2008 Mechanical Engineering Lecture Series

The Department of Mechanical Engineering is pleased to host

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Delay-Independent Stability and Synchronization of Interconnected Nonlinear Systems

Abstract: Coordination and control of interconnected nonlinear systems is important in numerous practical applications, such as sensor networks, unmanned air vehicles, and robot networks. Such systems are increasingly called on to perform critical tasks such as search-and-rescue, emergency response, surveillance, and telemedicine, among others. The aforementioned systems can be modeled as networked dynamical systems interacting over unreliable communication networks. However, the issues of coordination and control of networked heterogeneous dynamical systems with delays, losses, and network dropouts are not well understood.

In this talk we first study delay-independent stability of interconnected nonlinear systems with finite L_2 gain. We show that for time-varying delays, a modified small-gain condition dependent on the maximum rate of change of the delay can be used to ensure delay-independent stability. Passive systems, in general, do not admit a finite L_2 gain. However, for passive nonlinear systems, scattering theory can be used to provide delay-independent stability when the delays are constant. To handle time-varying delays, a modified scattering transformation approach is developed to ensure delay-independent stability of the closed loop system. The aforementioned results are then utilized to demonstrate delay-independent synchrony in networked passive systems. Specifically, a passive coupling control law is presented to output synchronize interconnected passive systems for arbitrary time delay. We then discuss the application of this approach to solve synchronization, trajectory tracking and coordination problems in multi-robot networks and bilateral teleoperation. The talk will conclude with some directions for future research.

Biography: Nikhil Chopra received his Bachelor of Technology (Honors) degree in Mechanical Engineering from the Indian Institute of Technology, Kharagpur, India, in 2001 and his Ph.D. degree in Systems and Entrepreneurial Engineering in 2006 from the University of Illinois at Urbana-Champaign. He was a Postdoctoral Research Associate in the Coordinated Science Laboratory at the University of Illinois at Urbana-Champaign from 2006-2007. His research interests are in developing a fundamental understanding of synchronization and control of networked dynamical systems interacting over unreliable communication networks. This work is important in practical applications such as semi-autonomous telerobotic networks. He was awarded the William A. Chittenden Award for outstanding graduate research and the Vodafone Graduate Fellowship in 2003. He co-chairs the IEEE Technical Committee on Telerobotics.

***Date*: November 7, 2008 at 2:00 pm**
***Place*: CSI (Computer Science Instructional Center) Room 3117**