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MHD Mixed Convection Flow Around a Deformable Stretching Sheet

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Abstract

Magnetohydrodynamic (MHD) mixed convection flow over deformable stretching surfaces is an important problem in fluid mechanics and heat transfer, with applications in polymer processing, cooling systems, metallurgical operations, extrusion processes, and manufacturing technologies. This study investigates the steady, two-dimensional MHD mixed convection flow of an electrically conducting fluid around a deformable stretching sheet. The interaction between the imposed magnetic field, stretching-induced motion, buoyancy forces, and thermal transport significantly influences the velocity and temperature distributions within the boundary layer. The governing equations describing conservation of mass, momentum, and energy are formulated under suitable boundary-layer assumptions. Through appropriate similarity transformations, the coupled partial differential equations are reduced to a system of nonlinear ordinary differential equations. The resulting equations can be analyzed using numerical or analytical techniques to determine the effects of relevant dimensionless parameters on the flow and heat-transfer characteristics. Particular attention is given to the magnetic parameter, mixed convection parameter, stretching-rate parameter, Prandtl number, and other physical parameters associated with the deformability of the sheet. The application of a magnetic field can modify the fluid velocity through the Lorentz force and consequently influence the temperature distribution and heat-transfer rate. The study provides insight into the coupled effects of magnetic forces, buoyancy, and surface deformation on boundary-layer behaviour. The results may be useful in optimizing industrial processes involving electrically conducting fluids and deformable surfaces, where control of fluid flow and thermal performance is essential.

Keywords: Magnetohydrodynamics, MHD, Mixed Convection, Stretching Sheet, Deformable Surface, Boundary Layer Flow, Heat Transfer, Electrically Conducting Fluid, Buoyancy, Lorentz Force.