Streamlining Photogrammetry Reconstructions of Bone Fragments for Bioarchaeological Analysis, Conservation, and Public Engagement

Adam Redford[1], Richard Mikulski[2] & Eike Falk Anderson[1]

[1] The National Centre for Computer Animation, Bournemouth University, UK
[2] Department of Archaeology & Anthropology, Bournemouth University, UK

The application of digital 3D imaging within the cultural heritage sector has expanded the range of tools available for creating and preserving records of all aspects of material culture [Gomes et al. 2014]. Photogrammetry has proven especially useful for archaeology [Sapirstein and Murray 2017] and has been found to be much more affordable yet almost as good as other techniques [Katz and Friess 2014].

Instead of the usually recommended photogrammetry workflows for digitising heritage objects in archaeology [Barnes 2011], which include a large number of processing steps, we have employed a workflow based on techniques and using software more usually found in the feature film visual effects industry (ReCap Photo, Maya, Mari), streamlining the process.

a) support frame for propping up larger objects
b) platform for the digitisation target
c) lazy Susan turntable
d) small platform for mini tripod and adjustable clamp for holding the camera monopod
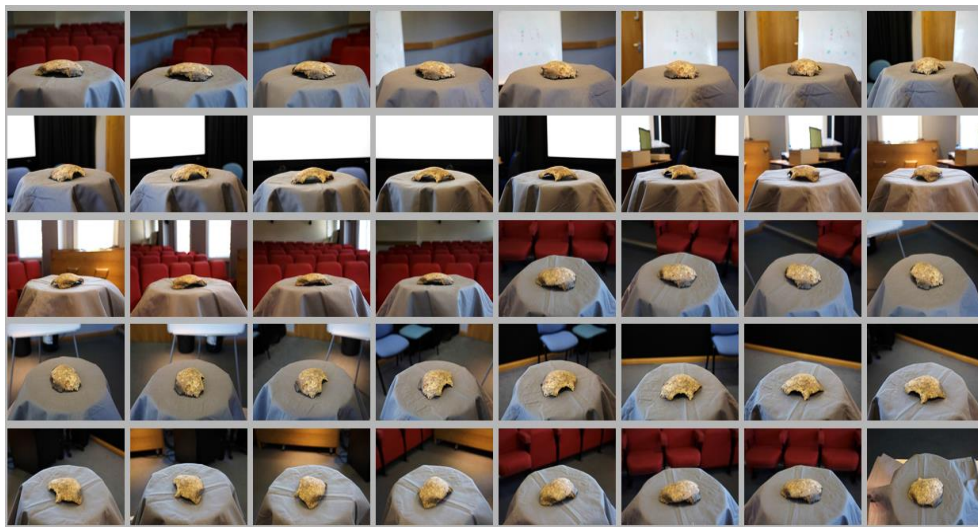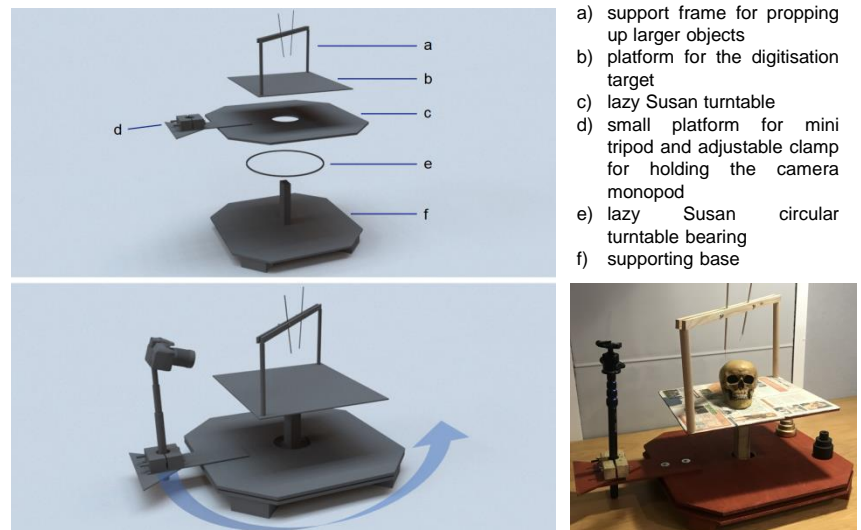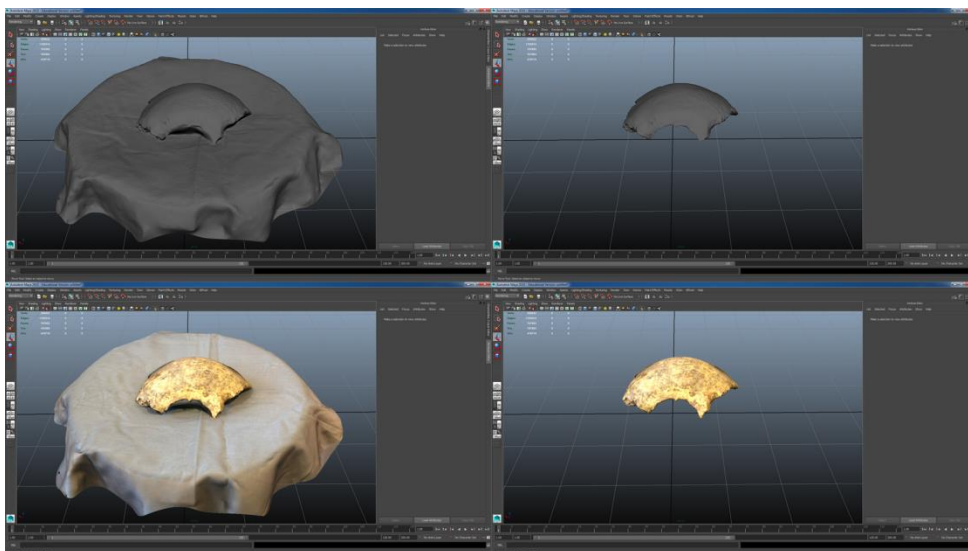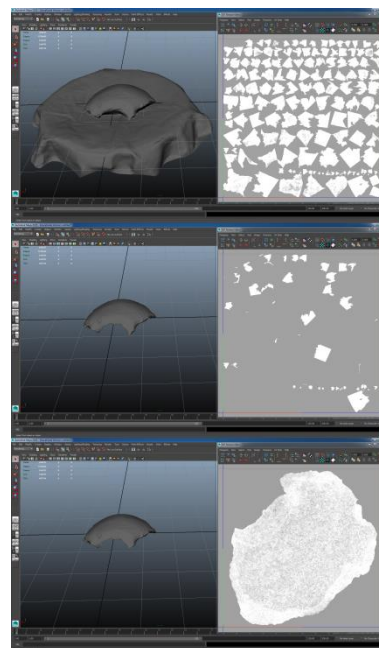e) lazy Susan circular turntable bearing
f) supporting base

Image acquisition using a stationary target object with the camera moving around the object.

The image acquisition process can be sped up and optimized by using a photogrammetry rig.

1. Before mesh optimisation the UV map includes texture information for the excess geometry.

2. After the removal of the excess geometry the UV layout is severely fragmented, requiring optimization.

3. The re-created UV layout covers a greater area of the UV map, facilitating greater texture resolution.

Before (left) and after (right) mesh clean-up (removal of excess geometry), without (top) and with (bottom) textures applied.
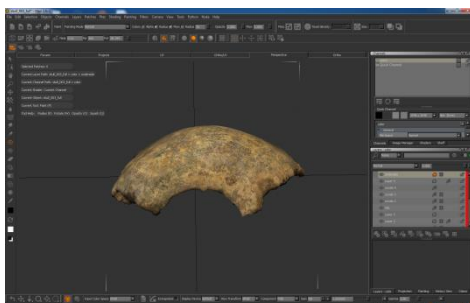
Textures are re-projected onto the mesh with the new UV layout and brightness, contrast, and colour balance of the textures are corrected.

The resulting 3D models achieve a resolution that is sufficient for the clear representation of bone elements and any gross changes affecting them, such as severe trauma.
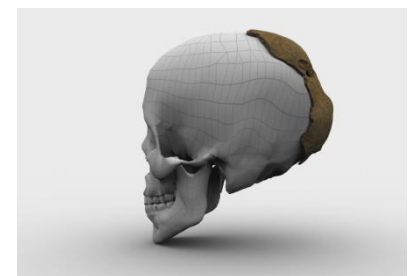
References

- Barnes, A. (2011). Close-Range Photogrammetry: A Guide to Good Practice. Archaeology Data Service / Digital Antiquity: Guides to Good Practice. http://guides.archaeologydataservice.ac.uk/g2gp/Photogram_Toc

- Gomes, L., Pereira Bellon, O.R. and Silva, L. (2014). 3D Reconstruction Methods for Digital Preservation of Cultural Heritage: A survey. Pattern Recognition Letters 50, pages 3–14.

- Katz, D. and Friess, M. (2014). Technical note: 3D from standard digital photography of human crania – a preliminary assessment. In American Journal of Physical Anthropology,154 (1), pages 152-158.

- Sapirstein, P. and Murray, S. (2017). Establishing best practices for photogrammetric recording during archaeological fieldwork. Journal of Field Archaeology 42(4), pages 337–350.