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Viscous ferrofluid films under the effects of magnetic fields[1]
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We consider a thin, ferrofluidic film flowing down an inclined substrate, under the action of a magnetic field, bounded above by an inviscid gas. The fluid is assumed to be weakly-conducting. Its dynamics are governed by a coupled system of the steady Maxwell's, the Navier-Stokes, and the continuity equation. The magnetisation of the film is a function of the magnetic field, and may be prescribed by a Langevin function. We make use of a long-wave reduction in order to solve for the dynamics of the pressure and velocity fields inside the film. The potential in the gas phase is solved with the use of Fourier Transforms. Imposition of appropriate interfacial conditions allows for the construction of an evolution equation for the interfacial shape via use of the kinematic condition. The magnetic effects give rise to a non-local contribution. We conduct a parametric study of both the linear and nonlinear stability of the system in order to evaluate the effects of the magnetic field.

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