

# Computational Fluid Dynamics in Sailing Research

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In 2015 Chalmers University of Technology became a National Sports University. Sports research was therefore encouraged, and the emphasis was placed on three sports: equestrian, swimming and sailing. The present talk will present some highlights of the sailing research, which had been underway for many years, albeit with a smaller effort. At present, the sailing research is organized in Chalmers Yacht Research Unit, CYRU ([www.chalmers.se/CYRU](http://www.chalmers.se/CYRU)).

The physics of a sailing yacht in a seaway is extremely complex. It includes unsteady hydro- and aerodynamics, rigid body motions in 6 DOFs, moving center of gravity, rudder control and fluid-structure interaction, especially for the sails. The ultimate goal of the research at Chalmers is to develop a numerical technique based on CFD that can handle this complex situation. The first version of this technique, named CVPP (CFD-based Velocity Prediction Program) will be presented. A commercial flow solver is monitored by an external Java script that determines the inflow to the domain and the rudder motions. For a given wind speed and direction a guessed initial state of the boat is advanced in time until steady state equilibrium is achieved in all six DOFs.

Apart from the CVPP developments research is carried out in two areas: development of boats/equipment and sailing techniques. Why have modern sailing yachts so wide sterns? The physics of transom stern flows is investigated to explore the optimum transom size and shape at different Froude numbers. What is the best bow shape beating upwind in a seaway? Numerical and experimental studies will be presented for three bow shapes with U, V and intermediate sections in several wave lengths. FSI is used to explore the possibility of twisting the centerboard of the Olympic 470 dinghy to windward under load, and the possible gains are reported. Sailing techniques will be presented for the Olympic Laser. What is the optimum position of the sailor in upwind sailing, i.e. what is the best trim and heel in different wind speeds, considering the resistance of the hull/appendages and the effect on the aerodynamic forces? These are examples of the research at Chalmers Yacht Research Unit, and will be presented at the Symposium.