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Inverse-Scattering Approaches for GPR Data Processing in Nonconventional Lebesgue Spaces

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Despite the significant advances in electromagnetic imaging techniques, the analysis of Ground Penetrating Radar (GPR) data is still an open challenge, and most commercial systems adopt qualitative approaches because of their simplicity and robustness. However, such processing methods do not usually provide a complete characterization of the dielectric properties of the targets, but often only some information about target shape and location can be obtained. The typical aspect-limited GPR configurations, in which measurements are not collected all around the target, are frequently an obstacle for the application of more advanced quantitative methods [1]. In this work, a novel quantitative technique is applied to invert Ground Penetrating Radar data. It consists of an adaptive and automatic procedure developed in the nonconventional mathematical framework of Lebesgue spaces with variable exponents, which is exploited inside an inexact-Newton loop. With respect to the previous approaches of the same class, it frees the user from the selection of a fixed Lebesgue-space exponent, which is case-specific and difficult to be performed without a-priori information [2]. The proposed reconstruction approach is preliminarily validated by means of GPR data obtained from numerical simulations.

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[2] C. Estatico, A. Fedeli, M. Pastorino, and A. Randazzo, “Quantitative microwave imaging method in Lebesgue spaces with nonconstant exponents,” IEEE Transactions on Antennas and Propagation, vol. 66, no. 12, pp. 7282–7294, Dec. 2018.