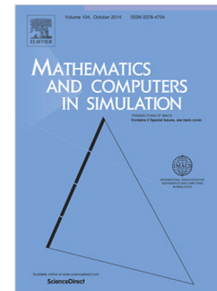


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# The method of simplified Tikhonov regularization for a time-fractional inverse diffusion problem \*

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**Abstract** In this paper, we consider a time-fractional inverse diffusion problem, where the data are given at  $x = 1$  and the solution is required in the interval  $0 < x < 1$ . This problem is typically ill-posed, i.e., the solution (if it exists) does not depend continuously on the data. The simplified Tikhonov regularization method is proposed to solve this problem. An *a priori* error estimate between the exact solution and its regularized approximation is obtained. Moreover, a new *a posteriori* parameter choice rule is proposed and the Hölder type error estimate is also obtained. Some different type examples are presented to demonstrate the feasibility and efficiency of the proposed method.

**keywords:** Time-fractional inverse diffusion problem; Simplified Tikhonov method; *A posteriori* parameter choice; Error estimate

## 1 Introduction

Partial differential equations with fractional order arose from the studies of continuous random walk [1], Levy motion [4], and high-frequency financial data [17]. Among these studies the modeling of advection and dispersion phenomena in groundwater hydrology to simulate the transport of passive tracers carried by fluid flow in a porous medium resulted in a partial differential equation with fractional order [2]. In general, fluid flow and diffusion phenomena are governed by a fractional advection-dispersion equation. If the initial concentration distribution and boundary conditions are given, a complete recovery of the unknown solution is attainable from solving a well-posed forward problem [12]. However, in some practical problems, the boundary data can only be measured

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