Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Prescribed surface deformation on low Re airfoil: Spatio-temporal variation of flow field and resulting aerodynamic performance ERNOLD THOMPSON, ANDRES GOZA, University of Illinois at Urbana-Champaign — The need for more maneuverable and disturbance-robust craft has driven investigations into flow control on canonical aerodynamic bodies. Our focus is on control strategies which employ surface deformation for aerodynamic benefit. We perform high-fidelity simulations at a Reynolds number of 1000 of a stationary NACA0012 airfoil with traveling waves prescribed along its suction surface. We quantify the effect of wavenumber and wavespeed of these prescribed surface motions on aerodynamic performance, and explain aerodynamically beneficial parameters in terms of their spatio-temporal impact on the pressure field and the formation and interaction of key vortical structures. To systematically build in problem complexity, we first consider a steady-flow case with the airfoil at an angle of attack of 5 degrees. We then incorporate surface deformations into an unsteady flow scenario, with the airfoil at an angle of attack of 15 degrees. In this unsteady setting, we highlight three separate behavioral regimes and explain their impact on aerodynamic performance by the way they interact with the underlying vortex shedding processes associated with the baseline (unactuated) case.

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Date submitted: 03 Aug 2020 Electronic form version 1.4