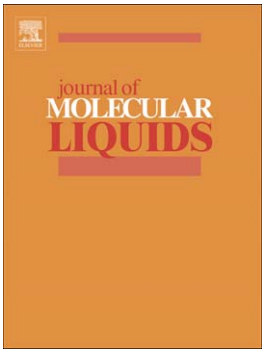

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An analytical solution of turbulent boundary layer fluid flow over a flat plate at high Reynolds number

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ABSTRACT

This is an analytical investigation of turbulent boundary layer flow over a flat plate in the range of Reynolds number between 10^6 and 10^9. With the use of novel similarity variables, the governing partial differential equations are transformed to an ordinary differential equation with inconsistent coefficients and they are solved analytically via the optimal homotopy analysis method (OHAM). To achieve the convergence of analytical series solutions, residual errors have been calculated and minimized. In addition, the distribution of the velocity profile, friction coefficient and thickness of the boundary layer are calculated and compared with the pertained experimental results in the literature, where good agreements between them are observed. Based on the series solution, analytical expressions for the friction coefficient and the hydrodynamic boundary layer thicknesses were proposed and compared with previously existed expressions. It was shown that the proposed expressions are highly accurate for the high Reynolds number.

Keywords:

Similarity solution, Flat plate, Turbulent Flow, Analytical model, Boundary layer

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