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2N order compact finite difference scheme with collocation method for solving the generalized Burger's–Huxley and Burger's–Fisher equations

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ABSTRACT

The generalized Burger's–Huxley and Burger's–Fisher equations are solved by fully different numerical scheme. The equations are discretized in time by a new linear approximation scheme and in space by 2*N* order compact finite difference scheme, after that a collocation method is applied. Also, the two-dimensional unsteady Burger's equation is described by our proposed scheme. Numerical experiments and numerical comparisons are presented to show the efficiency and the accuracy of the proposed scheme.

1. Introduction

Nonlinear partial differential equations (NPDEs) are commonly used to model most phenomena in science and engineering. The generalized Burger's–Huxley equation (GBHE), the generalized Burger's–Fisher equation (GBFE) and two-dimensional unsteady Burger's equation are examples of these equations, which describe the interaction between reaction mechanisms, convection effects and diffusion transports [1]. Obtaining an efficient and more accurate numerical solution for such equations has been the subject of many studies (see [2–6,10,14,15], and references therein).

Our contribution in this paper is to develop a general compact finite difference scheme of order 2*N* for solving the following nonlinear partial differential equations (NPDEs):

$$\textbf{I-}\ u_t + \mu u^\delta u_x - u_{xx} = f(u), \quad (x,t) \in D \times I, \tag{1.1}$$

with the initial condition

$$u(x,0) = G(x), \quad x \in D, \tag{1.2}$$

and the boundary conditions

$$u(a,t) = H_1(t), \quad t \in I, \tag{1.3}$$

$$u(b,t) = H_2(t), \quad t \in I, \tag{1.4}$$

II- The two-dimensional unsteady Burger's equation [14,15]:

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