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Nonlinear restoring forces in vortex-induced vibration A.W. MACKOWSKI, C.H.K. WILLIAMSON, Cornell University — When studying vortex-induced vibration of a rigid circular cylinder, almost all experimental and computational studies involve the cylinder being supported by linear springs. However, there are cases in which we may be interested in the VIV response of a cylinder supported by nonlinear springs. A system with nonlinearities in the restoring force has the potential to increase the amplitude response envelope, critical to the success of aero-vibrating energy harvesters. On the other hand, designing nonlinear restoring forces to decrease the amplitude response may lead to structures more able to withstand flow-induced vibration. In addition, adding nonlinear terms to the restoring force on a rigid cylinder might be used to simulate higher-order dynamics of long, elastic marine cables. To experimentally observe the effects of nonlinear springs on flow-induced vibration, we apply a novel approach that lets us parametrically control the nature of the springs and the strength of the nonlinearities. The technique, called Cyber-Physical Fluid Dynamics, uses a force-feedback control system to simulate arbitrary forces on a submerged body [the details of this system were shown in the APS presentation of Mackowski & Williamson (2010)]. We present results using this technique to explore the amplitude response of a circular cylinder in a crossflow.

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