Applicability of a tensorial artificial diffusion stabilization in numerical simulations of Oldroyd-B type fluids

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The numerical simulation of non-Newtonian viscoelastic fluids flow is a challenging problem. One of the well known problems is the so called High Weissenberg Number Problem, i.e. the instability of the numerical solution for higher values of Weissenberg number. One of the approaches being often adopted in this situation is based on addition of stress diffusion term into the transport equations for viscoelastic stress tensor. There is however also physical, fluid microstructure based argument on addition of such term into the constitutive model. In any case, the additional term affect the solution of the problem and special care should be taken to keep the modified model consistent with the original problem. In this work Applicability of a new tensorial artificial diffusion stabilization was tested. The steady solution is searched by solving an unsteady problem by a time-marching method, where the steady state is recovered for $t \to \infty$, subject to stationary boundary conditions. Instead of the classical addition of artificial stress diffusion term it was used the modified additional term which is only present during the transient phase and should vanish in when approaching the stationary case. The steady solution is not affected by such vanishing artificial term, however the stability of the numerical method is improved.