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ORIGINAL PAPER

Modal Shifted Chebyshev Spectral Collocation Technique for Solving Burger's–Fisher, Burger's–Huxley and Two-dimensional Burger's Equations

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Abstract
The spectral collocation method has gained great interest for many researchers in the last decade due to the rapid development in obtaining the optimal solution for real phenomena in the environment around us. In this paper, we used fully different spectral collocation method (SCM) than any SCM used in other papers to solve the one- and two-dimensional Burger's equations. Chebyshev and the shifted Chebyshev polynomials of the first kind are constructed in all directions. The time and the spaces steps are equally discretized for each axis. Numerical results and numerical comparisons with several recently numerical techniques indicate that the suggested scheme is more accurate than the other techniques.

Keywords Shifted Chebyshev spectral collocation method · Shifted Chebyshev polynomials · Nonlinear partial differential equations · 2D–unsteady Burger's equation · Burger's–Fisher equation · Burger's–Huxley equation

Introduction

Most real phenomena in engineering and science can be represented by nonlinear partial differential equations (NPDEs) such as the mathematical models which describe the wall motion in liquid crystals, the far field of the wave propagation in nonlinear dissipative systems [1], traffic, turbulence, the theory of flow in viscous fluid [2] and the interaction between reaction, convection and diffusion transports [3]. These mathematical models are called the generalized Burger's–Fisher equation (GBFE) Eq. (1.1) [4–12], the generalized Burger's–Huxley equation (GBHE) Eq. (1.1) [4, 5, 7, 8, 11, 13–16] and the two-dimensional unsteady Burger's equation (2D–UBE) Eq. (1.2) [4, 17–20], which are the following NPDEs, respectively:

$$u_t(x,\,t) + \alpha u^{\rho} u_x(x,\,t) - u_{xx}(x,\,t) = f(u), \quad (x,\,t) \in \left[x_0,\, x_{M_x}\right] \times \left[0,\, t_{M_t}\right] \tag{1.1}$$

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