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A microwave tomography strategy for structural monitoring

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The capability of the electromagnetic waves to penetrate optical dense regions can be conveniently exploited to provide high informative images of the internal status of manmade structures in a non destructive and minimally invasive way. In this framework, as an alternative to the wide adopted radar techniques, Microwave Tomography approaches are worth to be considered. As a matter of fact, they may accurately reconstruct the permittivity and conductivity distributions of a given region from the knowledge of a set of incident fields and measures of the corresponding scattered fields. As far as cultural heritage conservation is concerned, this allow not only to detect the anomalies, which can possibly damage the integrity and the stability of the structure, but also characterize their morphology and electric features, which are useful information to properly address the repair actions. However, since a non linear and ill-posed inverse scattering problem has to be solved, proper regularization strategies and sophisticated data processing tools have to be adopt to assure the reliability of the results.

To pursue this aim, in the last years huge attention has been focused on the advantages introduced by diversity in data acquisition (multi-frequency/static/view data) [1,2] as well as on the analysis of the factors affecting the solution of an inverse scattering problem [3]. Moreover, how the degree of non linearity of the relationship between the scattered field and the electromagnetic parameters of the targets can be changed by properly choosing the mathematical model adopt to formulate the scattering problem has been shown in [4].

Exploiting the above results, in this work we propose an imaging procedure in which the inverse scattering problem is formulated as an optimization problem where the mathematical relationship between data and unknowns is expressed by means of a convenient integral equations model and the sought solution is defined as the global minimum of a cost functional. In particular, a local minimization scheme is exploited and a pre-processing step, devoted to preliminary asses the location and the shape of the anomalies, is exploited.

The effectiveness of the proposed strategy has been preliminary assessed by means of numerical examples concerning the diagnostic of masonry structures, which will be shown in the Conference.

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