Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

The Dynamics of Controlled Flow Separation within a Diverter Duct Diffuser[1] C. J. PETERSON, B. VUKASINOVIC, A. GLEZER, Georgia Institute of Technology — The evolution and receptivity to fluidic actuation of the flow separation within a rectangular, constant-width, diffuser that is branched off of a primary channel is investigated experimentally at speeds up to M = 0.4. The coupling between the diffuser's adverse pressure gradient and the internal separation that constricts nearly half of the flow passage through the duct is controlled using a spanwise array of fluidic actuators on the surface upstream of the diffuser's inlet plane. The dynamics of the separating surface vorticity layer in the absence and presence of actuation are investigated using high-speed particle image velocimetry combined with surface pressure measurements and total pressure distributions at the primary channel's exit plane. It is shown that the actuation significantly alters the incipient dynamics of the separating vorticity layer as the characteristic cross stream scales of the boundary layer upstream of separation and of the ensuing vorticity concentrations within the separated flow increase progressively with actuation level. It is argued that the dissipative (high frequency) actuation alters the balance between large- and small-scale motions near separation by intensifying the large-scale motions and limiting the small-scale dynamics. Controlling separation within the diffuser duct also has a profound effect on the global flow. In the presence of actuation, the mass flow rate in the primary duct increases 10% while the fraction of the diverted mass flow rate in the diffuser increases by more than 45% at 0.7% actuation mass fraction.

[1]Supported by the Boeing Company.

Curtis Peterson
Georgia Institute of Technology

Date submitted: 01 Aug 2016 Electronic form version 1.4