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Dynamics and flow structures in the vortex-induced vibration of a curved flexible cylinder BANAFSHEH SEYED-AGHAZADEH, Darmouth Campus, University of Massachusetts, BRIDGET BENNER, XHINO GJOKOLLARI, YAHYA MODARRES-SADEGHI, University of Massachusetts, Amherst —
Vortex-induced vibration of a curved flexible circular cylinder placed in the test section of a re-circulating water tunnel and fixed at both ends was studied, experimentally. Both the concave and the convex orientations (with respect to the oncoming flow direction) were considered. The cylinder was tension-dominated by its own weight with an aspect ratio of 86 and a low-mass ratio of a 3.7. High-speed imaging technique was employed to record the oscillations of the cylinder in the crossflow direction for a reduced velocity range of $U^* = 4.8$- 42.3, corresponding to a Reynolds number range of $Re = 370$-2400. Mono- and multi-frequency responses as well as transition from low mode numbers to high mode numbers are observed. Regardless of the type of curvature, both odd and even mode shapes are excited in the crossflow directions. However, the response of the system, in terms of the excited modes, amplitudes and frequencies of oscillations, is observed to be sensitive to the direction of curvature (concave vs. convex), in particular at higher reduced velocities where mode transition happens. Hydrogen bubble image velocimetry flow visualization was conducted at multiple points along the length of the curved cylinder. Intermittency in the vortex shedding patterns in the wake of the cylinder and alternating wake along the cylinder are observed. The observed altering wake corresponds to the multi-modal excitation and dominant mode transition along the length of the cylinder.

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