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On the Origin of Secondary Tones in Trailing-Edge Noise at Moderate Reynolds Number Flows[1] TULIO RICCIARDI, WILLIAM WOLF, University of Campinas — Direct numerical simulations are carried out to investigate the flow features responsible for secondary tones arising in trailing-edge noise at moderate Reynolds numbers. Simulations are performed for a NACA 0012 airfoil at freestream Mach number 0.3 at different angles of incidence. The Reynolds number based on the airfoil chord is fixed at $Re = 10^5$. Flow configurations are investigated where scattering of boundary layer instabilities lead to tonal noise generation including equidistant secondary tones. Despite the geometric symmetry at zero deg. incidence, the flows become non-symmetric with a separation bubble only on one side of the airfoil. A separation bubble is also observed for the non-zero incidence flow. It is shown that low-frequency motion of the separation bubbles induces a frequency modulation of flow instabilities developed along the airfoil boundary layer. When the airfoil is at zero deg. angle of attack intense amplitude modulation and intermittency are also observed in the flow quantities, resulting in a complex vortex interaction mechanism at the trailing edge. Both amplitude and frequency modulations directly affect the velocity and pressure fluctuations that are scattered at the trailing edge, what leads to secondary tones in the acoustic radiation.

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