Title:

Information Asymmetry from Relative Sensing in Multi-Robot Systems

Abstract:

Groups of robots working collaboratively have the potential to change the way we sense and interact with our environment at large scales. However, in order to be useful in the real world, multi-robot systems must deal with the inherent asymmetry introduced by on-board sensing. Two robots carrying their sensors on-board will see the same world from different vantage points, leading to fundamental problems in multi-robot algorithm design and analysis. This talk will describe our recent efforts to explore control algorithms that are provably tolerant to this information asymmetry. First, I will describe a formation control scenario in which we would like a group of aerial robots to converge to a desired formation without a shared global reference frame. The robots use only on-board, downward-facing cameras for sensing. We propose a novel nonlinear control architecture that ensures asymptotic convergence to the desired formation. Experimental results with this control algorithm implemented on a network of quadrotor aerial robots will be shown. Next, I will describe recent efforts to characterize a broad class of multi-robot control algorithms that do not require a common reference frame. We call these control strategies SE(3) invariant because the motion of the robots under such a controller is invariant under rigid body (or SE(3)) transforms. We show that a multi-robot controller is SE(3) invariant if and only if it is quasi-linear. I will end with a discussion of open questions and next steps.

Bio:

Mac Schwager is an assistant professor in the Department of Mechanical Engineering and the Division of Systems Engineering at Boston University. He obtained his BS degree in 2000 from Stanford University, his MS degree from MIT in 2005, and his PhD degree from MIT in 2009. He was a joint postdoctoral researcher in the GRASP lab at the University of Pennsylvania and CSAIL at MIT from 2010 to 2012. His research interests are in distributed algorithms for control, perception, and learning in groups of robots and animals. He received the NSF CAREER award in 2014.