Master thesis project

High-performance sailing: Fluid Structure Interaction of hydrofoils

Background:

With the advent of foiling in the America's Cup in 2013 and the subsequent interest in foiling, the future of high-performance sailing is pending toward a large portion of foiling boats being sailed and built. The use of composite manufacturing and light-weight structures implies that significant deformations of the hydrofoils are present in all sailing scenarios, leaving the designers to investigate not only the hydrodynamic forces from the shape of the foil, but also its Fluid Structure Interaction (FSI) behaviour. The deflection and twists of the hydrofoils under fluid loads will ultimately affect the stability of the whole boat with implications in the overall speed and crew-safety.

Objective:

Understanding the effects of hydrofoil deformations on high-performance sailing boats.

Methodology:

In this project we will study the effects of structural deformation on hydrofoils subject to real-life sailing loads. The complexity of FSI effects will be broken down between the two master students to allow for a structural study of the hydrofoil as well as the hydrodynamics of the hydrofoil. STAR-CCM+ will be employed as the fluid solver and ABAQUS will be used for the structural analysis. Whilst building the confidence of numerical modelling from an initial investigation of a 2-dimensional NACA2412 to a more complex 3-dimensional hydrofoil, the students will understand the effects of tip deformations on the stability of the sailing boats.

Miscellaneous:

The project starts January 2021. The supervisory team composed of Arash Eslamdoost and Laura Marimon Giovannetti will provide some real-sailing scenarios and loading cases with the expertise from Laura of high-performance sailing both from an engineering and from a sailing perspective.

Prerequisites:

Background in Mechanical Engineering, Naval Architecture, or similar
Knowledge and interest in computational fluid dynamics as well as structural analysis
Sailing background is recommended but not necessary

Contact

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Figure 1: Hydrofoil subject to an extreme sailing load.

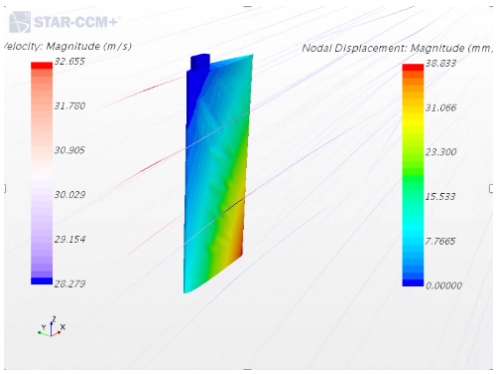

Figure 2: Aerofoil subject to wind tunnel loading and its ultimate deformation.