Bayesian detection of anomalies in EIT

Sampsa Pursiainen
Institute of Mathematics
Helsinki Univ. of Technology
Box 1100 FI-02015
Finland
(E-mail: sampsa.pursiainen@hut.fi)

The electrical impedance tomography problem is to estimate an unknown conductivity distribution of a given object from a set of static electric measurements on the boundary. In this study, the problem is formulated in terms of Bayesian statistics by treating the conductivity distribution within the object as a random variable with some posterior probability distribution and by employing Markov chain Monte Carlo sampling methods for exploring the properties of this distribution. The goal is to develop such an algorithm that finding a proper numerical solution would necessitate as small amount of computational work as possible. MCMC based estimates are compared to least-squares reconstructions. Numerical experiments concentrate on a special case where a relatively small perturbation is sought from otherwise constant conductivity distribution. To summarize the findings, it is often difficult to obtain any appropriate reconstruction which is due to the non-linearity and the strong ill-conditioned nature of the inverse problem. The statistical model is preferable to the least-squares approach only if there is accurate enough prior information available. Accuracy of both least-squares and statistical solutions can be improved through an enhanced model of voltage measurement errors which is based on Monte Carlo sampling of the prior density.