# Optimal Control in Magnetohydrodynamics

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Magnetohydrodynamics, or MHD, deals with the mutual interaction of electrically conducting fluids and magnetic fields. The nature of the coupling between fluid motion and the electromagnetic quantities arises from the following three phenomena:

1. The relative movements of a conducting fluid and a magnetic field induce an electromotive force (Faraday's law) to the effect that an electric current develops in the fluid.
2. This current in turn induces a magnetic field (Ampère's law).
3. The magnetic field interacts with the current in the fluid and exerts a Lorentz force in the fluid.

It is the third feature in the nature of MHD which renders it so phenomenally attractive for exploitation especially in metallurgical processes. The Lorentz force offers a unique possibility of generating a volume force in the fluid and hence to control its motion in a contactless fashion and without any mechanical interference.
We recall the velocity–current formulation of the stationary MHD system and present an optimal control setup motivated from practical applications. First-order necessary conditions are also derived and discussed.

[1] R. Griesse and K. Kunisch: *A Practical Optimal Control Approach to the Stationary MHD System in Velocity–Current Formulation*, RICAM Report 2005-02

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