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Unsteady Vortex Structures in the Wake of a Piezoelectric Flapping Wing[1] LUCAS CLEMONS, HIROFUMI IGARASHI, HUI HU, Aerospace Engineering Dept., Iowa State University — An experimental study was conducted to characterize the behavior of Unsteady Vortex Structures in the Wake of a piezoelectric flapping wing with miniaturized size (about 10mm in chord length), large flapping amplitude (up to 2.0 times of chord length) and high flapping frequency (60Hz) to explore the potential application of piezofans as the compact, gearless flapping-wings for the development of novel piezoelectric-flapping-wing-based Nano-Air-Vehicles (NAVs). The experimental investigation was performed in a low-speed wind tunnel. A digital particle image velocimetry (PIV) system was used to achieve phased-locked flow field measurements to quantify the transient behavior of the unsteady vortex structures in wake of the piezoelectric flapping wing. The effects of important parameters such as incoming flow velocity (i.e., forward flight speed), the flapping amplitude, and the incline angle of the flapping wing in relation to the incoming flow direction (i.e. the angle of attack) on the wake vortex shedding processes were examined to elucidate underlying physics in order to explore/optimize design paradigms for the development of novel piezoelectric-flapping-wing-based NAVs.

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