Spatial dynamics methods for axisymmetric solitary waves on a ferrofluid jet

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Abstract

We consider the irrotational flow of an incompressible, inviscid ferrofluid of constant density surrounding a metal wire in a vacuum, and examine whether the magnetic force in the ferrofluid induced by a constant current flowing in the wire can, together with surface tension, support axisymmetric solitary waves on its free surface. The hydrodynamic problem is formulated as an infinite-dimensional Hamiltonian system in which the longitudinal spatial direction is the time-like variable. A centre-manifold reduction technique is employed to reduce the system to a locally equivalent Hamiltonian system with a finite number of degrees of freedom. Homoclinic solutions to the reduced system, which correspond to axisymmetric solitary waves, are detected by a variety of dynamical systems methods.

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