An existence theory for solitary waves on a ferrofluid jet

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Abstract

We prove the existence of several families of axisymmetric solitary waves on the surface of an otherwise cylindrical ferrofluid jet surrounding a stationary wire. The ferrofluid is subject to a magnetic field which is generated by a current flowing along the wire. In the previous literature the ferrofluid waves are modelled by formally approximating the governing equations by a Korteweg-de Vries equation (strong surface tension) or by a nonlinear Schrödinger equation (weak surface tension). Using spatial dynamics methods, the formal approximations were proven rigorously by Groves & Nilsson (2018). In this work we provide an alternative proof in which we directly use the Zakharov-Craig-Sulem formulation of the ferrofluid problem and solve the reduced equations using fixed-point arguments. This work was conducted under supervision of Prof. Dr. Mark Groves (Saarland University) and Dr. Dag Nilsson (Lund University).