A numerical approach to viscoelastic fluid-structure interaction

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ABSTRACT

In this work we review the strategies we have developed to approximate fluid-structure interaction problems in the case in which the fluid is viscoelastic and the solid is hyperelastic [1]. For the flow problem, both the standard and the log-conformation formulations of the viscoelastic constitutive laws are considered. The resulting problem is approximated using a term-by-term stabilised formulation derived from the variational multiscale concept using orthogonal subgrid scales [2,3]. For the solid, the standard Galerkin formulation can be employed if it is not incompressible and the irreducible displacement formulation is employed. However, one may also consider the possibility of having an incompressible elastic solid, case in which mixed interpolations involving the pressure are required [4,5]. The algorithm employed for the coupling between the solid and the fluid is a classical block-iterative scheme, in which the solid and the fluid mechanics problems are solved sequentially. Several numerical examples are presented and discussed to assess the robustness of the proposed scheme and its applicability to problems with viscoelastic fluids in which elasticity is dominant interacting with hyperelastic solids.

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