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Separation Control in a 3D Diffuser using Plasma Actuators SVEN GRUNDMANN, JOHN K. EATON, Stanford University — Control experiments were conducted for the fully-turbulent flow in a 3D diffuser with an expansion ratio of 4.8. The uncontrolled flow for the same diffuser has a stable, three-dimensional separation zone which begins as a slender bubble in one corner before spreading across the entire width of the diffuser, giving the opportunity to develop and test active separation control devices. Dielectric-barrier discharge actuators were used to actively control the flow separation with the goal of improving the pressure recovery. The most effective control was achieved using spanwise acting plasma actuators in the inlet section of the diffuser which create streamwise vortices. The pressure recovery can be clearly improved or degraded depending on whether the actuators are operated pulsed or continuously. Parameter studies showed the dependence of the pressure recovery along the diffuser wall on the actuator operating parameters, including the modulation frequency and duty cycle. Velocity profile measurements in the inlet and outlet planes of the diffuser show the creation of the streamwise vortices and their influence on the uniformity of the velocity in the end of the diffuser. Frequency spectra taken in the exit plane using a hotwire probe show the influence of the operating parameters on the diffuser flow. A closed-loop control circuit for the automated adaption of the operating parameters is being tested.

Sven Grundmann
Stanford University

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