Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

New approaches to the design optimization of hydrofoils POORIYA BEYHAGHI, GIANLUCA MENEGHELLO, THOMAS BEWLEY, University of California San Diego — Two simulation-based approaches are developed to optimize the design of hydrofoils for foiling catamarans, with the objective of maximizing efficiency (lift/drag). In the first, a simple hydrofoil model based on the vortex-lattice method is coupled with a hybrid global and local optimization algorithm that combines our Delaunay-based optimization algorithm with a Generalized Pattern Search. This optimization procedure is compared with the classical Newton-based optimization method. The accuracy of the vortex-lattice simulation of the optimized design is compared with a more accurate and computationally expensive LES-based simulation. In the second approach, the (expensive) LES model of the flow is used directly during the optimization. A modified Delaunay-based optimization algorithm is used to maximize the efficiency of the optimization, which measures a finite-time averaged approximation of the infinite-time averaged value of an ergodic and stationary process. Since the optimization algorithm takes into account the uncertainty of the finite-time averaged approximation of the infinite-time averaged statistic of interest, the total computational time of the optimization algorithm is significantly reduced. Results from the two different approaches are compared.

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Date submitted: 27 Jul 2015 Electronic form version 1.4