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3D characterization of leading-edge vortex formation and growth[1]

KYOHEI ONOUE, KENNETH BREUER, Brown University — We examine the vorticity transport mechanisms responsible for regulating the stability and strength of the leading-edge vortex (LEV) on rapidly pitching plates with different planforms (swept vs. rectangular) in a uniform airflow. All experiments are carried out using a cyber-physical experimental setup (Onoue et al. 2015, JFS vol. 55) and synchronized 3D PIV measurements. In the case of a swept wing, two distinct regions of intense spanwise flow are observed around the LEV centroid—a feature conspicuously absent on a rectangular pitching plate. The interaction between these spanwise flows and the LEV core seems to play a role in prolonging the LEV residence time at the cost of the vortex circulation growth rate and magnitude. Detailed control volume analysis is performed to elucidate the flow physics at work.

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Kyohei Onoue
Brown University

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