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Deformations of micro-capsules through channels with corners[1]
LUCA BRANDT, LAILAI ZHU, KTH Mechanics, Linne flow centre — Deformable micro-particles moving in confined geometries are ubiquitous in nature from biological cells to biomedical and industrial applications such as synthetic capsules. Previous studies have demonstrated rich and complex behaviors of capsules and vesicles in the 2D Poiseuille flow, in a duct and in a pipe. Nevertheless, micro-particles commonly need to go through asymmetric geometries, for example a corner. Here we numerically study the dynamics of a Neo-Hookean capsule transported in a 3D channel with a 90 degree straight corner. We use the boundary integral method to solve the Stokes flow, accelerated by the general geometry Ewald method (GGEM) implemented in the framework of the general Navier-Stokes solver NEK5000 based on the spectral element method. A global spectral description utilizing spherical harmonics is incorporated to resolve simultaneously the membrane dynamics. We analyze the trajectory and deformation of the capsule, as well as the variation of area, velocity, principle stress and elastic energy. The influence of the capsule elasticity and wall confinement is also investigated. Finally, the flow in a smooth corner is simulated and compared with the straight counterpart, to provide hints for the design of micro-devices.

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