Analysis of a numerical method for radiative transfer equation based bioluminescence tomography

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Abstract

In the bioluminescence tomography (BLT) problem, one constructs quantitatively the bioluminescence source distribution inside a small animal from optical signals detected on the animal’s body surface. The BLT problem is ill-posed and often the Tikhonov regularization is used to obtain stable approximate solutions. In conventional Tikhonov regularization, it is crucial to choose a proper regularization parameter to balance the accuracy and stability of approximate solutions. In this talk, a parameter-dependent coupled complex boundary method based Tikhonov regularization is applied to the BLT problem governed by the radiative transfer equation. By properly adjusting the parameter in the Robin boundary condition, we achieve one important property: the regularized solutions are uniformly stable with respect to the regularization parameter so that the regularization parameter can be chosen based solely on the consideration of the solution accuracy. The discrete-ordinate finite-element method is used to compute numerical solutions. Numerical results are provided to illustrate the performance of the proposed method. This is a joint work with Joseph Eichholz of Rose-Hulman Institute of Technology, Xiaoliang Cheng of Zhejiang University and Weimin Han of University of Iowa.