Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

A Comparative Study of Spatially Modulated Forcing of Cylinder Wake with Segmented Plasma Actuators of Different Wavelengths[1]
SAMIK BHATTACHARYA, JAMES W. GREGORY, The Ohio State University
— The wake of a 1-inch diameter (D) circular cylinder was forced three dimensionally by mounting dielectric barrier discharge plasma actuators at specific spanwise locations. Actuators with spanwise wavelengths of 1, 2, 4 and 6D were used. Considerable drag reduction was achieved with 4D and 6D actuators compared to 1D and 2D actuators which showed no effect on the drag. In the case of the 6D actuator, prominent spanwise differences were observed in the wake mean velocity profiles, with a much wider wake behind the region of no plasma formation and differential development persisting well downstream. The different wavelength actuators were also compared in terms of their ability to induce streamwise vorticity in the wake. Segmented forcing with the 4D actuator augmented the generation of streamwise vorticity in the wake which was revealed in the cross-plane time-averaged data. A detailed study of vortex dislocation was carried out with a rake of eight hot wires. Segmented forcing with 4 and 6 D actuator introduced vortex dislocation in the Karman vortex street. The phenomenon of vortex dislocation due to phase mismatch is inferred as the primary reason for the effectiveness of 4D actuator in reducing drag.

[1]This work is supported by the Air Force Office of Scientific Research, Award Number FA9550-10-1-0490

Samik Bhattacharya
The Ohio State University

Date submitted: 03 Aug 2012 Electronic form version 1.4