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A study of vortex-induced vibration using hybrid cyber-physical supports A. MACKOWSKI, C.H.K. WILLIAMSON, Cornell University — In this work, we study the vortex dynamics of fluid-structure interaction using a novel technique, which we call Cyber- Physical Fluid Dynamics. Typically, when studying flow-induced vibration, one needs to select essential parameters for the body, such as mass, spring stiffness, and damping. Normally, these parameters are set physically by selecting mechanical elements. However, in our approach, which utilizes a water channel, a computer-controlled XY positioning system, and a force-feedback control system, we are able to impose mass- spring-damping forces in real time and with significant precision. A similar concept was pioneered by a group at MIT (Miller 1996; Hover, Techet, Triantfyllou 1997), in studies of vortex-induced vibration of cables. The present research expands on this technique, both with a new control system and the first ever implementation of Cyber-Physical Fluid Dynamics in a continuously flowing facility. Although the use of a cyber- physical system has clear advantages over using a fixed, physical experiment, there are serious challenges to overcome in the design of the governing control system. We will explore aspects of the control system and strategies for reducing the limitations of this approach. We shall present experimental results from selected problems of fluid-structure interaction using this new technique.

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