# Distributed Forcing of Flow over a Circular Cylinder

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**Abstract**

Three-dimensional numerical simulations are performed for control of flows over a circular cylinder for the Reynolds numbers from 40 to 3900. Distributed forcings are applied on the cylinder surface at $\pm 90^{o}$ from the stagnation point with the forcing (blowing/suction) profile varying sinusoidally in the spanwise direction and fixed in time. The phase difference between the forcing velocities from upper and lower cylinder surfaces is set to be zero (in-phase) or $\pi$ (out-of-phase). It is shown that the in-phase distributed forcing significantly weakens the vortex shedding and reduces the drag for both laminar and turbulent flow cases. We also find that there exists an optimal spanwise wavelength of the forcing for maximum drag reduction and it depends on the Reynolds number. The out-of-phase distributed forcing seems to be ineffective for laminar flow but works for turbulent flow.

***Keyword:*** *circular cylinder, blowing/suction, drag reduction*