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A sparsity approach to electrical impedance tomography

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ABSTRACT

The inverse problem of EIT (Electrical Impedance Tomography) asks to reconstruct the parameter D of

$$-div\ D\nabla u = 0 \ \text{ in}\ \Omega$$

from a partial knowledge of the Neumann - to - Dirichlet map. For a given Neumann data f, the resulting Dirichlet data g are measured. Hence $g = RL_1(D^*)f$, where D^* denotes the physically correct parameter, R denotes the restriction to the boundary and $L_1(D)$ is the solution operator of the stated partial differential equation with Neumann data f.

We now treat g as being the data of another boundary value problem with Dirichlet data. Let $L_2(D)$ denote the solution operator of the PDE above, but with Dirichlet data g.

For testing a particular choice of D, we first of all want to find the optimal current f by

$$max_f \|L_1(D)f - L_2(D)RL_1(D^*)f\| \ .$$

The f, which maximises this expression gives the most additional information on the difference $D - D^*$.

Furthermore, the optimal D is obtained by

$$min_D\ max_f\ \|L_1(D)f - L_2(D)RL_1(D^*)f\| \ .$$

We determine a soft shrinkage iteration for solving this ill-posed problem by a Tikhonov approach with a sparsity penalty term.

Analytical as well as numerical questions will be discussed.