

From the Field: The Use of Photogrammetry to Explore Complex Burials in Archaeological Contexts

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The use of digital technologies to record and reconstruct archaeological excavations is becoming increasingly popular. Archaeological excavation is an inherently destructive process, as such, the detailed documentation of the contexts is crucial. Digital advancements allowed for photogrammetry documentation and 3D model development of complex burial contexts for post-excavation analysis. The 3D models materialise post-deposition events, destroyed as a consequence of the excavation process, offering a view into post-deposition events that could not be achieved in laboratory analysis when the human remains are no longer *in situ*. To showcase the benefits of such approaches, we explored a double burial containing the remains of two people: both young adult males (Fig. 1). This double burial is part of a larger burial site under excavation at Lisbon's riverside (Portugal), associated with a 16th-century church destroyed in the 1755 earthquake. The site is very complex, with a high density of single and multiple burials, with significant overlapping and intercutting, resulting from a high cemetery space turnover. The aim of this study is to emphasise and promote the use of digital technologies in the interpretation of complex burials and all archaeoanthatological related issues after excavation completion.

Methodological approach

Due to the site complexity, alongside long-established archaeological and bioanthropological recording methods, photogrammetric documentation was conducted to accurately capture a three-dimensional digital model of the double burial *in situ* that can be viewed, georeferenced and measured post-excavation.

Data collection

Data collection consisted of sequenced handheld photographs with sufficient overlap (60-80%) [1] from multiple angles and distances, recording as much detail and depth of the burial as possible. A Canon 250D DSLR camera, with the Canon EF 18-55mm lens was used in this process. As the quality of the final model is directly related to the number and resolution of the photos taken, it was essential that these were in focus at all times.

Ground control points (GCPs), whose precise coordinates are known, were pinned around the burial limits in the form of paper plates. Using GCPs removes potential distortions, allowing to scale the model accurately and to reference it geographically. As adequate lighting is crucial for the image acquisition process, LED tripod flood lights were placed around the burial to provide artificial and consistent lighting, since natural lighting was insufficient on site.

Image processing

Images were processed using Agisoft PhotoScan Professional [2], which relies on structure from motion (SfM) technology. SfM aligns the images by identifying matching points between overlapping images. Thereafter, the software processes the collected data to extract the object's shape, generating a three-dimensional dense point cloud resulting in a 3D mesh of the skeletal remains. In the next stage, the mesh is overlaid with a high-resolution texture, creating a photorealistic representation of the burial's surface. Finally, the model is scaled based on the local coordinates collected from the GCPs used in the photogrammetric survey.



SCAN ME



Outcome

The photogrammetric survey generated a faithful 3D digital reconstruction of the original burial context. Minimal distortion was observed, and the scale accuracy of the model was confirmed, showing the metric data was fairly accurate with the measurements taken on site. This has also permitted measuring the elevation of specific points retrospectively. Furthermore, from the 3D model it was also possible to extract a geometrically correct and high-resolution orthophoto exported as TIFF (Tagged Image File Format) file for viewing and vectorisation for digital illustration. This format also includes georeferencing information. The 3D model itself was exported as OBJ (Wavefront .obj) format, chosen for its widespread compatibility with various 3D modelling and rendering software. This ensured easy integration into different programs for subsequent editing, visualization, or analysis.

Alongside the 3D model, this approach allows for a lasting detailed recording of the burial context, destroyed as part of the excavation process. Subsequent archaeoanthatological analyses, post-excavation interpretation, and within and between sites comparisons are more easily and successfully achieved. Furthermore, it identified which elements of the human remains will require extra care during laboratory bioanthropological analysis. And, although photogrammetry is routinely used for field recording, an integrated workflow encompassing both fieldwork and laboratory work is still lacking in many cases - which is what we are promoting.

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References

- [1] Waldhauser, P. & Ogleby, C. (1994) 3x3-Rules for Simple Photogrammetric Documentation of Architecture, International Archives of Photogrammetry and Remote Sensing, Volume XXX, Part 5, Melbourne, 1994, pp. 426-429
- [2] Agisoft PhotoScan Professional Edition, Version 2.1 2024 Agisoft LLC

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