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A METHOD OF DIRECTLY DEFINING THE INVERSE MAPPING FOR SOLUTIONS OF LAMINAR BOUNDARY LAYER FLOW OVER A WEDGE

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This study developed and applied a semi-analytical method called the method of directly defining inverse mapping (MDDiM) to obtain a series solution for the laminar boundary layer flow over a wedge with a uniform surface temperature. Laminar boundary layer flow over wedge-shaped surfaces is critical in various engineering fields, including aerodynamics, heat transfer, and fluid mechanics. The governing equations are derived from the continuity and Navier-Stokes equations under the boundary layer assumptions. Using an appropriate similarity transformation, the governing equations were transformed into a system of coupled nonlinear ordinary differential equations. Traditionally, researchers have widely used perturbation and asymptotic techniques to gain analytical approximations for nonlinear problems. Unfortunately, when nonlinearity becomes strong, perturbation and asymptotic approximations of nonlinear problems often break down. Furthermore, these methods depend on any small or large physical parameters. The MDDiM overcomes these limitations by providing an extremely large degree of freedom based on the concept of homotopy, a fundamental concept in topology and differential geometry, to choose base functions, initial guesses, and inverse linear operators, allowing for the simplification of solving complicated nonlinear differential equations in many cases. The results obtained, with minimum errors, are presented graphically and discussed. Since the direct definition of the inverse operator, the series solutions were obtained using less central processing unit (CPU) time, low error, and less complicated terms. The proposed technique produces a highly accurate and reliable solution to the problems in a few iterations. All computational results were achieved using Maple 16 mathematical software.

Keywords: Aerodynamics problems, Heat transfer problems, Laminar boundary, Method of directly defining inverse mapping