Boundary layer flow and heat transfer of nanofluids over a moving plate with partial slip and thermal convective boundary condition: stability analysis

ABSTRACT

The steady boundary layer flow and heat transfer of nanofluids over a moving plate with partial slip and thermal convective boundary condition is studied. The governing nonlinear partial differential equations are first transformed into a system of nonlinear ordinary equations using a similarity transformation. The system then have been solved numerically using the bvp4c solver in Matlab. The numerical results are presented in tables and graphs for the skin friction coefficient and the local Nusselt number as well as the velocity and the temperature profile for a range of various parameters such as nanoparticles, nanoparticles volume fraction, slip parameter, Biot number and velocity ratio parameter. It is observed that the skin friction coefficient and the local Nusselt number which represents the heat transfer rate at the surface are significantly influenced by these parameters. The results indicate that dual solutions (first and second solutions) exist when the plate and free stream move in the opposite direction. A stability analysis has been performed to show which solutions are stable and physically realizable. Based on the analysis, the results indicate that the first solution is linearly stable, while the second solution is linearly unstable.

Keyword: Boundary layer flow; Heat transfer; Slip; Biot number; Nanofluid; Dual solutions; Stability analysis