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Vortex-Induced Vibrations of a Flexibly-Mounted Cyber-Physical Rectangular Plate[1] KYOHEI ONOUE, BENJAMIN STROM, ARNOLD SONG, KENNETH BREUER, Brown University — We have developed a cyber-physical system to explore the vortex-induced vibration (VIV) behavior of a flat plate mounted on a virtual spring damper support. The plate is allowed to oscillate about its mid-chord and the measured angular position, velocity, and torque are used as inputs to a feedback control system that provides a restoring torque and can simulate a wide range of structural dynamic behavior. A series of experiments were carried out using different sized plates, and over a range of freestream velocities, equilibrium angles of attack, and simulated stiffness and damping. We observe a synchronization phenomenon over a wide range of parameter space, wherein the plate oscillates at moderate to large amplitude with a frequency dictated by the natural structural frequency of the system. Additionally, the existence of bistable states is reflected in the hysteretic response of the system. The cyber-physical damping extracts energy from the flow and the efficiency of this harvesting mechanism is characterized over a range of dimensionless stiffness and damping parameters.

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Kyohei Onoue
Brown University

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