Solving the nonlinear boundary layer flow equations with pressure gradient and radiation

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We will present the boundary layer problem of the incompressible, laminar flow past a flat plate with pressure gradient and radiation. The partial differential equations (PDEs) describing this problem are the continuity, the energy and the momentum equations with the boundary layer simplifications. Using the dimensionless Falkner-Skan transformation, a nonlinear coupled system of PDEs is obtained. This system is solved via the homotopy analysis method (HAM) in order to obtain an analytical solution that describes radiation and pressure gradient effects on the boundary layer flow. The analytical and the corresponding numerical results are in very good agreement.

Acknowledgement

Dr.U S Mahabaleshwar (USM) wishes to thank Bharat Ratna Prof. Dr C. N. R. Rao, Honorable Chairman VGST, Dept. of IT, BT ST, Bangalore, Govt. of Karnataka, India, for supporting this work under Seed Money to Young Scientists for Research (#VGST/SMYSR/GRD- 304/2013-14). USM would like to acknowledge the receipt of Asia Bridge Fellowship and thanks Prof. Akira Nakayama, Shizuoka University, Japan for his hospitality.

2010 Mathematics Subject Classification: 76D10, 35G60, 35Q35.

References

[1] N. Kafoussias, A. Karabis, M. Xenos, Numerical study of two dimensional laminar boundary layer compressible flow with pressure gradient and heat and mass transfer, *Int. J. Engin. Sci.*, **37** (1999), 1795-1812.

[2] N. Kafoussias, M. Xenos, Numerical study of two-dimensional turbulent boundary layer compressible flow with adverse pressure gradient and heat and mass transfer, *Acta Mech.*, **141** (2000), 201-223.

[3] S.J. Liao, *Beyond Perturbation: Introduction to the Homotoy Analysis Method*, Chapman & Hall/CRC, CRC Press LLC, Boca Raton, 2004.

[4] H. Schlichting, K. Gersten, *Boundary–Layer Theory*, 8th Edition, Springer–Verlag, Berlin, 2000.

[5] M. Xenos, Radiation Effects on Flow past a Stretching Plate with Temperature Dependent Viscosity, *Appl. Math.*, **4** (2013), 1-5.