Unsteady propulsion : Application to windsurfing

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The competitive practice of sailing and windsurfing is evolving. It may be assigned to the willingness to break the records increasing the performances of the sailing boats. Thus, the development of new platforms using hydrofoils, capable of providing lift, is replacing the use of the so-called "classic" windsurf that relies only on buoyancy. Among these innovations are the new "iQFoil" class of windsurf which will be used in the next Olympic Games.

The interest of using a foil, and the passage from an Archimedean boat to a dynamically supported boat, is to obtain a considerable increase of speed during sail races. An unsteady maneuver called "pumping" is essential [1]. For windsurfers, pumping consists in a periodic pitching of the sail with a certain kinematics and seems to be an efficient contribution to the propulsive force under certain wind conditions. It is used a lot in the beginning of the race to accelerate and after tack changes to stabilize the boat in flight mode. Understanding the details of the functioning of boats is complex like on a sailing yacht [2] and requires some measurements even more so difficult to do during navigation in a windsurf boat because of its size. It is a complex mechanical structure with deformation associating the mast, the sail and the battens that stiffen it, but also geometrically complex by the camber and the helical torsion of the sail. It has a fairly clear analogy with insect wings [3]. Here we investigate a simplified model of a pumping sail in a wind-wall open aerodynamic tunnel.

Figure 1. Chronophotography from top-left to bottom-right of a windsurfer during one oscillation period of a pumping phase.

Références

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