About the unsteady propulsion of an airfoil

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Unsteady aerodynamic problems have been studied extensively for swimming and fighting animals observed in nature, but also for helicopter rotors, wind turbines or micro air vehicles. For all these topics, the aim is to optimise the propulsive loads and the efficiency of the unsteady effects. In this way, we are interested in unsteady propulsion for sailing boats and, more specifically, for windsurfing.

The competitive practice of sailing and windsurfing is developing. It can be attributed to the willingness to break records, which increases the performance of sailing boats. At the start of a race or in light winds, to get or keep the board in foiling mode, for example after a tack change, athletes use intermittent propulsion by pumping the sail, i.e. periodically changing the angle of incidence of the sail relative to the wind. The flapping motion of the sail, and more generally of a foil, destabilises the flow and generates a flow dominated by a vortex alley in its wake. Depending on the flapping parameters, different types of wake are possible. Some even allow the generation of a thrust. At the very least, they all influence the aerodynamic forces acting on the wing [1]. We experimentally characterise the aerodynamics of the sail and its propensity to generate thrust for the boat.

Our aim is to compare the sailing (C_{drive}, C_{drift}) and aerodynamic (C_{drag}, C_{lift}) coefficients between a static and an oscillating sail [2]. We have obtained data on the forces acting on the foil using force sensors.

Références

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2. R.R. Schutt, (2019) Unsteady aerodynamics of sailing maneuvers and kinetic techniques, *, PhD Thesis*, Cornell University, p.57, 70.