

## Article

# X-ray Micro-Tomography as a Method to Distinguish and Characterize Natural and Cultivated Pearls

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**Abstract:** Digital radiography and computed tomography are two fundamental diagnostic techniques in different fields of research, including cultural heritage studies and gemmology. The application of these physical methods of investigation has gained considerable importance as they are non-invasive techniques. The presented work has been mainly focused on micro-tomographic analysis. The project is concerned with the study of natural and cultivated pearls in order to develop an investigation methodology for the analysis, distinction and characterization of different types of pearls, some of them belonging to different precious jewels from private collections. The investigations, carried out on a total of 22 heterogeneous types of pearls, allowed us to establish their origin (natural or cultivated) or to confirm/deny if a hypothesis was already expressed, and as well to highlight the cultivation methodology used case by case. Furthermore, it was possible to ascertain how large and varied the market for cultured pearls is nowadays and how difficult is, in some particular cases, to ascertain their attribution to a certain origin.

**Keywords:** radiography; micro-tomography; X-ray; pearls; gems



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## 1. Introduction

The study and development of different types of instruments based on X-ray emission gained increasing importance during the last years. In particular, imaging techniques, both digital radiography (DR) and computed tomography (CT), born at first mainly for medical aims, are now widespread in many other fields of application, including cultural heritage, thanks to the strong penetrating power of X-rays, imaging analysis applied to objects of artistic and cultural interest are widely used as non-invasive methods, i.e., they do not require a sample [1–4]. These techniques allow the visualization and study of the internal structure (thanks to the different attenuation coefficient of the materials), obtaining valuable information about the nature of constituent materials, constructive techniques and the state of preservation. In the cultural heritage field, objects are very different in shapes, sizes and composition. To carry out tomography in all the cases a single set-up is not sufficient because it can be optimized in terms of resolution, field of view and crossing thickness only for an object category. Therefore, there are different experimental set-ups: a few of them have been developed over time, starting within the framework of the “neu\_ART” project, born from the collaboration between the University of Torino, the National Institute of Nuclear Physics (INFN) and the Centro Conservazione e Restauro La Venaria Reale (CCR)