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INTELLIGENT NUMERICAL METHOD FOR STUDYING MHD MAXWELL WILLIAMSON NANOFLUID FLOW WITH BIO-CONVECTION AND ACTIVATION ENERGY

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Abstract

The use of artificial intelligence and its techniques has become increasingly widespread in recent times. It is being used to solve problems in various fields, especially in solving stiff non-linear equations that are considered mathematical models that represent a problem and predict results with high accuracy, effectiveness, and speed. Additionally, nanofluids play a pivotal role in studying heat *transfer, particularly in the field of solar energy and its sources. All of this was the reason and motivation for doing this work. This work investigates a two-dimensional magnetohydrodynamic stretched flow (2D-MHDSF) of Maxwell Williamson nanofluid (MWNF) affected by bioconvection and activation energy numerically through Levenberg-Marquardt backpropagation method (LMBM)-based supervised artificial neural network approach (ANN). The mathematical formulation for the problem was obtained through non-linear partial differential equations (PDEs). The leading PDEs were transmitted into non-linear ordinary differential equations (ODEs) by similarity transformation variables. The reference results for the 2D-MHDSF-MWNF model are produced by the Lobatto IIIA method through different scenarios of specific parameters for the flow velocity, fluid temperature, nanoparticle concentration, and motile density profiles. Using the obtained results as a dataset to apply the testing, training, and validation steps of the suggested ANN-LMBM for the 2D-MHDSF-MWNF model. The mean squared error, fitting curve, analysis of regression, and error histograms are presented to prove the efficiency and precision of the proposed method. The numerical results of ANN-LMBM are displayed as a study of the effects of different physical factors on flow dynamics for 2D-MHDSF-MWNF. For larger values of magnetic parameter, the flow velocity decreases while the distribution of the temperature, concentration rates, and microorganism density increase. The increasing value for the activation energy parameter leads to a rise in the concentration. In the future, analyze the impact of the activation energy on various nano-fluidic models by applying the proposed method LMBM.*

Keywords

Nanofluid, Artificial Neural Network, Levenberg Marquardt, Activation Energy, Bioconvection