HUMANITY CENTERED ROBOTICS INITIATIVE

BROWN

Ryan K. Williams
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"Interaction and Topology in Distributed Multi-Agent Coordination"

Friday April 11, 2014
12:00 – 1:00pm
CIT Room 477
Lubrano Conference Room

Interconnected systems have become the recent focus of intense investigation, particularly in the context of autonomous collaboration (such as in multi-robot or sensor systems), yielding fundamental advantages in adaptability, scalability, and efficiency compared to single-agent solutions. As recent work has demonstrated, the impact of such systems is far-reaching across various disciplines, ranging from sampling, tracking, and coverage, mobility and topology control, to general agent agreement problems. In this talk, I will focus on the typical topological assumptions that are found in distributed robotics, i.e., those properties defining interaction between robots in a network. Specifically, I will highlight the properties of network connectedness and graph rigidity. It has been shown that these topological assumptions have vast influence on multi-robot behaviors, from information consensus, to formation control, and localization. I will approach connectivity and rigidity in a taxonomic way, by identifying the theoretical possibilities when these assumptions are satisfied, the real-world barriers, and my current efforts to control and/or guarantee such topological properties and interactions. First, I will outline a constraint control framework based fully in robotic mobility, which proves useful in controlling connectivity and rigidity in proximity-limited systems. Then, methods for algebraic connectivity estimation and control which outperform the state of the art will be discussed. Finally, I will describe the combinatorial and algorithmic aspects of evaluating and controlling rigidity in a dynamic setting. The theoretical content will then close with a discussion of future concerns for topology in distributed robotics, including heterogeneity, asymmetry in interaction, and integration with "classical" notions of robotic intelligence (e.g., path planning).

The talk will then conclude with a brief addendum, detailing my experiences with working almost exclusively in a remote fashion, and the hurdles of disability in technical work.

Ryan K. Williams received the B.S. degree in computer engineering from Virginia Polytechnic Institute and State University in 2005. He is currently a Ph.D. candidate in electrical engineering at the University of Southern California, and a member of the Robotic Embedded Systems Laboratory. His current research interests include control, cooperation, and intelligence in distributed multi-agent systems, topological methods in cooperative phenomena, and distributed algorithms for optimization, estimation, inference, and learning. Ryan K. Williams is a Viterbi Fellowship recipient, has been featured by various news outlets, including the L.A. Times, and has a patent pending for his work on high-speed autonomous underwater vehicles.

This research talk is part of the HCRI's series of presentations that showcases diverse and groundbreaking research undertaken by leaders in science, technology, design, and impact of robotics on society.

For more information on this talk, contact hcri@brown.edu or visit hcri.brown.edu.