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Masonry Structure Diagnostics Via a Microwave Tomographic Approach

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Designing the structural reinforcement of a historical building is a complex process which, among other, requires diagnosing the building under test in order to detect possible damages of the structure due, for instance, to water infiltration or cracks.

In this framework, the research in non-destructive diagnostic procedures has gaining considerable attention, especially when a historical buildings is of concern, as such procedures offer a number of advantages as compared to the more usual destructive diagnostic methods.

First, the non-destructive methods do not require taking samples (which sometimes may regard the whole masonry structure thickness) of the structure under test nor to do inspection holes or cuts. Moreover, while employing destructive techniques the number and where to take the samples or to do holes or cuts depends inevitably on the restorer's experience and skill. Generally, inspections have to be performed over a limited set of points preferably in a region not directly visible (i.e., not over the front face of a monument). As opposed, non-destructive diagnostic techniques allow to monitor large areas (wherever it is needed); this is of great importance as a correct design of the reinforcement procedure requires the knowledge of the entire status of the structure.

Accordingly, in this contribution we consider the problem of diagnosing the internal status of a masonry structure by means of a non-destructive electromagnetic based technique.

A ground penetrating radar system is used to collect the electromagnetic field scattered from the wall under investigation. Then, after a standard background removal procedure, the data are processed according to a tomographic imaging algorithm.
The study is first developed through numerical arguments under a two-dimensional scalar geometry. Then, the imaging algorithm is checked against experimental data collected in-situ at the Carmine's church belfry.