Analytical and stability analysis of MHD flow past a nonlinearly deforming vertical surface in carbon nanotubes

ABSTRACT

This work aims at evaluating the effect of Magnetohydrodynamic (MHD) on the steady two-dimensional (2-D) mixed convection flow induced by nonlinear surface in carbon nanotubes. Water and kerosene are used as a base fluid with single and multi-wall carbon nanotubes (CNTs). Using a similarity transformation, the governing equations are converted to an ordinary differential equation which are then solved analytically. The novelty of this research is the exact analytical solution obtained for nonlinear flow in carbon nanotubes. The influence of governing parameters, i.e., magnetic, suction and nanoparticle volume fraction parameter on temperature and velocity profiles are discussed and analyzed in the graphical forms. The solution shows a unique solution for stretching case. However, the solution shows a dual nature for some values of parameters for shrinking case. Therefore, the stability analysis is executed using the bvp4c package in Matlab software to determine which solution is linearly stable and valid physically. It is also found that an addition of 0.05 vol fraction of carbon nanotube in water base fluid causes an increment for about 26% in skin friction and heat transfer rate.

Keyword: Carbon nanotubes; Dual solution; Exact solution; MHD; Stability analysis