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A user friendly interface for microwave tomography enhanced GPR surveys

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Ground Penetrating Radar (GPR) systems are nowadays widely used in civil applications among which structural monitoring is one of the most critical issues due to its importance in terms of risks prevents and cost effective management of the structure itself.
Despite GPR systems are assessed devices, there is a continuous interest towards their optimization, which involves both hardware and software aspects, with the common final goal to achieve accurate and highly informative images while keeping as low as possible difficulties and times involved in on field surveys.
As far as data processing is concerned, one of the key aims is the development of imaging approaches capable of providing images easily interpretable by not expert users while keeping feasible the requirements in terms of computational resources. To satisfy this request or at least improve the reconstruction capabilities of data processing tools actually available in commercial GPR systems, microwave tomographic approaches based on the Born approximation have been developed and tested in several practical conditions, such as civil and archeological investigations, sub-service monitoring, security surveys and so on [1-3]. However, the adoption of these approaches is subjected to the involvement of expert workers, which have to be capable of properly managing the gathered data and their processing, which involves the solution of a linear inverse scattering problem.
In order to overcome this drawback, aim of this contribution is to present an end-user friendly software interface that makes possible a simple management of the microwave tomographic approaches. In particular, the proposed interface allows us to upload both synthetic and experimental data sets saved in .txt, .dt and .dt1 formats, to perform all the steps needed to obtain tomographic images and to display raw-radargrams, intermediate and final results. By means of the interface, the users can apply time gating, back-ground removal or both to extract from the gathered data the meaningful signal, they can process the full set of the gathered A-scans or select a their portion as well as they can choose to account for an arbitrary time window inside that adopted during the measurement stage. Finally, the interface allows us to perform the imaging according to two different tomographic approaches, both modeling the scattering phenomenon according to the Born approximation and looking for cylindrical objects of arbitrary cross section (2D geometry) probed by an incident field polarized along the invariance axis (scalar case). One approach is based on the assumption that the scattering phenomenon arises in a homogeneous medium, while the second one accounts for the presence of a flat air-medium interface.

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