Use of X-Ray imaging techniques for analysis in the Cultural Heritage field

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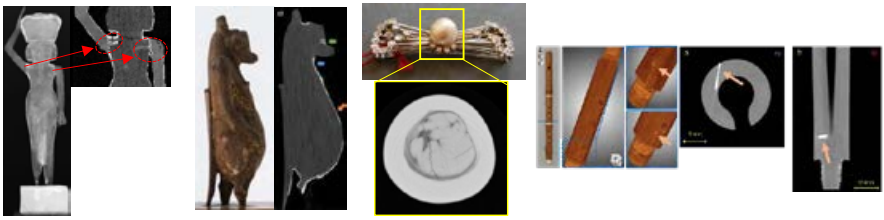
The study and development of different types of instruments based on X-ray emission has had a great boost over the decades. In particular, computed tomography (CT) used mainly for analysis in the medical field, is now widely applied in many other areas, including Cultural Heritage: thanks to the non-invasiveness and the high penetrating power of X-rays, CT applied to objects of artistic and cultural interest is very widespread [1, 2]. In particular, it allows the visualization and study of the internal structure, thus obtaining information on the composition, manufacturing techniques and state of conservation. Due to the high heterogeneity of the constituent materials, the shapes and sizes of these type of objects, specific experimental set-ups have been developed over time, optimized for the different needs.

In this work, different applications of CT analysis on different kind of artifacts are shown: the analysis allowed to distinguish some features otherwise visible only with invasive techniques requiring the cut of the samples. Some interesting results obtained will be presented, highlighting the versatility in analysing objects ranging from centimetres to half a metre such us pearls, ceramics, wooden statuettes. For example, on wooden statuettes from Ancient Egypt valuable information about the techniques of assembly, execution, gilding and previous interventions were provided [3, 4]. Moreover, micro-CT was able to distinguish natural from cultured pearls [5]. Furthermore, CT analysis was applied also to historical woodwind musical instruments (18th century) [6] with the aim to finally get playable replicas realized with additive manufacturing technique and replicate their ancient sound, since, for conservation reasons, is not possible to directly play the originals.



[1] Morigi, M.P. et al., 2010, *Applied Physics* A, 100, pp. 653-661.
[2] Re, A. et al., 2014, Heritage Science, 2:19
[3] Vigorelli, L. et al., 2021, *J. Imaging*, 7, 229
[4] Vigorelli, L. et al., 2022, *ACTA IMEKO* (2022) Volume 11, Issue 1, March 2022, pp 1-10
[5] Vigorelli, L. et al., 2021, *Condens. Matter*, 6, 51.
[6] Tansella, F. et al., 2022, *J. Imaging*, 8, 260.