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Numerical Simulation of Interfacial Flows of a Hydrogel LEI LI, Department of Chemical and Biological Engineering, University of British Columbia, Vancouver V6T 1Z3, Canada., PENGTAO YUE, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123, The United States of America., YUAN-NAN YOUNG, Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, NJ 07102, The United States of America., JAMES FENG, Departments of Mathematics and Chemical and Biological Engineering, University of British Columbia, Vancouver V6T 1Z3, Canada. — Hydrogels are crosslinked polymer networks swollen with an aqueous solvent, and play central roles in biomicrofluidic devices. In such applications, the gel is often in contact with a flowing fluid, thus setting up a fluid-hydrogel two-phase system. Using a recently proposed model (Y.-N. Young et al, Phys. Rev. Fluids 4, 063601, 2019), we treat the hydrogel as a poroelastic material consisting of a neo-Hookean polymer network and a Newtonian viscous solvent, and numerically study the motion and deformation of gel drops suspended in viscous flows. The gel-fluid interface is tracked by using the Arbitrary Lagrangian-Eulerian method that maps the interface to a reference configuration. The interfacial deformation is coupled with the fluid and elasticity governing equations into a monolithic solution algorithm using the finite-element library deal.II. Our numerical simulation of a hydrogel drop in sedimentation and shear flow shows that it deforms in ways that differ from that of a viscous drop or elastic particle, and the solvent perfusion can have a significant effect on the hydrogel dynamics.

James Feng
Dept of Math and Chemical and Biological Eng, Univ of British Columbia

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