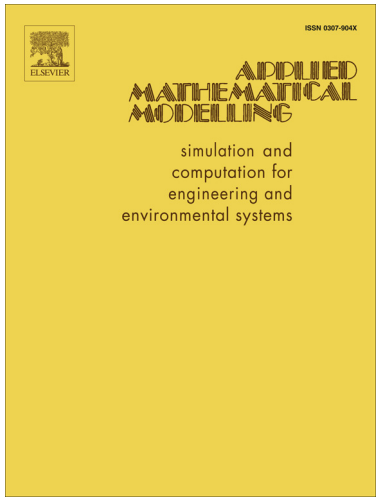

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Rational Homotopy Perturbation Method for solving stiff systems of Ordinary Differential Equations

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Abstract

This paper applies a new modification of the Homotopy Perturbation Method that is called Rational Homotopy Perturbation Method (RHPM) to obtain an analytic approximation of stiff systems of ordinary differential equations. The procedure of the method will be is explained briefly and some examples are presented to illustrate the method. The results of RHPM, are compared with those of traditional Homotopy Perturbation Method. The results show the accuracy and fast convergence of the proposed method.

Keywords: Rational Homotopy Perturbation Method, Stiff systems of ODEs

1 Introduction

The areas of chemical engineering, nonlinear mechanics, biochemistry and life sciences are sources of stiff problems. Unfortunately analytical methods which can solve stiff systems ~~of~~ are restricted. This is why the ability of solving these equations numerically is important. Haar wavelets are used for linear and nonlinear stiff systems of ODEs [8,9]. Adomian decomposition method applied on stiff problems [13]. Also several numerical and analytical methods have been developed [1,2,5-7,10,11,14,15].

One of the important semi-analytic methods for solving functional equations is Homotopy Perturbation Method (HPM), well addressed in [26-34]. The HPM is an efficient method to solve various kinds of nonlinear functional equations. For example, it was applied to nonlinear systems of mixed Volterra-Fredholm integral equations [19], Zakharov-Kuznetsov equations [20], hyperbolic partial differential equations [21], neutral functional-differential equations with proportional delays [22], stiff systems of ODEs [3,4,12], and some other equations [23-30].

So far, a lot of modifications and developments have been proposed to solve a range of problems. One of which is Homotopy-Padé technique [26,27,35]. The Homotopy-Padé technique was proposed by means of combining the Padé technique with the Homotopy Perturbation Method. In this way, the solution is obtained using the HPM, then Padé approximation of solution is calculated. It was illustrated that Homotopy-Padé technique can greatly enlarge the convergence region of the solution series. Besides, Homotopy-Padé approximants often converge faster than solutions calculated by HPM.

In this paper, we present another modification of Homotopy Perturbation Method that was

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