Numerical methods for models of liquid crystal dynamics

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Liquid crystal is an intermediate state of matter between the liquid and the solid phase, where the elongated molecules of the material are in partial alignment. Due to this, liquid crystals have unique physical properties that are used in various real-life applications, such as monitors (LCDs), smart glasses, navigation systems, shampoos, and others. Various mathematical models are available to describe their dynamics, among the most commonly used ones are the Oseen-Frank model, and the Q-tensor model by Landau and de Gennes, in which the alignment and its variation over time are described through systems of nonlinear PDEs. In this talk, I will describe these models and present results on the numerical approximation of PDEs that arise in these two modeling frameworks. These schemes are energy-stable, preserve the physical constraints in the discrete setting, and can be shown to converge within a particular range of material parameters.

Joint work with Yukun Yue (University of Wisconsin - Madison, USA), Varun Gudibanda (University of Wisconsin - Madison, USA) and Max Hirsch (Carnegie Mellon University, USA).