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A fully customizable data management system for Built Cultural Heritage surveys through NDT

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The diagnosis of Built Cultural Heritage using non-invasive methods is useful to deepen the understanding of building characteristics, assessing the state of conservation of materials, and monitoring over time the effectiveness of restoration interventions.

Ultrasonic and sonic tests are Non-Destructive Techniques widely used to evaluate the consistency of historic masonry and stone elements and to identify on-site internal defects such as voids, detachments, fractures. These tests, in addition to being suitable for Cultural Heritage because they are non-invasive, provide a fundamental preliminary screening useful to better address further analysis.

Ultrasonic and Sonic velocity tests performed on monuments involve a lot of different information obtained from many surveys. It is therefore important to optimize the amount of data collected both during documentation and diagnostic phase, making them easily accessible and meaningful for analysis and monitoring. In addition, investigations set-up should be following a standard methodology, repeatable over time, suitable for different types of artifacts, and prepared for comparison with other techniques.

An integrated data management system is then also useful to support the decision-making processes behind maintenance actions.

This work proposes the development of a complete management IT solution for the Ultrasonic and Sonic measurements of different types of masonry, and stone artifacts. The system consists of a browser-based collaboration and document management platform, a mobile/desktop application for data entry, and a data visualization and reporting tool. This set of tools enable the complete processing of data, from the on-site survey to their analysis and visualization.

The proposed methodology allows the standardization of the data entry workflow, and it is scalable, so it can be adapted to different types of masonry and artifacts. Moreover, this system provides real-time verification of data, optimizes survey and analysis times, and reduces errors.

The platform can be integrated with machine learning models, useful to gain insight from data.

This solution, aimed to improve the approach to diagnostics of Cultural Heritage, has been successfully applied by the LAM Laboratory of the Department of Earth Sciences (University of Florence) on different case studies (e.g., ashlar, frescoed walls, plastered masonries, stone columns, coat-of-arms, etc.) belonging to many important monuments.