

SPECIAL SEMINAR

DISTRIBUTED CONSENSUS IN MULTI-VEHICLE COOPERATIVE CONTROL: THEORY AND APPLICATIONS

Professor Wei Ren
Department of Electrical and Computer Engineering
Utah State University
Logan, UT

Abstract

While autonomous vehicles that perform solo missions can yield significant benefits, greater efficiency and operational capability will be realized from teams of autonomous vehicles operating in a coordinated fashion. Potential applications for multiple autonomous vehicles include autonomous household appliances, hazardous material handling systems, distributed reconfigurable sensor networks, surveillance and reconnaissance, space-based interferometry, and future autonomous combat systems. To enable these applications, a variety of cooperative control capabilities need to be developed. These capabilities include formation control, rendezvous, attitude alignment, flocking, foraging, task and role assignment, payload transport, air traffic control, and cooperative search. Execution of these capabilities requires that individual vehicles share a consistent view of the objectives and the world. Information consensus guarantees that vehicles sharing information over a network topology have a consistent view of information that is critical to the coordination task. By necessity, consensus algorithms are designed to be distributed, assuming only neighbor-to-neighbor interaction between vehicles. Consensus algorithms have applications in rendezvous, formation control, flocking, attitude alignment, and sensor networks.

The purpose of this talk is to overview our recent research in distributed consensus algorithms and their applications in multi-vehicle cooperative control. Theoretical results on distributed consensus algorithms where the dynamics of the information state evolve according to first- and second-order dynamics and according to rigid body attitude dynamics and Euler-Lagrange equations will be introduced. Application examples of the distributed consensus algorithms in multi-vehicle cooperative control including rendezvous and formation keeping for wheeled mobile robots, UAV formation flying, deep space spacecraft attitude alignment, and synchronization of networked Euler-Lagrange systems will also be introduced.

Speaker's Biographical Sketch

Wei Ren received the B.S. degree in electrical engineering from Hohai University, China, in 1997, the M.S. degree in mechatronics from Tongji University, China, in 2000, and the Ph.D. degree in electrical engineering from Brigham Young University, Provo, UT, in 2004. From October 2004 to July 2005, he was a research associate in the Department of Aerospace Engineering at the University of Maryland, College Park, MD. Since August 2005, he has been an assistant professor in the Electrical and Computer Engineering Department at Utah State University, Logan, UT. His research focuses on cooperative control of multi-vehicle systems, cyber-physical systems, and autonomous control of unmanned vehicles. Dr. Ren is an author of the book *Distributed Consensus in Multi-vehicle Cooperative Control* (Springer-Verlag, 2008). He was a recipient of the National Science Foundation CAREER Award in 2008. He is currently an Associate Editor for the IEEE Control Systems Society Conference Editorial Board.

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