Abstract Submitted
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Unsteady pitching flat plates KENNETH GRANLUND, MICHAEL OL, Air Force Research Laboratory, LUIS BERNAL, University of Michigan — Direct force measurements and qualitative flow visualization were used to compare flowfield evolution vs. lift and drag for a nominally 2D rigid flat plate executing smoothed linear pitch ramp maneuvers in a water tunnel. Non-dimensional pitch rate was varied from 0.01 to 0.5, incidence angle from 0 to 90 degrees, and pitch pivot point from the leading to the trailing edge. For low pitch rates, the main unsteady effect is delay of stall beyond the steady incidence angle. Shifting the time-base to account for different pivot points leads to collapse of both lift/drag history and flowfield history. For higher rates, a leading edge vortex forms; its history also depends on pitch pivot point, but linear shift in time-base is not successful in collapsing lift/drag history. Instead, a phenomenological algebraic relation, valid at the higher pitch-rates, accounts for lift and drag for different rates and pivot points, through at least 45 degree incidence angle.

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