A Numerical Simulation of non-uniform Magnetic Field Effect on Ferrofluid Flow in a Half-Annulus Enclosure with Sinusoidal Hot Wall

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Abstract

In this study, a significant problem which combines the laws of the ferro-hydrodynamics and magnetohydrodynamics is considered. Specifically, the two-dimensional laminar, ferro-megnetohydrodynamics fluid flow in a semi-annulus enclosure with irregular boundaries is solved numerically by the use of the dual reciprocity boundary element method (DRBEM). DRBEM is a computationally effective technique due to its inherent boundary only nature technique compared to the well-known domain discretization. The flow under the influence of a variable magnetic nodal source placed below the mid of the hot inner wall with a sinusoidal shape. The outer circular wall is kept at a constant cold temperature while the bottom straight walls are considered to be adiabatic. Numerical simulations are performed for various values of the physical parameters (namely, Rayleigh, Hartmann, magnetic numbers) in order to analyze the influence of these parameters on the flow behavior and the temperature distribution. It is well observed that Hartmann and Rayleigh numbers have opposite effects on the flow and temperature fields. That is, the stream function values increase in magnitude as Rayleigh number increases while they decrease as Hartmann number increases.