RECENT PROGRESS ON THE LS-STAG IMMERSED BOUNDARY METHOD FOR THE COMPUTATION OF VISCOELASTIC AND PSEUDO-PLASTIC LIQUIDS

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This communication presents a progress report on an ongoing project aiming at the computation of complex fluid flows with a realistic constitutive law, which would takes into account the pseudoplastic, viscoelastic and thixotropic behaviour of the materials. The flow solver is based on the LS-STAG method, which is an immersed boundary (IB) method that allows the computation of flows in complex geometries on simple Cartesian meshes, reducing thus the bookkeeping of body-fitted methods. One of the distinguished features of our method is to use level-set (LS) techniques for sharply representing the irregular boundary. The LS-STAG method has been validated on canonical Newtonian flows in both fixed and moving geometries [1].

In the AERC 2008 conference and in Ref. [2], we have extended the LS-STAG method to viscoelastic flows, and provided results on a popular benchmark in complex geometries: the four-to-one abrupt planar contraction with rounded re-entrant corners for a wide range of Weissenberg numbers. The next step is now to incorporate the pseudoplastic behaviour in the constitutive equation. According to the recent measurements of the rheological properties of typical yield-stress fluids such as carbopol or xanthan performed in our Group [3], the elastic modulus and the elastic dissipation remains constant under shear. The consequences for constitutive modelling are important. It implies that for a Jeffrey-type model, only the "solvent" viscosity does not depend on the shear, which is exactly the contrary to classical models such as the White-Metzner constitutive law. This new constitutive law will be tested on recent PIV measurements of wide-gap non-coaxial Couette flow of xanthan solutions at various concentrations performed in our group [4].

REFERENCES

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