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Fluid and Structure Dynamics of Flow over a Membrane Wing
AMORY TIMPE, LAWRENCE UKEILEY, University of Florida — The coupled effect of flow induced membrane deformations and their return influence on the flow are investigated. Multi-cell wings are made by adhering heated, thin Silicone membranes to 2.7 percent thick, rectangular aluminum frames with 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). Mean and instantaneous effects are studied at a chord based Reynolds number of 48,000, while metrics are compared for membrane cell size of aspect ratio 1 and 0.5. Two PIV measurement fields of view are employed to study flow over the membrane surface as well as that of the near wake. Power spectral density and correlation techniques will be utilized, along with analysis of membrane mean deformation and rms fluctuation behavior to better understand the fluid-structure interactions. The effects of membrane behavior on flow separation, shear layer size and location, along with vorticity will be analyzed in comparison to flow over a similar geometry flat plate.

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