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Low Reynolds Number Flow Dynamics of a Thin, Flat Airfoil with Elastically Mounted Leading Edge Actuator[1] SOURABH APTE, Oregon State University — Direct numerical simulations are performed to investigate the effect of an elastically mounted leading edge actuator on the unsteady flow at high angles of attack over a flat, thin airfoil at Reynolds number of 14700 based on the chord length. The leading edge actuator is mounted with a torsion spring at one-third the chord length allowing dynamic variations in the effective angle of attack through flow-induced oscillations. The goal is to investigate potential benefits of flow induced flapping motion of the leading edge actuator to the lift and drag characteristics of thin airfoils. The structural model for the rigid actuator is based on a torsional spring-mounted compound pendulum. A fictitious-domain based finite volume approach [(Apte et al. (JCP 2009)] is used to compute this fluid-structure interaction problem on a fixed background mesh. It is shown that a lock-in region leading to limit cycle oscillations of the leading edge actuator can be achieved for certain spring parameters leading to improvements in mean lift-to-drag ratio.

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