DRBEM Solution to MHD Flow Between Cylindrical Pipes with Slipping Walls

P. Senel, M. Tezer-Sezgin

Abstract

In this study, MHD flow between concentric cylindrical pipes with arbitrarily conducting, slipping walls is investigated. A pressure driven, steady, laminar, fully developed flow of an electrically conducting, viscous fluid subjected to a horizontally applied uniform magnetic field is considered within the cross-section of the pipes. The non-dimensional form of the 2D coupled MHD equations are discretized by the Dual Reciprocity Boundary Element Method (DRBEM) with constant elements. The resultant matrix-vector equations for the velocity, induced magnetic field and their normal derivatives are combined and solved as a whole reducing the computational cost. Numerical results are presented for different slip lengths and wall conductance ratios at the inner and the outer boundaries. The influences of the slip, wall conductivity, magnetic field strength and the radius of the inner pipe are discussed. The obtained results show that, in the absence of the slip, boundary layers are developed close to the pipe walls and the maximum velocity occurs below and above the inner pipe. The main effect of increases in the magnetic field strength or inner pipe radius is the retardation of the flow. When both walls are slipping, the slip at the inner wall dominates the flow behavior and uniform velocity occurs at the center of the flow region. Increasing the wall conductivity enlarges the induced current loops next to the wall and the slip at the same wall retards this effect.

References

[1] P.W. Partridge, C.A. Brebbia, L.C. Wrobel, *The Dual Reciprocity Boundary Element Method*, Computational Mechanics Publications, UK (1992).

[2] U. Muller, L. Buhler, *Magnetohydrodynamics in Channels and Containers*, Springer, New York (2001).

[3] S. Smolentsev, MHD duct flows under "hydrodynamics" slip condition, *Theoretical and Computational Fluid Dynamics*, **23** (2009) 557-570.

Correspondance

psenel@ktu.edu.tr; Department of Mathematics, Karadeniz Technical University, 61080, Trabzon , Turkey