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Analytical Solution of Blassius Equation Using the Kourosh Method

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Abstract : Most of the engineering problems are in nonlinear forms. Nonlinear boundary layer problems defined in infinite intervals contain specific complexities, especially in boundary layer condition conformance. As an example of these nonlinear complex problems, the well-known Blasius equation can be mentioned, which itself is one of the classic boundary layer problems. No analytical solution has been proposed yet for the Blasius equation due to its complexity. In this paper, an analytical method, namely the Kourosh method, based on the singularity perturbation method and the Liao homotopy analysis is utilized to solve the Blasius problem. In this method, an inner solution is developed in the [0,1] interval to expedite the solution convergence. The magnitude of the $f''(0)$, as an essential quantity for determining the physical parameters, is directly calculated from the solution of the boundary condition problem. The advantages of this solution are that it does not need any numerical solution, it has a closed form and that its validation is shown in the entire $[0,\infty]$ interval. Furthermore, all of the desirable parameters could be extracted through a series of simple analytical operations from the final solution. This solution also satisfies the continuity conditions, which is one of the main contributions of this paper in comparison with most of the other proposed analytical solutions available in the literature. Comparison with numerical solutions reveals that the proposed method is highly accurate and convenient for application.

Keywords : Blasius equation, boundary layer, Kourosh method, analytical solution
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