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The method of lines solution of the Forced Korteweg-de Vries-Burgers equation

[1]Nazatulsyima Mohd Yazid, [2]Kim Gaik Tay, [3]Wei King Tiong
[4]Yaan Yee Choy, [5]Azila Md Sudin and [6]Chee Tiong Ong

[1,4,5]Department of Mathematics and Statistics, Faculty of Science
Technology and Human Development
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja
Batu Pahat, Johor, Malaysia

[2]Department of Communication Engineering, Faculty of Electric and Electronic
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia

[3]Department of Computational Science and Mathematics
Faculty of Computer Science and Information Technology
Universiti Malaysia Sarawak, 94300 Kota Samarahan, Malaysia

[6]Department of Mathematical Sciences, Faculty of Science
Universiti Teknologi Malaysia, 81310 Johor Bahru

e-mail: [1]nazatulsyima91@yahoo.com, [2]tay@uthm.edu.my, [3]wktiong@fit.unimas.my
[4]yychoy@uthm.edu.my, [5]azzila@uthm.edu.my, [6]octiong@utm.my

Abstract In this paper, the application of the method of lines (MOL) to the Forced Korteweg-de Vries-Burgers equation with variable coefficient (FKdVB) is presented. The MOL is a powerful technique for solving partial differential equations by typically using finite-difference approximations for the spatial derivatives and ordinary differential equations (ODEs) for the time derivative. The MOL approach of the FKdVB equation leads to a system of ODEs. The solution of the system of ODEs is obtained by applying the Fourth-Order Runge-Kutta (RK4) method. The numerical solution obtained is then compared with its progressive wave solution in order to show the accuracy of the MOL method.

Keywords FKdVB Equation; partial differential equations; the method of lines; system of differential equation; Runge Kutta method.

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1 Introduction

There are many physical phenomena in engineering and physics which can be expressed by some nonlinear partial differential equations (PDEs) [1]. However, most of them do not have exact analytical solutions. Therefore, these nonlinear equations should be solved by using approximation method [2].

In literature, weakly nonlinear wave propagation in a prestressed fluid-filled stenosed elastic tube filled with a Newtonian fluid with variable viscosity fluid has been studied by [3] by applying the reductive perturbation method and long wave approximation, the governing equations. By employing the stretched coordinate of initial-value type and extending the field quantities into the asymptotic series of order ε, where ε is a small parameter, the nonlinear wave propagation in such medium is governed by the forced Korteweg-de Vries-Burgers (FKdVB) equation with variable coefficient. The FKdVB can be written as

$$U_\tau + \mu_1 U U_\xi - \mu_2 U_{\xi\xi} + \mu_3 U_{\xi\xi\xi} + \mu_4 (\tau) U_\xi = \mu (\tau), \tag{1}$$