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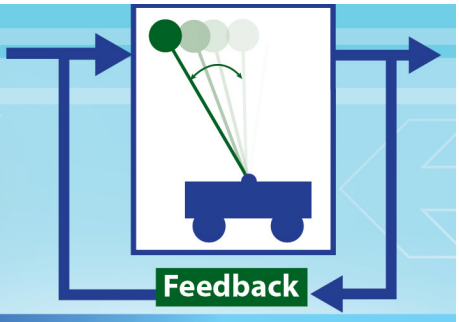
Control Seminar



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Optimal Control of Vibratory Systems with Power Directionality Constraints

Jeff Scruggs

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Department of Civil and Environmental Engineering

Friday, October 21, 2016

3:30 – 4:30 pm • 1500 EECS

ABSTRACT: In many vibration engineering applications, the control hardware exhibits power directionality constraints. A simple example is semiactive (i.e., controllable damping) vibration suppression technology for vehicle suspensions and civil structures. For these systems, energy absorption is controlled by varying the effective viscosities of controllable dashpot elements. This enables the implementation of high-bandwidth, non-colocated feedback control, but feasible feedback laws are prohibited from driving power into the vibratory system. Analogous mathematical problems arise in many other areas of vibration engineering, and recently have emerged as a fundamental aspect of control problems for vibration energy harvesting systems, including small-scale vibration energy scavengers, as well as Megawatt-scale ocean wave energy converters. In these technologies, it is often more economical to use power trains and converters that are capable of only single-directional power transmission. This talk will discuss some of the implications of power directionality constraints, for optimal control design. The presence of these constraints can make some control objectives trivial - most notably, stability robustness. However, performance optimization can be challenging, especially for problems involving stochastic or uncertain systems. An attempt will be made to emphasize common features shared by many application areas. Examples will be presented, pertaining to past work in earthquake engineering, wireless sensing, and ocean wave energy.

BIO: Jeff Scruggs is an Associate Professor in the Department of Civil & Environmental Engineering at the University of Michigan, which he joined in 2011. He received his B.S. and M.S. degrees in Electrical Engineering from Virginia Tech in 1997 and 1999, respectively, and his Ph.D. in Applied Mechanics from the Caltech in 2004. Prior to joining the University of Michigan, he held postdoctoral positions at Caltech and the University of California, San Diego, and was on the faculty at Duke University from 2007-11. Scruggs's current research is in the areas of mechanics, vibration, energy, and control. His research is supported by NSF, ONR, and DOE.

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