Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Numerical Simulation of the Dynamic FSI Response and Stability of a Flapping Foil in a Dense Fluid EUN JUNG CHAE, DENIZ TOLGA AKCABAY, YIN LU YOUNG, Department of Naval Architecture and Marine Engineering in University of Michigan — To advance the understanding of fish locomotion, improve the design biological devices or marine propulsions or turbines, or to explore innovative ocean energy harvesting ideas, it is important to be able accurately predict the dynamic fluid structure interaction (FSI) response and stability of flexible structures in a dense fluid. The objectives of this research are to (1) present an efficient and stable algorithm for numerical modeling of the dynamic FSI response and stability of a flapping foil in dense fluid, and (2) investigate the influence of fluid-to-solid density ratio on the FSI response and stability of a flapping foil. The numerical model involves coupling an unsteady RANS solver with a 2DOF structural model using a new hybrid coupling approach. The results show that the new hybrid coupling approach converge much faster than traditional loosely and tightly coupled approaches, and is able to avoid numerical instability issues due to virtual added mass effects for light, flexible structures in incompressible flow. The influence of density ratio on the FSI response, divergence and flutter speeds are presented, along with comparisons between viscous and inviscid FSI computations.

Eun Jung Chae
Department of Naval Architecture and
Marine Engineering in University of Michigan

Date submitted: 10 Aug 2012 Electronic form version 1.4