Smoothed-Particle Hydrodynamics simulations of viscoelastic integral fractional models

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In order to capture specific characteristics of non-Newtonian fluids, during the past years fractional constitutive models have become increasingly popular. Indeed, these models are able to capture in a simple and compact way the complex behaviour of viscoelastic materials, such as the change in power-law relaxation pattern during the relaxation process of some materials[1].

Classical integral viscoelastic models have been already proposed more than thirty years ago[2], however they required to perform complex tasks, such as reconstructing the flow history using Eulerian grid-based, e.g. finite element method, frameworks. Using the Lagrangian Smoothed-Particle Hydrodynamics (SPH) method[3] greatly ease the process, as the flow history is already available and the only passage needed is the computation of a convolution with a specific kernel.

Hence, we develop here a SPH integral viscoelastic method which is first validated for simple Maxwell or Oldroid-B models under Small Amplitude Oscillatory Shear flows (SAOS). The method is then expanded to include fractional constitutive models[4], validating the approach by comparing results with theory and experimental results under SAOS.

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