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Analysis of the Streamwise-Oscillating Cylinder Wake: Interplay Between Quasi-Steady and Unsteady Dynamics[1] MAYSAM SHAMAI, Caltech, SCOTT DAWSON, Illinois Institute of Technology, IGOR MEZIC, University of California, Santa Barbara, BEVERLEY MCKEON, Caltech — The flow around a cylinder oscillating (surging) in the streamwise direction with a frequency, f_f, much lower than the shedding frequency, f_s, has been relatively less studied than the case when these frequencies have the same order of magnitude. We combine particle image velocimetry and Koopman Mode Decomposition to investigate the cylinder wake for nominal parameters $f_f/f_s \sim 0.04 - 0.2$ and mean Reynolds number, $Re \approx 900$. The amplitude of oscillation is such that the instantaneous Reynolds number is far from the critical value. Characterization of the wake reveals a range of phenomena associated with nonlinear interaction of the two frequencies, including amplitude and frequency modulation. We perform analyses in multiple frames of reference to motivate use of the cylinder-fixed frame. Utilizing this frame, we present a scaling parameter and associated transformation in order to relate the unsteady, or forced, dynamics to that of a quasi-steady, or unforced, system. Implications for Koopman analysis of the flow around a moving body will be discussed. This work is supported under ARO grant W911NF-17-1-0306.

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