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An Alternative Nondimensional Vibration Frequency for Spanwise Tensioned Membranes in Low Re Flow ZHENG ZHANG, ANDREW WRIST, JAMES P. HUBNER, University of Alabama, LAWRENCE UKEILEY, University of Florida — For the fixed flexible membrane wing at low Reynolds number (Re $<$ 100,000), the membrane vibration interacts with the separated shear layer emanating from the leading edge, increasing the momentum transfer and reducing the flow separation. This investigation proposes an alternative vibration frequency scaling for the membrane wing. Compared to the traditional Strouhal scaling, the proposed nondimensional vibration frequency combines effects of the aerodynamically-induced tension, applied tension and membrane properties. A simplified aerodynamically-induced strain model is introduced through assuming uniform aerodynamic loading on the membrane. To verify the vibration frequency scaling and the accuracy of the aero-strain model, high-speed deformation measurement and force measurement of two-dimensional free leading- and trailing- edge membrane wings are performed in the low speed wind tunnel at Re $\sim$ 50,000. The preliminary data show that the proposed scaling is more appropriate than Strouhal scaling when the flow was driven by the membrane motion but not the shedding vortex.

Zheng Zhang
University of Alabama

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