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1:00-2:30PM

Room MEC 224

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Sensing, Estimation, and Control of Tire/Road Interactions

Abstact: Pneumatic tires and rubber wheels are critical components in mobile systems, such as vehicles and ground robots, which are widely used in our lives for passenger and goods transportation. The tire/road interactions in these systems play an extremely important role for not only in system design and efficiency improvement but also in safe operation. In this talk, I will discuss sensing, estimation, and control of tire/road interactions. I will first present two different modeling schemes for on-line estimation of the tire/road friction coefficient and braking control for automated vehicles. The first scheme is based on the pseudo-static relationship between the tire/road friction coefficient and tire slip. The second scheme uses a dynamic friction model. An attractive property of these two approaches is that, with an appropriate selection of initial conditions and gains of the adaptation systems, the estimates of the maximum friction coefficient and slip remain below their true values, which in turn guarantees the safety of the automated-vehicle spacing policies. In the second part of this talk, I will present the development of a tire rubber deformation sensing system for enhancing real-time tire/road friction estimation. Polyvinylidene fluoride (PVDF)-based sensor is designed and embedded inside a robotic tire to measure the rubber tread deformation. An analytical sensing output model that is used to capture the tire/road friction characteristics will be presented. A skid-steered robotic platform is developed as a testbed to demonstrate and validate the sensor models and measurements. The preliminary testing data has showed the feasibility of the estimate of wheel/ground interactions, such as tire slip and sliding friction coefficient. I will also discuss briefly on autonomous motorcycle and other ongoing projects at Rutgers Robotics, Automation, and Mechatronics (RAM) Lab.

Short Biography: Jingang Yi received the B.S. degree in electrical engineering from the Zhejiang University, Hangzhou, China, in 1993, the M.Eng. degree in precision instruments from Tsinghua University, Beijing, China, in 1996, the M.A. degree in mathematics, and the Ph.D. degree in mechanical engineering from the University of California, Berkeley, in 2001 and 2002, respectively. Dr. Yi is currently an Assistant Professor in mechanical engineering at Rutgers University. His research interests include autonomous robotic systems, dynamic systems and control, mechatronics, automation science and engineering, with applications to transporation and civil infrastructural systems, biomedical systems, and semiconductor manufacturing. Dr. Yi is a member of ASME and a senior member of the IEEE. He has co-authored papers that have been awarded the Best Student Paper Award Finalist of the 2008 ASME Dynamic Systems and Control Conference, the Best Conference Paper Award Finalists of the 2007 and 2008 IEEE International Conference on Automation Science and Engineering, and the Kayamori Best Paper Award of the 2005 IEEE International Conference on Robotics and Automation. He currently serves as an Associate Editor of the ASME Dynamic Systems and Control Division and the IEEE Robotics and Automation Society Conference Editorial Boards. He also serves as a Guest Editor of the IEEE Transactions on Automation Science and Engineering.

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