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AN IMPLICIT FINITE DIFFERENCE METHOD FOR SEMILINEAR TIME-FRACTIONAL DIFFUSION EQUATION

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This article is dedicated to "**Prof. V. Lakshmikantham**"

Abstract. The aim of this study is to obtain the numerical solution of first initial boundary value problem (IBVP) for semilinear fractional diffusion equation. An implicit finite difference scheme is developed. Also, the stability as well as convergence of the method is proved. The main idea of the proposed method is to convert the problem including linear and nonlinear terms to an algebraic system in order to simplify the computations. As an application of method test problems are also solved by using MATLAB.

Keywords. Caputo fractional derivative, Implicit finite difference method, stability, convergence..

AMS (MOS) subject classification: 35R11,65M06,65M12.

1 Introduction

Fractional calculus has been used to model physical and engineering processes that are found to be best described by fractional partial differential equations(FPDE)[12]. Numerical methods play very crucial role in FPDEs. Many authors have obtained numerical solutions for different types of FPDEs viz [3, 4, 5, 7, 11, 13, 16]. Though nonlinear fractional partial differential equations have lot of applications in various branches of sciences, published papers on numerical methods for nonlinear fractional partial differential equations are limited. This motivates us to consider an effective numerical method for such problems. Liu et al.[9] and Choi et al. [8] have developed a numerical technique for fractional diffusion equation with nonlinear source term. Also Zhang and Liu[15] considered Riesz space fractional diffusion equation with nonlinear source term. Futher Yang et al.[14] provided a numerical solution of fractional Fokker Plank equation with nonlinear source term and proved its stability and convergence. In this paper we consider the time fractional diffusion equation with nonlinear source term.