



## Evaluation of historical buildings using laser scanning - a case-study of Funchal Cathedral in Madeira (Portugal)

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### Abstract

Non-invasive and non-destructive procedures offer a benefit over standard methods of chemical analysis in the study of heritage. Unlike intrusive sampling, which involves removing a sample for examination, these approaches do not cause any damage to the materials being studied. The utilization of laser scanning enables the generation of a three-dimensional point cloud representing the object under investigation. In addition, the color and energy reflection of the objects are measured as a percentage of the energy emitted by the laser beam at the time of acquisition. Generating point clouds to document heritage structures, including individual objects or entire buildings, aids in the preservation of detailed information regarding their three-dimensional composition. If there is a loss, it is feasible to recreate the information from this source. Conversely, these can serve as the foundation for generating augmented reality content, allowing users to digitally explore a location and potentially aid, in the conservation of vulnerable sites. When applied to altarpieces, this technique enables a comprehensive examination of the painting's central area in three dimensions. This study helps identifying any potential issues with the wood, such as deformations in the wooden boards. The energy represented by the textural aspects of the painting can be divided into many value ranges. This division allows us to link a certain range to specific design elements of the painting and it may also be associated with the materials employed. The objective of the study conducted on the Funchal Cathedral in Madeira, Portugal, is to analyze the interior of the building, by examining the point cloud data. Additionally, the study seeks to analyze the altarpieces of different altars and establish a correlation between the reflection values and the materials used in the paintings.

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