Time-Fractional Generalized Equal Width Wave Equations: Formulation and Solution via Variational Methods

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Received: February 11, 2014; Revised: October 15, 2014

Abstract: This paper presents the formulation of the time-fractional generalized Equal Width Wave (EWW) equation and generalized Equal Width Wave-Burgers (EWW-Burgers) equation using the Euler-Lagrange variational technique in the Riemann-Liouville derivative sense, and derive respectively an approximate solitary wave solution. Our results witness that He’s variational-iteration method was very efficient and powerful technique in finding the solution of the proposed equation.

Keywords: Riemann-Liouville fractional operator; Euler-Lagrange equation; fractional EWW equation; He’s variational-iteration method; solitary wave.


1 Introduction

The generalized EWW equation has been used to describe approximately the unidirectional propagation of the regularized long wave in certain nonlinear dispersive systems [1], and has been proposed by Benjamin, Bona and Mahony as a model for small-amplitude long waves on the surface of water in a channel [2]. In physical situations one has unidirectional waves propagating in a water channel, long-crested waves in near-shore zones and many others. This equation also serves as an alternative model to the generalized regularised long wave equation and generalized Korteweg-de Vries equation (KdV) [3–5].

During the past three decades or so, fractional calculus has gained considerable popularity and importance as generalizations of integer-order evolution equations, and is applied to model problems in neurons, hydrology, viscoelasticity and rheology, image processing, mechanics, mechatronics, physics, finance and control theory, see [6–11]. If * Corresponding author: mailto:ywzhang02880165.com

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