

Classification of archeological pottery samples

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The study of human settlement, related economic and social structures is of paramount importance for human history. The spread of Farming, starting in Near East Anatolia about 12000 years ago before reaching Continental and Mediterranean Europe about 8000 years ago, it is a good indicator of social changes and new ways of life foreshadowing today's world. Tracking the spread of Farming is not straightforward due to the lack of written records. The analysis of pottery manufacturing technique is one of the important tools for this achievement [1]. We target here two techniques: the coiling and the spiralled patchwork one as illustrated in Fig. 1. Although the difference is obvious in Fig. 1, working with real archaeological samples needs a strong and rare expertise based on experimental or ethnological references because the archaeologists have to work with sherds (such as in Fig. 2 two left images) rather than whole pieces. Several non-invasive techniques have been tested so far such as CT-Scan or even synchrotron but they are bulky and costly. We propose here a new imaging modality based on sub-millimetre-wave measurements and Machine Learning (ML) classification. The choice of D-band is driven by the small size of air bubbles that are arranged in straight or curved lines depending whether the sherd is a coiling or a spiralled patchwork. However the submillimeter-wave images cannot be processed visually (see the two images on the right in Fig. 2). Here we study how to set the measurement parameters and implement ML algorithms and more specifically the SVM [3] for reaching out the best classification rate. Investigations were conducted on 16 sherds with classification results ranging from 80 to 100%.



Figure 1. Example of coiling (*left*) [2] and home-made spiralled (*right*) potteries.

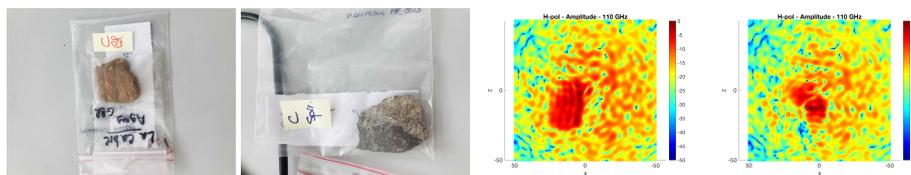


Figure 2. Archeological shards and corresponding millimetre-wave images obtained at 110 GHz. From left to right: g coiling sherd, spiralled sherd, 110 GHz image of the coiling sherd, 110 GHz image of the spiralled sherd.

References

- [1] L. Gomart, A. Weiner, M. Gabriele, G. Durrenmath, S. Sorin, L. Angeli, M. Colombo, C. Fabbri, R. Maggi, C. Panelli, D. F. Pisani, G. Radi, C. Tozzi and D. Binder, "Spiralled patchwork in pottery manufacture and the introduction of farming to Southern Europe", *Antiquity*, **91** (360), pp. 1501–1514, 2017. DOI=10.15184/aqy.2017.187
- [2] <http://passion-poterie.com/article/comment-couper-un-colombin-56.html>.
- [3] T. Fletcher, "Support vector machines explained", *Tutorial paper*, 2009.