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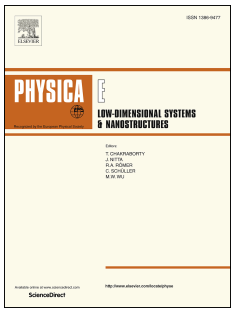

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Thermal and velocity slip effects on MHD mixed convection flow of Williamson nanofluid along a vertical surface: Modified Legendre wavelets approach

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Abstract

The purpose of the present work is to carry out the numerical simulation of magnetohydrodynamic (MHD) stagnation-point flow of non-Newtonian Williamson nanofluid towards a vertical moving surface. The focus of present work is to analyze the nanofluid characteristics for both buoyancy assisting and opposing flow regions. The stretching sheet is subject to uniform normal magnetic field and three types of slip conditions: velocity, thermal and solutal slip. The governing equations are derived in the form of nonlinear partial differential equations. Using suitable transformation variables such equations are converted into favorable nonlinear ordinary differential equations. New modification in Legendre wavelets method is proposed and applied to investigate the numerical solution of the reduced set of nonlinear ordinary differential equations. The simulation is performed for the emerging physical parameter on the nanofluid velocity, temperature, concentration, coefficient of skin friction, heat and mass transfer rate. The study concludes that the Modified Legendre Wavelets Method (MLWM) reduces the computational cost and very accurate to find the solution and can be extended for nonlinear diversify problems of physical nature. Moreover, skin friction at the stretching surface is increased due to increase in non-Newtonian Williamson fluid parameter which subsequently decreases the nanofluid velocity in the boundary layer.

Keywords: Legendre polynomials, Wavelets, Williamson nanofluid, slip flow, buoyancy flow.

1. Introduction

From two basic types of fluids, Newtonian and non-Newtonian, the latter is due to the nonlinear relationship of stress and strain. Such type of fluids can be encountered in our daily life.

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