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The Influence of Spanwise Segmented Plasma Actuator Forcing on a Circular Cylinder Wake and the Selection of Optimum Wavelength[1]

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Detailed investigations have been carried out on the effect of segmented plasma forcing on the wake of circular cylinder. Actuators of wavelength 1d to 6d (d=diameter) were used for three-dimensional actuation at Reynolds number of 4700. Two most important factors were wavelength of actuation and the power of plasma. Vortex shedding was not significantly attenuated below a certain threshold of the supplied voltage. However, for actuation wavelength more than 2d, the near wake developed a wavy profile due to emergence of streamwise vorticity. The reason for this development was differential displacement of the Karman vortex street behind the plasma forming and no plasma region. Forcing above the threshold voltage created strong circulating zones at each corner of the buried electrode, which diverted the flow from the no plasma region towards the plasma region. This process gave rise to alternate accelerated flow (behind the plasma region) and distinct reverse flow zones (behind no plasma regions). The strength of Karman shedding was attenuated as energy was extracted from it and fed to streamwise vorticity. This lead to significant reduction in drag in the event of high power actuation with 3d,4d and 5d actuators. The attenuation in shedding and reduction of drag was maximum for 4d actuator, which led to its selection as optimum wavelength. Significant difference in wake width was observed in high power forcing cases behind the two regions. This observation was attributed to spanwise difference in vortex formation length due to segmented forcing.

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