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On heat transfer in Carreau fluid flow with thermal slip: An artificial intelligence (AI) based decisions integrated with Lie symmetry

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A R T I C L E I N F O

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A B S T R A C T

It is well accepted that non-Newtonian fluid flow narrating differential systems with thermal slip conditions at the surface plays an important role in instabilities subject to polymer extrusion like stick–slip and gross-melt-fracture instabilities. Therefore, the present article contains the artificial neural networking evaluation of the friction at magnetized porous surface having thermal and velocity slip boundary conditions. The Carrea fluid flow is mathematically formulated at a porous surface. The novelty is enhanced by considering velocity slip boundary condition, thermal slip boundary condition, chemical reaction, magnetic field, and heat generation effects. The flow differential equations are reduced by using Lie symmetry analysis. The reduced equations are solved by using the shooting method. The neural networking model is constructed by engaging 132 values of SFC. 92 (70%) is marked for training, and 20 (15%) each is marked for validation and testing. 10 number of neurons are chosen in the hidden layer. Levenberg-Marquardt algorithm is carried out to train the network. The performance of the constructed neural networking model is evaluated by MSE and R. The developed ANN is the best to predict the friction values at the magnetized porous plate. Owning to predicted values of ANN, SFC shows inciting values towards the magnetic field parameter.

1. Introduction

The thermal and velocity slip conditions at the surface are important in the continuum method because they compensate for non-equilibrium factors. As a result, significant effort has been expended in attempting to study slip velocity/temperature models, such as the Monte Carlo method used by Ng et al. (Ng et al., 2002) to examine the impact of slip boundaries for lubrication of gas. According to the findings, the slip velocity in the transition zone was influenced by density and shear stress. Shear stress to density ratio own linear relation with velocity slip in ultra-thin film lubrication environment. This was especially true for Knudsen number near 1 or higher. A Reynolds equation with slip correction was also generated and numerically solved using this unique model. The stress-density ratio model was shown to be more applicable than earlier slip models. In polyatomic gas flows, Meolans (Meolans, 2003) proposed thermal jump boundary conditions at the surface. By ignoring dissociation effects, the calculations and conclusions were focused on vibrational nonequilibrium circumstances. The normal circumstances were first briefly discussed. The proposed boundary conditions in the study were then validated using prior experimental data. The different fluxes were provided. Georgiou (Georgiou, 2003) offered a solution for the Carreau fluid model for compressible swell and Poiseuille flows. Based on experimental findings using polyethylene melts, a slide occurred along the wall with a slip equation. The numerical outcomes correspond favorably with some analytical Poiseuille flow approximations. Mass-flow rate oscillations and pressure drop were seen to be self-sustaining. As the Re decreases and approaches the experimental circumstances, the radial oscillation amplitude was reduced. Khaled and Vafai (Khaled and Vafai, 2004) investigated flow for thin films in the presence of slip conditions both analytically and numerically. This study took into account flow disruptions caused by external squeezing and internal pressure pulsations. The impact of flow parameters on the

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