Computational Mathematics Seminar Series

Numerical Schemes for Mixtures of Isotropic and Nematic Flows Taking into Account Anchoring and Stretching Effects

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Digital Media Center 1034
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Abstract:
The study of interfacial dynamics between two different components has become the key role to understand the behavior of many interesting systems. Indeed, two-phase flows composed of fluids exhibiting different microscopic structures are an important class of engineering materials. The dynamics of these flows are determined by the coupling among three different length scales: microscopic inside each component, mesoscopic interfacial morphology and macroscopic hydrodynamics. Moreover, in the case of complex fluids composed by the mixture between isotropic (newtonian fluid) and nematic (liquid crystal) flows, its interfaces exhibit novel dynamics due to anchoring effects of the liquid crystal molecules on the interface.

In this talk I will introduce a PDE system to model mixtures composed by isotropic fluids and nematic liquid crystals, taking into account viscous, mixing, nematic, stretching and anchoring effects and reformulating the corresponding stress tensors in order to derive a dissipative energy law. Then, I will present new linear unconditionally energy-stable splitting schemes that allows us to split the computation of the three pairs of unknowns (velocity-pressure, phase field-chemical potential and director vector-equilibrium) in three different steps. The fact of being able to decouple the computations in different linear sub-steps maintaining the discrete energy law is crucial to carry out relevant numerical experiments under a feasible computational cost and assuring the accuracy of the computed results.

Finally, I will present several numerical simulations in order to show the efficiency of the proposed numerical schemes, the influence of the shape of the nematic molecules (stretching effects) in the dynamics and the importance of the interfacial interactions (anchoring effects) in the equilibrium configurations achieved by the system.

Speaker's Bio:
I am currently an Assistant Professor at University of North Texas with research interests in applied mathematics. In particular, in my research I focus on modeling, numerical analysis and scientific computing techniques with special emphasis on applications to life and material sciences that are formulated using systems of coupled PDEs.

I obtained a Ph.D. in Mathematics at Universidad de Sevilla (Spain) in 2012 under the supervision of Prof. Francisco Guillén-González. Then I held postdoctoral researcher positions in ACMS (Department of Applied and Computational Mathematics and Statistics) at the University of Notre Dame and in the Mathematical Institute at Charles University in Prague (Czech Republic). After that I was a Research Assistant Professor at Temple University.

This lecture has refreshments @ 03:00 pm

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