Experimental archeology and serious games: challenges of inhabiting virtual heritage

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Experimental Archeology and Serious Games: Challenges of Inhabiting Virtual Heritage

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Experimental archaeology has long yielded valuable insights into the tools and techniques that featured in past peoples' relationship with the material world around them. However, experimental archaeology has, hitherto, confined itself to rigid, empirical and quantitative questions. This paper applies principles of experimental archaeology and serious gaming tools in the reconstructions of a British Iron Age Roundhouse. The paper explains a number of experiments conducted to look for quantitative differences in movement in virtual vs material environments using both "virtual" studio reconstruction as well as material reconstruction. The data from these experiments was then analysed to look for differences in movement which could be attributed to artefacts and/or environments. The paper explains the structure of the experiments, how the data was generated, what theories may make sense of the data, what conclusions have been drawn and how serious gaming tools can support the creation of new experimental heritage environments.

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General Terms: Serious Games, Motion Capture, Archaeology, Heritage, Reconstruction

1. INTRODUCTION

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

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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 to his 1999 essay, 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' (Gillings 1999). However, over the past decade, the use of digital gaming tools or "Serious Games" has allowed researchers to populate their models with virtual characters "enacting" behaviours and activities, or simply acting as guides. The use of these gaming tools changes the role of heritage models. Authors such as Chen and Kalay refer to :

> "designing the content of the reconstruction, in addition to designing its context… because the new representational media transform a cultural heritage reconstruction from a means of communication to an environment that affords a variety of online activities. As such, their design merits a closer look at the difference between a digital model and virtual environment: a digital model depicts the building, the monuments and the artefacts of a cultural heritage site, and sometimes the depiction of the people who lived and worked at that site. A virtual environment adds the ability to 'visit' the site in the form of an avatar—an embodied representation of the visitor. This ability transforms the model from an abstraction into a 'lived' place." (Chen and Kalay, 2008).

This notion of a "Lived Place" is central to the Motion in Place Platform (MiPP) project (http://www.motioninplace.org), a UK Arts and Humanities Research Council funded project investigating the use of motion capture technologies outside environments where they have been traditionally used, that is to say specifically (and expensively) equipped motion capture studios. Before launching the Motion in Place Platform project, the authors consulted existing reconstructions which had used motion capture techniques to animate virtual characters such the Chang-An, Tang Dynasty Dance (Tang 2002), Rome Reborn (Gutierrez, 2007) and King's Visualisation Labs Roman Villa at Boscoreale projects (Bergman 2010). All of these projects sought to animate virtual heritage reconstructions by placing animated characters in the environments. Every one of these projects took actors into bare motion capture studios and directed them to "enact" activities assumed to have occurred in these locations. In the case of Chang-An and Appia, the actors were asked to dance. For the Rome Reborn project, actors were asked to fight as gladiators. In some of these examples, such as Chang-An, the actors wore close fitting clothing dictated by the restrictions of the motion capture technology being used without consideration for how the clothing of the era being depicted effected the would have effected the movement of the characters in the original environment. The Chang-An scrolls depict a dancer wearing long flowing robes. The modellers have the virtual character long robes, but the actor they captured to animate the character danced in form-fitting lycra. The final motion does not include any of the graceful, flowing movements created by the weight of the and the skeleton captured from the actor does not have any of the forces of tension momentum acting upon it which would exist if she had been captured wearing the robes. Similarly, none of the projects consulted attempted the match the footwear of the actors to the footwear of their virtual models and all ignored the manners in which the textures, solidity, and materials of the floor of the capture space influence the movement of the actors. None of the project consulted attempted to match the surface of the capture space to the surface of their virtual environment. The developers of these virtual heritage reconstructions had been exceptionally rigorous in their use of textures and materials for their reconstructions, but appeared not to have given any consideration to the forms of movement used to bring life into their reconstructions. None of the projects attempted to capture or account for the inability to capture the linkages between the motions captured and materials and environmental conditions and to include these in the their models.

Video game technologies are being used frequently for the presentation of virtual heritage reconstructions. This reduces cost and makes the reconstructions more accessible. Unfortunately this also creates the temptation to use the tools included with game engines and modelling packages without rigorous consideration of their applicability. Tools for capture and animation in video games are in their infancy. They are frequently optimised for rendering speed and minimal processor load rather than being optimised for realism.

The MiPP project sought to address this need for rigour in planning, capturing, and introducing movement into heritage reconstructions. MiPP explored the use of Serious Games tools and technologies within interpretive and archaeological contexts. The MiPP team, including the authors of this paper, worked with Brighton-based motion capture developers, Animazoo to adapt their inertial motion capture suits to allow capture “in the wild”, i.e., on archaeological dig sites and in physical reconstruction developed by experimental archaeologists.

This paper details the challenges the MiPP team experienced when capturing movement for an augmented reality reconstruction of a Round House from the southern British Iron Age, the dimensions of which were determined from the outline of a structure uncovered at the site of Silchester in Hampshire, England (Clarke et al. 2007). In an exploration of applying serious game techniques to experimental archaeology the MiPP team initially created an immersive visualisation of the round house using the Unity3D game engine and mapped movement in real-time from a set of actors into the roundhouse in order to obtain more “authentic” capture. During the second of these immersive capture sessions, the team realised the virtual environment did not contain enough cues to inform the actors’ movements. The team also realised that even though they had created a virtual environment, they were using physical artefacts in their movement. Little effort had been made to match artefacts to the virtual environment. This mismatch became clearly apparent when one of the actors tried to use a 20^{th} century broom to sweep out the Iron-Age round house. Using this data with a virtual character would have been roughly equivalent to putting double-paned windows or textures of corrugated aluminium in our round house reconstruction.

The paper explains how the MiPP team designed and conducted what is believed to be a pioneering experiment to quantify the effect physical environments and artefacts have on simple motions, and how this needs to be taken into account when capturing movement for virtual characters instead of simply adopting animation tools developed for the movement of non-player characters or crowds in video games. The paper explains how movement captured in a physical reconstruction built by the experimental archaeologists at Butser Ancient Farm (www.butserancientfarm.co.uk) was contrasted with movement captured in a virtual reconstruction made from the same archaeological data. The data from both sets of capture sessions are compared and suggestions are offered for the use of motion capture in virtual heritage reconstructions.

The paper poses complex questions, and touching on numerous disciplines, including the understanding and representation of space in archaeology, animation, 3D rendering, and the treatment and documentation of artefacts (Bodenhamer 2010). More than this however, the paper seeks to consider the use of serious gaming tools in the context of the theory and practice of experimental archaeology.

2. EXPERIMENTAL ARCHAEOLOGY

Experimental archaeology is a branch of archaeology, which replicates or attempts to replicate past processes in order to understand what is found in archaeological record. This branch is often cited as offering an important asset in the study of human interaction with material culture, particularly when dealing with remote periods of history where there are few other sources of data on the human interventions. However, due to an understandable desire to adhere to empirical evidence, means of inferring the human movement behind interventions are rarely considered in the reconstruction of archaeological environments. The most obvious reason for this is that buildings, features and artefacts can be understood and reconstructed (whether digitally or not) from empirical archaeological remains, whereas there is little or no direct evidence for how people might have looked and moved through the places they created. Approaches that seek to go beyond this are methodologically fraught as a result of 'the human factor'. It is further inevitable that such living interpretation will be problematic, since environments, objects and landscapes are, to one extent or another, cultural constructs: society attaches significance to landmarks and features which cannot be retrieved without written records. However, implicit in all archaeological interpretation is the truth that this human factor is behind the process of the material record's creation. Human processes have, in the past, been regarded as intangible and unrecoverable, and therefore implicitly and explicitly written off in experimental archaeology. For this reason, experimental archaeologists have traditionally shunned 'the human factor', focusing instead on the re-creation of archaeological features from empirical evidence (Harding 2009, Coles 1979). Indeed, the very notion of attempting to include 'the human factor' in experimental reconstructions is viewed with scepticism at best and outright hostility at worst. As Peter Reynolds, the founding director of the Butser Ancient Farm project has put it:

> "In real terms it is only sensible to examine structures physically and as far as possible to dehumanise the examination process. Re-enactment is best left as a dramatic indulgence to the imagination, which can be recognised as singularly valueless and instantly forgettable ... History, and by implication prehistory, is swiftly becoming a tabloid newspaper sub-editor's view of the past" (Reynolds 1993).

While some might view the strength of this distinction as being somewhat harsh, it nonetheless highlights a significant gap not only between 'physical world' reconstruction projects such as Butser Ancient Farm and cognitive considerations of how the reconstructed spaces may have been used, but also between the application of virtual reality reconstruction and any attempt to (re)create past movements in any place, physical or virtual.

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 (Coles 1979). 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 (Reynolds 1993).

3. CASE STUDY: 3D MOVEMENT RE-PRESENTATION IN IRON AGE BRITON

In British Iron Age domestic culture, there are no historic or material referents to how particular houses were built, or how artefacts such as arrowheads or ceramics were made. The process must be inferred by a process of logical deduction, and examination of the available empirical evidence. However, how we approach this process of deduction can, and often does, involve the human factor. The reconstruction processes in experimental archaeology now has a long tradition of researching and utilizing past methods construction and craft to construct (the term 'reconstruct' is explicitly avoided in the literature – see Reynolds 1993) non-extant buildings using those methods. The experimental approach, now well established and widely referred to, requires the 'human factor', in that it requires human intervention in, and interaction with, the physical world; exactly the set of processes which motion capture was designed to record and document.

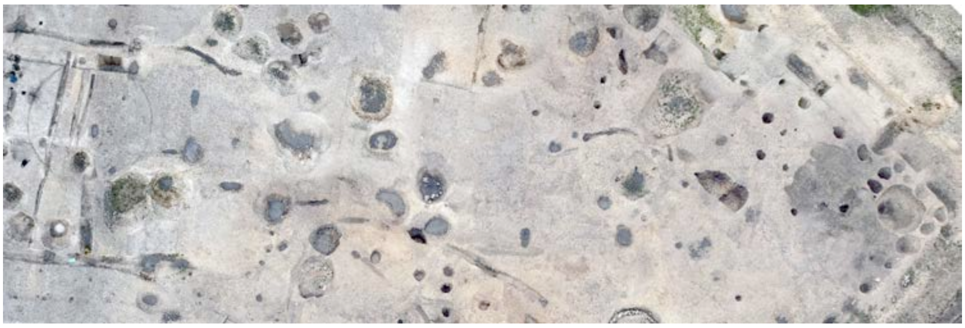

Fig 1. Overhead photograph of Silchester site showing impression of Iron Age Roundhouse in on left side of image

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. (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. At this phase of excavation, evidence was emerging of an earlier Iron Age town on the Silchester site (Clarke et al 2007; see figure 1). One of the most striking features of this evidence was a clear circular contour of a wall which can be seen in the left side of image 1. A 3D reconstruction of the roundhouse was generated, starting from the dimensions indicated by this impression. Once the overall layout of the buildings had been defined the likely shape and fabric of the structures were interpreted. Inferring evidence for the types of materials used was relatively straightforward, as the materials from previous constructions had been deposited into the ground. However the shape of the structures could not be evidenced in the same way and the team had to rely upon the interpretation of the archaeological record. Guided by illustrations and photographs of comparable structures, the building was modelled and textured in Autodesk Maya (see figure 2).

Fig 2. Low-poly models of Iron Age and early Roman buildings in Maya

Given that round houses were domestic settings, the team determined that the behaviours populating this virtual roundhouse should be day-to-day activities, with the actions themselves being based as far as possible on available evidence from elsewhere. In order to capture these motions as realistically as possible, the team decided to use software under development at the University of Sussex as part of the e-move project enable real-time full-body movement within video game environments. (Dunn 2012, Pascu 2010). This software allowed actors to control the movements of characters within a range of video game engines using Animazoo's IGS-190 inertial motion capture suits. Initially, the team used the Unreal engine because of the richness of the authoring tools included in the Unreal Development Kit (UDK). However, the restrictions in the UDK licensing agreements made it very difficult for the University to collaborate with its industrial partner, Animazoo. For the MiPP project, licenses were purchased for the Unity3D game engine, and combination of UDP servers and C# . NET classes were developed to allow movement data from the Animazoo suits to be transmitted to a client running the Unity engine and mapped onto the skeleton of virtual characters created using Maya and ZBrush. The motion data was simultaneously saved in Biovision Hierarchy (bvh) format, so it could be subsequently analysed and/or attached to a character models in a stand-alone version of the virtual round house. This use of serious gaming tools allowed the actors to move around inside a virtual environment at the same time their motion data was being captured instead of them being captured in sterile environment (see Figure 3).

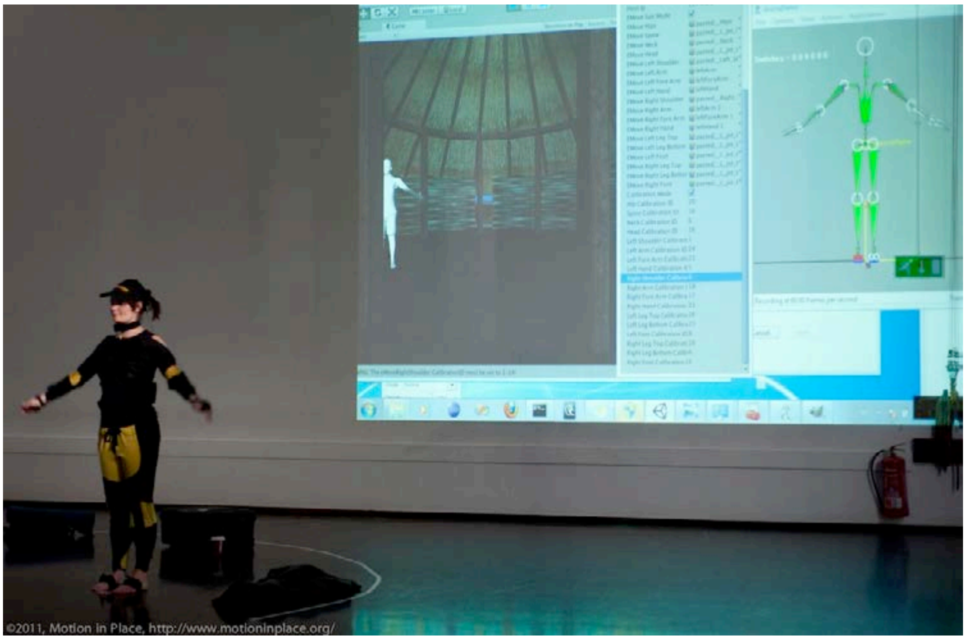

Fig 3. Capture of motion data within virtual roundhouse

In order to populate the Silchester round house, a virtual round house was set up in a studio at the University of Bedfordshire. Two dancers were put in Animazoo capture suits and asked to explore and participate in the type of daily tasks that might have been performed by inhabitants of early British Iron age roundhouses. After consultation between the dancers, a choreographer, and an archaeologist, tasks were chosen included sweeping, cooking and lifting water from a well were chosen. The handling of water in the re-enactment 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. Conjectures about daily activities had been published (Farvo, 2010), but the lack of available information highlighted how much undocumented interpretation had been used in earlier captures of movement for virtual environments.

4. RELATIONSHIPS BETWEEN MOVEMENT AND ARTEFACT

Fig 4. Motion data mapped onto character using the Unity 3D game engine

For capture sessions, the MiPP team followed the norms used for film and video game motion capture and used a CAVE-like setup (Cruz-Neira 1992) projecting elements of the of the virtual environments on the walls of the capture space. The location and boundaries and of conjectured walls, hearth, and other elements were taped onto the stage floor and various items were used as stand-ins for artefacts. Dancers were given direction by a choreographer or movement coach as to how they should move and what they should do while wearing the motion capture suits. When dancers were asked to perform various 'everyday' tasks such as fetching water and wood, tending a fire, and sweeping the house, the value and validity of these movements was not questioned until one of the dancers picked up a modern push-broom from the corner of the studio and began sweeping with it. It was immediately obvious that she was creating a very specific movement closely linked to an artefact which would not have been present in an Iron Age roundhouse. After the dancer was reminded that the push broom was a 20th century invention, she swung the broom from side-to-side without touching the floor. Neither of these sweeping actions could be considered "correct", as neither helped understand how or why round houses were constructed in forms we have found, nor did they illustrate how these structures and artefacts were used.

This event illustrated the difficulty of using contemporary motion capture techniques developed for video games in virtual heritage modelling. Most motion capture tools used in animating virtual characters were developed for the entertainment industry where the "look" and "flow" of the movement is more important than its provenance or 'accuracy'. Many motion capture tools exist for medical or biomechanics applications, but these are seldom used in virtual heritage or serious games. More importantly, the experience documented the impact the artefact (i.e. broom) had on the movement. This is illustrated in figure 5 examining the physical stance and tracing the path of the user's left hand while sweeping in a studio with both a contemporary push broom and a broom approximating ones likely to have been used in the Iron Age.

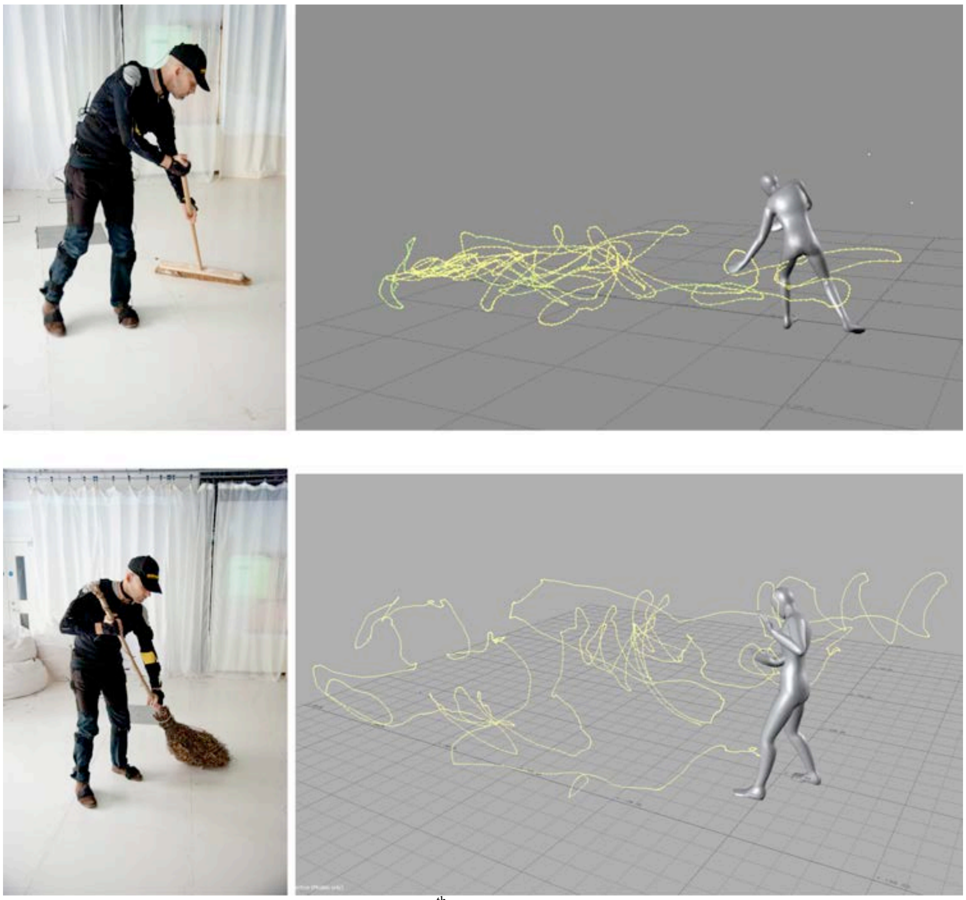

Fig 5. Comparison of Sweeping using 20th Century vs Iron Age broom styles

As can be clearly seen in figure 5, the stance with the modern push broom is very different from the stance adopted with a traditional broom. The pushbroom is kept in front of the body with the user's weight forward. The traditional broom requires the user to stand upright and rotate his/her weight from the forward foot to a backward foot. The action of the broom is also very different. With the pushbroom, the broom stays in front of the user while with the traditional broom, the broom is pushed from behind to forward of the user and back. At first glance, these seem to minor differences, but as the intention of the MiPP experiment was to explore how human movement could be added to a virtual environment with the same level of rigour used in creating the virtual buildings, adding the motion from a pushbroom would be equivalent to putting textures of corrugated aluminium on the model of an Iron Age roundhouse.

This link between specific artefacts and the movement required to manipulate them is well known. Its importance is clearly explained by French sociologist Marcel Mauss as he described cultural difficulties with techniques required to shovel soil: “during the War I was able to make many observations on this specificity of techniques. e.g. the technique of digging. The English troops I was with did not know how to use French spades, which forced us to change 8,000 spades a division when we relieved a French division, and vice versa.” (Mauss 1973:71)

This link between movement and artefact is complicated when the movements of interest occurred in the past – especially the distant past. The philosophical construct of phenomenology, of interpreting locations in terms of experience of them, has a long heritage in archaeology. Typically it has focused on the embodiment of interpretation of locations-specific practices such as cult and religion, or the remediation of pathways through the landscape that are demarked by some extant physical structure, such as earthworks (see Tilley 1994; Copeland 2009). In a wide-ranging review of the subject in 2005, Joanna Brück notes that

> “[O]ne of the most productive strands of phenomenological writing within archaeology has been the deconstruction of the dualistic thinking that is a product of post-Enlightenment rationalism. This has facilitated a radical reconceptualization of the nature of materiality and the relationship between people and artefacts. … Only by seeing objects as inanimate can we adhere to a model according to which humans impose meaning on a passive and pre-cultural universe. If, on the other hand, we recognize that artefacts, buildings, monuments and landscapes not only affect us but make us who we are, then our engagement with the archaeological record is necessarily a dialogue in which both archaeologists and the axes, houses or burials we study are created and transformed (Brück 2005: 65).”

5. MOTIONS IN PLACE

The experience with the broom showed that the connection to material objects such as tools and buildings are of crucial importance in elucidating our understanding of possible behaviours and movements at a historically inaccessible period. Consequently, a further set of experiments was devised in an attempt to test the influence of a place or location on movement. The opportunities for testing and experimenting with motion capture technology across both ‘real’ and ‘virtual’ settings are rather limited, given the relative rarity of 1:1 scale 3D reconstructions of non-extant historic sites. Fortunately the Butser Farm experimental archeology lab in Hampshire, UK, contains several example of 1:1 physical (re)construction carefully built to match existing archeological data from other sites. The MiPP team consulted with archeologists from Butser and found a round house on the Butser site of an approximate age and scale as the conjectured round house at

Silchester. The original round house was located at Moel y Gerddi, Harlech, Llanfair SH61663170 excavated in 1980-1. and dated c. 330-190 b.c. see Figure 6. (Kelly 1988). The house at Butser is constructed according to data provided by RS Kelly and recorded in *Proceedings of the Prehistoric Society.* The (re) construction of this house currently standing at Butser was constructed on a 1:1 scale in 2001-2 and has an internal diameter of 9.4 m and a circumference of approx. 30 m. The walls are approx. 1.5 m high and the height to the top is approx. 6.5 m. The twelve posts used to build the inner ring are ash, as are the components of the ring beam. The walls are of oak stakes with some seven hundred 3 m long hazel rods providing the wattle. The daub was a mixture of clay, dung, soil and fibre. The rafters are Scots pine, one of only three native conifers. The purlins are again hazel and there are some five hundred of these on the roof. The 2.5 tonnes of long straw used for the thatch was grown locally. It is tied in place using sisal twine, a fibre not dissimilar to that found in prehistory. It some three months to thatch the house.

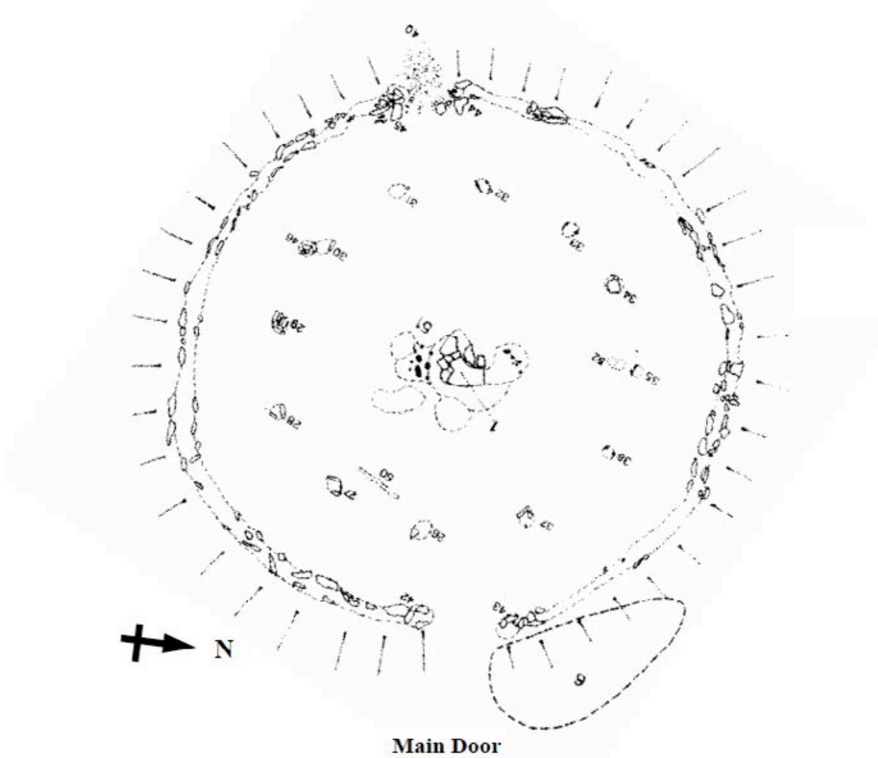

Fig 6. Excavation report of Moel y Gerddi roundhouse, middle Iron Age

Figure 7: The (re)constructed Moel y Gerddi round house at Butser Ancient Farm

To match the physical (re) construction of the Moel y Gerddi house in at Butser, the MiPP team created a virtual model in Unity3D to the same dimensions. At first, the team attempted to use a headmount display connected to an Animazoo "Hybrid" ultrasonic tracking system to allow actors to walk around inside the virtual roundhouse. However, the amount of lag between the tracking system and the game engine made the system unusable, so the team returned to the method of projecting images on four walls, taping out locations of features including posts, doors, fire pits, and using boxes to indicate the position of items such as a quern, loom, and bed.

Two new actors were given a broom, constructed using materials and methods sufficiently generic as to approximate to those likely to have been used in the Iron Age, to sweep the virtual round house, as well as being invited to complete a number of day-to-day tasks including grinding grain with a quern fetching wood and putting water in a pot over a fire. A day later, the actors were taken to the physical (re) recreation of the round house at Butser and asked to repeat the activities they had performed in virtual round house (see figure 7). In the virtual round house, their movements had no effect on the virtual environment. The smooth, flat floor of the studio offered little resistance to the brooms and the even floor and lack of physical consequences related to sweeping through posts or walking into walls appeared to invite the dancers to move aggressively and openly. In the physical round house, the floor was uneven and the dancers had to move the broom around posts while not stepping into the hearth. There was great deal of variation in the resistance to the movement of the broom on the floor. At the same time, the dancers learned that large, fast movements created dense clouds of dust and damaged the floor of the house.

Figure 8: Sweeping in a virtual and physical round house

In order to analyse the capture data created in both versions of the roundhouse, the authors developed a bespoke application to track the position of the dancer's hands while sweeping and to determine the distance the hands travelled and the amount of time required for an average "sweeping" motion or cycle. A single sweep motion or cycle was defined as the time between when a broom was placed down on the floor until the next time it was placed on the floor. Figure 9 shows a plot of sweeping in both the virtual roundhouse and the physical roundhouse. Both graphs show the position of the dancer's right hand over approximately 45 seconds of sweeping. The plots in the bottom right show the composite 3D motion trajectories the hand (i.e., its position in 3D space). The other two graphs plot the distance away from the centre of the body. The top graphs show these positions on a traditional timeline while the graph in the bottom left plots y-offset, (the height above the body's centre) on the y-axis against xy-offset (the length of a vector from the center of the body to the body part being tracked). This plot also highlights the current sweep cycle or stroke and the current position in this cycle.

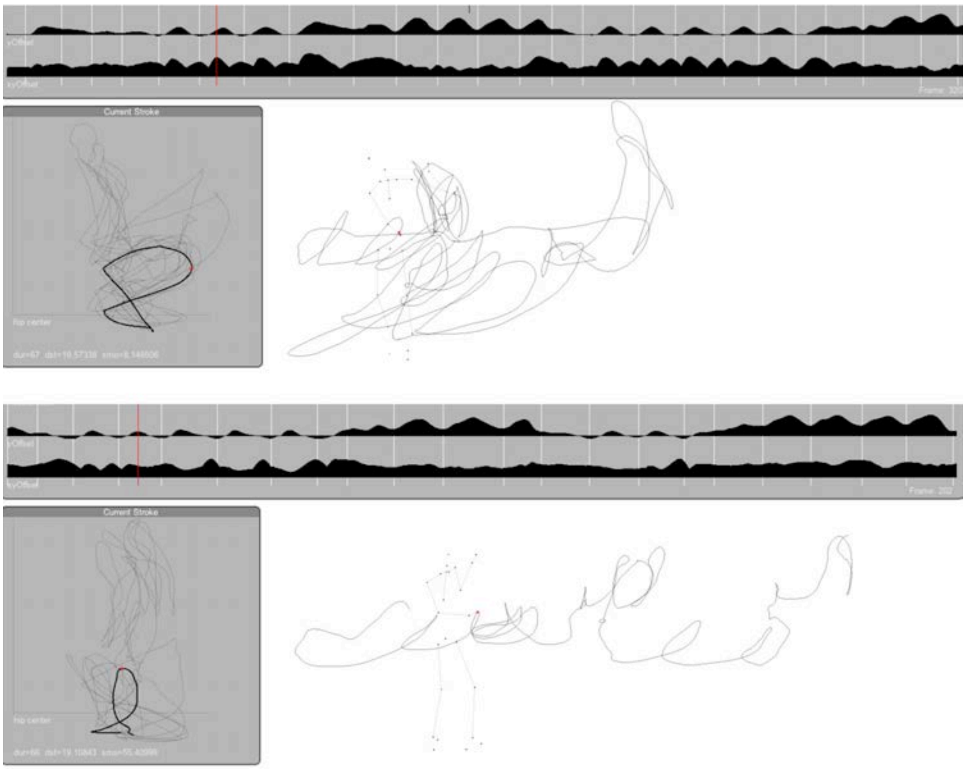

Figure 9: Sweep analysis in a virtual vs physical round house

The numbers listed in the bottom-left graph indicate the duration of the current sweep stroke, the distance travelled by the hand, and a numerical representation of the smoothness of the stroke. By averaging the durations and distances of all sweep strokes, the following were determined:

Virtually (re)constructed round house:
avg stroke dur, 2.3 sec,
avg stroke dist 8.97 cm/sec

Physically (re)constructed round house:
avg stroke dur, 2.05 sec,
avg stroke dist 7.75 cm/sec

This data would appear to demonstrate that the actor did, made larger sweeping strokes in the virtual roundhouse as well as making sweeping strokes of shorter duration in the physically reconstructed roundhouse. This may be a result of the dust stirred up by sweeping in the physically constructed space, or it may be a result of the amount of resistance of the rough, uneven floor. Because the experiment was only carried out with 2 actors, it’s not statistically relevant, and no it’s no definitive statements can be made, but the data does appear to demonstrate that engagement with the environment has altered the actor's movement. This change in movement was expected as it has been explored by numerous theoreticians including Architecture theorist, Juhani Pallasmaa who states:

> "Our bodies and movements are in constant interaction with the environment; the world and the self inform and redefine each other constantly. The percept of the body and the image of the world turn into one single continuous existential experience; there is no body separate from its domicile in space, and there is no space unrelated to the unconscious image of the perceiving self.' (Pallasmaa, 2009:40-41).

The differences in the data does appear to illustrate the fact that the actors moved differently in the two environments and that data captured in the virtual environment did not correspond to movement in the physical (re) construction. Elements of actual location such as the uneven surface of the floor and the friction of the broom against the edges of the firepit are encoded in the motion data captured on the physical site, but completely missing from the data captured in the studio.

7. CONCLUSIONS

As far as we are aware, this is the first attempt to explicitly link a remediated virtual environment with a physical environment by human agency, using serious gaming tools and techniques. 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 in archaeology, the use of serious games, and in understanding and experiencing archaeological locations.

During the capture process, we became aware that we were making numerous assumptions about movement and not recording enough information provide a context for the motion data. For example, when capturing in the studio, we became aware of how much the hard floor and actor'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 actor impacted the motion data. Many assumptions of this kind are implicitly encoded into virtual models. While we cannot remove such assumptions from the reception and transmission of virtual environments, our experiments have allowed us to begin to isolate and critically assess them. It became clear that one key factor missing from our reconstruction of hypothetical tasks is the ability to annotate and describe the motion data. 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 what material evidence relates to each action or, if there is no material evidence, what that action has been represented.

The MiPP project seeks to replicate contemporaneously the actions that the evidence suggest was carried out in a round house, document those using serious gaming techniques, and integrate that documentation within the reconstruction. The approach has the potential to not only turn the virtual round house into a “lived” place, but into a serious virtual research laboratory where conjectures and interpretations about past movement and action can be tested and explored. The theoretical questions this raises about how serious games can – and the degree to which they 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. This has been made possible through the carefully considered use of serious gaming tools and techniques. The experiments in the physical and virtual (re)construction of the Moel y Gerddi round house, demonstrate how, if we had used the “canned” movement technologies in the current generation of game engines, at best we would only be illustrating our pre-conceived notions of how the original site was used, rather than developing a tool to explore and communicate what may have actually occurred on the site.

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

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