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Coupled Fluid and Structure Measurements over a Low Aspect Ratio Membrane Wing LAWRENCE UKEILEY, MANUEL ARCE, AMORY TIMPE, University of Florida, ZHENG ZHANG, JAMES HUBNER, University of Alabama — The coupled effect of flow induced membrane deformations and their return influence on the flow are investigated on an aspect ratio 2 thin wing. The wings have multiple cells with a free scalloped trailing edge and are made by adhering heated, thin Silicone membranes to thin rectangular aluminum frames with a rigid leading edge and battens. Time-resolved flow and structure deformations are measured by synchronized acquisition of high-speed two-component particle image velocimetry (PIV) and stereoscopic digital image correlation (DIC) at a chord based Reynolds number of 48,000 and several angles of attack. Flow and structure metrics are compared for membrane with different values of pretension in the rubber. Instantaneous flow fields and mean flow properties are analyzed and compared to a rigid plate of the same dimensions. Specifically, the effects of membrane behavior on flow separation, shear layer size and location, along with vorticity will be analyzed. Power spectral density and correlation techniques are utilized, along with analysis of membrane mean deformation and rms fluctuation behavior to better understand the fluid-structure interactions and how the membranes interact with each other.

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