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Vortex induced motion in compliant structures ARNOLD SONG, MAX TUTTMAN, KENNETH BREUER, Brown University — The coupling of the unsteady shedding of vortices from the leading and trailing edges of a flat plate can lead to large scale oscillations of a structure. Examples of these large motions abound in engineered structures (Traffic signs vibrating in the wind, wing flutter, chattering venetian blinds, etc.) and in nature (the rustling of leaves on a tree in the wind). In all of these examples, the efficiency of energy extraction from the flow to the structure increases dramatically as the vortex shedding and structural vibrations near resonance. As the motion becomes more exaggerated, the fluid-structure interaction becomes increasingly nonlinear as the motion of the plate becomes increasingly important to the vortex shedding dynamics. We present experimental results from two related systems tested in a low speed wind tunnel (using high-speed videography, PIV and hotwire anemometry) (i) a rectangular cantilevered flat plate free to bend and twist, and (ii) a flexible ribbon pinned at its two ends and exposed to the flow. In both systems, a rich phase map of vortex-induced vibrations is described in which both mechanisms for vortex shedding and structural vibration can be tuned independently using geometry, material properties and flow conditions.

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