Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Separation Control by External Acoustic Excitation on a Finite Wing at Low Reynolds Numbers[1] SHANLING YANG, GEOFFREY SPEDDING, University of Southern California — For Reynolds numbers between 10000 and 100000, many smooth airfoils have complex lift-drag polars that can include multiple states at single points in the control parameter, the angle of attack. The E387 experiences pre-stall hysteresis and abrupt switching between stable states that result from sudden flow reattachment and the formation of a laminar separation bubble. External acoustic excitation is shown to strongly modify the flow dynamics. Separation control, hysteresis elimination, and more than 70% increase in aerodynamic efficiency are obtained at select excitation frequencies and sound pressure levels. Flow reattachment and the appearance of vortical structures in the separated shear layer are achieved by acoustic forcing. Correlation between the effects from acoustic forcing and wind tunnel resonances shows that the anti-resonances in a closed chamber correspond to the largest improvement in wing performance. Further applications for the control and stabilization of small-scale aircraft both in and out of closed chambers are considered.

[1]This work was supported by AFOSR grant no. FA 9550-11-1-0106.

Geoffrey Spedding
University of Southern California

Date submitted: 24 Jul 2012 Electronic form version 1.4