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Solving Discrete KDV Equation by Reconstruction of Variational Iteration Method

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Abstract
In this study, accurate analytical solution for KDV Equation is derived. This solution is called Reconstruction Variational Iteration Method (RVIM). Numerical results show the efficiency of the proposed algorithm. By using RVIM, only a few iterations lead us to high accuracy of the solutions and it is valid for whole solution domain.

Keywords: Reconstruction Variational Iteration Method (RVIM), KDV Equation

1. Introduction

Differential equations are widely used to describe physical problems. In most cases, the exact solution of these problems may not be available. In addition, it is much easier computing and analyzing these solutions by means of the numerical methods without wasting time or spending money for experimenting problems. Alternatively, the numerical methods can provide approximate solutions rather than the exact solutions. But most of these methods have low accuracy and are highly time consuming. Reaching to a high accurate approximation for linear and nonlinear equations has always been important while it challenges tasks in science and engineering. Therefore several numbers of approximate methods have been established like Homotopy perturbation Method (HPM) Variational Iteration Method (VIM) and so on each of which has advantages and disadvantages. We introduce a new analytical method of nonlinear problems called the reconstruction of variational iteration method, which in the case of comparing with VIM [1-4] and HPM [5-8], not uses Lagrange multiplier as variational methods do and not requires small parameter in equations as the perturbation techniques. RVIM has been shown to solve a large class of nonlinear problems with approximations converging to solutions rapidly, effectively, easily, and accurately. The method used gives rapidly convergent successive approximations. As stated before, we aim to achieve analytic solutions to problems. We also aim to approve that the reconstruction of variational iteration method is powerful, efficient, and promising in handling scientific and engineering problems.

2. Basic Idea of RVIM

To clarify the basic ideas of our proposed method in [9], we consider the following differential equation same as VIM based on Lagrange multiplier [10]

\[ Lu(x_1, \cdots, x_k) + Nu(x_1, \cdots, x_k) = f(x_1, \cdots, x_k) \]  

(1)

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