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INTRINSIC CURVE DYNAMICS OF MAGNETIC FILAMENTS[1]

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Dynamics of an elongated ferromagnetic filament shape under the action of a rotating magnetic field is considered by mathematical modelling. We denote the partial derivative $\frac{\partial q}{\partial l}$ for the function $q(l,t)$ respect to space variable l with $q'(t)$ (l is the arclength of the center line, t is the time, L is the total length of filament $l \in [0,L]$). The actual shape of a droplet is obtained by solving initial-boundary value problem of following partial differential equation (PDE) [1]:

$$\frac{\partial \vec{r}}{\partial t} = -\vec{r}'''' - Cm\,\vec{n}\,' + (\Lambda\,\vec{t}\,)\,',$$

where for 2D case $\vec{r} = (x,y,0)^T$ - the configuration vector of filament, $\vec{t} = (x',y',0)^T$, $\vec{n} = -(y',x',0)^T$ - the tangent and normal vectors respectively, Cm - the magnetoelastic number. The Lagrange multiplier Λ is found using the conditions of inextensibility of filament. For the curvature of filaments $K(t,l)$ we have the system of two nonlinear PDEs

$$\frac{\partial K}{\partial t} = -K^{(4)} - 3.5K^2K'' - 3K(K')^2 - K^5 + 2\Lambda K^3 + 3\Lambda' K' + \Lambda K'',$$

$$\Lambda'' - CmK' + K(K'' + 0.5K^3) - \Lambda K^2 = 0,$$

For the discretization in space the central differences are used. Time evolution of nonstationary and coresponding of stationary solutions are obtained with MATLAB by solving large system of ordinary differential equations. The shape of filaments is obtained by solving the stationary equations of curvature. It is shown that curve dynamics of magnetic filaments may be obtaned by solving the equations for intrinsic parameters.

REFERENCES

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