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TECHNICAL REPORT

SOLVING NONLINEAR EQUATION BY USING HOMOTOPY ANALYSIS METHOD (HAM)

NUR SAADAH MOHTAR
2014949213 D1CS2496A
SYARIFAH NUR AININA SAID ABDUL KARIM
2014354227 D1CS2496A

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TABLE OF CONTENTS

ABSTRACT

In this research, the Homotopy Analysis Method (HAM) was studied and had been employed to obtain the approximate analytical solution of non-linear of Couple-Burgers Equation and Fornberg-Whitman Equation. When applied to non-linear equation the numerical result revealed that this method was more accurate, reliable and easy to implement. This was because of some limitations that appeared in other methods. Some other perturbation methods could only be solved based on small convergence region and was only valid for small parameter. By using Homotopy Analysis Method (HAM) we could choose the auxiliary parameter so that the zero-order and higher-order deformation equation could be obtained. Then two examples which are Couple-Burger Equation and Fornberg-Whitham Equation were applied. The final result that was reported by HAM is compared with the exact solution and Adomian Decomposition Method (ADM). The solution then was graphed using Maple software. Corresponding to it, it was found that the Homotopy Analysis Method was more accurate and effective compare to Adomian Decomposition Method that obtained by previously published work for validation.

1 INTRODUCTION

All this while we have found various method to solve linear and nonlinear equation, such as substitution, elimination, Perturbations, Adomian Decomposition (ADM), Homotopy Analysis and others. Like other nonlinear analytical method, ADM is restricted by its own limitation because this method is only valid for small parameter (Wahab et al., 2016). Hence, new analytical technique known as Homotopy Analysis Method (HAM) has proposed in by Liao in 1992 to overcome this limitation.

In the last two decades, linear and nonlinear differential equation has been involved in many scientific, engineering and even finance sector. Due to this, Homotopy Analysis Method has been applied. Liao (2004) proposed that HAM is an approximation method for highly nonlinear problem. The work was extended by Turkyilmazoglu (2010) where the procedure to choose the suitable base function, initial approximation, auxiliary linear operator and parameter which are important to approximate the solution's convergency was found. Through this method, the limitation of the other perturbation and non perturbation method can be eliminated which can only be solved based on small region of convergence that is mostly valid for small parameter. Besides, the complicated equation can be transformed into simpler ones. This is one of the advantages of this technique for solving the linear and nonlinear equation.

Briefly speaking, the Homotopy Analysis Method (HAM) does not depend on the existing of small or large parameters. Thus, it is one of the advantages for this method. Even if the nonlinear equation does not have any parameter, Homotopy Analysis Method is still applicable. Second, Homotopy Analysis Method (HAM) provides a suitable way to adjust and control the convergence region. Thus, rate of approximation of nonlinear equation are more accurate and reliable.