Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Lift enhancement with extremum seeking control for a low-aspect-ratio wing KUNIHIKO TAIRA, Florida State University, CLARENCE ROWLEY, Princeton University, TIM COLONIUS, California Institute of Technology — We introduce active flow control around a low-aspect-ratio flat-plate wing at post-stall angles of attack for lift enhancement. The separated flow is numerically examined with the immersed boundary projection method and the actuator is modeled as periodic momentum injection. It is emphasized that the present control technique does not suppress separation but benefits from the formation of the leading-edge vortices to take place closer to the suction side of the wing. This positions the low-pressure cores of the leading-edge vortices directly above the wing to provide added lift. For a certain range of actuation frequency, the wake is found to lock onto a periodic state that provides lift enhancement. To seek this high-lift state, we design a feedback controller with the extremum-seeking algorithm to determine the optimal actuation frequency. We discuss the design methodology and explain how the dynamics of the wake vortices is modified to yield added lift.

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Date submitted: 03 Aug 2012 Electronic form version 1.4