ECE Distinguished Seminar

Mobile Data Collection in an Aquatic Environment: Cyber Maritime Cycles for Distributed Autonomy

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Abstract:

There is a perceivable trend for robots to serve as networked mobile sensing platforms that are able to collect data in aquatic environments in unprecedented ways. We argue that the effective transformation between Eulerian and Lagrangian data streams represents a fundamental principle underlying many ongoing research efforts. Timely transformation of data streams is the major challenge to construct cyber cycles that are needed by marine autonomy. Data driven machine learning methods have great potential, but are constrained by special difficulties for underwater communication. A distributed autonomy structure that is able to cope with the limited information sharing is envisioned as the future. This challenge can only be addressed by interdisciplinary efforts from researchers in underwater acoustics, underwater networking, and marine robotics.

This talk will discuss recent advancements towards integrating marine robotic platforms with underwater communication and networking technology. In particular, we will address the influences from both environmental motions (caused by ocean flow) and controllable platform motion on the transformation of the data streams. Even though such motions have been known to degrade the performance of acoustic communication and networking, the quantitative relationships have yet to be established, calling for tremendous efforts for theoretical analysis, simulations, and experimental study. One of our approaches, named Motion tomography (MT), develop generic environmental models (GEMs) to combine computational ocean models with real-time data streams collected by mobile sensing platforms to provide high-resolution predictions of ocean current in a small spatial area around the mobile platforms. With better known environmental motion, the performance of acoustic networking can be better analyzed. This will be demonstrated through lab-based experiments leveraging micro autonomous vehicles equipped with acoustic modems. Our efforts also indicate that future research requires open and cost-effective experimental infrastructure that integrates marine robotic platforms, underwater acoustic device, and underwater networking equipment.

Bio:

Dr. **Fumin ZHANG** is Professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology. He received the B.S. and M.S. degrees from Tsinghua University, Beijing, China, in 1995 and 1998, respectively. 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. He also serves as the deputy editor-in-chief for the Cyber-Physical Systems Journal.