Semi-analytical multiple solutions for nanofluid flow and heat transfer past a shrinking surface within porous media

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September 11, 2020

Abstract

A considerable amount of the energy consumption has indeed been affected in industry by friction and inefficient heat transfer. One promising way of overcoming this deficiency of ordinary heat transferring fluids is to use the nanoparticles. Recently, several studies have documented that nanofluid, formed by adding the nanoparticles to the base fluid, can significantly improve the thermal efficiency of these base fluids. In this communication, we present a numerical study for two-dimensional flow of Graphene-oxide (GO)/water nanofluids generated by a stretching/shrinking surface in the presence of porous media. The heat transfer analysis is further investigated under the influence of second order partial slip and mass suction. The current problem is governed by a system of partial differential equations which are derived using conservation laws and Boussinesq-approximations. These non-linear governing equations are converted into a set of ordinary differential equations with the help of similarity transformations. Multiple solutions are achieved analytically for flow fields while numerically for temperature fields. Numerical simulations are conducted using boundary value problem solver (bvp4c) in MATLAB. The influences of various physical parameters, for instance, nanoparticles volume fraction, porosity parameter, suction parameter, first and second-order slip parameters as well as Prandtl number on momentum and thermal boundary layers are presented graphically in detail. It is observed that the solution domain is significantly widen by increasing the nanoparticles volume fraction.

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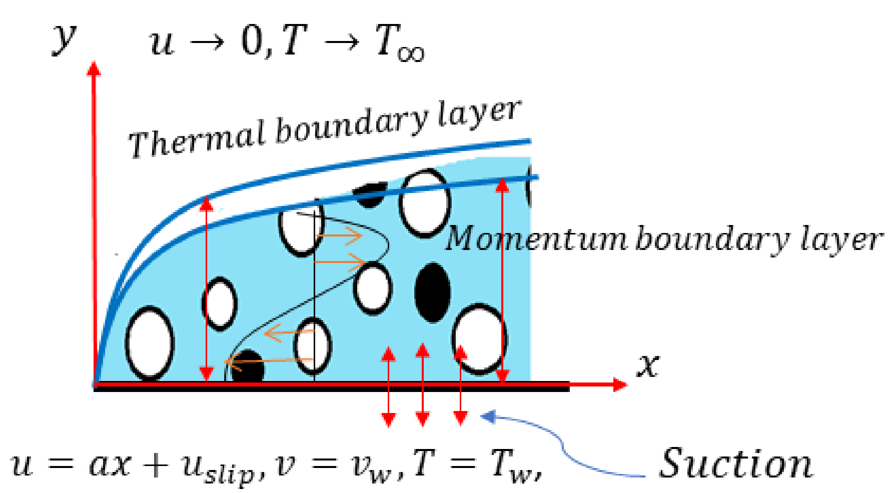

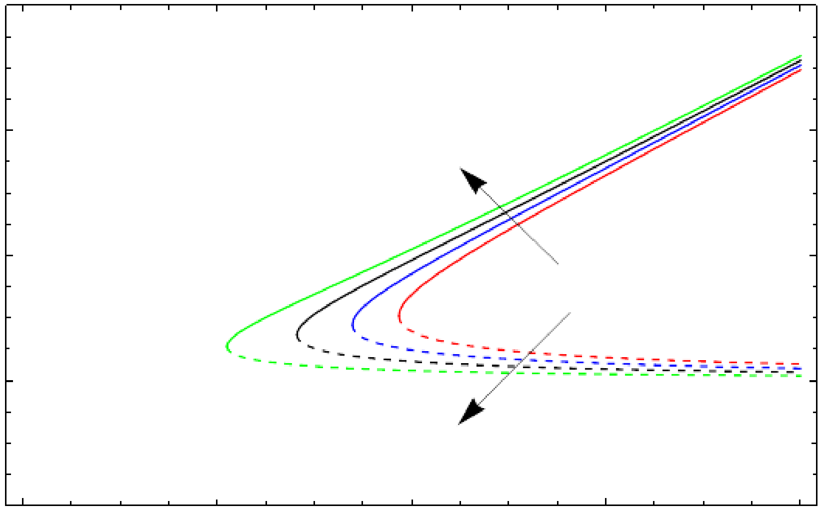

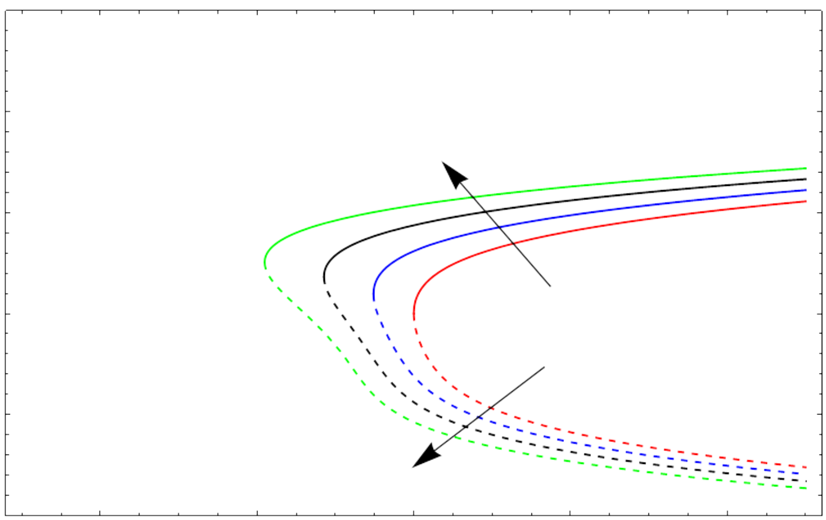

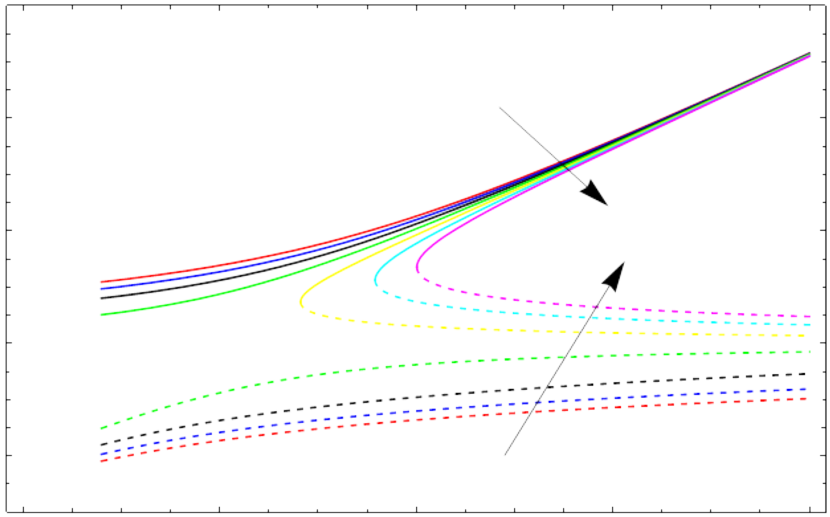

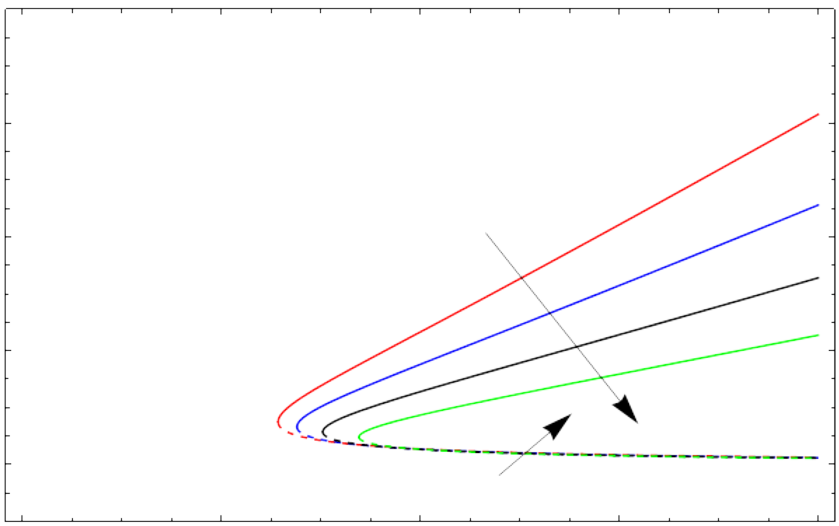

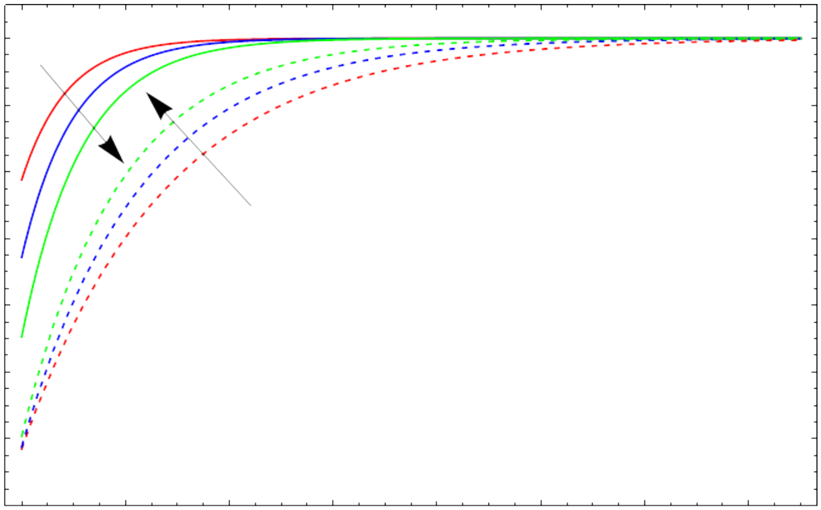

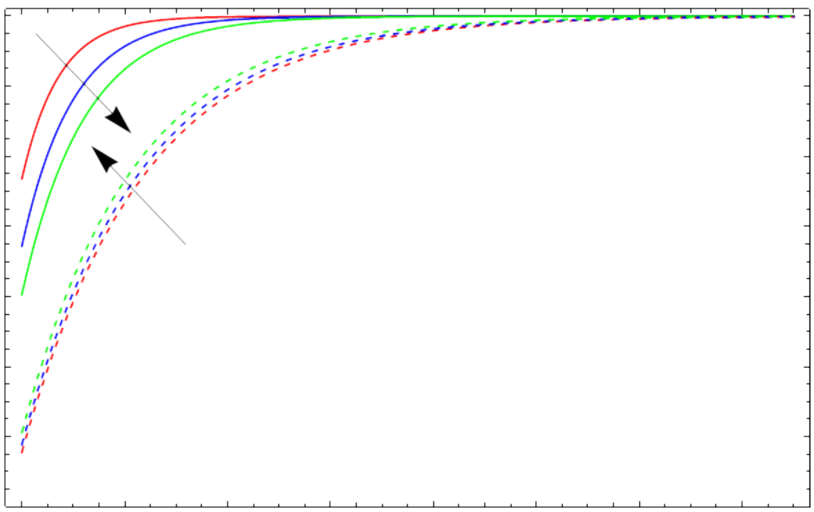

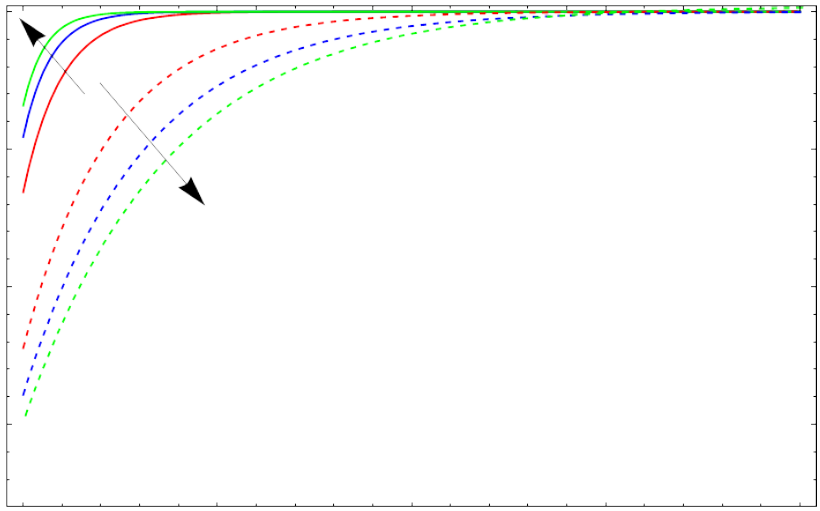

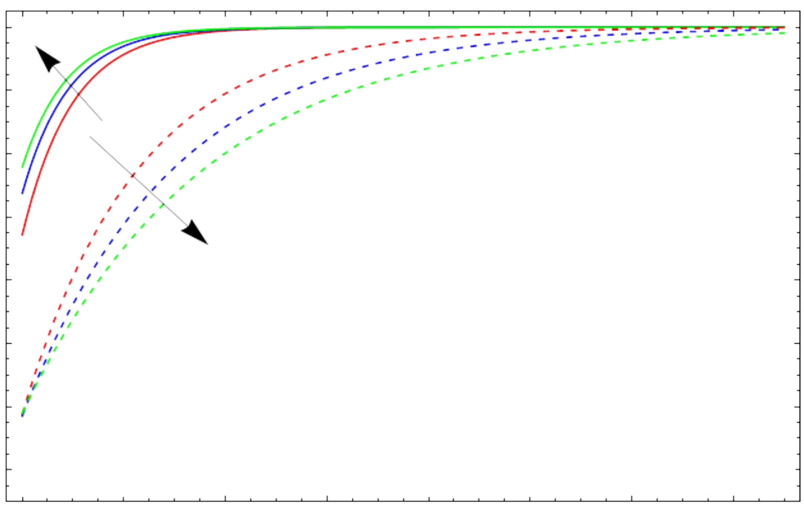

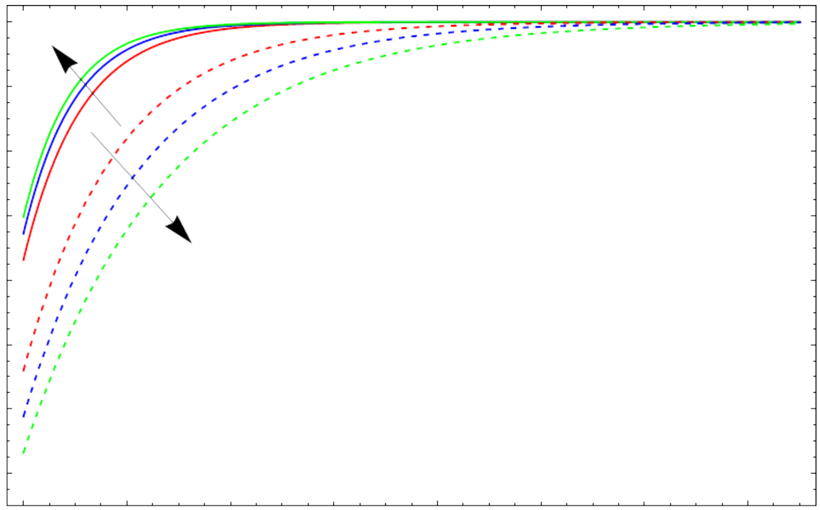

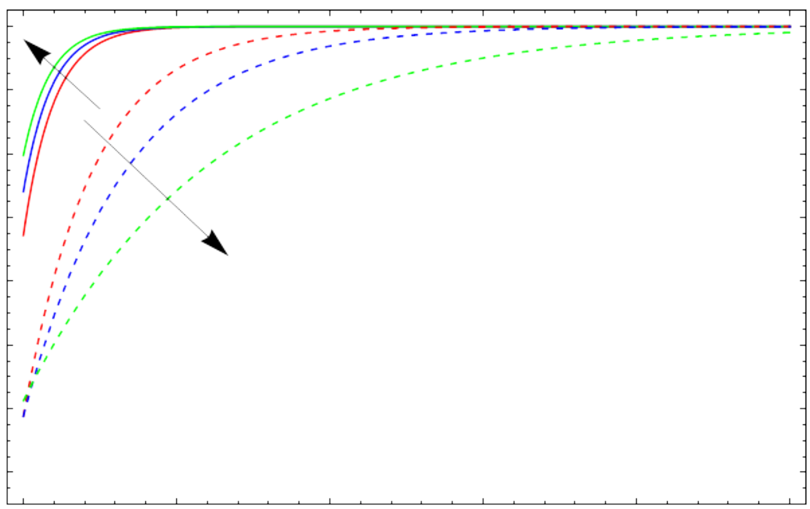

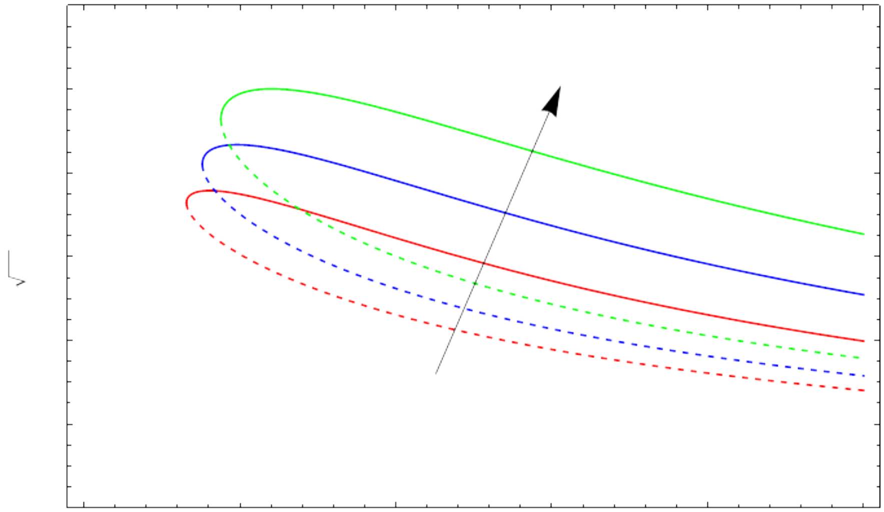

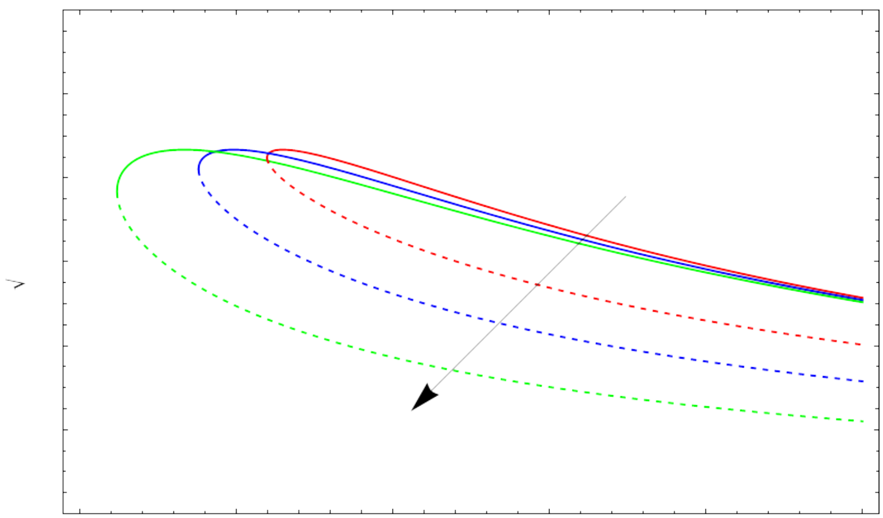

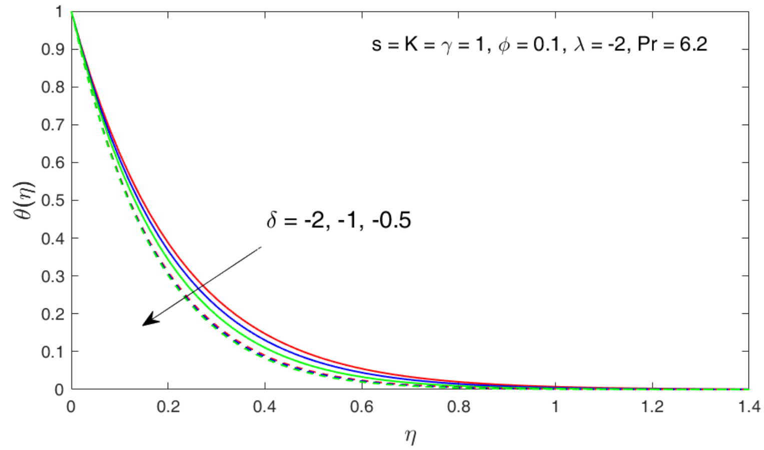
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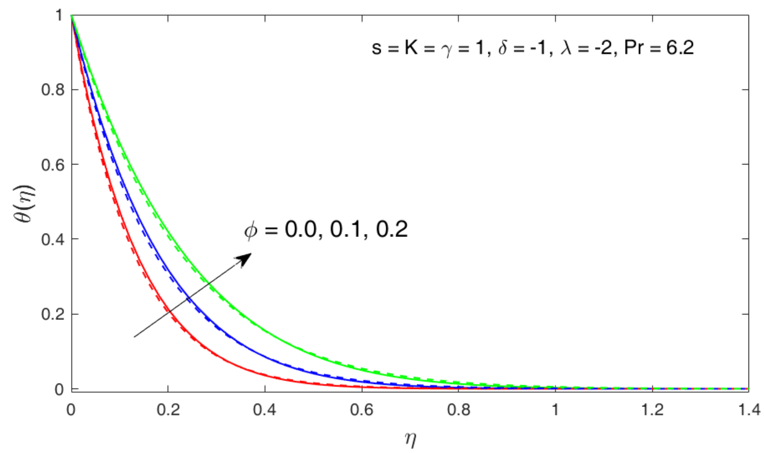
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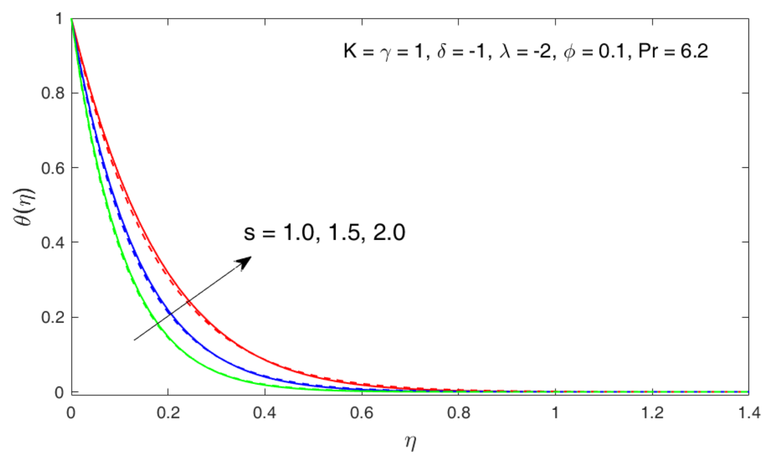
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θ(η)
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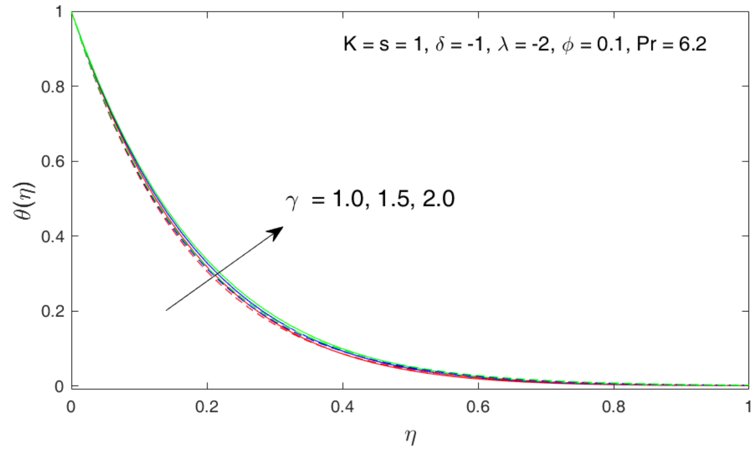
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1