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Computational analysis of Ferro-nanofluid flow and heat transfer over a stretching sheet with convective boundary condition and heat source/sink using Levenberg–Marquardt back propagation neural networks

Sunendra Shukla[1], Abhishek Sharma[2], H. P. Rani[3], Ram Prakash Sharma[4,*]

[1,2]Department of Basic & Applied Science, National Institute of Technology Arunachal Pradesh, Jote, Papum Pare District, Arunachal Pradesh-791113, India.
[3]Department of Mathematics, National Institute of Technology Warangal, Warangal, Telangana -506004, India.
[4*]Department of Mechanical Engineering, National Institute of Technology Arunachal Pradesh, Jote, Papum Pare District, Arunachal Pradesh-791113, India.

ABSTRACT

This study examines a two-dimensional electrically conducting incompressible time-dependent Ferro-nanofluid flow over a stretching sheet with convective boundary conditions under the influence of a heat source (Fig.1). The governing equations are transformed into a system of ordinary differential equations (ODEs) using appropriate similarity variables. These ODEs are then numerically solved. Additionally, an Artificial Neural Network (ANN) model is utilized to investigate the impact of heat transfer within the system. The study discusses the significant dimensionless parameters that play a crucial role in determining the behavior and patterns of the fluid flow and heat transfer phenomena. The study's findings demonstrate that the Biot number, heat source parameter, and parameter governing the magnetic effect have a positive impact on the temperature profile, while the buoyancy parameter enhances the flow of Ferro-nanofluid. The agreement between the obtained results and existing findings reinforces their credibility. Moreover, the developed ANN model proves to be reliable, as it exhibits excellent accuracy during the training, validation, and testing phases. These results offer valuable insights for the future development of innovative heat transfer devices and serve as a valuable reference for researchers exploring flow behavior under different assumptions.

Keywords: stretching sheet; Ferro-nanofluid; heat source; convective boundary condition; ANN model.

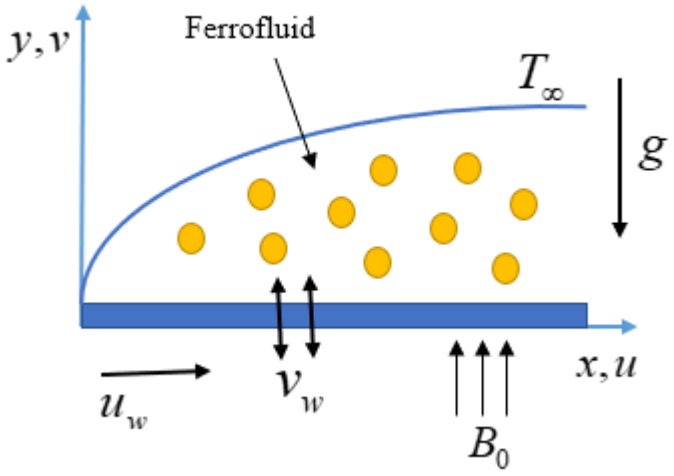

Fig. 1 Ferro-nanofluid flow over a stretching sheet. The notations are explained in the Nomenclature

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Nomenclature

B_0	Magnetic field
v_w	Suction velocity
T_w	Temperature at the wall (K)
T_∞	Ambient temperature (K)
T	Fluid temperature (K)
u,v	Velocity components along x and y directions (ms^{-1}) nanofluid
u_w	Stretching velocity at the wall