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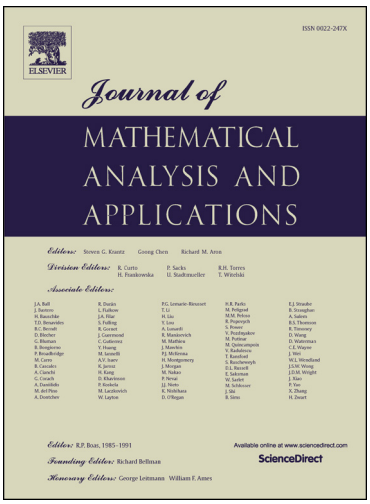

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Existence and uniqueness results for a time-fractional nonlinear diffusion equation

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Abstract

In this work we consider a nonlinear ordinary integro-differential equation which arises in the studies of time-fractional porous medium equation. The nonlocality of the resulting free-boundary problem is governed by the Erdélyi-Kober operator which requires using other than classical proof techniques. To prove the existence and uniqueness of a compactly supported solution we reduce the free-boundary case to the initial-value problem. Next, we use the sub- and supersolution technique to show that there exists a globally defined unique solution. As a side product, some estimates on the exact solution are found.

Keywords: time-fractional diffusion, porous medium, existence and uniqueness, Erdélyi-Kober operator

1. Introduction

During recent years an interest in anomalous diffusion has flourished greatly. There exists a rich experimental evidence of various processes that show either sub- or superdiffusive character [1, 2]. Apart from many, we mention moisture percolation in porous media [3], protein random walks in cells [4], telomere motion [5, 6], economic fluctuations [2] and diffusion of cosmic rays across the magnetic fields [7].

This paper is motivated by experiments showing that in certain construction materials water infiltration undergoes a slower than usual evolu-

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