Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

The Hydroelastic Response of a Flexible Surface-Piercing Strut in Wetted, Ventilated, and Cavitating Flows[1] CASEY HARWOOD, JACOB WARD, YIN LU YOUNG, University of Michigan, MARIO FELLI, MASSIMO FALCHI, CNR INSEAN, STEVEN CECCIO, University of Michigan — High-speed and highly loaded lifting surfaces are prone to ventilation and cavitation. Increasing use of compliant materials (e.g. composites) in such systems necessitates a better understanding of the fluid-structure interactions of lifting surfaces in multiphase flow. Experiments on a flexible surface-piercing hydrofoil have been performed in a towing tank and a free-surface cavitation tunnel. The objectives are (i) to demonstrate the effects of material compliance upon hydrodynamic performance and stability of multiphase flow regimes, and (ii) to quantify the effects of multiphase flow upon the structural response and hydroelastic stability of flexible lifting bodies. A non-optical shape-sensing method is developed, which permits 3D bending and twisting deformations of the hydrofoil to be accurately inferred. The effects of the foil's compliance on hydrodynamic loads, structural motions and flow regimes are discussed. Partial immersion of the hydrofoil causes a mode-dependent change in added-mass that can encourage coalescence of higher modes. At the same time, increasing flow speed and ventilated flow decrease the damping associated with certain modes. Unsteady cavity shedding modulates the system parameters, causing a broadening of the frequency response.

[1]The authors would like to acknowledge the support of Dr. Ki-Han Kim under ONR grant number N00014-13-1-0383 and N00014-16-1-2433.

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Date submitted: 01 Aug 2016 Electronic form version 1.4