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Flow control by combining radial pulsation and rotation of a cylinder in uniform flow H. OUALLI, S. HANCHI, École Militaire Polytechnique, Algiers, Algeria, A. BOUABDALLAH, Université des Sciences et de la Technologie Houari Boumedienne, Algiers, Algeria, M. GAD-EL-HAK, Virginia Commonwealth University, Richmond, USA — Flow visualizations and hot-wire measurements are carried out to study a circular cylinder undergoing simultaneous radial pulsation and rotation and placed in a uniform flow. The Reynolds number is in the range of 1,000–22,000, for which transition in the shear layers and near wake is expected. Our previous experimental and numerical investigations in this subcritical flow regime have established the existence of an important energy transfer mechanism from the mean flow to the fluctuations. Radial pulsations cause and enhance that energy transfer. Certain values of the amplitude and frequency of the pulsations lead to negative drag (i.e. thrust). The nonlinear interaction between the Magnus effect induced by the steady rotation of the cylinder and the near-wake modulated by the bluff body's pulsation leads to alteration of the omnipresent Kármán vortices and the possibility of optimizing the lift-to-drag ratio as well as the rates of heat and mass transfer. Other useful applications include the ability to enhance or suppress the turbulence intensity, and to avoid the potentially destructive lock-in phenomenon in the wake of bridges, electric cables and other structures.

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