Journal of Archaeological Science: Reports 44 (2022) 103518

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep

# Comparison of two ancient Egyptian Middle Kingdom statuettes from the Museo Egizio of Torino through computed tomographic measurements

Luisa Vigorelli [a,b,c], Alessandro Re [b,c,*], Paola Buscaglia [d,h], Nicole Manfredda [d], Marco Nervo [c,d], Tiziana Cavaleri [d,e], Paolo Del Vesco [f], Matilde Borla [g], Sabrina Grassini [h], Laura Guidorzi [b,c], Alessandro Lo Giudice [b,c]

[a] Dipartimento di Elettronica e Telecomunicazioni, Politecnico di Torino, C.so Duca degli Abruzzi, 24, 10129 Torino, Italy
[b] Dipartimento di Fisica, Università degli Studi di Torino, Via Pietro Giuria 1, 10125 Torino, Italy
[c] INFN, Sezione di Torino, Via Pietro Giuria 1, 10125 Torino, Italy
[d] Centro Conservazione e Restauro "La Venaria Reale", Piazza della Repubblica, 10078 Venaria Reale, Torino, Italy
[e] Dipartimento di Economia, Ingegneria, Società e Impresa, Università della Tuscia, Via Santa Maria in Gradi, 4, 01100 Viterbo, Italy
[f] Fondazione Museo delle Antichità Egizie di Torino, Via Accademia delle Scienze 6, 10123 Torino, Italy
[g] Soprintendenza ABAP-TO, Torino, Piazza San Giovanni 2, 10122 Torino, Italy
[h] Dipartimento di Scienza Applicata e Tecnologia, Politecnico di Torino, C.so Duca degli Abruzzi, 24, 10129 Torino, Italy

ARTICLE INFO

*Keywords:*
Egypt
Statuettes
Comparison
Museo Egizio
Tomography

ABSTRACT

X-ray Computed Tomography (CT) has a significant role as investigation tool not only in medical and industrial applications, but also in cultural heritage studies. One of the main reasons for such broad adoption of this method is its non-destructive capability to investigate the inner structure of precious and unique artefacts that would instead be damaged by traditional sampling procedures. Ordinary X-ray radiography is limited and gives only 2D images, while high-resolution X-ray CT imaging gives non-invasive access to three-dimensional (3D) information. This article focuses on the comparison of micro-CT results obtained from the analysis of two ancient Egyptian wooden statuettes representing offering bearers. The artefacts belong to the collection of the Museo Egizio of Torino as part of the funerary assemblage of Minhotep, discovered in the Asyut necropolis. For the analysis, an upgraded version of the X-ray imaging apparatus located in the Centro Conservazione e Restauro "La Venaria Reale" (CCR) was used, in order to reach a higher final resolution than the one already present and used at CCR. Thanks to this investigation, much information on the artistic technique was obtained and it was possible to highlight differences and similarities in the technical features of the two statuettes, acquiring elements to understand the specific contribution of micro-tomography in studying the finds and hypothesizing a common production method.

## 1. Introduction

Accessing the inner structure of an object has been an ongoing problem in many disciplines. Historically, while a number of science fields could afford several micro-invasive analyses (e.g. biology, geology, materials science), this process was extremely limited for objects in the field of Cultural Heritage, being necessary to preserve the original materials of the artworks. The discovery of X-rays made it possible to see through matter non-invasively and the development of computed tomography (CT) to obtain three dimensional images. The capability of reading inside the objects boosted the chance of access to information supporting the study of the artistic technique. X-rays methods are based on the physical and chemical principles by which different materials and densities absorb the radiation (Kak & Slaney, 1987). The elemental composition of an object will determine the amount of X-rays from the incident radiation that are absorbed or scattered; the alteration of the transmitted beam is used to obtain an image of the inner components of the object. 2D images from X-ray radiography show overlapping spatial planes in the resulting image, making the examination of three-dimensional objects difficult and less clear. Tomographic analysis favours instead the interpretation of internal features, giving the possibility to reach a 3D visualization of the inner structure of the objects and

* Corresponding author at: Dipartimento di Fisica, Università degli Studi di Torino, Via Pietro Giuria 1, 10125 Torino, Italy.
*E-mail address:* alessandro.re@unito.it (A. Re).

https://doi.org/10.1016/j.jasrep.2022.103518
Received 15 December 2021; Received in revised form 18 May 2022; Accepted 6 June 2022