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Open-loop and closed-loop excitation of the wake behind a circular cylinder DAVID WILLIAMS, Illinois Institute of Technology, KELLY COHEN, STEFAN SIEGEL, TOM MCLAUGHLIN, United States Air Force Academy — Both open loop and closed loop control were used to modify the flow around a circular cylinder at $Re = 20,000$. Independent plasma actuators were installed on the sides of the cylinder at $\pm 90^\circ$ from the forward stagnation line. The actuators could be excited in-phase or 180° out of phase with one another. In the case of open-loop forcing, in-phase excitation at twice the von Karman vortex shedding frequency produced large changes in the wake structure, similar to the experiments done by Williams, Mansy & Amato (JFM, 1992.) Negligible changes in wake structure occurred when the out-of-phase actuation was used, although the lock-on phenomenon was observed, suggesting that the wake structure modification resulting from the interaction between the forcing field and near wake is independent of Reynolds number. Closed-loop excitation using a proportional-derivative controller was done using a hot-film probe positioned at $x/D=1.5$, $y/D = 1.5$. The amplitude of the wake oscillation was shown to be sensitive to both the gain and phase of the controller. The amplitude of oscillations at a fixed controller gain are enhanced or suppressed relative to the non-forced level, depending on the controller phase. The vortex shedding frequency is changed when the PD controller is in a region of suppression. The expert assistance of SSgt. Mary S. Church is gratefully acknowledged.

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