**Liao, Shijun**

**A uniformly valid analytic solution of two-dimensional viscous flow over a semi-infinite flat plate.** (English) Zbl 0931.76017

J. Fluid Mech. 385, 101-128 (1999).

Summary: We apply a new analytic technique, namely the homotopy analysis method, to give an explicit, analytic, uniformly valid solution of the equation governing the two-dimensional laminar viscous flow over a semi-infinite flat plate, $f'''(\eta) + \alpha f(\eta) f''(\eta) + \beta[1 - f'^2(\eta)] = 0$, under the boundary conditions $f(0) = f'(0) = 0$, $f'(+\infty) = 1$. This analytic solution is uniformly valid in the whole region $0 \leq \eta < +\infty$. For Blasius' (1908) flow ($\alpha = 1/2$, $\beta = 0$), this solution converges to Howarth's (1938) numerical result and gives analytic value $f''(0) = 0.332057$. For the Falkner-Skan (1931) flow ($\alpha = 1$), it gives the same family of solutions as Hartree's (1937) numerical results, and provides a related analytic formula for $f''(0)$ when $2 \geq \beta \geq 0$. Additionally, this analytic solution allows to prove that for $-0.1988 \leq \beta < 0$, the Hartree's (1937) family of solutions possesses the property that $f' \to 1$ exponentially as $\eta \to +\infty$.

**MSC:**

| | | |
|---|---|---|
| 76D10 | Boundary-layer theory, separation and reattachment, higher-order effects | Cited in **158** Documents |
| 76M45 | Asymptotic methods, singular perturbations applied to problems in fluid mechanics | |

**Keywords:**

Hartree's family of solution; Blasius' flow; Falkner-Skan flow; homotopy analysis method

**Full Text:** DOI