Étude numérique des écoulements d'un fluide Oldroyd-B dans une géométrie *cross-slot*

et

Numerical study of an Oldroyd-B fluid flow in a *cross-slot* geometry

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Résumé :

Numerical simulations of viscoelastic flows for high elasticity levels can lead to a loss of positive-definiteness of the extra-stress tensor and produce non-physical instabilities in the numerical scheme, known as Hadamard instabilities. This is normally avoided by adding an artificially large stress diffusion in the numerical problem. In order to overcome this issue, Balci *et al.* (JNNFM, 2011) proposed a square-root formulation for the conformation tensor of viscoelastic fluids. This methodology has already been applied to some well-known geometries, resulting in significant gain in terms of accuracy and stability. As pointed out by Cruz *et al.* (JNNFM, 2014) and Souza *et al.* (JNNFM, 2015), in a *cross-slot* arrangement for a viscoelastic fluid, the elastic instabilities are mainly characterized by two different regimes that appear by increasing Weissenberg number: firstly, an asymmetric steady flow and then a time-dependent flow. In this work, the square-root formulation proposed by Balci *et al.* (JNNFM, 2011) is implemented in a finite-volume numerical code (Mompean *et al.*, JNNFM, 1997) and used to simulate the flow of an Oldroyd-B viscoelastic fluid in a planar *cross-slot* geometry. The critical elasticity levels that delineate the transition between each of the flow regimes cited above are identified. These results are validated by comparing them with experimental and previous numerical results, in order to exhibit the benefits of the square-root formulation in this particular geometry.