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A NONITERATIVE RECONSTRUCTION METHOD FOR THE INVERSE POTENTIAL PROBLEM FOR A TIME-FRACTIONAL DIFFUSION EQUATION

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Abstract. This paper is concerned with the reconstruction of the support of the potential term for a time-fractional diffusion equation from the final measured data. The aim of this paper is to propose an accurate approach based on the topological derivative method. The idea is to formulate the reconstruction problem as a topology optimization one minimizing a given cost function. We derive a topological asymptotic expansion for the fractional model. The unknown support is reconstructed using the level-set curve of the topological gradient. We finally make some numerical examples proving the efficiency and accuracy of the proposed algorithm.

1. Introduction

In the last few decades fractional differential equations have attracted great attention from many researchers because they were widely used in model anomalous diffusion [29]. More precisely, they can be used to describe several phenomena in different areas of science and engineering. For example in physics [31], signal processing, mechanical engineering, and systems identification [27], chemistry and biochemistry [40], medicine and finance [12], and so forth.

Let $T > 0$ and $\Omega \subset \mathbb{R}^d$ $(d = 2, 3)$ be an open bounded domain. By ∂_{0+}^{γ} we denote the left-sided Caputo time fractional derivative, of order $0 < \gamma < 1$,

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