Finite-Element approximation of viscoelastic flows at large Deborah number

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Scaling assumptions in thin-layer viscoelastic flows show that the elongational rheology is most important at first order. Now, in presence of a free-surface, i.e. assuming the flow incompressible and nearly hydrostatic in Saint-Venant fashion, a *hyperbolic* system of PDEs can effectively be obtained which accounts for non-Newtonian normal stresses [2]. It consists in a non-Newtonian version of the shallow-water equations consistent at main-order with coupled Navier-Stokes/Maxwell equations. Then, as usual for hyperbolic systems, the homogeneous case without source term is of primary importance to build solutions. Here the homogeneous case coincides with the large-Deborah-number limit of the system. We shall discuss the numerical approximation of such limit cases with finite-elements in particular, and draw connections with other well-known difficulties as concerns the numerical simulation of viscoelastic flows [1].

References

[1] J. W. Barrett and S. Boyaval, *Existence and approximation of a (regularized) Oldroyd-B model*, arXiv:0907.4066v1, 2009.

[2] François Bouchut and Sébastien Boyaval, *A new model for shallow viscoelastic fluids*, M3AS **23** (2013), no. 08, 1479–1526.