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RESEARCH PAPER

Applications of q-Homotopy Analysis with Laplace Transform and Padé- Approximate Method for Solving Magneto Hydrodynamic Boundary-Layer Equations

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Abstract

The magnetohydrodynamic (MHD) boundary layer flow under a magnetic field's effect was analyzed using a new analytical method named q-HALPM. This technique is based on integrating the q-homotopy analysis method with the Laplace transform, and Padé approximation methods. The flow velocity and heat transfer were investigated under the impact of the magnetic field. The results show that when the magnetic field increases from 2000 to 20000, then the velocity and heat decrease. Moreover, the results establish that q-HALPM is effective and extremely accurate in determining the analytical approximate solution for magnetohydrodynamic (MHD) boundary layer equations. Furthermore, the graphs of this novel solution demonstrate the validity, and usefulness of q-HALPM, and are consistent with the results of earlier studies.

Keywords: q-Homotopy analysis method; Laplace Transform; Padé approximation; MHD; Boundary layer**.**

1. Main text

Magnetohydrodynamics (MHD) is the study of the interaction of conductive fluids with magnetic phenomena (the flow of an electrically conductive fluid in the presence of a magnetic field) and has applications in various fields of technology and engineering, such as the MHD of generators, power generation, pumps, etc. The boundary velocity of the flow of a viscous fluid resulting from stretched boundaries is important in extrusion processes. The flow of the boundary layer in recent years has received great attention, and this stems from the many applications of engineering, technology, and metallurgical industries such as polymer extrusion, wire drawing, continuous casting, and others [1]. Most of the boundary layer MHD models can be reduced by converting them to systems of nonlinear ordinary differential equations (ODEs). Many researchers have solved the MHD boundary layer problem using numerical and analytical methods. Such as Sajid and Hayat [2] studied the magnetic hydrodynamic viscous flow problem due to the shrinkage of the plate in the case of two-dimensional shrinkage and axial contraction, and it was solved by the homotopy analytic method (HAM). Sajid et al [3] solved the MHD problem of the circulating flow of a viscous fluid over a shrinkage plate using the homotopy perturbation method, and the results

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