DE / CONSTRUCTION SITES: ROMANS AND THE DIGITAL PLAYGROUND

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Abstract – The Roman world, as attested to archaeologically and as interacted with today, has its expression in a great many computational and other media. The place of visualisation within this has been paramount. This paper argues that the process of digitally constructing the Roman world and the exploration of the resultant models are useful methods for interpretation and influential factors in the creation of a popular Roman aesthetic. Furthermore, it suggests ways in which novel computational techniques enable the systematic deconstruction of such models, in turn re-purposing the many extant representations of Roman architecture and material culture.

INTRODUCTION

Computer graphic technologies such as virtual reality, animation, game engines and graphic design play a growing role in the definition of specific representations of Classical architectural forms, peoples, activities and landscapes. In children's books painted and drawn reconstructions, cutaway models and detailed vignettes are commonplace. Similarly, in the spheres of adult popular and academic writing reconstructions serve a diverse purpose – instructing on volumes, suggesting embellishments and making concrete imagined places and the contents of descriptive histories. Alongside these, computational visualisation techniques are becoming dominant representative mechanisms.

The process of producing digital constructions of the Roman world and the exploration of these models have been seen by a growing number of authors as useful methods for interpretation. However, much attention is paid to the development of rigorous reconstruction methodologies and to the demonstration of the fidelity of the resultant models [1]. Such an approach, although rightly linking the interpretative process with the growing gamut of modelled Roman environments, has perhaps been over-indulged [2]. The viewer in whatever context – game player, school pupil, or documentary buff – has become attuned to the contingent nature of the representations with which they are daily accosted. Beginning with the characteristic forms of Classically-oriented reconstruction work this paper prefers to concentrate on digital world building as an investigative, confrontational process. In examples from Roman Italy, Egypt and Spain the worlds defined are seen as of significance when examined and played with, when constructed and reconstructed, and when understood as a performative aspect of academic practice. The paper suggests ways in which the systematic deconstruction of such models is a powerful method for analysis, prompting the re-purposing the many extant representations of Roman architecture and material culture produced by experts from across the visual arts, humanities, computer science and elsewhere.

PART ONE: CONSTRUCTING ROMAN SPACE

The recent volume Imaging Ancient Rome [3], resulting from the Third Williams Symposium on Classical Architecture held in Rome in 2004, provides an excellent introduction to the status quo in the use of computer graphics within Roman archaeological and architectural practice. As such it serves as a useful mechanism for the exploration of the common critiques and perceived benefits of reconstruction modelling. The volume also suggests interesting analogies between academic practice within studies in Classical architecture and the scoping exercises relevant to contemporary CGI work in archaeology.

In his introduction to the volume Haselberger talks of the approaches to "regaining the three-dimensional realities of some of Rome's major structures and civic spaces" [4]. It is his suggestion, and the overriding feeling of the symposium, that computer graphic models provide a novel means for investigating the decontextualised study of Roman architecture and also the relationship between monuments and spaces. The model becomes a locus for interpretation, a format for inter-comparison and a source of alternative encounters with the Roman past. The research projects documented within Imaging Ancient Rome also demonstrate the potential for graphical constructions within wider analytical processes. Model building is itself to be seen as interpretative, exemplified by Wulf and Riedel's use of three dimensional methods, in combination with databases, and conventional survey so on, to approach problems of the Domus Severiana [5].

The idea that the model construction process is significant is growing [6]. In 2000 Barceló suggested that "the process of model building is, in fact, a reasoning mechanism of exploration" [7]. He and others have also emphasized the importance of interactivity to such interpretations and therefore highlight so-called virtual reality approaches, which offer a mediated experience that more closely approximates to the modelling process than prescribed animation. The computer game and the game engines increasingly used within archaeological analyses [8] exemplify the virtual reality interface. In the game engine all aspects of the model's design are predicated on the player's interaction with the game environment. At the same time most games also provide examples of the directed cut-scene, non-interactive approach seen in other popular formats such as the television documentary [9].

The potential of granting control over a partially imagined Roman world was recognised early in the development of computer graphics. One example is Woodwark's 1986 reconstruction of the temple precinct of Roman Bath: "[p]lacing the viewer at the entrance of the reconstructed precinct suggested that a person standing in this part of the precinct would have been immediately impressed by the aspect of the temple of Sulus Minerva. In stark contrast, in the view from the top of the steps of the temple towards the entrance the attendant structures seem to shrink away." [10]. This model was seen to provide an excellent record of surviving objects and spatial relationships; one which could be explored "more fully than ever before" [11]. This belief and vocabulary have been pervasive, with many examples in the Classical sphere reusing exactly this terminology as justification for the reconstructions represented. In addition, the manipulation of three-dimensional representations has been seen to allow far easier understanding of complex structures, often even more than detailed static images and plans. Thus, in Viscogliosi's work on the Roman Domus Aurea [12] reconstruction is presented as a fluid and creative process. The reconstruction provides a place within which to play: to play with spatial configurations; to play with conflicting interpretations, to play with varied techniques; and to play with and within visual metaphors and cues.

Playing at Romans

Let us then consider what one may mean by 'playing' in this context [13]. Playing implies a surrogate practice; a form of engagement with the real world through a lens. Playing at soldiers leads to no casualties, similarly playing dead leaves the actor alive and well as the play ends. Playing at Romans within a graphically structured computer game is a more awkward relationship to define however. Here both the cultural and material context and the role player are distant from the subject. The game player or virtual actor is required to place him or herself within a carefully bounded universe of discourse and to assimilate diverse sensory inputs and other forms of information. The rules of this universe do in many cases relate to a striking degree to contemporary debates in archaeologies of the same real world. The notion of playing within graphically constructed, virtual worlds is then a metaphor both for wider reconstruction modelling and for its critiques.

The kinds of recreated Classical environments and forms of interaction made possible within games and television reconstructions define the Roman world to a growing audience. Recent developments, perhaps typified by the extraordinarily successful Second Life [14] and the expanding television history use of theatrical recreation, have proven wrong earlier critiques of the cyber revolution and indeed the power of the digital image [15]. The Second Life environment now has approaching six million users and at any one time a player may share their world with more than one hundred thousand other users from around the globe. The Roma simulation, which includes a theatre, stadium, senate house, and a museum, is perhaps the best known Roman component to Second Life. Here the visitor is invited to play the role of a Roman figure, within an environment that includes some documentation as to its relationship to reality. It is seemingly through this provision of metadata that the simulation is rendered intellectually valid; documentation separates the perceived play from the educational stimulation. The Second Life Roma's creator describes creating "unique architecture based on canonical Roman architectural forms while allowing for a great deal of reinterpretation" [16].

Roma aside, reconstructed Roman worlds are often rather dull and homogeneous [17]. In contrast other popular representations such as those of Pharaonic Egypt tend more towards the emotive. These incorporate a Western mysticism through certain forms of lighting and colour, whilst Roman representations are more likely to present a distanced, sparse, architectural model. The Roman monument tends to be presented as a separate, objectified entity, rather than as a coherent part of the surrounding space. Similarly the material culture represented shows little of the diversity and excitement archaeological specialists might associate with a given Roman context. Wheatley has suggested that this pattern results from modelling being "easiest to undertake with buildings and monuments which can be represented as consisting of regular geometric shapes, with the result that there has been a preponderance of Roman or Medieval architecture [and]… without some strategic input in the form of theory, there will continue to be an unintentional drift towards 'an archaeology of least resistance'" [18].

Whilst this is certainly true, the bias seen was already present in the visual representation record long before the advent of the computer game. Piggott noted in the new topographical approach to landscape the climate in which the previous Classical bias that had pervaded in painting (as a result of a belief in the superiority of the Vitruvian form over what had followed) was supplemented by subjects from the local countryside [19]. Similarly Morriss notes the bias in high status, military and religious architecture in illustrations [20]. This prevails in conventional painting where the temple is frequently the key element, domestic life being treated more rarely and almost always in the context of emotive artistic renderings.

The represented style of the CGI Roman world is also predominantly imperial, frequently irrespective of representative context, and employs arrays of cloned architectural components which distribute masonry according to unwavering, and rigorously enforced inter-columnations and proportions. In the Roman milieu the CGI designer has thus been afforded the dual impetus of a form of architecture which is readily absorbed into the software of computer graphics (a fact of course largely dependent on the prevalence of such forms in contemporary architecture) and one in which extrapolation from the footprint of a building to its solid completion can apparently be performed using a system of rules and through agglomeration of elements. The modeller may simply download an architectural component and incorporate it uncritiqued into his or her own model.

New directions for Roman models

The preceding survey of contemporary reconstruction practice leads to a number of recommendations for further practice. Ongoing work on the reconstruction of the Roman port of Myos Hormos [21] forms the focus for these developments. Firstly, it is clear that very few models produced for museums or for the analysis of architectural forms or spatial arrangements contain human agents [22.1] [22.2]. Conversely this is an area in which computer games are adept. It is vital that we populate our views of the Roman world if they are to become truly engaging and lived places. This means the use of agent modelling components, skinned bipedal systems and also the introduction of narrative. At Myos Hormos work has focussed on the documentation of personal reconstructed actors – the donkey driver, sailor or stevedore – and on the excavators themselves as interpretative agents.

Figure 1. Screenshots from models of the virtual Myos Hormos.

Secondly, we may note that popular models include as much detail as required by the plot and also by the need to engage the viewer. Our needs are far greater than this, and our potential pool of information should similarly be larger and better understood.

Collaborative projects [23] hold the key to assembling experts and confronting the variability of our record. At Myos Hormos ongoing discussions with the field staff and interaction with the primary data have led to a vast resource of texture, imagined sights, smells and sounds. Such human responses also mean that, if the models we produce are to inform our understanding of the use and appearance of space in antiquity, we should constrain our views to those physically possible. The modelled Roman world should be a physically accurate one, not because this authenticates our modelling exercise, but because it is only through the creation of human scale interactions – human field of view, size of objects, propagation of light, or multi-sensory engagements – that intellectually significant interactions with constructed Roman worlds can develop. In this we have a great deal to learn from novel computational methods in the areas of participating media, E-Science and GRID based stereo approaches, and remote and selective rendering solutions [24.1] [24.2] [24.3] [24.4] [24.5].

PART TWO: DECONSTRUCTING ROMAN SPACE

The work required to produce digital imagery of the type discussed in the previous section generates complex, often extensively researched three-dimensional databases. The breadth of interest in Roman architecture and archaeology has resulted in a vast array of reconstruction projects, objects and environments. Availability and interoperability of such work is currently limited but given the many recent initiatives relating to the standardisation of approaches, the potential database of Roman models available to the research community is extremely large [25.1][25.2][25.3]. In this second section I shall consider ways in which this work may be re-purposed.

Previous spatial analyses

Archaeology makes extensive use of analytical approaches to space. In the context of local and urban studies work derived from architectural analysis has predominated. These approaches have been complemented by the explosion of Geographic Information Systems (GIS) analyses seen in wider landscape studies within archaeology. Most recently a blurring of the technological boundaries between landscape and urban scale analyses has occurred [26.1][26.2]. Alongside this, technological convergence has allowed for a digital approach to space that is neither GIS nor CGI based, but rather a hybrid [27]. This builds from a planar model to a fully three-dimensional representation, and employs appropriate analytical schemes.

Planar studies and pseudo three-dimensional studies derive broadly from architecture, urban planning and geography. Common approaches include the visibility graph, isovist and access analysis [28.1][28.2]. These approaches are at some level based on an attempt to condense and summarise repeated potential engagements with a space over time, with an emphasis on visual and potential physical connectivity. These analyses use the relationships between rooms, activity areas or indeed any perceived places as nodes in a connectivity graph. They explore these nodes in terms of relative distance and visibility and in turn produce metrics which may be related to contemporary spatial experience. Thus a given series of spaces may have a simple metric measurement of enclosure or liminality [29]. They are taken as an amalgamation of experience of visualisation and, despite theoretical critiques of the structural bias to such models, have been extensively employed within Roman archaeology [30.1][30.2]. This has been stimulated by an interest within Roman archaeology in social relationships that may be indicated by built spatial form: issues of privacy, status, social membership and community [31].

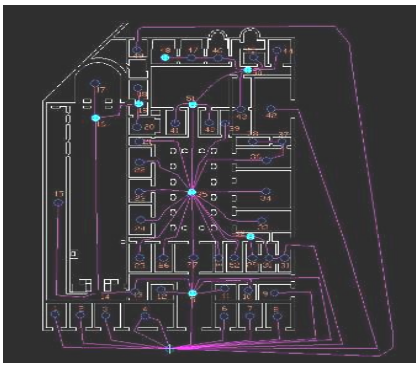

Figure 2. Access analysis map of Casa de la Exedra, Italica.
(Elisabetta De Gaetano, University of Southampton)

Such applications have not been without their critics [32.1][32.2]. In addition to concerns over the appropriateness of some data for such studies and the ever present debate over the primacy of the visual [33], one key concern is the emphasis on plan. Not only must any critique of a planar spatial analysis take account of the inherent biases of a Cartesian world view, but it must also consider whether extrapolating from this view renders spatial relationships any clearer. Can an examination of spatial experience devoid of texture and detail offer anything more than a sterile view of the archaeologically attested past? It is my contention that in the analysis of Roman built space in particular the use of three-dimensional world views provides a more honest and interpretatively useful structure for analysis. A wealth of further interpretation is made possible by the movement from the (largely) two-dimensionally known, or the poorly preserved three-dimensional fragment, to a constructed space. Not only do the graphic models provide spaces within which to think; within which to re-contextualise artefacts and surface properties, but once filled with the material culture components that are associated with them, they provide a far more detailed input to mathematical means of analysing the world than the empty plan.

New approaches to Roman space: visualisation and analysis

The texture viewsheds approach to analysis of modelled three-dimensional spaces was developed in 2004 [34]. Unlike other attempts to introduce the third dimension into spatial analyses [35] it works fully in three dimensions and allows for concave surfaces, using the same scene graph as the visualisation. It employs a CGI-based rendering process common to game engines and other interactive virtual reality systems known as light mapping or texture baking. This technique extracts a surface summary of incident light sources and other rendered components from objects within a scene. Each summary image is matched to the underlying geometry within given tolerances and provides an effective expression of the modelled environment on a polygon by polygon basis. The texture viewsheds approach re-purposes the model geometry and the texture baking technique in order to produce a numeric summary of the objects in the scene for use in spatial analyses.

The approach begins by the division of the scene into a pseudo-voxel summary of full and empty space. This summary is required to position observers within the scene, which in turn provide the input to the spatial summary. All areas of empty space are considered to be potential loci for observers and according to a given sampling strategy are divided between a related number of observers. Thus, an inter-observer distance of 0.5m in the horizontal plane could be considered appropriate, with a vertical separation determined by a similar arbitrary value such as 0.5m or indeed according to biometric values, such as lying, sitting, standing short and standing tall heights. Such observer locations conform to the empty space in the horizontal and vertical planes, accounting for undulations in ground surface and obstructions. The scene is therefore populated with objects representing the possible locations of human agents within the area represented. A cross-section through a single layer of these observers is shown below.

Next the scene is temporarily mapped using a non-reflective texture with a linear falloff in luminance relative to incident illuminance values. Having sited a single omni-directional luminaire in the scene at the location of one observer the textures for all objects in the scene are baked. The light source is then moved to the next observer, and the process repeated. The result is a library of texture maps each of which capture the angle of any light incident to them. Given the physical interactions within the scene, allowing for no falloff of lighting energy over distance, linear diffusion across co-planar surfaces, and no inter-surface transfer of light energy, these values equate to complex patterns of visibility within the scene. Hence the term texture viewshed: each single map is equivalent to a single observer viewshed in GIS.

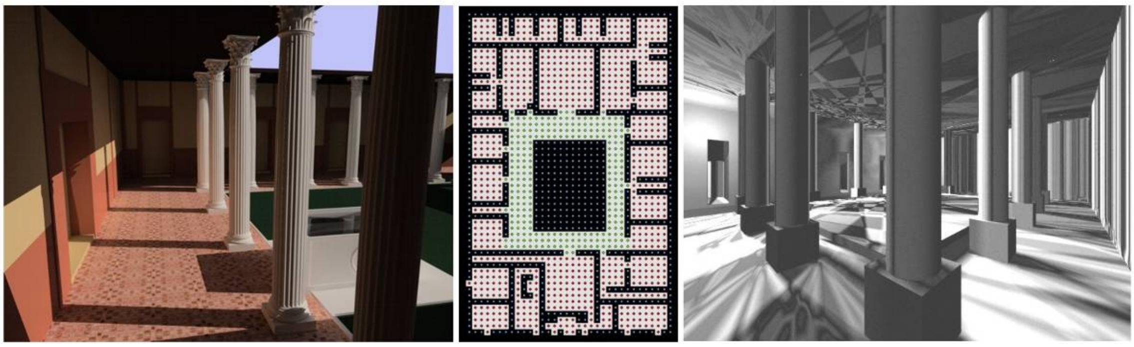

Figure 3. Sample texture viewsheds analysis: Casa de los Pajaros, Italica.

The technique continues the analogy of the viewshed by allowing for combination of the separate visibility samples. Thus, a given cumulative texture viewshed summarises the angle of view of any part of that object from all possible observers. In its binary format is provides a clearer numerical summary – a map of the number of observers by which any given part of the object may be seen. Finally, by computing all of the potential visibility relationships within the scene the results most closely approximate to a fully three-dimensional implementation of the total viewshed approach [36].

The potential of this approach to analysing models designed ostensibly for visualisation is only beginning to be explored. However, it seems that two specific routes may offer valuable insights into potential spatial experience in the past. These are based on (a) the numerical summary of fully three-dimensional spaces and (b) the re-mapping of such summaries onto model surfaces and their use in defining novel visualisations. Since each texture viewshed corresponds to a particular mapped geometric object within the analysed scene, in order to standardise the numerical summaries associated with these objects their spatial properties must first be defined.

Expressed simply, the surface area of the object must be related to the raster representation of its surface properties. Having defined this surface area value, the mapping co-ordinate system may be used to relate the surface area to the texture viewshed, and in turn produce numerical output: (i) scaled per object value indicating number of observers per unit area; (ii) per object unit area visible from each observer; (iii) summary statistics for range of observer to object and angle of view.

These outputs allow a range of interesting spatial questions to be asked: Which objects are most visually prominent, in Llobera's terms, visually exposed, based on number of observers and/ or average angle of view? Which areas provide optimal viewing conditions or greatest contrast between viewing conditions when the observer is in motion? How do these visible areas relate to physically accurate modelled patterns of light and shade in the environment? For a given observer which areas are seen from above, on a level and below? Finally, which observers fit within ranges of view distance, angle and visible area that correspond to perceptual terms such as enclosed, directed, funnelling, overlooked, dominating, inter-connecting or circulatory? These questions extend the two-dimensional perceptual metrics introduced above [37.1] [37.2]. In the context of Roman urban spaces such a three-dimensional spatial summary allows for more detailed analyses which in turn may be correlated to the experiences described through conventional visualisation of digital spaces. Developing the critique of two-dimensional approaches to Roman space above, the metrics take account of all material components rather than the ground plan alone and also permit comparison of spaces in order to test hypotheses. Thus the analyses may use varying spatial configurations, ideas concerning Roman use of space, and indeed material parameters.

CONCLUSION

Computer graphic modelling of Roman archaeological data has come a long way since early museum representations of Roman Bath. The modelling technologies and visualisation interfaces of game engines and high fidelity graphics software produce ever more impressive surrogate Roman environments. These are places to explore and interpret, and their construction is a vital part in these processes. Furthermore, the modelled spaces produced themselves offer possibilities for quantitative approaches in parallel with traditional and virtual phenomenologies. As models of the Roman world improve in quality, multiply in numbers and converge in format so our opportunities to explore spatial interactions in the Roman world will increase. The next phases of Roman de/ construction should be exciting indeed.

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