in real-time, into the virtual 3D round house using Unity3D and a suite of software tools developed as part of the eMove project: a joint research project between Sussex informatics department and Animazoo (http://www.mocapsuit.com, last accessed 29th Aug 2011). The data was simultaneously saved in Biovision Hierarchy (bvh) format, so the resulting motion data could be subsequently analysed and/or attached to a character model for further animation.

The dancers decided to (re)present "household actions" including sweeping, cooking and lifting water from a well. When the handling of water led to numerous discussions about whether water would have been stored in the building, fetched from a well or other source, how it was carried, how it was used, etc., the Mipp team consulted published souces about daily activities in Iron Age Britain, [7] but the Reading archaeologists suggested contacting the experimental archaeology lab of Butser Ancient Farm,

where further capture sessions were conducted with another group of dancers and the Butser archeologists, themselves (see figure 3).

Experimental archaeology seeks to evaluate the methods (although not necessarily the tools) used to create features such as buildings and artefacts, such as arrowheads, with the evaluations derived from empirical evidence. Careful observation and recording of the construction and creation processes can lead to new insights in to how buildings and artefacts were created, and in some cases can help explain anomalous or unusual features in the material record. For, example the presence of curved depressions in the ground near the structure of the round house at Pimperne Down, Dorset, had no apparent function or relationship with the building whatsoever. In the process of reconstructing this round house at the Butser Ancient Farm experimental archaeology site, it was found that such depressions are made when manoeuvring the structure's roof beams in to place. [7]

Motion Assumptions

Alongside the development of technologies and platforms which support the (re)creation of ancient environments in 3D has been a marked increase in the availability, affordability and robustness of 3D motion capture apparatti. Data derived from motion capture can take numerous forms. These can be classified, after Moeslund et al. [8], in to broad categories of surveillance, control and analysis. Surveillance is the observation of the behaviour of individuals and/or crowds; for example for public order at sports grounds. Control is where a human uses a piece of hardware to direct action in a virtual environment (such as a game). Analysis is where motion capture is used to build and/or augment other forms of information, particularly the annotation of video and motion traces. The simulation and documentation of various human activities that were (or may have been) carried out in and around both past and present environments falls chiefly in to the category of analysis.

While this has been investigated previously, many such approaches are purely representational, tending to avoid the pressures that integration of motion capture data with 3D environments places on interpretation. During the capture process, we became aware that we were making numerous assumptions about motion which we needed to record in order to provide a context for our motion data. For example, when capturing in the studio, we became aware of how much the hard floor and dancer's shoes constrained the movement, so we replicated the motions barefoot, outdoors on uneven, grass. We realised how much external factors such as footware, clothing, training, age and gender of the mover impacted the motion data. Many assumptions of this kind are implicitly encoded into virtual 3D models, of which the round house we produced is an example. While we cannot remove such assumptions from the reception and transmission of VR environments, our motion capture trials using the model have allowed us to begin to isolate and critically assess them. It became clear that one key factor missing from our reconstruction of the hypothetical tasks is the ability to annotate and describe the motion data objects. The key difference between the kind of 'human factor' representations and re-enactments that are currently viewed with suspicion by experimental archaeologists is that digital capture should allow particular actions, and particular temporal points in each trace, to be labelled with a) what material evidence relates to each action or trace or, if there is no material evidence, what that action has been represented.

Conclusion

MiPP seeks to replicate, contemporaneously, the actions that the evidence suggest was carried out in a round house, document those using motion capture technologies, and integrate that documentation within the reconstruction. The approach has the potential to bring to life not only the round house, but the hypothesized activities of its inhabitants. The MiPP team is just beginning to explore the use of Augmented Reality techniques for overlaying (re)recreations and dynamic visual interpretations on the exiting site (see figure 2). It is hoped that these techniques will allow close links between site and activities movement by visually combining them. The theoretical questions this raises about how 3D visualization can – and the degree to which it should – impact on our perception of the ancient world are far-reaching. Archaeology is fundamentally about the material record: tracing what has survived in the soil, and building theories top of that. Since the eighteenth century, Britain's museums have operated on, and extended, the same principle: they are polished presentations of the 'final' material record. However, many of our theories concern what people did, and where and how they moved while they were doing. We have reconstructed in a practical and agentive way how certain everyday tasks might have been accomplished by the Iron Age inhabitants, and further development of the project will seek to refine and formalize the evidence framework in which this rests. As far as we are aware, this is the first attempt to link, explicitly, a remediated VR with the 'real world' by human agency, as represented by empirical motion capture data. In this paper, we have attempted to set out the limitations that undoubtedly exist in reconstructing and visualizing human agency but believe that, within those limitations, this approach has a valuable contribution to make to the development of virtual models for Arts and Humaities research and understanding and experiencing locations, sites or "places".

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For more information, please see http://www.motioninplace.org

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