Abstract Submitted for the DFD12 Meeting of The American Physical Society

Unsteady Lift Response and Energy Extraction in Gusting Flows JEESOON CHOI, TIM COLONIUS, California Institute of Technology, DAVID WILLIAMS, Illinois Institute of Technology — The unsteady aerodynamic forces associated with streamwise (surging) and transverse (plunging) oscillating motions are studied to understand the dynamic response to gusts and the potential for energy extraction. We focus on 2D thin airfoils at low sub- and super-critical Reynolds number so that the role of wake instability can be isolated. Simulations are performed in a large parameter space of angle of attack, reduced frequency, and oscillation amplitude. At low angle of attack, the magnitude and phase of the fluctuating lift are in reasonable agreement with classical theory at all reduced frequencies. In this case, the quasi-steady force is modified by contributions from shed vorticity at the trailing edge and added-mass at high reduced frequency. At high angle of attack, the fluctuating forces are found to be enhanced or attenuated by a leading-edge vortex, depending on the reduced frequency. Resonance with the wake instability is also investigated.

Jeesoon Choi California Institute of Technology

Date submitted: 03 Aug 2012

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