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Path instability of a buoyancy-driven body: a sensitivity analysis to measure the fluid-object coupling JOEL TCHOUFAG, Universite de Toulouse- IMFT, OLIVIER MARQUET, ONERA Meudon, DAVID FABRE, Universite de Toulouse- IMFT, JACQUES MAGNAUDET, CNRS - IMFT — The dynamical path of buoyancy-driven bodies in a viscous fluid is investigated in a linear stability framework. The departure of falling/rising objects from a straight vertical path can be understood by examining the unstable linear global modes of the fully coupled fluid-solid system linearized around the falling/rising steady state. Although this approach offers a quantitative prediction of the various possible trajectories, it raises new questions about the physical interpretation of fully coupled fluid/solid modes. Are the observed trajectories driven by the fluid dynamics, the solid dynamics, or by their coupling? In which flow regions are those dynamics most active? To answer these questions, we present a straightforward adjoint-based-method that can be used to measure the coupling in any problem where reciprocal interactions between two sub-parts of a system take place. This method is exemplified on the case of a two-dimensional falling ellipse. In the particular case of large body-to-fluid inertia ratios, a clear distinction between body-related and wake-induced modes is observed, in line with results predicted by a quasi-static approach.

Joel Tchoufag
Universite de Toulouse- IMFT

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