Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Plasma Flow Control Optimized Airfoil[1] VLADIMIR VOIKOV, THOMAS CORKE, CHUAN HE, BENJAMIN MERTZ, University of Notre Dame, MEHUL PATEL, Orbital Research Inc. — Recent advances in flow control research have demonstrated that plasma actuators can be efficient in different aerodynamic applications, particularly in providing flight control without conventional moving surfaces. The concept involves the use of a laminar airfoil design that employs a separation ramp at the trailing edge that can be manipulated by a plasma actuator to control lift, similar to trailing-edge flaps. The advantages are lower drag by a combination of the laminar flow design, and elimination of parasitic drag associated with wing-flap junctions. This work involves numerical simulations and experiments on a HSNLF(1)-0213 airfoil. The numerical results are obtained using an unsteady, compressible Navier-Stokes simulation that includes a model for the plasma actuators. The experiments are performed on a 2-D airfoil section that is mounted on a lift-drag force balance. The results demonstrate lift enhancement produced by the plasma actuator that is comparable to a plane flap. They also reveal an optimum actuator unsteady frequency that scales with the length of the separated region and local velocity, and is associated with the generation of a train of spanwise vortices. Other scaling including the effect of Reynolds number is presented.

[1]Supported by U.S. Air Force

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Date submitted: 29 Jul 2005 Electronic form version 1.4