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Effect of Oscillatory Plunging Motion on Airfoil Boundary Layer and Wake Behavior[1] MARK AGATE, JESSE LITTLE, Department of Aerospace and Mechanical Engineering, The University of Arizona, ANDREAS GROSS, New Mexico State University, HERMANN FASEL, Department of Aerospace and Mechanical Engineering, The University of Arizona — The effects of small amplitude ($0.030 < A/c < 0.048$) high frequency ($0.61 < \pi fc/U_\infty < 0.70$) plunging motion of the X-56A airfoil are examined at Re=200,000 for three angles of attack. Two angles of attack were chosen at pre-stall conditions and one angle of attack was selected to study post-stall effects. Static stall of the airfoil is 12.25° and the examined angles are 10°, 12°, and 14°. The purpose of this research is to examine the aerodynamic influence of structural motion when the wing is vibrating close to its eigenfrequency near static stall. The aerodynamic characteristics generated by the plunging motion are considered with specific focus on the laminar separation bubble near the leading edge. For the cases examined, the static lift is greatly exceeded. At the plunging case of 10° angle of attack, experimental results are very similar to those obtained from Theodorsen's Theory. For the 12° plunging case, lift exceeds that predicted by Theodorsen's Theory and the leading edge bubble bursts during the oscillation cycle. At the static stall condition of 14°, plunging periodically reattaches the flow and the bubble bursting is much more significant.

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