Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Global modes and nonlinear simulations of inverted flag flapping[1]

ANDRES GOZA, TIM COLONIUS, California Institute of Technology, JOHN SADER, University of Melbourne, California Institute of Technology — Inverted flag flapping, in which the flag is clamped at its trailing edge with respect to the oncoming flow, is capable of undergoing substantially larger-amplitude flapping than in the conventional configuration, where the flag is pinned or clamped at its leading edge. The associated increase in bending makes the inverted flag system a promising candidate for energy harvesting technologies that convert strain energy to electricity using, *e.g.* piezoelectric materials. Because of this potential, recent studies have sought to investigate the response of the inverted flag system for a range of physical parameters. Of particular interest for this study, vortex shedding has been associated with large-amplitude flapping, and Sader *et al.* (2016) showed that flapping possesses many features of a vortex-induced vibration (VIV) for a range of physical parameters. In this talk, we use a global mode analysis and nonlinear simulations to identify the mechanisms that initiate flapping. VIV is confirmed for a range of flow/flag parameters, and is shown to be initiated by an inherent instability in the deflected flag's equilibrium. Moreover, it is shown that non-VIV flapping is possible under a certain parameter space. This is yet to be observed experimentally.

[1]We gratefully acknowledge funding through AFOSR (grant FA9550-14-1-0328) and Bosch

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Date submitted: 29 Jul 2017 Electronic form version 1.4