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Experimental investigation of a large aspect ratio flat plate encountering a steam-wise gust KAREN MULLENERS, EPFL, PETER MANCINI, ANYA JONES, University of Maryland — While humans are capable of mimicking, and even outperform, the kinematic capabilities of natural flyers, birds and insects are still way ahead of us when it comes to anticipating and dealing with turbulent and gusty flow conditions. To tailor and improve flight control capabilities of low Reynolds number flyers in real weather, we need to bridge this gap of knowledge. As a first step, we experimentally studied the aerodynamic influence of a simplified stream-wise gust on a large aspect ratio flat plate. The experiments were conduction in the $7 \times 1.5 \times 1\text{m}^3$ towing tank at UMD which was equipped with a 4-axis computer-controlled motion system. The effect of a stream-wise gust was simulated by accelerating or decelerating the wing to a new constant velocity after an initial constant surge. A high-speed camera and light sheet optics were attached to the tow carriage allowing for time-resolved particle image velocimetry along the entire motion in addition to direct force measurements. A proper orthogonal decomposition of the flow field was carried out to study the time scales related to changes induced by the sudden acceleration or deceleration in addition to analyzing the size, position and trajectory of prominent vortices and associated forces during the gust encounter.

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