Modelling Magneto-Thermal Boundary Layer Flows of Nanofluids and Its Engineering Cooling Applications

Oluwole Daniel Makinde

Faculty of Military Science, Stellenbosch University, Private Bag X2, Saldanha 7395, South Africa.

Abstract: The high heat generation during operation of several engineering and industrial devices has adverse effects on the user's health and product's reliability and performance, creating the essential need for thermal management in all devices. Recent advancements in the nanotechnology have led to the production of an innovative thermal management technologies known as nanofluids to improve the system performance and reliability by removing high heat flux generated in the engineering and industrial devices. In this paper, the effects of an imposed magnetic field on the heat transfer enhancement of a water-based conducting nanofluid flows past a convectively heated slippery surface is theoretically examined. The nonlinear model equations are obtained, analysed and solved numerically via shooting technique with the Runge-Kutta-Fehlberg integration scheme. The influence of embedded thermophysical parameters on the overall flow structure and the system thermal management are displayed graphically and discussed.

Keywords: Heated slippery surface; Nanofluid; Engineering cooling; Dual solution; Numerical simulation

Reference

1.) O.D. Makinde, F. Mabood, M.S. Ibrahim. Chemically reacting on MHD boundary layer flow of nanofluid over a non-linear stretching sheet with heat source/sink and thermal radiation. Thermal Science, 22(1B) 495-506, 2018.
2.) O.D. Makinde, W.A. Khan, Z.H. Khan, Stagnation point flow of MHD chemically reacting nanofluid over a stretching convective surface with slip and radiative heat. Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering. Vol. 231(4), 695–703, 2017.
3.) O.D. Makinde, W.A. Khan, J.R. Culham: MHD variable viscosity reacting flow over a convectively heated plate in a porous medium with thermophoresis and radiative heat transfer. International Journal of Heat and Mass Transfer, Vol.93,595–604, 2016.
4.) O. D. Makinde: Computational modelling of nanofluids flow over a convectively heated unsteady stretching sheet. Current Nanoscience, Vol.9, 673-678, 2013.
5.) O. D. Makinde,W. A. Khan, Z. H. Khan: Buoyancy effects on MHD stagnation point flow and heat transfer of a nanofluid past a convectively heated stretching/shrinking sheet.International Journal of Heat and Mass Transfer 62, 526-533, 2013.
6.) W. A. Khan, O. D. Makinde, Z. H. Khan: Non-aligned MHD stagnation point flow of variable viscosity nanofluids past a stretching sheet with radiative heat. International Journal of Heat and Mass Transfer, Vol.96,525-534, 2016.
7.) W. Ibrahim, O. D. Makinde: Magnetohydrodynamic stagnation point flow and heat transfer of Casson nanofluid past a stretching sheet with slip and convective boundary condition. Journal of Aerospace Engineering, Vol. 29, Issue 2, Article number 04015037, 2016.