Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Understanding mode transitions in vortex-induced vibrations of a circular cylinders using controlled vibration T.L. MORSE, C.H.K. WILLIAMSON, Cornell University — In this study we have made extensive measurements of the fluid forces on a cylinder that is controlled to oscillate transverse to a free stream at Re = 4000. These measurements were used to create extremely high-resolution contour plots of the magnitude of the fluid force, and the phase angle between the forces and body motion, in the plane of normalized amplitude and frequency. We find transitions in certain regions of this plane where the character of the fluid forces changes between distinct modes. Interestingly, these transitions correspond well with boundaries separating different vortex shedding modes in the Williamson-Roshko (1988) map. A further fascinating characteristic, which is only observable with very high-resolution data, is the existence of regimes where two modes overlap. By examining the energy transfer from fluid to cylinder we are able to predict the response of an elastically mounted cylinder that agrees surprisingly well with measured the free vibration response of Govardhan & Williamson (2006) at both high and low mass-damping. Furthermore, by looking at the shape of the excitation contours and the transitions between different modes, we are able to exhibit clearly the hysteretic and intermittent switching mode transitions, which occur between different branches of the free vibration response. As part of our ongoing research, we plan to extend our high-resolution data to higher Re.

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Date submitted: 02 Aug 2006 Electronic form version 1.4