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Regimes of flow induced vibration for tandem, tethered cylinders
GARY NAVE, MARK STREMLER, Virginia Tech — In the wake of a bluff body, there are a number of dynamic response regimes that exist for a trailing bluff body depending on spacing, structural restoring forces, and the mass-damping parameter $m^*\zeta$. For tandem cylinders with low values of $m^*\zeta$, two such regimes of motion are Gap Flow Switching and Wake Induced Vibration. In this study, we consider the dynamics of a single degree-of-freedom rigid cylinder in the wake of another in these regimes for a variety of center-to-center cylinder spacings (3-5 diameters) and Reynolds numbers (4,000-11,000). The system consists of a trailing cylinder constrained to a circular arc around a fixed leading cylinder, which, for small angle displacements, bears a close resemblance to the transversely oscillating cylinders found more commonly in existing literature. From experiments on this system, we compare and contrast the dynamic response within these two regimes. Our results show sustained oscillations in the absence of a structural restoring force in all cases, providing experimental support for the wake stiffness assumption, which is based on the mean lift toward the center line of flow.

Gary Nave
Virginia Tech

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