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**Nonlinear Stability Characteristics of an Elastically Mounted Pitching Wing**[1] YUANHANG ZHU, YUNXING SU, KENNETH BREUER, Brown University — We study the nonlinear stability boundaries of an elastically mounted pitching wing in a water flume, with the wing structural dynamics (inertia $I$, stiffness $k$, damping $b$) simulated using a cyber-physical system. We fix $b$ to be small and systematically vary $k$ at different $I$ to test for the onset and extinction of self-sustained oscillations. We find that when $I$ is large, the system bifurcates from a fixed point to small-amplitude oscillations followed by large-amplitude limit cycle oscillations via a subcritical bifurcation, which features hysteretic bistability and an abrupt amplitude jump at the bifurcation. At this $I$, the wing pitching frequency $f_p$ locks onto its structural frequency $f_s$, indicating dominating structural force. Force and PIV measurements reveal the emergence of a secondary leading edge vortex (LEV) after the shedding of the primary LEV. As $I$ decreases, the width of the bistability region shrinks. When $I$ is sufficiently low, the pitching amplitude changes gradually with $k$ without hysteresis, revealing a supercritical bifurcation. At this $I$, $f_p$ is relatively constant and lower than $f_s$, indicating dominating fluid force. The secondary LEV is not present. We also report the effect of sweep angles on the stability boundaries.

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