Photography based 3D reconstruction for archaeology and heritage recordings

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INTRODUCTION

Three dimensional models as a way of recording objects in heritage and archaeology are obviously more valuable research assets than the more traditional data recordings such as photographs, sketches, selected measurements, bearings, verbal and written descriptions. Indeed most of the above, and other metrics, can be derived if one had an accurate 3D model. There are various approaches to the capture of 3D models, including but not limited to, structured light scanners, depth cameras, laser scanning, various 3D volumetric scanners and photogrammetry. 3D reconstruction from photographs has been an area of active research over the last 4-5 years. The improvement in the algorithms has resulted in a corresponding improvement in the quality of the resulting models. For many types of model, especially those requiring capture in the field [1], a skilled practitioner can photograph and reconstruct models with an accuracy that challenges the more traditional view that laser scanning is the gold standard. In the poster a number of examples of 3D reconstructed models in heritage and archaeology by the author will be presented. Reference will be made to the simplicity of capture, compared to many other techniques and comments around the question of accuracy [2][3]. Finally, some of the challenges will be presented arising from the storage of large textured meshes in databases, their intelligent searchability and online delivery.

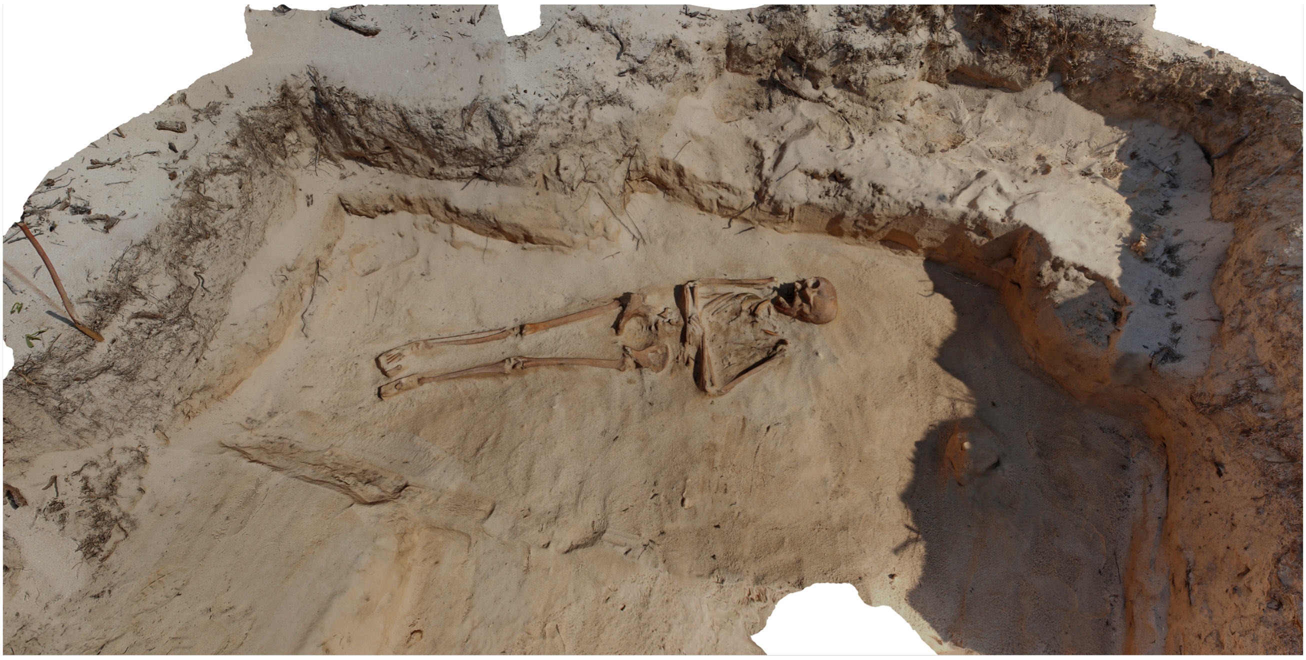

Figure 1. 3D model of an exposed skeleton on Beacon Island, a victim of the Batavia shipwreck in 1629 on the Morning Reef near Beacon Island in the Wallabi Group, part of the Houtman Abrolhos Islands. Five grave sites were reconstructed at multiple times during the excavations, typically 200 photographs per recording and reconstruction.

DATA STORAGE, SEARCHING AND DELIVERY

A number of challenges remain for the storage, interrogation and delivery of textured 3D models. It is not uncommon for a model mesh to contain 5 million triangles and for there to be a number of 16MPixel texture files. As such 1GB per 3D model representation is not uncommon. These full resolution models are of high research value and while subsampled versions may be useful for some purposes, the full resolution are equally important, particularly for many analysis processes.

These geometric forms can have questions asked of them above what might be baked into a database record through meta data, even questions relating to research questions unanticipated at the time of capture. For example, measures of roughness, dimensions, major/minor axes, colour metrics, area of surface with a particular facing and so on. These are geometric properties that can be computed from the data and as such would ideally be capabilities of the database query language.

Lastly, how are these potentially large objects delivered to an end user, client or researcher on a network connection of unknown bandwidth? Standard techniques exist for incremental delivery of large images, for example gigapixel images are partitioned into tiles where only those tiles are delivered that are visible within the viewer window and progressively revealed to the appropriate resolution. While there are attempts at progressive textured mesh delivery [6] and it is an active area of computer graphics research, there are as yet no standards for the delivery of multiresoluton textured meshes. Noting that storing multiple copies at different resolutions is not ideal nor efficient, one expects a means that provides progressive refinement rather than simply one of a number of level of detail models.

Figure 2. Example of highly convoluted structure of a cave in West Angeles, Western Australia. The highly convoluted rock structure at different levels (for example upper left hand side) and piles of rocks (for example right rear) would mean that a very large number of laser station positions would be required to achieve the coverage shown in this photographic reconstruction.

AIUTHOR REFERENCES

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ABOUT THE AUTHOR

Prof Paul Bourke is the manager of an advanced visualisation facility, the Expanded Perception and Interaction Centre (EPICentre) located on the Art and Design campus at the University of New South Wales, Australia. The initiative, focusing on medical and mental health, hosts world class display infrastructure, supports diverse research applications and develops visualisation and interface tools supporting the data-to-knowledge creation process by University researchers and students.

During his career as a visualisation researcher, Paul has worked in organizations where he concentrated on architectural, brain/medical, astronomy and heritage visualisation. Of particular interest is the application of novel and emerging data capture and display technologies. This includes displays that leverage the capabilities of the human visual system and how these may be used to facilitate insight in scientific research and increase engagement for public outreach and education.