Homotopy Solution for Non-Similarity Boundary-Layer Flow near a Stagnation Point

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In this paper, non-similarity boundary-layer flow of a Newtonian fluid near an asymmetric plane stagnation point with a dimensionless external flow velocity $u_e = x/(x+1)$ is studied. The original boundary-layer equations are transferred into a nonlinear partial differential equation (PDE) with variable coefficients. An analytic technique for strongly nonlinear equations, namely the homotopy analysis method (HAM), is applied to replace the nonlinear PDE by an infinite number of linear ordinary differential equations (ODEs) with constant coefficients. An artificial parameter, called the convergence-control parameter, is introduced to ensure the convergence of solution series. Accurate analytical approximations of skin friction and boundary-layer thickness are obtained, and the effect of the external flow velocity on the non-similarity flows is investigated. This approach has general meanings and can be applied to many other non-similarity boundary-layer flows.

Key words: Non-Similarity; Boundary-Layer; Stagnation Point Flow; Series Solution.