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Power loss minimizing blowing and suction profiles for drag reduction on a circular cylinder PRITAM GIRI, RATNESH SHUKLA, Indian Institute of Science, Bangalore — Active and passive flow control strategies that facilitate drag reduction at low energetic costs are of considerable fundamental and practical relevance. Here, we investigate the efficacy of a zero net mass transpiration blowing and suction flow control strategy based on intake and expulsion of fluid from the boundary of a circular cylinder placed in a uniform cross flow of a viscous incompressible fluid. We find this control strategy to be most effective when the blowing and suction profile is such that the fluid intake and expulsion occur over upstream and downstream portions of the circular cylinder, respectively. With increasingly strong intake and expulsion, the vorticity production at the cylinder surface diminishes significantly and the unsteady vortex shedding is suppressed entirely. We find that for sufficiently strong blowing and suction strengths the net power consumption attains a minimum for a significantly reduced net drag force. At a Reynolds number of 1000 the drag is reduced by a factor of over 15 from its base value for a stationary cylinder with zero mass transpiration. We show that a self-propelling state with zero drag force is achieved for a configuration that corresponds to an irrotational flow with vanishing tangential but finite normal surface velocity.

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