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Analytical Study for Non-Linear Model of Boundary Layer Flow over a Flat Plat Problem by Perturbation Iteration Technique

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Abstract. In this paper, the flow of the incompressible two-dimensional laminar boundary layer over a flat plate as well as the Blasius flow problem are investigated. The partial differential equations developed from the systems of Blasius models are transformed into ordinary differential equations through the appropriate similarity variables. The ordinary differential equation obtained has been resolved using the perturbation iteration technique (PIT). The accuracy of the analytical method for the flow model is analyzed. A comparison of the results of PIT and the numerical method (Blasius) leads to the conclusion that the solutions have an excellent agreement. The results of PIT were tabulated for the similarity of stream function. They can be observed with a high degree of accuracy by comparison with those obtained using the homotopy perturbation technique (HPT) and the search results using the variational iteration technique (VIT) for the same problem. Finally, PIT is an efficient and widely applicable method for solving ordinary differential equations.

Keywords: Analysis of convergence, Boundary Layer, Blasius Flow Problem, Perturbation Iteration Technique, Laminar Flat Plate.

INTRODUCTION

In physics, specifically in fluid mechanics, the Blasius of the boundary layer can be described as a two-dimensional steady laminar boundary layer that is formed on a semi-infinite plate running parallel to a unidirectional constant flow. Furthermore, a boundary layer can be defined as, a thin layer of gas or liquid flowing in contact with a surface, such as the surface of an aircraft wing or within a tube, where the fluid of the boundary layer is subject to a special force called shear force. In general, most differential equations are modeled in scientific problems as partial differential equations, ordinary differential equations, and fractional differential equations. That is, there are a limited number of cases, most of which do not have an analytical solution (exact). The steady flow of viscous, incompressible fluids which govern the boundary layer problems have no exact solutions. In recent years, these problems have received great attention from many researchers due to their critical role in many scientific and engineering applications [1, 2], and to overcome the difficulties faced by researchers have been solved by semi-analytical [3, 9] by numerical methods. One of these semi-analytical methods is the perturbation iteration technique [10, 11]. This method is based on an algorithm that is classified by the number of terms n_1^* in the perturbation expansion and the degrees of derivatives n_2^* in the Taylor expansions, such that n_1^* must always be equal to or less than n_1^*. In addition, this method has been called as perturbation iteration technique (n_1^*, n_2^*). In different fields, perturbation iteration techniques (n_1^*, n_2^*) have a famous technique for solving problems in science and engineering. This study aims to find the approximate analytical solution that is convergent and has high accuracy. The general

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