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Investigating Separated Shear Layer Development over an Airfoil with an Imbedded Microphone Array SERHIY YARUSEVYCH, RYAN GERAKOPULOS, University of Waterloo — At low Reynolds numbers, laminar boundary layer separation on an airfoil often leads to deterioration in airfoil performance and noise emissions. The development of a separated shear layer is governed by laminar to turbulent transition, involving formation of coherent structures. This study highlights the design of a time-resolved surface pressure measurement system capable of estimating salient flow characteristics based on the analysis of surface pressure fluctuations. Wind tunnel experiments were performed for a symmetric NACA 0018 aluminum airfoil model equipped with a total of 95 static pressure taps and 24 microphones. Tests were performed for a range of angles of attack and Reynolds numbers to investigate two flow regimes common to airfoils operating at low Reynolds numbers, namely, flow separation without subsequent reattachment and separation bubble. Experimental results show that the microphones can be utilized to estimate the extent of the separation region and study the development of flow disturbances in the separated shear layer. Using hot wire measurements for validation, it is demonstrated that the microphones can detect the frequency signature of disturbances amplified in the separated shear layer. Further statistical analysis is employed to estimate such important characteristics of the disturbances and coherent structures as spanwise correlation, propagation speed, and phase.

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