Simulation of Flows over Cylinders Influenced by a DBD Plasma Actuator

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Abstract

Plasma actuator is a kind of mechanism which applied electrohydrodynamic (EHD) and magnetohydrodynamic (MHD) phenomena on many different applications, no matter the semiconductor, 3C industrial or even the pollution treatment etc. have already widely exploited the technic. The work here is to figure out how a dielectric barrier discharge (DBD) plasma actuator influences the flow characteristics over a cylinder under different Reynolds number. Furthermore, the application of plasma actuator on an airfoil will also be discussed in the paper. In numerical approximation, we applied the mathematical model developed by Suzen and Haung [1] to model the plasma actuator as a source term in the flow field. Also, a case without applied plasma actuator is indispensable and was done for the comparison. The results can be separated into three distinctive convergence outcomes, lift and drag coefficient and vorticity. It is clearly to see that no matter the lift coefficient nor drag coefficient are significantly decrease due to the effects of plasma actuator. The vorticity plot also had a dramatically decrease as shown in the contour plot.

Keywords: Plasma actuator, Dielectric Barrier Discharger, Flow control
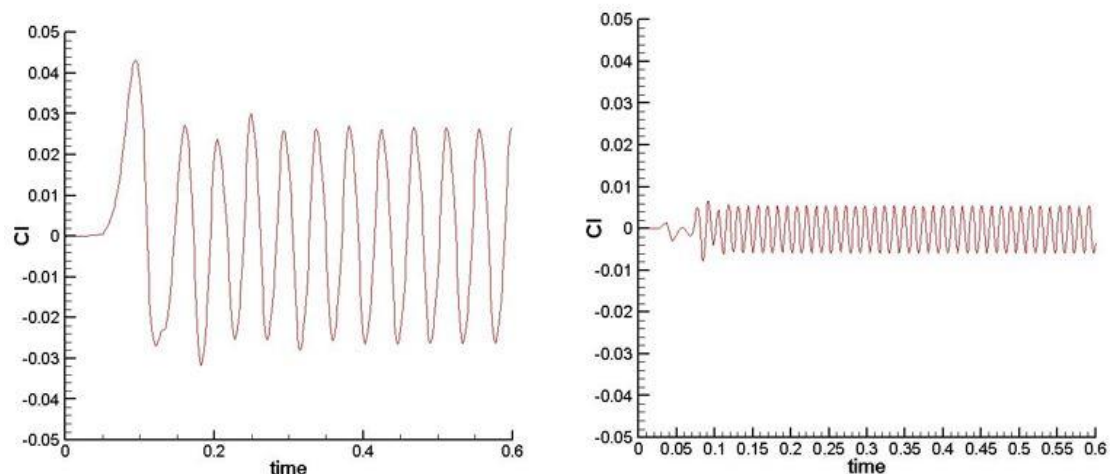

Figure 1. Lift coefficient with and without plasma actuator on a cylinder (left: w/ actuator, right: w/o actuator)
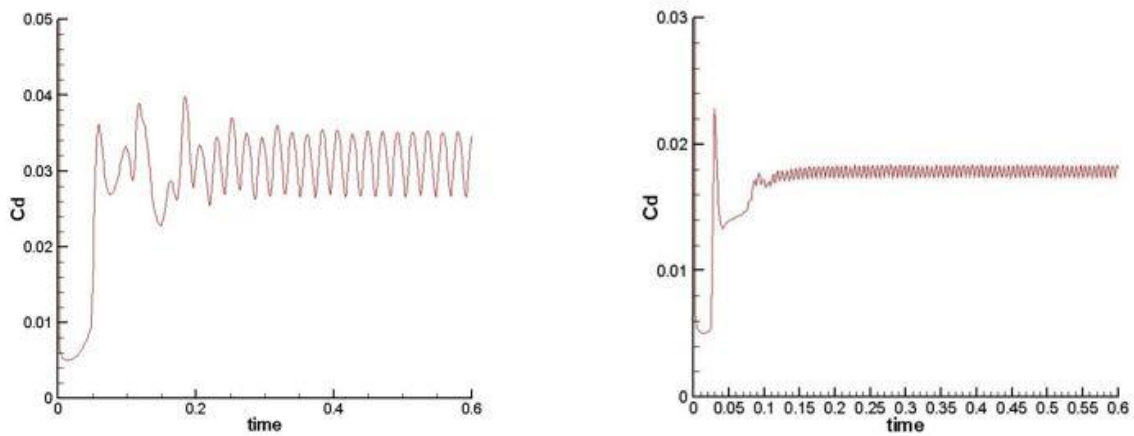
Figure 2. Drag coefficient with and without plasma actuator on a cylinder (left: w/ actuator, right: w/o actuator)
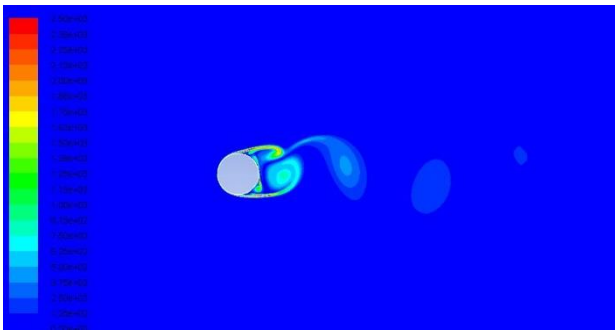

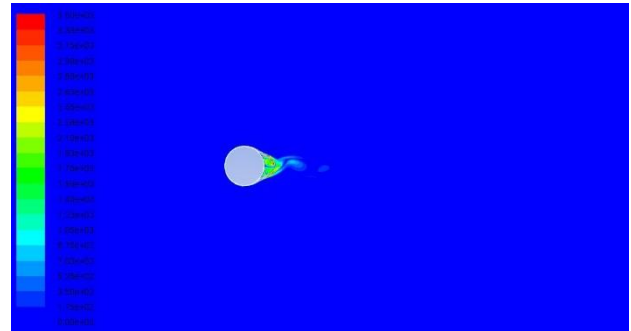Figure 3. Vorticity without plasma actuator on a cylinder
at time= 5 sec

Figure 4. Vorticity with plasma actuator on a cylinder
at time= 5 sec

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