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**Vortical Flow Structures in the Near-Wake of a Heaving Airfoil with Passively Actuated Leading and Trailing Flaps.**[1] FIRAS SIALA, ALEXANDER TOTPAL, JAMES LIBURDY, Oregon State University — The flow physics of flying animals has recently received significant attention, mostly in the context of developing bio-inspired micro air vehicles and oscillating flow energy harvesters. Of particular interest is the understanding of the impact of airfoil flexibility on the flow physics. Research efforts showed that some degree of surface flexibility enhanced the strength and size of the leading edge vortex. In this study, the influence of flexibility on the near-wake dynamics and flow structures is investigated using 2D PIV measurements. The experiments are conducted in a wind tunnel at a Reynolds number of 30,000 and a range of reduced frequencies from 0.09 to 0.2. The flexibility is attained using a torsion rod forming a hinge between the flap and the main wing. Vortex flow structures are visualized using large eddy scale decomposition technique and quantified using swirling strength analysis. It is found that trailing edge flexibility increases the vortex swirling strength compared to a rigid airfoil, whereas leading edge flexibility decreases the swirling strength. Furthermore, the integral length scale determined from the autocorrelation of the velocity fluctuations is found to be approximately equal to the actual vortex size. The vortex convective velocity is shown to be independent of flexibility and oscillation frequency, and it is represented by a trimodal distribution, with peak values at 0.8, 0.95 and 1 times the free stream velocity.

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