ELECTRICAL & COMPUTER ENGINEERING SEMINAR

"Robust Decision-Making Control Algorithms: A Hybrid Systems Approach"

by

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Monday, April 7, 2008 9:00 a.m.
LSC Room 211E

Abstract & Biography

Abstract: Recent technological advances have enabled engineering systems to be reconfigurable, to utilize modular hardware and software, and to employ networks as a means for control and communication. For these systems to be safe and reliable, the design procedures employed should guarantee certain margins of robustness to uncertainty and unexpected events. One aspect of these systems, which makes analysis and design challenging, is the inherent mixed or "hybrid" nature of their dynamics as they incorporate analog and digital components, switching devices, computer programs, etc. This raises the following question: How can we systematically analyze and design such "hybrid" systems with provable robustness to uncertainties arising in real-world environments? In this talk, we present recent efforts towards answering this question in the context of control systems. We consider a robust control problem, which we motivate by several robotic and aerospace applications, for which it is not evident how to design a single, state-feedback law that solves it. We propose a control algorithm combining multiple state-feedback laws as well as human inspired and optimal open-loop signals to solve the problem. We show how to model this controller as a hybrid control system and also that it renders the closed-loop system robust to uncertainty by design. Finally, we recast the closed-loop system as a general hybrid system, describe some of the analysis tools we have developed to assert robust stability for these systems, and discuss their potential in solving other challenging, open theoretical and applied control problems in robotics, aerospace, and biology.

Biography: Ricardo Sanfelice is a Postdoctoral Associate at the Laboratory for Information and Decision Systems at the Massachusetts Institute of Technology, where he is also affiliated with the Department of Aeronautics and Astronautics. He received his B.S. degree in Electronics Engineering from the Universidad de Mar del Plata, Buenos Aires, Argentina, in 2001. He joined the Center for Control, Dynamical Systems, and Computation at the University of California, Santa Barbara in the Fall of 2002, where he received his M.S. and Ph.D. degrees in 2004 and 2007, respectively. His current research interests are in both theory and applications arising from and intersecting the areas of robotics, aerospace, and biology. Topics of particular interest include modeling, stability, robust and multivariable control, and simulation of nonlinear, hybrid, and embedded systems.

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