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An explicit, totally analytic approximate solution for Blasius' viscous flow problems. (English) Zbl 1342.74180

Int. J. Non-Linear Mech. 34, No. 4, 759-778 (1999).

Summary: By means of using an operator $\mathcal{A}$ to denote non-linear differential equations in general, we first give a systematic description of a new kind of analytic technique for non-linear problems, namely the homotopy analysis method (HAM). Secondly, we generally discuss the convergence of the related approximate solution sequences and show that, as long as the approximate solution sequence given by the HAM is convergent, it must converge to one solution of the non-linear problem under consideration. Besides, we illustrate that even though a non-linear problem has one and only one solution, the sole solution might have an infinite number of expressions. Finally, to show the validity of the HAM, we apply it to give an explicit, purely analytic solution of the 2D laminar viscous flow over a semi-infinite flat plate. This explicit analytic solution is valid in the whole region $\eta = [0, +\infty)$ and can give, the first time in history (to our knowledge), an analytic value $f''(0) = 0.33206$, which agrees very well with Howarth's numerical result. This verifies the validity and great potential of the proposed homotopy analysis method as a new kind of powerful analytic tool.

MSC:

74S30 Other numerical methods in solid mechanics (MSC2010)
34A05 Explicit solutions, first integrals of ordinary differential equations

Cited in **186** Documents

Keywords:

2D Blasius' viscous flow; Explicit analytic solution; Non-linear differential equation; homotopy analysis method; Independent upon small parameters

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