



On uniqueness of a spacewise-dependent heat source in a time-fractional heat diffusion process

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Abstract

In this paper, a multi-dimensional inverse source problem for the time-fractional diffusion equation is investigated. Uniqueness results have been proved under some conditions on the problem. The fractional differentiation is considered to be of Riesz-Caputo type.

Keywords: time-fractional equation, uniqueness result, heat source, inverse problem, parabolic heat equation.

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1 Introduction

In recent years, fractional differential equation have attracted wide attentions. Various models using fractional partial differential equations have been successfully applied to describe problems in biology, physics, chemistry and biochemistry, and finance. These new fractional-order models are more adequate than the integer-order models, because the fractional order derivatives and integrals enable the description of the memory and hereditary properties of different substance. Time-fractional diffusion equation is deduced by replacing the standard time derivative with a time fractional derivative and can be used to describe the superdiffusion and subdiffusion phenomena. The direct problems, i.e., initial value problem and initial boundary value problems for time-fractional diffusion equation have been studied extensively in recent years, for instances, on maximum principle, on some uniqueness and existence results, on numerical solutions by finite element methods and finite difference methods, on exact solutions [7]. The early papers on inverse problems were provided by Murio in [1, 2] for solving sideways fractional heat equations by mollification methods. After that, some works have been published. In [3], Cheng et al. considered an inverse problem for determining the order of fractional derivative and diffusion coefficient in fractional diffusion equation and gave a uniqueness result. In [4], Liu and Yamamoto solved a backward problem for the time-fractional diffusion equation by a quasi-reversibility regularization method. Zheng and Wei in [5, 6] solved the Cauchy problems for time fractional diffusion equation on a strip domain by a Fourier regularization and a modified equation method. In [7] the one dimensional initial-boundary value problem for time fractional diffusion equation has been dealt with in terms of left-sided

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