

Determining the Space Dependent Coefficients in Space-Time Fractional Diffusion Equations via Krylov Preconditioning

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Abstract

We consider a time-space fractional diffusion equation with a variable coefficient and investigate the inverse problem of reconstructing the source term, after regularizing the problem with the quasi-boundary value method to mitigate the ill-posedness. The equation involves a Caputo fractional derivative in the space variable and a tempered fractional derivative in the time variable, both of order in $(0, 1)$. A finite difference approximation leads to a two-by-two block linear system of large dimensions. We conduct a spectral analysis of the associated matrix sequences, employing tools from Generalized Locally Toeplitz (GLT) theory, and construct the preconditioner guided by the GLT analysis. Numerical experiments are reported and commented, followed by concluding remarks.