2022

Remote Analysis Capabilities of Digitally Rendered Models of Human Remains: Obtaining Osteometric Data & Assessing Pathology and Taphonomic Alteration - Using Non-Human Animal Remains as an Analogue

M. Elizabeth Dyess
Eastern Washington University

Remote Analysis Capabilities of Digitally Rendered Models of Human Remains: Obtaining Osteometric Data & Assessing Pathology and Taphonomic Alteration

Using Non-Human Animal Remains as an Analogue

M. Elizabeth Dyess
Eastern Washington University

INTRODUCTION

Computed tomography (CT), photogrammetry, and laser-surface scanning technologies have enabled remote, non-invasive, and non-destructive analysis of skeletal human remains of various contexts. Such technologies have found applications in the disciplines of osteoarchaeology, forensic anthropology, the medical sciences, and other related fields of inquiry. This presentation will discuss the accuracy and reliability of osteometric data obtained from digitally rendered models, as well as the clarity and level of detail attained. Such qualifying standards are essential if practitioners are to reliably assess pathology and taphonomic alteration to the specimens from which the scans are modeled. The suitability of each of the aforementioned technologies are discussed with regard to their intended use. A photogrammetry scan of non-human animal remains was obtained for illustrative purposes.

Fig. 1 Burnt non-human animal bone. Cross-sectional view exposing internal trabeculae

ETHICAL CONSIDERATIONS

In consideration to the complex ethical concerns surrounding the display of human remains, non-human animal remains were scanned for the purposes of this presentation. However, in conducting studies on human remains - in which the remains will be scanned or photographed - several considerations should be made.

- Consider the circumstances under which the remains were acquired and whether it is ethical to proceed
- Ensure that the proper degree of consent has been obtained from all relevant stakeholders
- Consider the purpose of obtaining the photographs or scans, and whether the process is likely to cause detriment to the remains

METHODOLOGY

The digitally rendered model - featured in Fig. 1, Fig. 2, and Fig. 3 - was created using structure-from-motion photogrammetry and processed in the Agisoft Metashape Professional 1.8.3 software program.
The model was created using 36 photographs, taken at 10˚ increments.

SUITABILITY & CONSTRAINTS

In selecting the appropriate digitization method – whether it be computed tomography, photogrammetry, or laser-surface scanning – the following should be considered.

- Accessibility, in terms of equipment, software, and associated costs
- User abilities
- Morphology of the specimen of interest
- Research objective:
  - Obtaining reliable and accurate osteometric data
  - Accurately modeling non-metric traits
  - Illustrating or assessing pathology or trauma
  - Illustrating or assessing taphonomic alteration

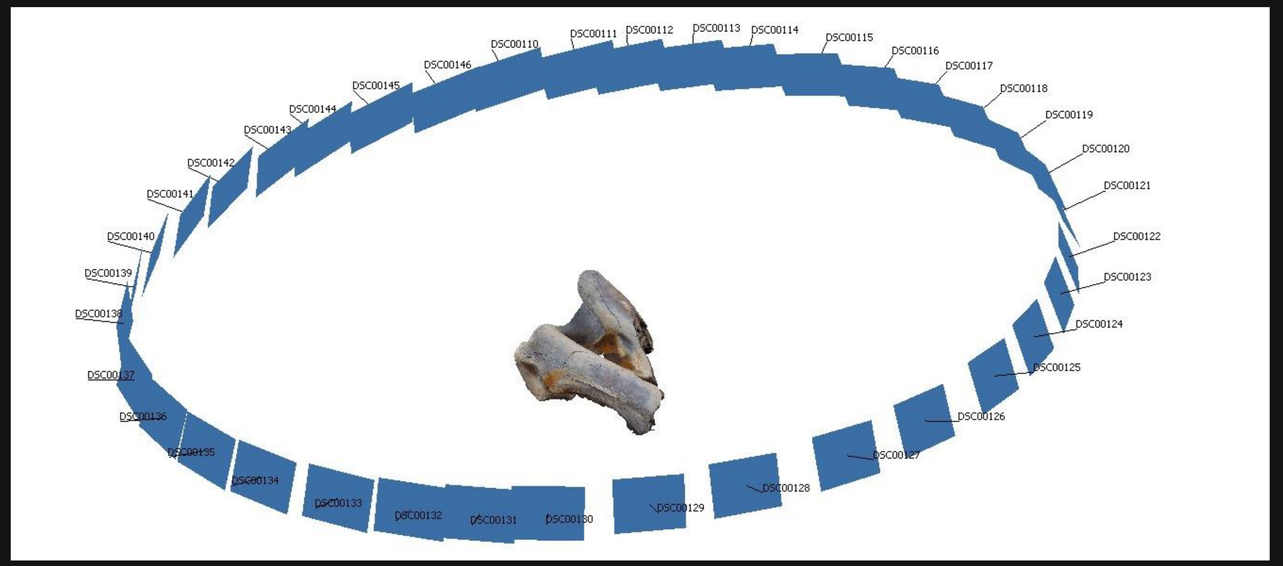

Fig. 2 Model processing view positioned at 30˚

OSTEOMETRIC DATA

The distances between osteometric landmarks, traditionally taken with vernier or digital calipers, may be reliably collected from digitally rendered models (Garvin and Stock. 2017). Computed tomography seems the preferred method as it:

- Produces high resolution scans, and is
- Well established in collecting metric data

PATHOLOGICAL LESIONS

CT scans do not preserve color or texture and are therefore not suitable for preserving evidence of pathology or taphonomic alteration. Similarly, complex surfaces, such as malignant bone lesions, are difficult to model with laser-surface scanners. Thus, photogrammetry is likely the most appropriate method for capturing complex pathology.

TAPHONOMIC ALTERATION

Taphonomic alteration, characterized by changes in color and or texture, may be accurately captured by either laser-surface scanners or photogrammetry (Fig. 1 and Fig.2).

Fig. 3 Burnt non-human animal bone. View of articular surface

ACCURACY & RELIABILITY

The consensus among field professionals seems to be that digitally rendered models enable reliable, remote analysis of remains.
However, in the absence of standardized methodologies, the scientific validity of applying 3D digitization technologies in research cannot be fully assessed (White et al. 2018).
Preliminary studies and literature have identified several factors that may affect the accuracy of scans obtained:

- Specimen morphology
- User-set parameters
- Choice of equipment and software, and
- Environmental conditions

Acknowledgments: Dr. Brian Buchanan, Dr. Julia Smith, & Dr. Michael Zukosky. The Eastern Washington University Anthropology Lab

Literature Referenced

Archaeology Data Service (ADS) and Digital Antiquity. (2016). 3D Models in Archaeology: A Guide to Good Practice. https://guides.archaeologydataservice.ac.uk/g2gp/3d_Toc. Accessed December 29, 2021.

British Association for Biological Anthropology and Osteoarchaeology (BABAO). (2019). BABAO Code of Ethics.

Fourie, Zacharias., et al. (2011). Evaluation of Anthropometric Accuracy and Reliability Using Different Three-Dimensional Scanning Systems. Forensic Science International, 207:127-134.

Garvin, Heather M. and Michala K. Stock. (2017). The Utility of Advanced Imaging in Forensic Anthropology. Academic Forensic Pathology, 499-510.

Hirst, Cara. S., et al. (2018). Standardisation in 3D Geometric Morphometrics: Ethics, Ownership, and Methods. Archaeologies: Journal of the World Archaeological Congress, 272-298.

White, Suzanna, et al. (2018). The Suitability of 3D Data: 3D Digitisation of Human Remains. *Archaeologies: Journal of the World Archaeological Congress*, 250-271