Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Optimization of energy harvesting efficiency of an oscillating hydrofoil: Sinusoidal and Non-sinusoidal trajectories MICHAEL MILLER, BEN STROM, KENNETH BREUER, SHREYAS MANDRE, Brown University — We determine the feasibility of applying optimization algorithms to an oscillating hydrofoil's motion trajectory to determine maximum efficiency of energy capture. Optimization is performed using the Nelder-Meade downhill simplex method. The objective function is the energy captured measured experimentally in run-time with an oscillating hydrofoil capable of measuring mechanical energy capture in a laboratory flume. For sinusoidal trajectories, optimization is performed over pitch and heave amplitudes as well as frequency; this system is shown to be capable of optimization in run-time. The optimum efficiency of 30% is found for a pitch amplitude of 70°, a heave amplitude of 0.8*chord and a dimensionless frequency of 0.13. To treat non-sinusoidal trajectories, we expand them in a truncated Fourier series and consider the coefficients of this series as variables for optimization. The sinusoidal case is simply an extreme case of such a truncated Fourier series, with only one term in the series retained. We present a systematic method for optimization over general non-sinusoidal trajectories by including more and more terms in the Fourier series.

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Date submitted: 01 Aug 2014 Electronic form version 1.4