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

Youwei Zhang *

Department of Mathematics, Hexi University, Gansu 734000, China

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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.*

Mathematics Subject Classification (2010): 35R11, 35G20.

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:ywzhang0288@163.com