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Off-plane motion of a non-spherical capsule in simple shear flow

TOSHIHIRO OMORI, TAKUJI ISHIKAWA, YOHSUKE IMAI, TAKAMI YAMAGUCHI, Tohoku University — Dynamics of a capsule and a biological cell in fluid flow is now of great interest in chemical engineering and bioengineering. In this study, we numerically investigated the motion of a spheroid capsule in simple shear flow including a red blood cell type biconcave disk. The membrane of a capsule was modeled by a two-dimensional hyperelastic material, and its large deformation was solved by a finite element method. The motion of internal and external liquids was estimated as a Stokes flow and solved by a boundary element method. The results showed that the orientation of a spheroid capsule is variant under time reversal, though that of a rigid spheroid is invariant. The final orientation of a spheroid capsule over a long time duration tends to converge to a certain direction depending on the shear rate despite initial placement with random orientation. These results can be utilized for a particle alignment technique and form a fundamental basis of the suspension mechanics of capsules and biological cells.

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