HOW REAL IS YOUR REALITY?

VERISIMILITUDE ISSUES AND METADATA STANDARDS FOR THE VISUALISATION OF CULTURAL HERITAGE

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ABSTRACT

For in excess of one hundred years, photogrammetry has played a significant role in documenting the cultural heritage of nations and peoples. Many recent advances in the technique have enhanced the use of photogrammetry as a recording tool, enabling more complex representations of objects and moving access to the procedure from the expert to the interested user. Some of these recent developments include low cost digital photogrammetric systems, image sequence analysis, bundle adjustment and camera calibration procedures, and three dimensional laser scanning. All of these procedures give dimensions of objects to a calculated or pre-determined accuracy.

More recently the output from these photogrammetric processes have been 3d computer graphics files, often presented as rendered images or animations showing reconstructions of the monuments and sites. There are also many such reconstructions being prepared by researchers in the fields of history and archaeology, and these can be found on sites on the Internet and popular magazines. The procedures of reconstruction rely less on coordinate precision but instead involve a variety of data sources including archaeological evidence, history, architectural analogy and the expertise of the individual.

At the Virtual Systems and Multimedia conference in Japan last year concern was expressed over the proliferation of such reconstructions appearing without the normal supporting documentation found in academic papers, concern that as many of these images are very realistic that the viewer will accept the reconstruction as representing the actual monument. There can be many interpretations of archaeological data which can result in different reconstructions, however the appearance of an image or animation in a digital format out of context can be misleading. The verisimilitude of the computer based image should be questioned in the same manner as a picture in a journal, the digital medium does not facilitate this questioning.

A working group of the VSMM had been liaising with Working Group V of CIPA to determine a method of developing an ‘index’ to be carried with the images so that viewers and fellow researchers can be made aware of the processes undertaken in the visualisation. The ‘index’ will be applied to several virtual reality type reconstructions, including the Ayutthaya project in Thailand. It is intended that this will reduce some of the concerns being expressed by various international organisations and publishers.

INTRODUCTION

The advent of digital information systems and the Internet has changed for ever the way that information is disseminated. The speed of information distribution, the reach of the distribution systems and the ease of graphical display now means that an image can be created and displayed without the viewer having any degree of certainty of its providence or veracity. Whilst this may not initially appear to matter, it has become a concern to institutions such as UNESCO that deal formally with the representation of cultural monuments. Before, it took a refereed publication and an author with an established reputation in the field of interpretation in order to publish, now anybody with a CAD package and computer can reconstruct world monuments. It is the diffusion of visualisations and reconstructions in a digital format that raises concerns, currently there is no established ontology to moderate the process.

There is a lasting fascination with things ancient and exotic. Virtual reality models of archaeological monuments are now part of popular 'cyberculture', and they appear in a wide range of publications (for example Novitski 1998 and Hamilton 1998 are articles published in consumer gomputer graphics magazines).

Recent developments in the science of photogrammetry have led to, in many cases, the automation or semi-automation of the CAD modelling process (Gruen, 1998). It is very easy now to use photogrammetry to create three dimensional models of cultural monuments and artefacts, and to display or publish this information on the Internet. There are a variety of low cost packages like Photomodeler that provide photogrammetric solutions for the non-photogrammetrist (for evaluation of these packages see Hanke and Ebrahim, 1997, and Patias, et al 1998). There are many more modelling packages like *MicroStation, 3D Studio Max, Alias|Wavefront Maya* and so on that give substantial rendering and visualisation power on a desk top computer. The techniques and procedures are well known within the computer graphics industry, the close-range photogrammetric industry and increasingly so in architecture and archaeology.

The availability of the technology means that people with a wide variety of backgrounds and experience are re-creating lost worlds, and users and viewers of these visualisations have little idea from where the information is derived and how closely these truly represent the real monuments. Often images are supplied or transmitted without any supporting documentation whatsoever, leaving the user no alternative but to accept the interpretation being offered. This is not the case necessarily with traditional publication methods, and even where interpretations are provided often there is sufficient data in accompanying tables, diagrams and text to enable the reader to moderate their opinion on the result.

IMAGES OF STONEHENGE

One relatively simple way to demonstrate part of the problem is to use examples of a range of interpretations applied to a well known cultural monument, in this case Stonehenge in England. Some of the images presented here were created before the development of 'scientific rigour' in the documentation of monuments earlier this century, however it could be argued that for many computer based visualisations there may have been a return to the age of 'artistic' rather than 'scientific'. This will be discussed later.

Few observers would now consider these to be a true documentary record of this site, however that is a result of years of conditioning in the scientific method of observation. These images come from either Mitchell 1982 (noted as A) or Piggot, 1978 (noted as B)

Figure 1: Stonehenge by W. Blake (A)

Figure 2: Merlin constructing Stonehenge (A)

Figure 3: The castle and human sacrifice are fictitious.(A)

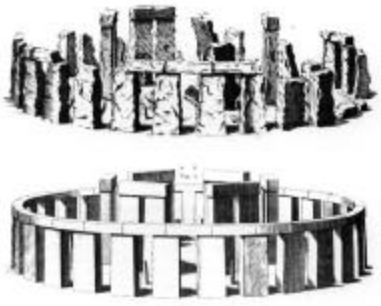

Figure 4: One possible interpretation (B)

Figure 5: Ancient festivals at Stonehenge (B)

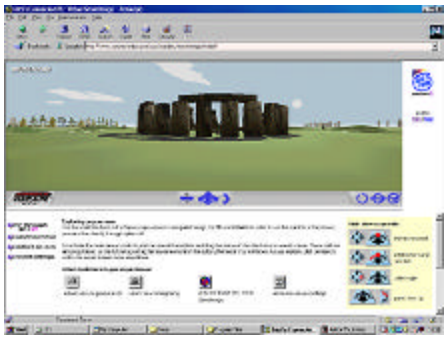

Figure 6: A virtual Stonehenge. From http://www.intel.com/cpc/explore/stonehenge/

The purpose of these illustrations is to show that, at least before the introduction of detached scientific observation, the records that were produced incorporated the biases of the recorder and even perhaps the expectation of the viewing public. Does the use of elaborate computer generated images now reflect similar biases and expectations?

ELEMENTS OF PHOTOREALISM

Computer visualisation has developed from a tool used by researchers to display difficult or non-visible information in a graphical form to one of the fastest growing mass entertainment media. Computer graphics encompasses the production of pie charts from spreadsheet packages to the generation of photo-realistic interpretations of ancient cultures and landscapes. The power of modern computers facilitates the production of images indistinguishable from photographs, and there is a cultural conditioning that means that photographs are understood to represent reality.

The elements of photorealism can be summarised as follows (Fleming, 1998, p3):

- Clutter and chaos
- Personality and expectations
- Believability
- Surface texture
- Specularity
- Dirt, dust and rust
- Flaws, scratches and dents
- Bevelled edges
- Material depth, and
- Radiosity

If it was possible to de-construct visual reality these are the features of a scene (apart from perspective geometry) that are processed by the human cognitive system to give the impression of realism. All of these features can now be added or modelled by modern computer graphics and virtual reality systems, and the incorporation of these image artefacts increases the level of acceptance of the images as representing a real situation.

THE VISUALISATION PROCESS - FROM PHOTOGRAMMETRY TO VIRTUAL REALITY

The contribution that the science of photogrammetry can make to the documentation of cultural heritage is significant and well documented, particularly in the International Archives of Photogrammetry and Remote Sensing Commission V (ISPRS) and the International Committee for Architectural Photogrammetry (CIPA). Traditionally the photogrammetric process generated maps and plans suitable for an architect or archaeologist to interpret for their purposes, adding another level of interpretation in the process (camera - stereo-plotter operator - cartographer - other 'expert'). The intention of the procedure was to make the photogrammetric record as 'true' to reality as the cartographic process permitted, within the existing syntax of the medium. More recent advances mean that it is now commonplace for the photogrammetric process to be the primary method of generating computer aided design (CAD) models of the object under study, and then for these models to be further enhanced through some form of visualisation.

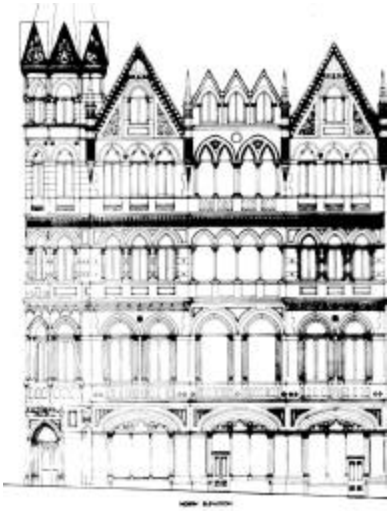

Figure 7. The Rialto Façade, Collins Street, Melbourne. A 'traditional' representation of the monument

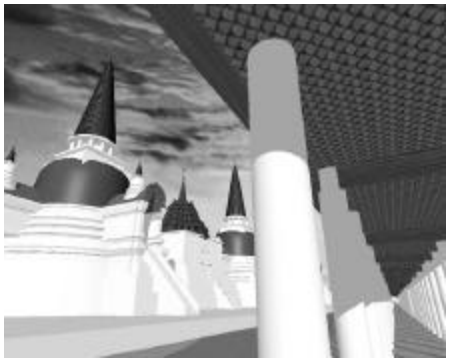

Figure 8: Wat Si Sampet, Ayutthaya' A 'modern' representation of a reconstructed monument.

There are two issues here, the first being the representation of the actual monument under study, and the second being the visualisation of the reconstruction of the monument.

The Ayutthaya Project.

The reconstruction of the ancient Thai capital of Ayutthaya is a good example of the problems facing researchers in attempting to create a 'true' record of past events. As has been previously reported (Ogleby 1997) this project in Thailand is creating a virtual reality representation of the ancient capital as it appeared before being sacked and razed. It uses photogrammetry as the primary data acquisition tool, and combines this with historical narrative and modern expertise to produce an 'Ayutthaya Experience'.

There is an artistic tradition associated with the period, which determines the form of the architecture and in particular the Buddha statues associated with the religious structures. This artistic tradition has survived the sacking of Ayutthaya, and parallels can be found throughout Thailand today that give a good indication of the form of the buildings and monuments.

In the Ayutthaya project it does not suffice to use off-the-shelf CAD models that can be purchased from modelling companies like Viewpoint Data Labs, (for example see Figures 9 and 10)' the visual appearance of a Buddha at Ayutthaya is well known, and the use of a model from another period or even country would be ludicrous.

Figure 9: A stock Buddha model

Figure 10: An Ayutthaya period Buddha

All effort has been made to use costumes, music, artefacts and architecture from the specific period under question, as to otherwise would not produce a record that could be used by other researchers, it would lack 'verisimilitude'.

Figure 11: Traditional dancers combined with the VR model at Ayutthaya. The dancers are in costume of the period under study, the dance is from the same period.

A VERISIMILITUDE INDEX

There are several suggested approaches to authenticating VR reconstructions of historic architecture and landscapes, although at this stage they are merely suggestions and open for discussion. The ad-hoc working group of the Virtual Systems and Multi Media Society is currently investigating approaches, and it is the intention of this paper to further the debate and to widen the scope of potential contributions.

The issue of 'authentication', that is does the visualisation come from where and whom it purports to come from. This is being addressed by other organisations, in particular those involved with digital museum resources on the Internet. Some of the solutions being proposed include:

- The creation of copyright deposits
- Certification of the original sources
- Registration of unique document identifiers
- Publishing key data about the documents which should match that of the document in hand
- Digital signatures and watermarks
- And defining metadata standards to carry document suthentification

(Bearman and Trant, 1998)

This is one issue, the other is to determine a measure of how well the visualisation represents the original - a very different problem.

One suggestion is to develop a graphical indicator that could be embedded with the image or video sequence that shows the 'audit trail' of the process undertaken to create the visualisation, including the geometrical accuracy of primary resources and estimates of the level and thoroughness of interpretation applied. This is not an easy task, as in order for it to be successful must also take into consideration the reputation and expertise of the personnel involved (as was done traditionally with refereed publications). There are statistical plots like star charts and even *Chernov Faces* that show multivariate correlation, if the criteria can be determined to the satisfaction of archivists and researchers then this may offer one solution. To use Ayutthaya as an example, an index would need to consider the geometrical accuracy of the base models, the adherence to styles of the period, the data sources for interpretative material, an indication of the sources of texture maps, adherence to the solar ephemeris for lighting, correct vegetations, costumes, animals, sounds… The list is long, and the data would need to travel with the images.

Another is to further the proposal to develop metadata standards for heritage visualisation, and to carry this information with an image or animation, either via tags in the Internet pages or even embedding in the image header as is done with some of the modified image formats like GeoTIFF.

CONCLUSION

This conference paper has outlined some of the current concerns regarding the visualisation of cultural heritage using virtual reality techniques, and how the lack of standards and an ontology creates uncertainty regarding the verisimilitude of the results. There are several proposals 'on-the-table' so to speak, and there should hopefully be a solution developed in the near future. Further suggestions can be forwarded to the Author at the email address shown on the title sequence.

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