outlineR: An R package to derive outline shapes from (multiple) artefacts on JPEG images

David Matzig, Aarhus University, david.matzig@cas.au.dk
Felix Riede, Aarhus University, f.riede@cas.au.dk

Geometric morphometric methods (GMM) in archaeology are experiencing a sharp increase in application and popularity since the last decade or so and seem to be more popular now than ever. In general, they constitute a major advance vis-à-vis earlier qualitative descriptions, typological assessment, or linear measurements of artefacts. GMM approaches can be divided into methods that use landmarks, and those that use trigonometric descriptions of whole outlines. The bulk of archaeological applications of GMM have so far relied on landmark-based approaches, although a surge of recent studies is demonstrating the utility of whole-outline approaches using so-called elliptical Fourier analysis (EFA; Kuhl and Giardina 1982) and cognate approaches. Landmark approaches offer a straightforward way of delineating homologous structures, but their application also incurs a significant loss of shape information. In addition, the a priori identification of homologous landmarks on artefacts can be difficult and inherently subjective unless unambiguous theoretical expectations are available. Therefore, outline approaches offer an alternative, robust and information-rich way of capturing artefact shape data. Accurate artefact outlines can also be extracted efficiently from widely available legacy data, especially from artefact line drawings. There currently exist various standalone software applications as well as some R packages for the extraction and analysis of landmarks and whole-outlines. However, the extraction step always involves a considerable amount of manual processing and manual tracking of either the landmarks or whole-outlines, which proves to be the definite bottleneck of many studies.

In this paper we introduce the R package outlineR that allows for a fast and efficient extraction of whole-outlines from multiple artefacts on images, ready to be analysed in the Momocs (Bonhomme et al. 2014) environment. We give insight to the workflow and how it compares to existing methods of whole-outline extraction thus showing the advantages and savings in time when using outlineR for the digitization of large amounts of legacy data, such as artefact photographies or drawings. Finally, we present a case study using a large dataset of Late Neolithic/Early Bronze Age projectile points from Northwestern Europe extracted using the outlineR package to showcase the possibilities of whole-outline GMM regarding the creation of typologies and inference of chronological information.

References

Bonhomme, V., Picq, S., Gaucherel, C., & Claude, J. (2014). Momocs : Outline Analysis Using R. Journal of Statistical Software, 56(13). https://doi.org/10.18637/jss.v056.i13
Kuhl, F. P., & Giardina, C. R. (1982). Elliptic Fourier features of a

closed contour. Computer Graphics and Image Processing, 18(3), 236–258. https://doi.org/10.1016/0146-664X(82)90034-X