Exact Interior Controllability of Magnetoelastic Plates Using Purely Magnetic Actuation

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We establish exact interior controllability for a two-dimensional magnetoelastic plate system with control acting solely in the magnetic field equation. The main result shows that the coupled system is exactly controllable in arbitrarily small time T ¿ 0, even though the control influences only the magnetic dynamics. This extends the principle of indirect control - previously observed in thermoelastic systems - to the magnetoelastic setting, demonstrating that the mechanical plate displacement can be steered using magnetic actuation alone.

The analysis uses an operator-theoretic multiplier method adapted to handle the coupling between the mechanical and magnetic components. The proof consists of three main steps: establishing trace regularity for the adjoint system, deriving a suitable energy estimate, and applying a compactness-uniqueness argument to remove lower-order terms.

This work provides the first exact controllability result for magnetoelastic systems and extends the indirect control framework from thermoelasticity to this setting. The techniques developed here are relevant for the control-theoretic study of magnetically coupled elastic structures, with potential applications in smart materials and electromagnetic actuators.