

Friday, April 3, 2009

12:00—1:00 PM

Palmer Hall Room 3190

Collective Perception and Control in Large-Scale Dynamic Systems

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The increasing demand for autonomy, flexibility, efficiency, and ability to handle complicated tasks has made the modern control systems inherently complex. This presentation talks about the techniques that exploit learning, optimization, and perception to address the complexity and uncertainty in such systems. These complex systems require advanced perceptive ability which necessitates the development of enhanced algorithms that can gather and process information from multiple sensors. The first part of the presentation discusses critical issues in multiple sensor data fusion including sensor modeling, uncertainty handling, elimination of spurious data, and knowledge generation from ambiguous and missing information. An innovative unified strategy to fuse multi-sensor data is presented that utilizes statistical and intelligent learning, and information theory in a Bayesian framework to address these crucial issues. The proposed technique is verified via extensive simulations and implemented experimentally to successfully obtain the three-dimensional profile of a robotic workspace in an occupancy grid framework using multiple vision sensors and laser proximity sensor. The second part of this presentation talks about control of large-scale interconnected systems in context of swarm robotics. In particular, a swarming behavior inspired by biological morphogenetic pattern formation is discussed where heterogeneous mobile robots achieve segregation based on differential profiles of attractive/repulsive potential. Further, an application of swarm robotics in collaborative wildland fire-fighting using several Unmanned Aerial Vehicles (UAVs) is presented. The presentation ends with a discussion of future applications of research in this area.

Manish Kumar received his Bachelor of Technology degree in Mechanical Engineering from Indian Institute of Technology, Kharagpur, India in 1998, and his M.S. and Ph.D. degrees in Mechanical Engineering from Duke University, NC, USA in 2002 and 2004 respectively. After finishing his Ph.D., he worked as a postdoctoral research associate in the Department of Mechanical Engineering and Materials Science at Duke University from 2004 to 2005. In 2005, he received the Research Associateship Award from National Research Council (NRC). This award allowed him to work as a postdoctoral Research Associate with the Army Research Office, NC, USA from 2005 to 2007. As a part of his NRC Associateship program, he was a visiting scholar at General Robotics, Automation, Sensing, and Perception (GRASP) laboratory at the University of Pennsylvania, PA, USA. In 2007, he joined the Department of Mechanical Engineering at the University of Cincinnati, OH, USA as an Assistant Professor. He is the director of Cooperative Distributed Systems (CDS) Laboratory at the University of Cincinnati. His current research interests include intelligent modeling of uncertainties in sensor measurement, development of novel techniques to fuse data from multiple sources, robotics, distributed systems, and multiple robot coordination and control. He is a member of American Society of Mechanical Engineers.



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