A Structure-Preserving Finite Element Method for Uniaxial Nematic Liquid Crystals

Ricardo Nachotto, University of Maryland

The Landau-DeGennes Q-model of uniaxial nematic liquid crystals seeks a rank-one traceless tensor Q that minimizes a Frank-type energy plus a double well potential that confines the eigenvalues of Q to lie between -1/2 and 1. We propose a finite element method (FEM) which preserves this basic structure and satisfies a discrete form of the fundamental energy estimates. We prove that the discrete problem Gamma converges to the continuous one as the meshsize tends to zero, and propose a discrete
gradient flow to compute discrete minimizers. Numerical experiments confirm the ability
of the scheme to approximate configurations with half-integer defects, and to deal with
colloidal and electric field effects. This work, joint with J.P. Borthagaray and S. Walker, builds on our previous work for the Ericksen's model which we review briefly.