Communications in Nonlinear Science and Numerical Simulation

Volume 14, Issue 5, May 2009, Pages 2144-2159

A general approach to get series solution of non-similarity boundary-layer flows

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https://doi.org/10.1016/j.cnsns.2008.06.013

Abstract

An analytic method for strongly non-linear problems, namely the homotopy analysis method (HAM), is applied to give convergent series solution of non-similarity boundary-layer flows. As an example, the non-similarity boundary-layer flows over a stretching flat sheet are used to show the validity of this general analytic approach. Without any assumptions of small/large quantities, the corresponding non-linear partial differential equation with variable coefficients is transferred into an infinite number of linear ordinary differential equations with constant coefficients. More importantly, an auxiliary artificial parameter is used to ensure the convergence of the series solution. Different from previous analytic results, our series solutions are convergent and valid for all physical variables in the whole domain of flows. This work illustrates that, by means of the homotopy analysis method, the non-similarity boundary-layer flows can be solved in a similar way like similarity boundary-layer flows. Mathematically, this analytic approach is rather general in principle and can be applied to solve different types of non-linear partial differential equations with variable coefficients in science and engineering.

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PACS

47.15.Cb; 02.30.Lt; 02.60.Lj

Keywords

Non-similarity; Boundary-layer; Series solution; Homotopy analysis method; Non-linear PDE with variable coefficient

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