Application of the finite-element method within a two-parameter regularized inversion algorithm for electrical capacitance tomography

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ABSTRACT

In this paper, we present a theoretical study of the use of finite-element techniques in the numerical solution of the inverse problem of calculating the permittivity coefficient in electrical capacitance tomography (ECT), particularly applied to the minimization of a special functional that depends on two regularization parameters. This algorithm uses the adjoin and sensitivity equations. One of the regularization parameters is associated with the permittivity (as in conventional Tikhonov algorithms) but the other is associated with the electrostatic potential. Our numerical algorithm is tested using simulated data on several examples of interest, and the results obtained are quite encouraging, especially regarding the accuracy of the reconstructed images with respect to the true permittivity distribution, showing a clear improvement over iterated Tikhonov methods.