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Adaptive Spectral Decomposition for Inverse Scattering Problems

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A nonlinear optimization method is proposed for inverse scattering problems, when the unknown medium is characterized by one or several spatially varying parameters. The inverse medium problem is formulated as a PDE-constrained optimization problem and solved by an inexact truncated Newton-type method. Instead of a grid-based discrete representation, each parameter is projected to a separate fnite-dimensional subspace, which is iteratively adapted during the optimization. Each subspace is spanned by the first few eigenfunctions of a linearized regularization penalty functional chosen a priori. The (small and slowly increasing) finite number of eigenfunctions effectively introduces regularization into the inversion and thus avoids the need for standard Tikhonov-type regularization and, in practice, appears more robust to missing data or added noise. Numerical results illustrate the accuracy and efficiency of the resulting adaptive spectral regularization for inverse scattering problems for the wave equation in time domain.

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