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Harvesting energy in the wake of a circular cylinder using piezoelectric materials DOGUS H. AKAYDIN, NIELL ELVIN, YIANNIS ANDREOPOULOS, City College of New York, Mechanical Engineering — The voltage generated by short, flexible piezoelectric cantilever beams placed inside turbulent wakes of circular cylinders at Reynolds numbers of 10,000 is investigated experimentally and computationally. The coherent vortical structures present in this flow generate a periodic forcing on the beam which when tuned to its resonant frequency produces maximum output voltage. There are two mechanisms which contribute to the driving forcing of the beam. The first mechanism is the impingement of induced flow by the passing vortices on one side of the beam and second is the low pressure core region of the vortices which is present at the opposite side of the beam. The sequence of these two mechanisms combined with the resonating conditions of the beam generated maximum energy output which was also found to vary with the location in the wake. The maximum power output was measured at about two diameters downstream of the cylinder. This power drops off the center line of the wake and decays with downstream distance as $(x/D)^{-3/2}$. A three-way coupled interaction simulation that takes into account the aerodynamics, structural vibration and electrical response of the piezoelectric generator has been developed.

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