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An efficient adaptive boundary algorithm to reconstruct Neumann boundary data in the MFS for the inverse Stefan problem

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Abstract

In this exposition, a simple practical adaptive algorithm is developed for efficient and accurate reconstruction of Neumann boundary data in the inverse Stefan problem, which is a highly nontrivial task. Primarily, this algorithm detects the satisfactory location of the source points from the boundary in reconstructing the boundary data in the inverse Stefan problem efficiently. To deal with the ill-conditioning of the matrix generated by the MFS, we use Tikhonov regularization and the algorithm is designed in such a way that the optimal regularization parameter is detected automatically without any use of traditional methods like the discrepancy principle, the L-curve criterion or the generalized cross-validation (GCV) technique. Furthermore, this algorithm can be thought of as an alternative to the concept of Beck's future temperatures for obtaining stable and accurate fluxes, but without it being necessary to specify data on any future time interval. A MATLAB code for the algorithm is discussed in more-than-usual detail. We have studied the effects of accuracy and measurement error (random noise) on both optimal location and number of source points. The effectiveness of the proposed algorithm is shown through several test problems, and numerical experiments indicate promising results.

Keywords: Inverse Stefan problem, Method of Fundamental Solutions,

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