Resolving contentions through real time control and scheduling

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ABSTRACT:

This talk introduces a design approach to resolve contentions in real-time control systems when multiple controllers need to access a shared resource. Important application scenarios of contention include (1) networked control systems, where the shared resource is the communication channel; (2) human-multirobot autonomy, where the shared resource is the human attention; and (3) vehicle scheduling at a traffic intersection, where the shared resource is access to the intersection. An arbitration mechanism is needed in all three cases to determine which system can access the shared resource, calling for an optimal way to assign priorities among the systems. The assignment of the contended resource needs to be computed as a schedule. We have developed the method of significant moment analysis (SMA) that generates a timing model to be used to predict the access to the contended resource under different scheduling algorithms. Contention resolving model predictive control is developed to compute optimal control and optimal scheduling at the same time for a class of cost functions. We designed a tree search algorithm to compute the optimal solutions in real-time. We will discuss these solutions in the context of intelligent traffic scheduling and human-multirobot autonomy.

BIOSKETCH:

Dr. Fumin ZHANG is Professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology. He received a PhD degree in 2004 from the University of Maryland (College Park) in Electrical Engineering, and held a postdoctoral position in Princeton University from 2004 to 2007. His research interests include mobile sensor networks, maritime robotics, control systems, and theoretical foundations for cyber-physical systems. He received the NSF CAREER Award in September 2009 and the ONR Young Investigator Program Award in April 2010. He is currently serving as the co-chair for the IEEE RAS Technical Committee on Marine Robotics, associate editors for IEEE Journal of Oceanic Engineering, Robotics and Automation Letters, IEEE Transactions on Automatic Control, and IEEE Transactions on Control of Networked Systems.