Modeling and simulation of nematic liquid crystal elastomers

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We consider a continuum model1 describing the dynamic behavior of nematic liquid crystal elastomers and implement a numerical scheme to solve the governing equations. In the model, the free energy and Rayleigh dissipation are used, within a Larangian framework, to obtain the equations of motion. The free energy consists of both elastic and nematic contributions, each of which is a function of the material displacement and the orientational order parameter. The model gives the dynamics of the material displacement, the scalar order parameter and the nematic director, the latter two of which correspond to the uniaxial order parameter tensor. Our simulations are carried out by solving the governing equations using an implicit-explicit method and the Chebyshev polynomial method. The simulation shows that our model can successfully capture the shape changing phenomena of LCEs that have been observed in experiments, and also track the dynamics of the order parameter tensor.

1. R. Ennis, L. Malacarne, P. Palffy-Muhoray and M. Shelley, *Phys. Rev.* E **74** 061802 (2006)