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Towards Mission Adaptability of Small UAVs: A Leading-Edge Alula-Inspired Device (LEAD) DIAA ZEKRY, SHYUAN CHENG, LEONARDO CHAMORRO, AIMY WISSA, University of Illinois at Urbana-Champaign — The Leading-Edge Alula-Inspired Device (LEAD) is a bioinspired flow control device developed based on the alula feather structure on a bird wing. In bird flight, the alula only deploys during complex maneuvers such as take-off, landing, and perching. On an engineered wing, the addition of an alula-inspired device, such as the LEAD, enhances lift and mitigates stall at high angles of attack. Here, we explore an alula-inspired leading-edge device installed on a high-lift airfoil and a moderate aspect ratio wing. Wind tunnel experiments are conducted at post-stall and deep-stall angles of at Reynolds numbers of 100,000. Experimental results including integrated force measurements and hotwire anemometry, and PIV are discussed. We examine the distinct effects of the geometric parameters of a LEAD on the aerodynamic performance of both an airfoil and an finite wing. Results show that these lift improvements are more sensitive to the LEAD relative angle of attack and root location than to the LEAD tip deflection angle. The LEAD affects the airflow in two fundamental ways. First, it increases the capability of the wing to maintain higher pressure gradients by modifying the near-wall flow close to the leading-edge. Second, it generates tip vortices that modify the structure of the turbulence on the upper-surface of the wing, delaying flow separation

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