Ancient Olympia as a Three Dimensional Museum Experience

Cliff Ogleby [*], *Sarah Kenderdine* [#]

[*] Department of Geomatics, The University of Melbourne, Victoria, 3010, Australia
Email: c.ogleby@eng.unimelb.edu.au
Powerhouse Museum, Sydney, 2007, Australia
Email: sarahk@phm.gov.au

ABSTRACT
This paper will present the techniques used in the production of a 3D narrated tour of the ancient precinct of Olympia set in 200 BC; and detail the approaches undertaken to digitise the Statue of Zeus using an hand held laser scanner, together with the processing of this data into a high resolution model suitable for interactive display. The web site will be briefly described with focus directed to a statistical analysis of its usage.

KEYWORDS: Olympia, virtual reality, reconstruction, website, stereo, 3D, laser scanning, cultural heritage, panoramic, high resolution, zoomable

INTRODUCTION

The advent of the Sydney 2000 Olympic games in Australia was an occasion for celebrations and festivities of many different kinds, as well as the sporting event itself. In conjunction with the athletic events there were cultural events, ranging from classical and contemporary dance through art displays and including the *1000 Years of the Olympic Games – Treasures of Ancient Greece* exhibition at the Museum of Applied Arts and Sciences. This Exhibition showcased 54 antiquities loaned from the Hellenic Ministry of Culture that depicted Olympic sporting events, and incorporated two virtual reality components.

The subject of this paper is the preparation of the virtual reality data used in the two interactive exhibits, and the associated website. The works included a digital reconstruction of the site of the ancient games, Olympia, and a high-resolution digital model of a statue from the Museum of Antiquities in Athens. The works are analyzed below in terms of both quantitative and qualitative survey. The website will be briefly described with focus directed to a statistical analysis of its use (a full analysis and design specification of the website can be read in Kenderdine 2001).

PROJECT ELEMENT A: ANCIENT OLYMPIA

Olympia is located between the Cladeus and Alpheios rivers on the western side of the Pelloponese. It is an archaeological site, where most of the monuments lie scattered as a result of two earthquakes and numerous floods over the centuries. The foundations that survive from many of the buildings date to different periods, from the Archaic, Classical, Hellenistic and Roman times.

Olympia became the primary site for the games held in honour of Zeus, and with the rise of Zeus through the pantheon of Greek gods the games at Olympia increased in importance. The Games were a time of peace throughout the Hellenic world and an occasion for displays of sportsmanship and athleticism. The games were also a time for business deals to be struck, war booty to be displayed, and state and city honour to be upheld. Following the Roman rule of the Hellenic world, and the rise of Christianity, the games diminished and eventually the site was abandoned.

Excavations at Olympia were begun in May 1829 by French archaeologists, who transferred many of the finds to the Louvre where they are still being exhibited. When the Greek government was informed of the looting of artefacts, the excavation was stopped. Excavations started again 45 years later by German archaeologists, which continues to this day. Much of the material published as a result of the excavations formed the basis of the reconstructions used in this project (Adler, F. et al, 1892-1897/1966).

ARCHITECTURAL AND SCULPTURAL ELEMENTS

Olympia was first and foremost a place of worship, and a place for the celebration of the games held in honor of the Gods. Many of the structures on site were temples, with a few administrative and special accommodation buildings. In 200BC, there were buildings at Olympia from most of the main architectural periods, dating back to around 700BC. The date of 200BC was chosen as the epoch was indicative of the evolution of the site, but without the more recent Roman additions.

Information on the architecture was obtained mostly from the publications of the this German material, and from Pausanias, a travel writer of the first Century AD (Levi, 1979). For a full set of reference please refer to the website bibliography and associated resource materials *(http://www.phm.gov.au/ancient_greek_olympics)*.

The reconstruction of ancient Olympia has been a long and involved process. At all times effort was made to create models and materials that were not only visually appealing but also historically correct. A multitude of published sources were consulted in order to determine the architecture of the missing buildings, the form and colours of the decoration, the statues, the terrain features and vegetation. All of the architectural elements have been built as close to their 'original' descriptions as possible.

The original building models were created in Bentley System's MicroStation CAD package, primarily because of the level of experience with this package and its suitability for precise dimension control. This caused many difficulties when translating data into the 3D modelling package used, the only common workable export format was DXF which not only gave considerable errors in relative position of elements but also created very large polygon counts for even simple objects. Much of the building elements were re-created in 3D Studio Max from scratch.

All of the structures are in the locations derived from the archaeology of the site, and are true to scale in all dimensions. The heights of the buildings were derived from the architectural remains, and were

extracted from the publications. The materials and textures were composed of colours derived from the archaeological and historical record, as well as using contemporary materials typical of the period. The descriptions of the buildings and statues by Pausanias were also used as the basis for much of the material mapping, and for the style and location of the statuary.

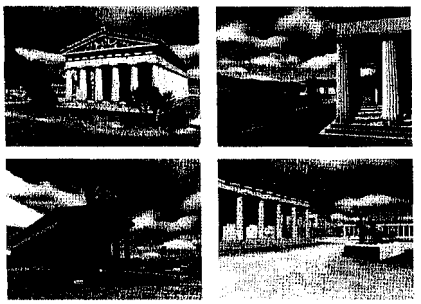

Figure 1: Postcards from Olympia

All of the animations were created using 3D Studio Max. Consideration was given to using a variety of other packages however the 'render-farm' facility of 3D Studio Max offered substantial (essential) timesavings. The render-farm finally consisted of approximately 60 machines, ranging from very fast Pentium PIII to PII computers. Whilst the render-farm required considerable nurturing the process greatly facilitated the delivery of the exhibition in a very short time period.

The rendering consisted of 14 animation sequences timed to fit the narration, created as single left and right channel frames for later composition and post production, in excess of 40,000 frames.

Presentation and delivery

The 3D experience offered to visitors was developed in Macromedia Director using a 'stage' that was 1600x600 pixels. The two separate 768x576 (PAL) animations sequences that made up each tour path were composited into one 1536x576 movie, ensuring perfect synchronisation between the left and right channels. These animation sequences were then used in Director, where the interactivity and additional material was added. Visitors to Ancient Olympia would be guided through the site along pre-determined paths, accompanied by a narrative explaining the monuments with anecdotes of life in during the games.

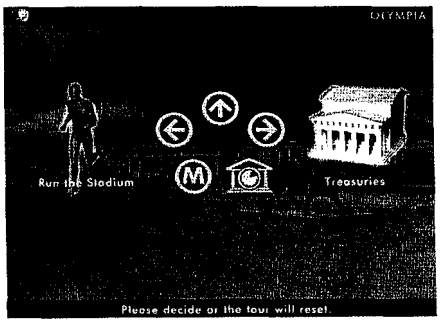

Figure 2: A decision point screen from the narrated tour interactive exhibition

Two rear-projection capable projectors were used to overlap the left and right channel images onto a 4m wide screen in a 5m square room. A custom built console was designed to facilitate user interaction at the decision points, and mounted on a stand approximately 3m from the screen.

The computer used to deliver the movies was a 2x800MHz Pentium III machine, with 500Mbyte of

RAM, fast disk access and a Matrox G400 graphics card. This card has a twin screen output of 800x600

resolution, which was used to drive the two projectors.

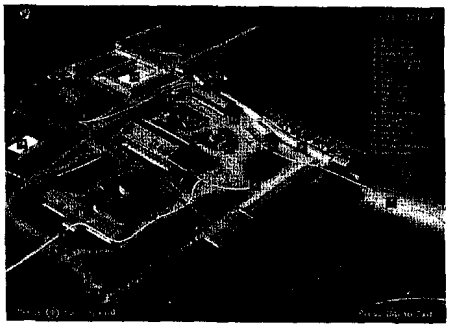

Figure 3: The navigation map with legend

PROJECT ELEMENT B: THE STATUE OF ZEUS-POSEIDON

One of the most significant sculptures in the National Archaeological Museum in Athens is the statue of Zeus from Artemision (Artemesium), also considered to be perhaps a statue of Poseidon. This bronze sculpture is slightly larger than life size, and was found in 1926 in the sea off Cape Artemision. It is one of the few surviving examples of Early Classical statuary, and represents the deity as a perfect human form. It is presented in the Museum in Athens on a pedestal, in a sunlit room with other statuary around the walls.

In order to develop a high resolution digital 'copy' of the statue of Zeus it was decided to use state-of-the-art reverse engineering techniques. This approach would enable a dense three-dimensional coordinate data set to be acquired within the minimum time possible.

A Modelmaker Laser Scanner mounted on a Faro 3D Coordinate Measurement Arm was used to create high resolution point clouds of the surface of the statue. A purpose built scaffold was fabricated in Athens to give the facility to elevate the scanner in order to access the top of the statue whilst also ensuring a stable fixture. The entire sculpture was digitised over several daytime sessions in multiple parts. There were considerable restrictions on this part of the project (including initially no photography, essential for material maps), no method or re-orienting the scanning system datum, and a very short working period in the Museum. These hurdles created complications in the data stitching process, as each scan was effectively an independent data set with no points in common other than overlapping surfaces.

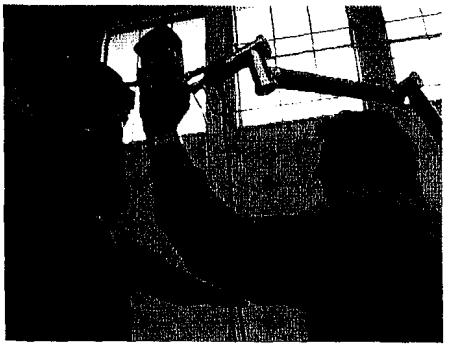

Figure 4: Scanning the Statue of Zeus/Poseidon

Presentation and delivery

The Zeus model was presented in a separate 3D virtual reality booth at the Exhibition. It was displayed using shuttered glasses technology (they were suspended from the roof), driven by proprietary software running on Intergraph hardware. The use of shuttered glasses necessitates the presence of a museum attendant; this option was not pursued for the reconstruction of the city that used polarised projection. The model was

rendered in real-time, and was displayed at life size on one screen and as a close-up of the head on another.
A limited amount of interactivity was provided where users could zoom in and out and rotate the model about its vertical axis.

Figure 5: The Statue of Zeus/Poseidon virtual model

ANALYSIS

The response to the Olympia model in the Exhibition was very enthusiastic. A survey based on responses from 302 visitors was undertaken by the Powerhouse Evaluation and Audience Research Group. It identified that 37% of the visitors preferred the virtual exhibits in preference to the objects themselves. Also that the group was equally represented through age groups, and that most had exceptionally high levels of formal education.

Particularly notable during the Exhibition itself was the large number of senior or retired citizens who readily engaged with the Olympia model. With good content the technology did not appear to present difficulty of use.

When the interactive components were designed it was expected that visitors would spend perhaps 5 minutes (of the possible 20 minutes) in the Virtual Tour booth, and then move. From observation, a large proportion of the visitors stayed for the entire duration of the tour, some even waiting for the tour to re-start so as to see the part they may have missed. The Virtual Olympia component occasionally caused a blockage in the flow of visitors through the exhibition (although this problem of congestion was common to the whole exhibition); if the exercise was to be repeated then more space would need to be allocated and perhaps a better designed booth to ensure that lingerers would not cause obstructions.

Consideration was also given during the exhibition to duplicating the Virtual Olympia tour as a 2d display for another lecture theatre in the Museum for the large number of school children who tended to congregate in the booth. The survey identified the huge demand for a product to takeaway from the Exhibition in the form of CD ROM.

> *'Outstanding – Virtual reality tape descriptions were exceedingly accurate. Best however was the 3D Olympia - unique! You should market it to schools!'* (respondent to the survey).

PROJECT ELEMENT C: THE WEBSITE

The website consisted of six content layers. These contained the following information.

1. **The Exhibition**: a series of zoomable panoramas of the Exhibition at the Powerhouse Museum augmented by 3D object movies and high-resolution zoomable images of objects, and supplemented with object information as text. (see illustration on next page).

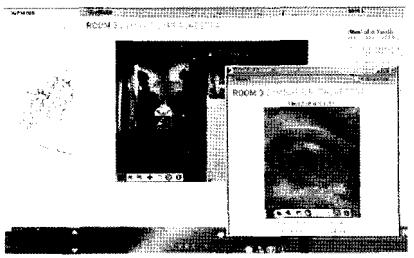

Figure 6: The Web Based Exhibition Tour

Virtual Olympia: this section contains a rich collection of materials separated into 4 sub-sections including:
Archaeological and geographic maps of Olympia;
A panoramic tour of the digital reconstruction of Olympia presented as 360° zoomable panoramas (viewable at full screen) with audio files. The option to download individual buildings to compliment scholarly research is also available. Essays are available as PDF files;
29 zoomable 360° panoramas of the archaeological site at Olympia taken in March 2000 (viewable at full screen). Essays are available as PDF files;
The statues from the Temple of Zeus shown as a 360° panorama of the main room at the Museum of Olympia, and a series of zoomable object movies. The metopes are further supplemented by reconstructed line drawings and colour interpretations using archaeological and historical records as the sources for reconstruction.

3D Zeus: a web version of the laser scan of the Zeus of Artemision (using the Zoom Viewer plugin), with the option to view as a 3D anaglyph through downloadable anaglyph glasses.

Resources - this section contains:
14 researched PDF articles;
Education programmes;
Glossary of terms linked to the PDF articles;
A nodal genealogy of the gods;
Supplementary programme of events to compliment the Exhibition at the Powerhouse Museum;
All audio files are listed.

Image archive: due to the extensive visual components in the website this section offers a quick entry to all the individual panoramas, zoomable images, object movies and jpegs. Selected buildings from the digital reconstruction of Olympia are available here, for research purposes, to download and print.

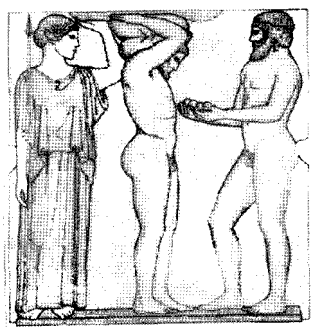

Figure 7: Artist's Impression of a Metope

Timeline: a timeline of events at Olympia over a 1000 years period is organised into:
Events specific to the Games at Olympia (events added after 200 BC not included);
Events relevant to Olympia itself (building programme until end of Hellenistic period only);
Events, political, around the Mediterranean world – after 200 BC only events directly relevant to Greece or Olympia included: politics, arts & sciences.

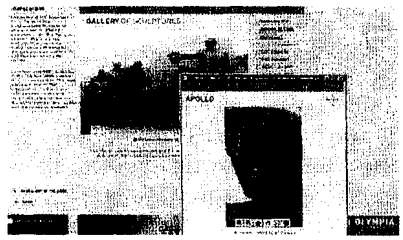

Figure 8: The Metopes as LivePicture Objects

THE ANALYSIS

Statistical data has so far been analysed for the four-month period of the Exhibition — from the beginning of August 2000 until the end of November 2000. An examination of the period shows a predictable variation in the data display. The most active day of use was during the Olympic period and on September 16, 2000
with 92,352 hits. Weekdays rather than weekends showed a larger number of hits although it was after-hours that numbers were marginally higher. This contradicts our initial expectations that the high bandwidth required to access the site would preclude extensive home use.

What is potentially of more interest is the length of stay by each visitor. 45% of visitors accessed just the first two pages of the website. There was a corresponding drop off as the number of pages increases. However, a relatively high proportion (8% of the visitors) was staying over 20 minutes to access 43% of the total page views. This last statistic would suggest that those visitors who were interested in the site found rich and rewarding content. At one point in the 4 month period over 18% of the visitors were staying over 20 minutes. In web lingo this has been referred to web "stick-ability" (and hopefully not a measure of slow content download!).

CONCLUSION

The overall project has won many awards in the short time since its launch. The most important of these include a Virtual System and Multimedia award for the Best Virtual World Heritage reconstruction; the Best of the Best website for the Australian Interactive Multimedia Industry Awards; the Best Interface Design at AIMIA; Hitwise Top 10 for Education and Research 2000; and the website was a finalist in the British Association for Film and Television Interactive Entertainment Awards 2000.

The versatility of use for the Olympia and Zeus models, and the rich website content demonstrate that rigorous scholarship is a worthwhile investment and can command a significant audience. The repurposing of the underlying content has enabled the works to be developed for different platforms and delivery mechanisms. The works have now been repurposed for a CD ROM that will be distributed to schools in Australia courtesy of Intel Corporation.

ACKNOWLEGEMENTS

This project was made possible through the generous provision of the Hellenic Ministry of Culture (http://www.culture.gr). A number of people in the Ministry worked hard on our behalf to make the data collection process possible. Sponsorship to complete the work was generously provided by the Intel Corporation (http://www.intel.com). Thanks also to the Australian Ambassador in Athens, Ross Burns, and consul Deborah George, to Jan Casson-Medhurst at the Australian Archaeological Institute at Athens, Judith Swaddling at the British

Museum for her time in reference to the scale model of Olympia housed at the Museum. The website was conceived and design by the Powerhouse Museum (http://www.phm.gov.au) with implementation by Massive Interactive. The photographic work at the archaeological site was undertaken by Peter Murphy, Sydney. The overlays for the metopes were draw under the direction of Kate Da Costa by a meticulous and hardworking David Loong.

REFERENCES:

1. Adler, F., Curtius, E., Dörpfeld, W., Graef, P., Partsch, J. & Weil, R. 1897/1966 *Olympia 1: Topographie und Geschichte*, Amsterdam

2. Adler, R., Borrmann, R., Dörpfeld, W., Graeber, F. & Graef, P. 1892/1966 *Olympia II: Die Baudenkmäler von Olympia*, Amsterdam

3. Kenderdine, S., 2001, '1000 years of the Olympic games: treasures from ancient Greece. Digital reconstruction at the home of the Gods'. Paper for WWW 10, Hong Kong, 1-5 May 2001. CD ROM.

4. Levi, P. 1979 (trans.) Pausanias *Guide to Greece vol 2: Southern Greece*, London

ABOUT THE AUTHORS

Cliff Ogleby is a Senior Lecturer in the Department of Geomatics at the University of Melbourne, with 20 years experience in applying information technology in the disciplines of archaeology and cultural heritage management. He is Secretary General of CIPA-I^{2}DOC, the liaison committee for the documentation of cultural heritage between the International Society for Photogrammetry and Remote Sensing (ISPRS) and the International Council on Monuments and Sites (ICOMOS). He works in visualization and virtual reality, as well as site documentation.

Sarah Kenderdine is a maritime archaeologist and museum curator. Sarah has been involved in the development of large-scale internet based museum web projects and portals since 1994; and is currently involved in digital reconstruction and visualization projects. She was Project Manager and Creative Director for the *1000 years of the Olympic games: treasures of ancient Greece* Exhibition website (http://www.phm.gov.au/ancient_greek_Olympics) and CD-ROM. She is currently Project Manager of Special Projects at the Powerhouse Museum in Sydney.