STEVENS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

Thursday, May 11, 2006
Carnegie Bldg, Room 315, Time TBD

Sensor rich challenges/opportunities for autonomous navigation and modern mechatronic systems

Professor Guang Lu
Department of Mechanical Engineering
Tulane University

Sensors are the key part of any modern mechatronic system, as they monitor the system status and provide real time feedback information. Recent advances in sensor technologies have offered us unprecedented opportunities in designing a mechatronic system, as we can use sensors that are now becoming much cheaper, smaller, more reliable and accurate, low power, and even wireless. Not only may we choose to use new types of sensors, but we can increase the number of sensors in use. However, challenges are also imminent. Sensor rich does not necessarily mean information rich. Data processing algorithms are the key to help us properly understand the sensor outputs. However, how can we make full use of the information to develop the most suitable control and decision making algorithms? From the control point of view, how do we rate each sensor output and combine them in the optimal way? When we increase the number of sensors, we also have to develop a fault management system and a reconfigurable control system in order to accommodate any sensor failure in the system.

Sensors and sensing based decision making play a major role in autonomous navigation. To make a robotic vehicle navigate fully autonomously in an unknown environment, we have to rely on the numerous on-board sensors. The sensed data will be processed in real time and decisions have to be made in time for obstacle avoidance, path planning, speed and steering control, etc. As the number of measurements increases, so is the complexity in the design of the mechatronic system. It was not surprising that DAPPA offered 2 million dollars in 2005 for whoever could develop a robotic vehicle that could finish 140-mile desert journey fully autonomously within the shortest amount of time. In this talk, I will address the sensing and control problems that we met in designing autonomous vehicles. The use of different sensors such as LIDAR, GPS, and magnetometers will be considered. Both sensor data processing algorithms and control techniques based on the benefits generated from these sensors will be presented. Based on the results we have found, I will sketch the outline of my future research.

Dr. Guang Lu received a B.S. degree from Tsinghua University in Precision Instrument and Machinery in 1997, a M.S. degree in Mechanical Engineering from the University of Alabama in 1999, and a Ph.D. degree in Mechanical engineering from the University of California, Berkeley, in 2004. He is currently an assistant professor in the Department of Mechanical Engineering, Tulane University. He was one of the three student recipients of the 1999 American Society for Precision Engineers Annual Conference Scholarship for his paper on the development of a precision fast tool servo system. He also received Best Presentation Awards both in 2002 and 2004 from American Control Conference, and Research Equipment Award in 2005 from the Robotics Industries Association. His research interests are controls and dynamics, mechatronics, intelligent sensors and sensor networks, with applications to intelligent machines, automated vehicles, robotics, machine status monitoring and decision making, and precision manufacturing, etc.