Rotation of Non-Spherical Particles in Canonical Flows

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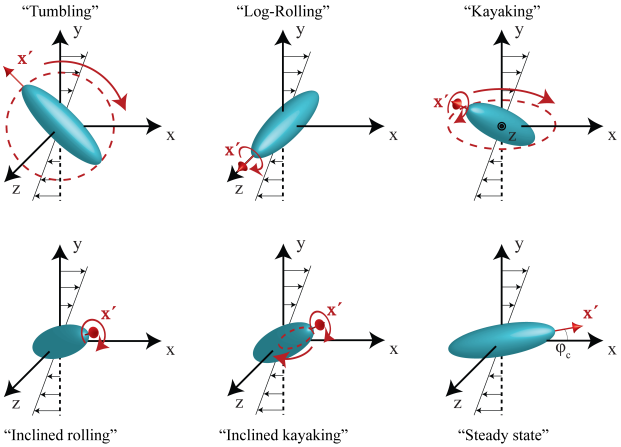

Non-spherical particles occur in many biological, natural and engineering situations. They can be volcanic ash particles, fibres, soot particles or something else. Compared to spherical particles, non-spherical particles present a number of additional complications. One of the most important ones is that the force on the particle becomes a function of the particle orientation and consequently, the orientation has to be modelled.

This project aims at mapping out how non-spherical particles rotate in different flow situations. Initially, single ellipsoids in linear shear flow will be studied. In this case, it is the aspect ratios of the particle and two non-dimensional numbers characterising the dynamics that control the particle rotation. The numbers are the Reynolds and Stokes numbers, quantifying the effects of fluid and (rotary) particle inertia, respectively. These effects have been studied numerically using a lattice Boltzmann method with external boundary forcing. The case of a single prolate spheroid in a linear shear flow has been found to be particularly rich in dynamical states (see figure) and several bifurcations have been observed. Further on, also oblate and tri-axial particles will be considered. Additionally, experiments might be needed to confirm the results.

T. Rosén, F. Lundell, C.K. Aidun, Effect of fluid inertia on the dynamics and scaling of neutrally buoyant particles in shear flow, J. Fluid Mech., 738, 563-590 (2014)