

Semi-Lagrangian discretization of the upper-convective derivative in Non-Newtonian fluid flow

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The simulation of non-Newtonian fluids is a challenging task in computational rheology. The dynamics of the fluid are described by the Navier-Stokes equations. Whereas Newtonian fluids have constant viscosity, in non-Newtonian fluids a variety of models for the viscous terms are available. Viscosity may depend on the shear rate or even on the deformation history. The latter leads to models for the stress-strain rate relation analogous to viscous solids. The Non-Newtonian stresses evolve along particle paths according to an evolution equation. The temporal derivative in this case is the upper convected derivative. We describe a semi-Lagrangian discretization of the upper convected derivative. Numerical results for the flow through a contraction are given.