



The Modified Fractional Power Series Method for Solving Fractional Undamped Duffing Equation with Cubic Nonlinearity

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Received: July 23, 2018; Revised: November 21, 2020

Abstract: In this paper, the strongly nonlinear fractional undamped Duffing equation for undamped oscillators is studied. The physical and the mathematical model of nonlinear fractional Duffing equation for undamped oscillators is presented. The modified fractional power series (MFPS) method is employed to compute an approximation to the solution of this problem. The validity of the MFPS method is ascertained by comparing our results with numerical results and other methods in the literature. The results reveal that the proposed analytical method can achieve excellent results in predicting the solutions of such problems. The existence of the solution is proved. In addition, the convergence of the proposed method is investigated.

Keywords: *fractional Duffing equation; nonlinear boundary value problem; modified fractional power series method.*

Mathematics Subject Classification (2010): 76A05, 76W05, 76Z99, 65L05.

1 Introduction

In 1918, George Duffing presented the Duffing equation in his publication entitled “Erzwungene Schwingungen bei veranderlicher Eigenfrequenz und ihre technische Bedeutung”. Duffing simplified the mathematical model of

$$x''(t) + a^2x(t) - \beta x^2(t) - \gamma x^3(t) = k \sin \omega t \quad (1)$$

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