

NUMERICAL SIMULATION OF NON-HOMOGENEOUS BUCKMASTER EQUATION USING A HYBRID NUMERICAL TECHNIQUE

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ABSTRACT. This paper employs a hybrid numerical technique based on uniform Haar wavelets and θ -weighted scheme for numerical solution of non-homogeneous Buckmaster equation. In the solution process, after applying θ -weighted scheme to Buckmaster equation, the time derivative is approximated by the forward difference and then non-linear terms in this equation are linearized by Taylor series expansion. Thereafter, Haar wavelet collocation method has been employed to solve the resulting ordinary differential equation. To verify the competence of the present technique to solve Buckmaster equation, some test problems have been solved and the present results have been compared with the exact results. It can be seen from the numerical simulation that the computed solutions are in excellent agreement with the exact solutions for very small number of collocation points.

1. INTRODUCTION

The Buckmaster equation is a parabolic partial differential equation which finds its use in the field of fluid mechanics. The surface of a thin sheet of viscous fluid is modelled by Buckmaster equation. The dynamics of thin viscous sheets exhibit some instabilities like draw resonance or buckling. Large scale long term deformations are also described by Buckmaster equation [1]. The general form of non-homogeneous Buckmaster equation is

$$\dot{u} = (u^4)'' + (u^3)' + q(x, t), \quad (1.1)$$

subject to

$$\begin{aligned} u(a, t) &= \phi_1(t), \quad u(b, t) = \phi_2(t), \quad 0 \leq t \leq T, \\ u(x, 0) &= \varphi(x), \quad a < x < b, \end{aligned}$$

where, $(.)$ and $(')$ indicate the differentiation with respect to t and x , respectively.

Although, numerous work has been done to study various linear and non-linear differential equations as they model most of phenomenon in the field of science and engineering [2–7], a very little attention has been paid to Buckmaster equation. The authors found only two published papers solving integer order Buckmaster equation. Hussain and Alwan [8] solved Buckmaster equation by using finite volume method (FVM). Chanthrasuwan *et al.* [9] employed θ -weighted method and developed two schemes namely Crank-Nicolson (C-N) and fully implicit to solve Buckmaster equation. Further, for collocation purpose, they used

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