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Recovering the historical distribution for nonlinear space-fractional diffusion equation with temporally dependent thermal conductivity in higher dimensional space

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Abstract

In this paper, we investigate the problem of recovering the historical distribution for a nonlinear space-fractional diffusion equation with temporally dependent thermal conductivity in higher dimensional space. This problem is obtained from the classical diffusion equation by replacing the second-order space derivative with a fractional laplacian of order $\alpha \in (1/2, 1]$, which is usually used to model the anomalous diffusion. The problem is severely ill-posed. To regularize the problem, we propose a modified version of the Tikhonov regularization method. A stability estimate of Hölder type is established. Finally, several numerical examples based on the finite difference approximation and the discrete Fourier transform are presented to illustrate the theoretical results.

1 Introduction

Fractional calculus was born at the end of seventeenth century, shortly after the development of classical calculus. For a long time, fractional calculus has been regarded as a pure mathematical domain without real applications. However, it has been found in recent decades that fractional calculus can be a useful tool to derive more adequate models comparing to the integer order

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