Multilevel approximations in sample-based inversion from the Dirichlet-to-Neumann map.

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In 2005, Christen and Fox introduced a delayed acceptance Metropolis-Hastings (DAMH) algorithm that improved computational efficiency in sample-based imaging of electrical conductivity (EIT). This work used a linear approximation to the forward map in the first step of the algorithm. In this paper, we develop an alternative approximation for use in DAMH, namely a multilevel approximation developed from the hierarchy of coarse-scale models obtained by variational coarsening. This approach builds on two important strengths of robust multigrid solvers. First, the cost of a fine-scale solution of the forward map scales linearly with the degrees of freedom, and hence, it is provides better efficiency for algorithms performing sample-based inference. Second, the homogenization implicit in robust variational multigrid methods gives better solutions at coarse scales than homogenization by averaging of coefficients. We report results from a stylized example in electrical impedance imaging where data is a noisy and incomplete measurement of the Dirichlet-to-Neumann map.