Regularization with sparsity constraints and impedance tomography

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Abstract

The general theory of sparsity constraint regularization techniques for non-linear operator equations is well developed by now. However, the use of such regularization methods for complex applications is still a challenge and requires additional analytic investigations. We will investigate the inverse problem of impedance tomography, i.e. the task of recovering the parameter σ from a partial knowledge of the Neumann-to-Dirichlet map (NtD) for $div \sigma \nabla u = 0$.

The reconstruction is based on a min-max formulation using a suitable discrepancy functional. Applying an iterated shrinkage method requires to obtain differentiability results of this functional in L_p - spaces, which extends the know L_∞ - results. Moreover, a strategy for optimal experiment design is obtained by an iteration of Isaacson type, this necessitates the derivation of the adjoint operator in suitable function spaces.

We present numerical results, which show the potential of this method for obtaining quantitative results. This is a critical improvement when compared with the typically over-smoothed reconstructions obtained by classical regularization.) We also obtain quantitative results with variable background, including complete electrode models and for non-convex inclusions.

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