Numerical investigation of fluidic active flow control on circular cylinder in transitional regime

Wasim Sarwar and Fernando Mellibovsky
Polytechnic University of Catalonia, Spain

The fluid flow past bluff bodies even in the low to moderate regimes results in large unsteady wakes that are the source of high aerodynamic drag, vibration, noise etc. Most applications aim at the reduction of the drag force and vibrations to improve aerodynamic performance, while an enhancement of the wake instability can be beneficial for energy harvesting applications. In the present numerical study, we apply spanwise-dependent fluidic actuation, both steady and time-periodic, on the flow past a circular cylinder at Reynolds number 2000. The actuation takes the form of in-phase blowing and suction from slits located at ±90° (top and bottom) with respect to the upstream stagnation point. Optimal forcing amplitude and wavelength are obtained by sweeping across the parametric space. A promising reduction in drag force, combined with the suppression of lift fluctuations, is obtained for spanwise-dependent steady actuation with appropriate actuation wavelength. Several actuation frequencies are investigated for time-dependent actuation. Lift fluctuations and drag force are found to increase significantly under actuation at frequencies close to the shear layer instability, thus indicating a potential interest for energy harvesting applications at these low Reynolds numbers.

Figure 1: Spanwise-dependent steady actuation of flow past circular cylinder at Re=2000 with wavelengths $\lambda_z = 0.25D$, 0.5D, 1D, and 2D, where D is the cylinder diameter.

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Biography

Wasim Sarwar is pursuing his PhD from the Technical University of Catalonia, Department of Physics, Aerospace Engineering Division, under the supervision of Dr. Fernando Mellibovsky. His research interests include boundary layer separation, turbulent transition, active flow control, dynamical systems, bifurcation theory, etc.