Note: This may not be fully compatible to view on all Mac operating systems

The Digital Advantage:

How 3D digitisation can aid in trauma analysis on human remains

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Introduction

The adoption of digital technology in archaeological recording and research has proceeded at varying pace in differing sub-fields. An area where this trend is currently gathering momentum is bioarchaeology, where aspects of the discipline that have conventionally relied on manual analysis are beginning to adopt more technological methods. This opens doors to new modes and standards of analyses with potential to provide more finely grained information than was previously obtainable or which previously could not be captured at all.

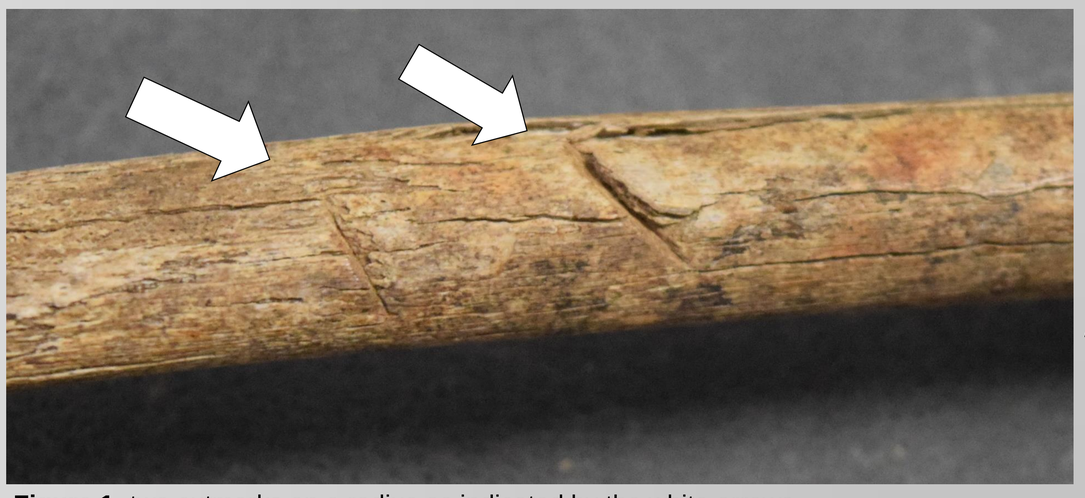

Figure 1: two cutmarks on a radius as indicated by the white arrows.

Bioarchaeological Importance

- Helps allow for comparison of cutmarks and quantitative analysis in 3D (i.e. geometric morphometrics)
- Allows for comparison between collections that may not be in the same physical space
- Permits opinions from other experts in the field who are remote
- Provides the ability to analyse aspects of cutmarks/defects to bone that are essentially inaccessible using conventional manual caliper measurements (i.e. opening angle, wall heights)
- Lets the researcher manipulate the cutmark to examine it in ways that would risk irreversible damage to the actual bone
- Permits replicable studies without needing to repeatedly handle the bone
- The use of digital, especially macro lenses allows more details to be revealed
- Allows for a permanent record of the cutmark to be retained for future analysis whilst preserving the original (i.e. allows different and new methods of analysis, preserve a record of the trauma for future comparisons, with appropriate permissions it allows for a record of the remains to be kept if they need to be reburied or repatriated)
- In a forensic context, the use of 3D visualisation can help preserve evidence, create the ability to bring sensitive evidence into the courtroom, and has the potential to be able to refit pieces of bone or possibly match weapons to injuries (for further discussion, see papers such as Collings and Brown 2020 and Errickson et al. 2014, 2020)

Methods and Aims

The method employed in the current study was structure from motion multi-view stereo photogrammetry (SfM-MVS) (Micheletti et al. 2015). This involved taking pictures around an object and using software to turn the photographs into a 3D visualisation via point matching and determining the position of common points. It is low-cost and is very accessible compared to many other methods such as laser scanning or micro-CT scanning whilst still creating high-quality results (Olson et al. 2013; Maté González et al. 2017). The quality of the camera can range and there are both freeware and commercial versions of the processing software.

The overall purpose of this project was to explore the potential to create reliable 3D models of cutmarks on bone to examine such trauma in close detail. This objective was met successfully and a workable methodology was developed (Tamminen et al. 2019). This poster focuses on the advantages this technique offers for bioarchaeology.

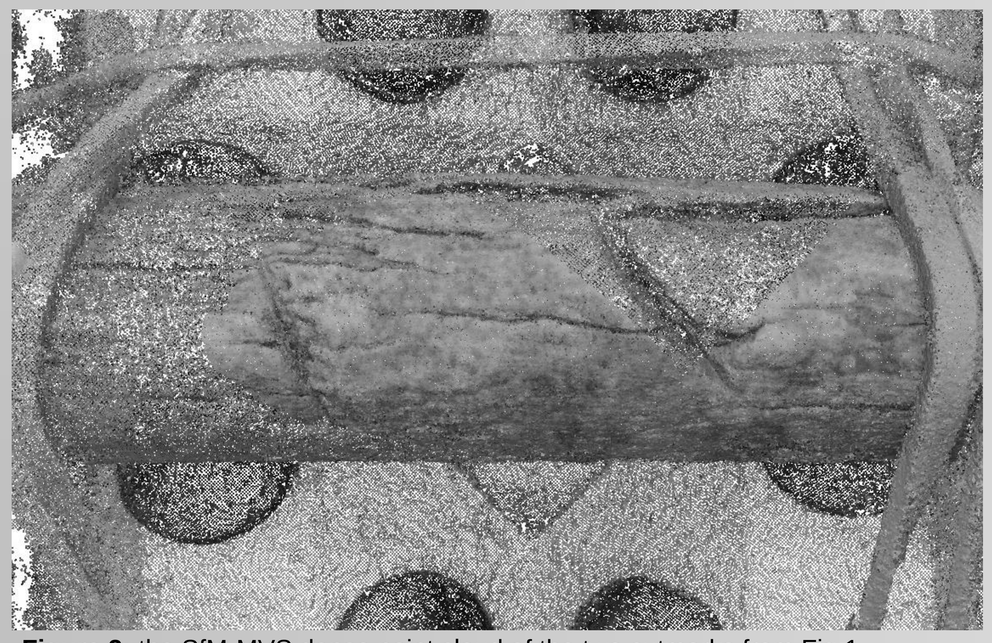

Figure 2: the SfM-MVS dense point cloud of the two cutmarks from Fig.1.

Possibilities for Cross-Disciplinary Research

The ability to have a digital copy of a bone or an aspect of a bone allows for new types of analysis to be performed. Fields such as machine or deep learning are areas which could help with the identification of features such as taphonomic patterns or pathological lesions. Analyses such as 3D geometric morphometrics could be performed more commonly. Other fields such as geoinformations can contribute their knowledge to investigate the surfaces of bones through Geographic Information Systems (GIS).

Conclusion

Using 3D visualisation and technology in the analysis of human remains can provide many advantages when compared with conventional modes of analysis. It opens doors to novel techniques which may not otherwise have been a possibility whilst allowing the preservation of the remains. It is important to ensure that appropriate contextual information is additionally recorded or important data can be lost (Eve 2018).

Overall, the use of 3D technology in bioarchaeology is increasing and should be cautiously embraced after thorough testing. It can have large added benefits to analysis and therefore the limitations must be discovered so it is used appropriately.

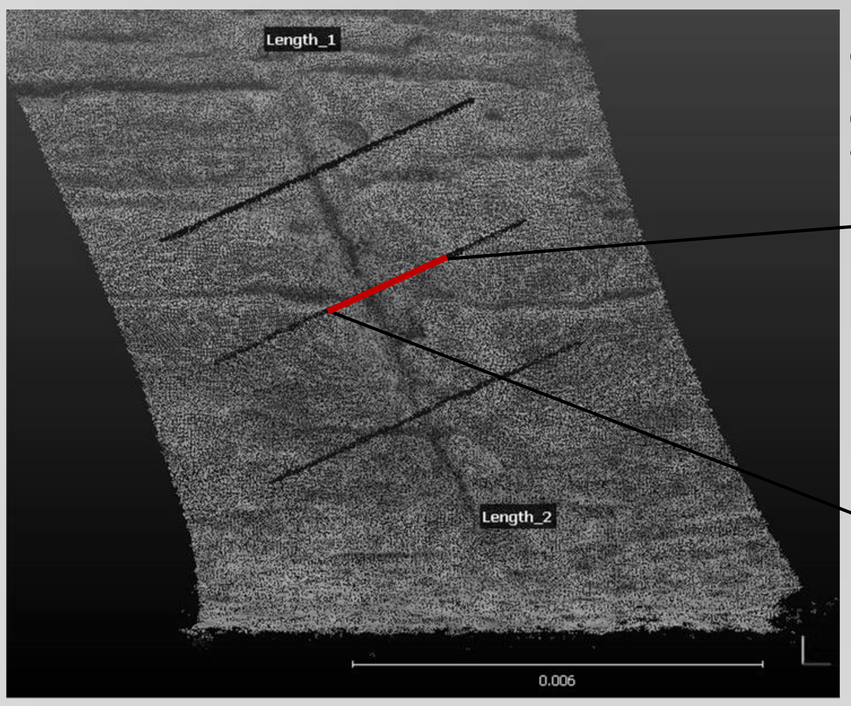

Figure 3.a: the close-up of one of the cutmarks in Fig. 2 with lines denoting where 25, 50, and 75% of its length is located

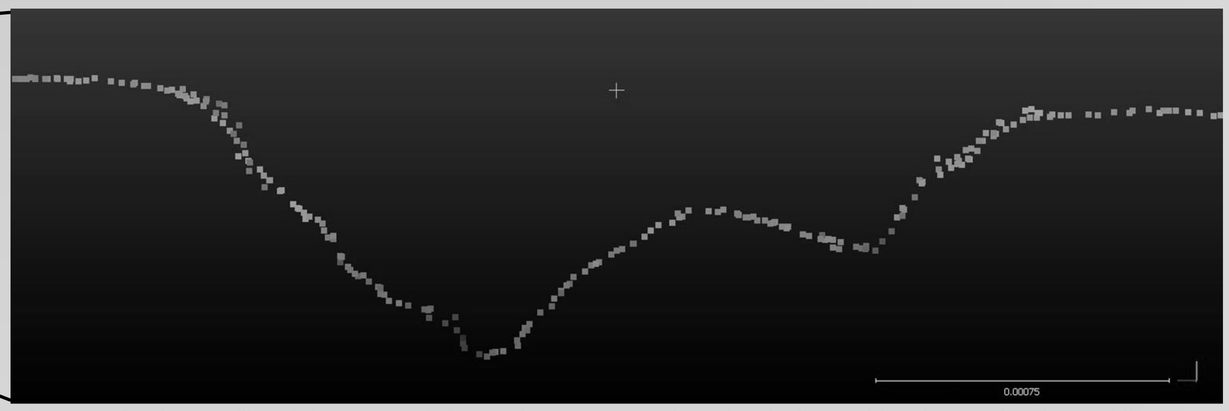

Figure 3.b: the profile of the cutmark from Fig. 2 at 50%, location indicated in Fig. 3.a by the red line

Acknowledgements

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Micheletti, N., Chandler, J.H., and Lane, S.N., 2015. Structure from motion (SFM) photogrammetry. *In:* Clarke, L.E. and Nield, J.M., eds. *Geomorphological techniques* [online]. London: British Society for Geomorphology, 1-12.

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