EGU22-5091
https://doi.org/10.5194/egusphere-egu22-5091
EGU General Assembly 2022

Diagnostic process of an ancient colonnade using non-invasive volume visualization multi techniques

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The diagnostic process on the cultural heritage by non-invasive multi techniques generates multiple volumes of different data sets. Such volumes can be applied to a whole range of problems from diagnostics of the building stone materials to their in-time monitoring for maintenance and conservation. The results of the diagnostic process in multimodal data sets can be rendered effective by comparing multiple volumes at the same time and over time since the safety of monumental structures requires periodic monitoring. As already shown in recent works that focused on the integration of heterogeneous data from complementary techniques, the use of a single technique is generally insufficient to obtain a reliable diagnostic process.

The multi-technique high resolution 3D models described in this paper was aimed to investigate the conservation state of a precious carbonate colonnade in the ancient church of Saints Lorenzo and Pancrazio, dating to about the second half of the thirteenth century and located in the old town of Cagliari (Italy). The diagnostics of the carbonate colonnade was made by 3D non-invasive multi-techniques, i.e. Terrestrial Laser Scanner (TLS), close range photogrammetry (CRP) and ultrasonic tomography supported by petrographic investigations. To obtain a natural colour texturized 3D model of the columns with calibrated scale and coordinates both the TLS and CRP techniques were applied. The geometrical anomaly and reflectivity maps derived from the data of the TLS-CRP survey show presence of some anomalies worthy of attention. The 3D reconstruction with previous techniques was the essential base for the planning and execution of the 3D ultrasonic tomography that played an important role in detecting internal defects and voids and flaws within the materials by analysing the propagation of ultrasonic waves.

The results of the non-invasive diagnostic techniques on the building carbonate materials of the ancient colonnade were supported by thin section and mercury intrusion porosimetry (MIP) analyses in order to study their porosity and other textural characteristics such as the grains-matrix or grains-cement relationships, the bioclasts packing, the pore network and other petrophysical parameters (i.e. permeability and tortuosity). Knowledge of these characteristics is key to understanding the different susceptibility of the building carbonate materials to degradation and recognizing any forms of degradation while providing fundamental support to

the interpretation of the geophysical data.

Acknowledgements

This work was supported by *Regione Autonoma della Sardegna* (RAS) (Sardinian Autonomous Region), Regional Law 7th August 2007, no. 7, Promotion of scientific research and technological innovation in Sardinia (Italy), Resp. Sc. S. Fais.