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Energy Extraction from Fluid Flow Via Vortex Induced Angular Oscillations AMITABH BHATTACHARYA, SHAHAJHAN H. SORATHIYA, Department of Mechanical Engineering, I.I.T. Bombay — Using Lattice-Boltzmann simulations, we study angular oscillations of an elliptical cylinder attached to a torsional spring, with the axis placed perpendicular to a uniform flow, at low Reynolds numbers (Re=100 and Re=200). The equilibrium angle and stiffness of the torsional spring is chosen such that the ellipse reaches stable equilibrium at an angle of roughly 45° with respect to the incoming flow. This configuration leads to large unsteady torque due to vortex shedding, which in turn can lead to large oscillations of the ellipse, with several frequency modes. Along with measuring the angular oscillations of the ellipse, we also measure the potential for power-extraction from this setup, by attaching an external angular damper to the axis of the ellipse. For low density ratios, the ellipse tends to oscillate within the first quadrant, while, for higher density ratios, the ellipse, due to its tendency to auto-rotate, undergoes very large oscillations. The ellipse locks on to primary and secondary vortex shedding modes over the range of density ratios studied here. The power output of this setup increases with increasing Reynolds number and density ratio, with peak efficiency of 1.7%.

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