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Predicting the response of a cylinder undergoing vortex-induced vibration using controlled vibrations TIMOTHY L. MORSE, CHARLES H.K. WILLIAMSON, Cornell University — In this study, we measure the fluid forces on a cylinder that oscillates with a sinusoidal motion transverse to a free stream. We generate contour plots of the fluid force, phase, and energy transfer in the plane of normalised amplitude and frequency (and compare with Hover, et al., 1998; Carberry et al., 2001). Interestingly, the regime boundaries of force and phase in our study correspond well with the boundaries separating vortex wake modes in the Williamson-Roshko (1988) map of modes. Using these measurements, we are able to predict the response of an elastically mounted cylinder, and we find good agreement with the free vibration response plots of Govardhan & Williamson (2000). We have been especially careful to match the experimental conditions of both the controlled and free vibration cases. Further studies of the energy transfer between fluid and body motion suggest conditions under which one might expect hysteretic jumps or intermittent switching between free vibration modes. We also predict the effects of mass and damping on the response and the regime of synchronization of a freely vibrating cylinder.

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