Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Energy Harvesting of a Flapping Airfoil in a Vortical Wake Z. CHARLIE ZHENG, University of Kansas, ZHENGLUN WEI, Georgia Institute of Technology — We study the response of a two-dimensional flapping airfoil in the wake downstream of an oscillating D-shape cylinder. The airfoil has either heaving or pitching motions. The leading edge vortex (LEV) and trailing edge vortex (TEV) of the airfoil play important roles in energy harvesting. Two major interaction modes between the airfoil and incoming vortices, the suppressing mode and the reinforcing mode, are identified. However, distinctions exist between the heaving and pitching motion in terms of their contributions to the interaction modes and the efficiency of the energy extraction. A potential theory and the related fluid dynamics analysis are developed to analytically demonstrate that the topology of the incoming vortices corresponding to the airfoil is the primary factor that determines the interaction modes. Finally, the trade-off between the input and the output is discussed. It is found that appropriate operational parameters for the heaving motion are preferable in order to preserve acceptable input power for energy harvesters, while appropriate parameters for the pitching motion are essential to achieve decent output power.

Z. Charlie Zheng
University of Kansas

Date submitted: 29 Jul 2014 Electronic form version 1.4