Aerodynamic design of the tunnel section of a high speed catamaran using RANS CFD coupled with evolutionary optimisation.

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ABSTRACT

Optimising the performance of a high speed catamaran for applications such as XCAT racing is a complex task. Drag tends to be dominated by hydrodynamics but the overall craft dynamic performance at high speed is also dictated by aerodynamic loads across the craft body and, in particular, through the catamaran's tunnel. This paper will present the results of an optimisation study exploring optimal aerodynamic design of the tunnel section of a high speed catamaran. The aerodynamic optimisation was focussed on lift maximisation within the tunnel in order to raise the running line of the catamaran thus minimising hydrodynamic drag. Reynolds-averaged Navier-Stokes CFD methods using the finite volume method applied to unstructured meshes [1] was used to assess the aerodynamic performance of varying tunnel designs using a standard XCAT geometry as a starting point. A Modified Cuckoo Search [2] evolutionary optimisation algorithm was then used to evolve the catamaran tunnel design to maximise aerodynamic lift using a mesh-based parameterisation approach [3]. The pre-optimisation and post-optimisation performance of the catamaran is then considered taking into account both aerodynamic and hydrodynamic loading. Hydrodynamic simulations were carried out using a lattice Boltzmann approach with free surface modelling implementation [4].

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