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Uncovering Roman Society through Archaeological Features on Ceramics

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Abstract

Roman ceramics provide a unique glimpse into the daily life and culture of ancient Roman society. These ceramics were used for a variety of purposes, from storing food and drink to serving as decoration in homes and public spaces. In this article, we will explore some of the key archaeological features found on Roman ceramics and what they can tell us about Roman society. The main challenge is to create a Digital Twin of the ARS objects and artefacts using geometric capturing and semantic modelling of archaeological information. Moreover, the individualization and comparison of features, along with their visualization, extraction, and rectification, results in a strategy and application for comparison of these features using both geometrical and archaeological aspects with a comprehensible rule set. This method of a semi-automatic semantic model-based comparison workflow for archaeological features on Roman ceramics is showcased, discussed, and concluded in three use cases: woman and boy, human–horse hybrid, and bears with local twists and shifts.

Keywords: Semantic modelling; Rectification; Interdisciplinary research; Ceramics.

Introduction

Roman ceramics were often decorated with intricate designs and patterns. These designs could be purely decorative or could have had symbolic meaning. For example, some ceramics featured images of gods

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and goddesses, which were believed to offer protection and good fortune. Other designs might have included images of animals or plants, which were often associated with certain virtues or values.

In addition to images, Roman ceramics were often decorated with inscriptions. These inscriptions might include the name of the maker, the intended purpose of the vessel, or other information about its use or ownership. Within Roman pottery research, research on African Red Slip Ware (ARS) has been massively hindered by the lack of a methodological framework to address the issue of feature comparisons. The lack of digitized objects and annotated machine-readable resources has obstructed the usage of AI and ML methods. Due to the lack of such a methodological framework which would enable us to address the complex issues of pottery workshop relations and chronologies, most of the hitherto published research is limited to iconological and art historical aspects of the imaging world depicted on these vessels.

Digital archaeology is part of the digital transformation from analogue to digital humanities science using Knowledge Graphs and Machine Learning methods. This consecutive and dynamically interacting process of era paradigms must consider the contributions and challenges of each paradigm within its social and research context. Each era creates relevant knowledge within the research community in which it is embedded.

Within archaeology, exploration of the usefulness of AI techniques was first begun about ten years ago. AI methods and techniques are currently applied in archaeology for, e.g., the discovery of archaeological sites, the recognition and reassembly of archaeological pottery, the extraction of text and named-entity recognition, and iconography. Examples that illustrate AI technologies include applying or enabling comparisons of parts of archaeological artefacts, which can be applied in the ceramic research domain and in numismatics.

Many ML/DL methods on 2D raster images are applied in numismatics, serving as a basis for comparing and clustering coins and their depictions. The Big Data Lab at Goethe University Frankfurt am Main has applied and implemented a variety of recognition and implicit comparison approaches in student theses such as Loyal, Krause, and Combining machine learning methods of image and text recognition on ancient coin data. Gampe described the considerable challenges in the condition of the coins and the training data. However, the greatest problem with image recognition is the network's focus on the inscriptions on the coins instead of on the portrait.

An example of an AI approach based on semantic reasoning combined with Linked Open Data (LOD) is the Academic Meta Tool. AMT is a methodological proposal for modelling vagueness in graphs using a specific ontology, and can help to compare potter dies. The JavaScript library can perform reasoning with several logics. For example, the AMT approach has been used to model a South Gaulish Terra Sigillata pottery network with the AMT concepts Potter and Die. With axioms, one can determine several pieces of information. For example, if a potter created a die, it can be automatically rule-based from a surmoulaged die that the potter eventually worked in the same workshop.

While details such as inscriptions on coins are difficult to observe in 2D raster images, this information can become visible in high-resolution 3D models, as the third component, the depth/height of the objects in the 3D models, is known. Optical 3D close-range scanners provide high accuracy for detailed analysis of objects. For example, Mara used high-resolution 3D models to improve the readability of ancient stone inscriptions on cuneiform tablets. In addition, filter and pattern recognition methods have been developed based on 3D data, and enable the automatic extraction of cuneiform characters. Writing and other details on objects, such as damage or ornamentation, can be recognized and analyzed in high-precision 3D models.

Precise digital 3D models are an essential factor in industry, and are mainly used for quality control. For example, 3D models of produced components are created and a surface comparison with the corresponding constructed design model is carried out to check how high the deviations from the CAD model are and whether they are within the tolerance range. After a surface comparison, minor deviations can be displayed in colour. The colour scale can be adjusted as desired, allowing even the slightest deviations to be made visible. This comparison method can be transferred to archaeology, except that there are usually no nominal dimensions for archaeological objects. Instead, two similar objects or parts of objects can be compared with each other or an object can be compared in different states, e.g., before and after conservation. Through 3D digitisation, a data basis is created that offers the potential for many analysis possibilities.

Manufacturing Techniques

Roman ceramics were produced using a variety of manufacturing techniques, including wheel-thrown pottery, mold-made pottery, and handmade pottery. Wheel-thrown pottery was the most common technique and involved spinning a lump of clay on a pottery wheel while shaping it with the hands. Mold-made pottery involved pressing clay into a pre-made mold to create a specific shape or design. This technique allowed for more precise and intricate designs than wheel-thrown pottery. Handmade pottery, as the name suggests, involved shaping clay by hand without the use of a pottery wheel or mold. This technique was used for more simple designs or for creating unique, one-of-a-kind vessels.

Conclusions

Roman ceramics provide a wealth of information about ancient Roman society, from its cultural values and beliefs to its technological innovations. By studying the decorative elements, manufacturing techniques, and materials used in Roman ceramics, archaeologists can gain a better understanding of the daily life and culture of this fascinating civilization.

These results confirm the assumption that the production process must lead to similarities in appliqués and that this should be visible when comparing them. Together with the archaeological content, this provides a basis for considering further research questions. To ensure that research on this collection is as broadly based as possible, all content is openly accessible and modelled based on the latest methods of linked data management. Moreover, the archaeological data are linked to the digital object models and the geometric derivatives. As a result, all content relevant to research is available to all those who wish to use it for their own research purposes.

The methodological approach using semantically modelled decision trees presented in this study fundamentally enhances previous ARS research. The combined comparisons of appliqués by geometrical and archaeological observations and statements allow future ARS research to present verifiable and comprehensible insights into the relations between ARS potters and potteries. Our methodological approach provides ARS research with a multiperspective view beyond the current art-historical iconographical and iconological figure stamp comparisons.

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