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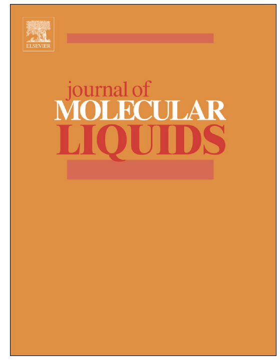

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Unsteady flow and heat transfer past a permeable stretching/ shrinking sheet in a nanofluid: A revised model with stability and regression analyses

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Abstract

This article investigates the unsteady flow and heat transfer in a nanofluid over a stretching/shrinking sheet with injection/suction effects to overcome the deficiency found in the previous model that was to control the nanoparticles fraction actively. Besides, this study controls the nanoparticles volume fraction on the boundary passively rather than actively in order to make the model physically more realistic with zero flux at the surface. This approach makes the Buongiorno's nanofluid model more effective for the plate problems in reality. The governing partial differential equations are transformed into ordinary differential equations via the similarity transformation and are then solved numerically using the bvp4c function. Effects of different flow parameters on the velocity profile, the temperature distribution, the skin friction coefficient and the local Nusselt number are deliberated in detail. Dual solutions are observed for the stretching/shrinking sheet and suction/injection parameter in some certain range. Stability analysis is conceived to check the reliability and stability of the solutions. The local Nusselt number is estimated through multiple linear and quadratic regressions. A comparison is made to validate the obtained results. Results indicate that the first solution is stable and physically realizable as compared to the second solution either fluid flow is under suction or injection effect. The Brownian motion parameter is not significant, and the local Nusselt number is almost independent of the Brownian motion parameter, but it depicts decreasing behavior for the Schmidt number and the thermophoresis parameter for suction and opposite behavior for the injection case. The rise in the suction parameter causes the streamlines to get closer to each other while for the impermeable case, the oncoming flow is the same as for the stagnation point flow.

Key words: Multiple solutions; Realistic approach; Stability analysis; Regression analysis; Suction/injection effect; Unsteady flow.

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