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Numerical study of a metallic fluid flow in a magnetohydrodynamic pump

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A magnetohydrodynamic (MHD) pump is a device that can move/pump a metallic fluid by utilizing an electric current together with a magnetic field. The operation of the pump is based on the principles of an electrically conductive fluid that is exposed to electromagnetic forces. When a metallic fluid passes through the device, the current and magnetic field combine to produce the Lorentz force. This force is responsible for the pump's operation and can be harnessed for various industrial and energy applications. The advantage of the MHD pump over traditional mechanical pumps is that, besides the working fluid, it operates with no moving parts. Mercury has been used as a working fluid in magnetohydrodynamic pumps since the early years of its development in the 1960s. Galinstan, an alternative liquid metal with similar properties, is now widely used in MHD pumps. The switch to Galinstan from mercury was made due to concerns over the toxicity and environmental impact of mercury. This change was a result of extensive research to find a safer and more environmentally friendly substitute for mercury in MHD pumps. As a result, there are numerous new applications of the MHD pump and this research endeavours to study the flow properties of the fluid in small-scale applications.
In the present study, we investigate the properties of the fluid flow in the MHD pump using numerical techniques. This is a precursor to developing a measurement technique thereafter to experimentally study the flow properties. As a first step, we numerically solve the fluid equations to gain insight into the behaviour of the working fluid under various operating conditions. The initial investigation will discuss the motion of a single particle in the presence of an electric and magnetic field. This will be followed by the numerical simulation of the MHD fluid equations. The numerical simulation will be a set of differential fluid equations that are discretized using the finite difference method and solved in MATLAB by using standard programming practices. The results will be presented for the various scenario-based simulations.

Apply to be considered for a student ; award (Yes / No)?

No

Level for award;(Hons, MSc, PhD, N/A)?

N/A

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