Three-dimensional flow of a nanofluid over a permeable stretching/shrinking surface with velocity slip: A revised model

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ABSTRACT

A reformulation of the three-dimensional flow of a nanofluid by employing Buongiorno's model is presented. A new boundary condition is implemented in this study with the assumption of nanoparticle mass flux at the surface is zero. This condition is practically more realistic since the nanoparticle fraction at the boundary is latently controlled. This study is devoted to investigate the impact of the velocity slip and suction to the flow and heat transfer characteristics of nanofluid. The governing partial differential equations corresponding to the momentum, energy, and concentration are reduced to the ordinary differential equations by utilizing the appropriate transformation. Numerical solutions of the ordinary differential equations are obtained by using the built-in bvp4c function in Matlab. Graphical illustrations displaying the physical influence of the several nanofluid parameters on the flow velocity, temperature, and nanoparticle volume fraction profiles, as well as the skin friction coefficient and the local Nusselt number are provided. The present study discovers the existence of dual solutions at a certain range of parameters. Surprisingly, both of the solutions merge at the stretching sheet indicating that the presence of the velocity slip affects the skin friction coefficients. Stability analysis is carried out to determine the stability and reliability of the solutions. It is found that the first solution is stable while the second solution is not stable.