Analysis of a stabilized finite element method for linearized viscoelastic flows

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ABSTRACT

In the work we present the results obtained from the analysis of a stabilized finite element formulation for the linearized viscoelastic flow equations. The method is based on a term-by-term stabilization of the different terms that may cause instabilities, namely, the pressure interpolation, the stress interpolation and the convective terms of both the momentum and the constitutive equations. The stabilization consists on adding a least-squares form of the orthogonal component of the term to be stabilized. After presenting the method, which is described in [1], we show that it is stable and convergent in a mesh dependent norm. In the case of small Reynolds and Weissenberg numbers, we also prove stability and convergence in natural norms, that is to say, in the norms of the spaces where the unknowns belong. Apart from being a first step towards the analysis of the transient and nonlinear problem, this analysis reveals the effect of the cell Reynolds number and the cell Weissenberg number in the numerical stability and accuracy of the formulation. The results presented are proved in [2].

REFERENCES

[1] Ernesto Castillo and Ramon Codina, Numerical Analysis of a Stabilized Finite Element Approximation for the Three-Field Linearized Viscoelastic Fluid Problem using Arbitrary Interpolations, *Mathematical Modelling and Numerical Analysis*, to appear.

[2] Ernesto Castillo and Ramon Codina, Variational multi-scale stabilized formulations for the stationary three-field incompressible viscoelastic flow problem *Computer Methods in Applied Mechanics and Engineering*, Vol. 279 (2014), 579-605.