

Optimizing Wing Sails with Actuator Line Simulations and an Effective Angle of Attack Controller

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ABSTRACT

This paper presents two ways to simplify the optimization of the angle of attack of multiple wing sails: the actuator line method and an effective angle-of-attack controller. The actuator line method reduces the computational time compared to full CFD, while capturing interaction effects between sails and the rest of the ship. The effective angle of attack controller adjusts sail orientation based on local flow measurements, as an alternative to a full optimization procedure. The rationale for this controller is based on the observation that the optimal angle of attack is usually the one that maximizes the lift. This combined approach enables practical optimization of multi-sail wind propulsion systems. Case study results on a 200-meter bulk carrier demonstrate significant sail-ship interaction effects, with optimal orientations differing substantially from those predicted by isolated sail models.