g-Jitter Induced MHD Mixed Convection Flow of Nanofluids past a Vertical Stretching Sheet

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Abstract. The unsteady two dimensional convective boundary layer flow of nanofluids past a vertical permeable stretching sheet associated with the effect of g-jitter is studied in this paper. Two different types of water based nanofluids are considered which are copper (Cu) and aluminium oxide (Al_2O_3). The governing boundary layer equations in the form of partial differential equations are transformed into nonlinear coupled ordinary differential equations and solved numerically using an implicit finite-difference scheme known as the Keller-box method. The effects of amplitude of modulation, frequency of oscillation and solid nanoparticle volume fraction parameters on the reduced skin friction and Nusselt number are presented and discussed. An excellent agreement was observed between the current and earlier published results for some special cases. Numerical results show that, the values of reduced skin friction increase with the increasing of solid nanoparticle volume fraction but produce the opposite behaviour for the values of heat transfer coefficient.

INTRODUCTION

A large number of studies in literature related to the flows of nanofluids for both experimental and theoretical works were conducted by many researchers due to its important application in many industrial fields. Nanofluids is widely used in the industrial cooling applications, nuclear reactors, transportation industries and biomedical field [1] due to its ability to increase the heat transfer rate [2].There are two types of mathematical models for boundary layer flow of nanofluids. The first model was introduced by Buongiorno [3] which incorporates the effect of Brownian motion and thermophoresis, meanwhile the second one is proposed by Tiwari and Das [4] model which the solid nanoparticles volume fraction is taking into account to analyze the behavior of nanofluids. Nield and Kuznetsov [5] studied the effect of Brownian motion and thermophoresis on boundary layer flow of nanofluids past a flat surface in a porous medium. Kuznetsov and Nield [6] obtained similarity solution for natural convection flow of nanofluids along a vertical plate. The studies restricted to the boundary layer flows of nanofluids due to a stretching sheet can be found in [7-11]. Recently, Uddin *et al.* [12] investigated the effects of linear hydrodynamic slip, thermal slip and temperature dependent viscosity on mixed convective boundary layer flow of nanofluids past a permeable stretching sheet with the effect of g-jitter where the solutions are obtained using quasi-linearization technique.

g-Jitter can be defined as the inertia effects due to quasi-steady, oscillatory or transient accelerations arising from crew motions and machinery vibrations in parabolic aircrafts, space shuttles or other microgravity environments. Studies on g-jitter effects indicate that convection in microgravity is related to the magnitude and frequency of g-jitter and to the alignment of the gravity field with respect to the growth direction or the direction of the temperature gradient [13, 14]. Very recently, Uddin *et al*. [15] extended the previous paper to the Buongiorno-Darcy porous medium model

Advances in Industrial and Applied Mathematics
AIP Conf. Proc. 1750, 030017-1–030017-7; doi: 10.1063/1.4954553
Published by AIP Publishing. 978-0-7354-1407-5/$30.00