Abstract Submitted
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Experimental investigation of the flow and pressure fields around a harmonically pitching airfoil.[1] JIBU JOSE, SUBHRA SHANKHA KOLEY, CHRISTOPHER WILLIAMS, AYUSH SARASWAT, JIN WANG, JOSEPH KATZ, Johns Hopkins University — Experimental studies of aeroelastic flutter use pitching and heaving foils to characterize the complex flow response to coupled bending and torsion. The current study examines the flow around a harmonically pitching, 50mm chordlength, 189 mm span, modified NACA 0015 hydrofoil oscillating at a frequency of 2.7Hz between 5^o and 20^o incidence. At a freestream velocity of 1 m/s, the Reynolds number is 50,000. The time-resolved stereo-PIV measurements are performed in a refractive index-matched water tunnel, where the refractive index of the acrylic foil is matched with that of the liquid. Data is recorded in the mid span at 1250 frames/s, providing 463 vector maps per cycle. Assuming a 2D flow, the time resolved data is used for calculating the distribution of material acceleration, which is then integrated spatially to determine the pressure distribution. Having the data recorded on both sides simultaneously enables calculation of the lift, pitching moments, and load distribution. Results show that phase lags in the development of the separated region on the suction side create very different flow structures and load distributions during upstroke and downstroke at the same angle both in instantaneous realizations and phase averaged flows.

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