Instabilities in electrically conducting fluids driven by rotating magnetic fields

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Rotating or alternating magnetic fields are used for non-intrusive flow control of liquid metals especially in metallurgy [1]. Currents are induced in electrically conducting fluids when subjected to rotating magnetic fields, generating a body force which drives the fluid [2]. We consider a cylindrical annulus of electrically conducting fluid, which is driven by rotating magnetic field. We perform numerical simulations to study the stalling of the flow occurring at high wave speed of the rotating magnetic field. The magnetic Reynolds number in our study is based on the speed of the wave [3]. The effects of different parameters like the Hartmann number, hydrodynamic Reynolds number, Prandtl number, and the wavenumber of the rotating magnetic field on the stalling of the flow are studied. We also present various time averaged quantities like the azimuthal flow-rate, volume averaged components of velocity and magnetic field, etc., for different aforementioned parameters. An objective of this study is to facilitate the development of an experimental setup similar to Pereira *et al.* [4] to observe stalling of the flow at high magnetic Reynolds number.

Références

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