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Stagnation-point flow toward a stretching/shrinking sheet in a nanofluid containing both nanoparticles and gyrotactic microorganisms

Abstract

The *stagnation-point flow* and heat transfer toward *a* stretching/shrinking sheet in *a nanofluid* containing gyrotactic microorganisms with suction are investigated. Using a similarity transformation, the nonlinear system of partial differential equations is converted into nonlinear ordinary differential equations. These resulting equations are solved numerically using a shooting method. The skin friction coefficient, local Nusselt number, local Sherwood number, and the local density of the motile microorganisms as well as the velocity, temperature, nanoparticle volume fraction and the density of motile microorganisms profiles are analyzed subject to several parameters of interest, namely suction parameter, thermophoresis parameter, Brownian motion parameter, Lewis number, Schmidt number, bioconvection Péclet number, and the stretching/shrinking parameter. It is found that dual solutions exist for a certain range of the stretching/shrinking parameter for both shrinking and stretching cases. The results indicate that the skin friction coefficient, local Nusselt number, local Sherwood number, and the local density of the motile microorganisms increase with suction effect. It is also observed that suction widens the range of the stretching/shrinking parameter for which the solution exists.

Keywords; Nanofluids, Stagnation-point flow, stretching/shrinking sheet, Dual solutions, Heat transfer, Gyrotactic microorganisms