Full-waveform inversion of Ground Penetrating Radar data for target characterization in multilayer environments

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In the last decades, ever growing efforts have been devoted to the development of techniques for extracting information from Ground Penetrating Radar (GPR) measurements. In particular, the processed data are used to retrieve two different kinds of features. The first kind includes the so-called qualitative properties of buried targets, which are typically related to the location and/or the shape of the objects. The second kind of features is related to the quantitative dielectric characterization of the underground targets. Both strengths and weaknesses of qualitative and quantitative approaches are well known in the scientific community. Despite the more complex mathematical structure of quantitative techniques, their use is attracting an increasing attention in multiple geophysical and engineering applications.

In this contribution, the full dielectric characterization of the region of interest is retrieved by a quantitative inversion approach that works in the mathematical framework of Lebesgue spaces with variable exponents. The most important parameter of this algorithm is represented by the map of the exponent function inside the investigation domain. Here, different strategies for obtaining and refining this map in an adaptive fashion iteration-by-iteration are proposed. Numerical results are presented to check the effectiveness of the inversion approach.