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A Meshless Method Using the Radial Basis Functions for Numerical Solution of the Gilson-Pickering Equation

F. Zabihi
University of Kashan

M. Saffarian*
University of Kashan

Abstract

In this article, thin plate splines radial basis function method is presented for solutions of Gilson-Pickering equation. This scheme works in a similar form as finite difference methods and we use collocation points for basis nodes in radial basis function. A numerical example is studied to demonstrate the accuracy and efficiency of the presented method.

Keywords: Gilson-Pickering (GP) equation, Radial basis functions (RBFs), Thin plate splines radial basis functions(TPS-RBFs)
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1 Introduction

We consider a class of fully nonlinear third-order partial differential equations for studying by name Gilson and Pickering equation as follows [1]:

$$u_t - \epsilon u_{xxt} + 2\kappa u_x - u u_{xxx} - \alpha u u_x - \beta u_x u_{xx} = 0, \tag{1}$$

where ϵ, κ, α and β are arbitrary constants. Three special cases of equation have appeared in the literature, up to some resealings. If $\epsilon = 1, \alpha = -1, \beta = 3$, and $\kappa = \frac{1}{2}$, then (1) is the Fornberg-Whitham equation, for $\epsilon = 0, \alpha = 1, \beta = 3$, and $\kappa = 0$, (1) is Rosenau- Hyman equation and (1) is the Fuchssteiner-Fokas-Camassa-Holm equation for the parameters $\epsilon = 1, \alpha = -3$, and $\beta = 2$.
Irshad and Tauseef [1] applied tanh-coth method for obtaining numerical solutions of GP equation. Also, Fan and other authors [4] used the $\frac{G'}{G}$-expansion method for solving this equation. Fronberg and Flyer [5] obtained accuracy of radial basis function interpolation. The purpose of this paper is to study numerical results of thin plate splines radial basis function methods to GP equation. TPS-RBF-methods for solving the GP equation is a new work.

*Speaker