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A Higher-Order Upwind Method for Viscoelastic Flow in Irregular Geometries ANDY NONAKA, University of California, Davis, DAVID TREBOTICH, Lawrence Livermore National Laboratory, GREG MILLER, University of California, Davis, DAN GRAVES, PHIL COLELLA, Lawrence Berkeley National Laboratory — We present a high-resolution numerical method to capture elastic shear waves in incompressible viscoelastic fluids. The viscoelastic fluid is described by the Oldroyd-B constitutive equation for the polymer stress coupled to the incompressible Navier-Stokes equations. In our approach, we leverage the hyperbolic nature of the equations to make use of higher-order Godunov methods which have been previously used with much success in capturing shocks in compressible flow. The hyperbolic step also utilizes a new exact and efficient Riemann solver. Incompressibility is enforced through a projection method and a special partitioning of variables which leads to proper characteristic properties in the hyperbolic step. An embedded boundary method / volume-of-fluid method allows irregular geometries to be represented on Cartesian grids whereby the boundary cuts regular cells into irregular control volumes requiring special discretization stencils; away from boundaries standard finite differences are used. We demonstrate second-order accuracy for both highly elastic flows of a Maxwell fluid and steady-state flow of an Oldroyd-B fluid in the Newtonian limit.

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