Abstract Submitted for the DFD20 Meeting of The American Physical Society

Cyber-Physical Approach to a Self-Propelled Flapping Airfoil¹ JAY YOUNG, JAMES LUO, CHK WILLIAMSON, Cornell University — Traditional flapping airfoil studies tether the airfoil in place and fix the imposed freestream velocity. However, this approach does not accurately reflect practical conditions in which the propulsor would be free to accelerate if thrust is generated. Using the Cyber-Physical Fluid Dynamics (CPFD) Facility (Mackowski & Williamson 2011), a closed-loop force-feedback system, we study a flapping airfoil undergoing selfpropulsion. The airfoil freely accelerates from rest until an equilibrium cruising velocity is achieved wherein the net thrust and drag forces are balanced. We explore the optimal combination of heave and pitch amplitudes to minimize energy expenditure for a given cruising velocity and examine the underlying vortex dynamics that generate efficient propulsion. With CPFD, the airfoil accelerates in response to the net thrust generated. We study the vortex dynamics giving rise to the unsteady aerodynamics of the self-propelled airfoil.

¹This material is based upon work supported by the NSF Fellowship, GRFP under Grant No. DGE-1650441 and the AFOSR Grant No. FA9550-19-1-0142, monitored by Dr. Gregg Abate.

Jay Young Cornell University

Date submitted: 03 Aug 2020

Electronic form version 1.4