Cymer Center for Control Systems and Dynamics

A Passivity-based Approach to Distributed Control and Optimization: from Robots to Networks

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Cooperative systems with distributed decision making arise in many nature and man-made systems, for examples, collaborative load carrying in social insects, formation flying in flocking birds, congestion control in data networks, power distribution in power systems, and collaborative transport and assembly in team robots. In the absence of a centralized leader or coordinator, it is still possible to achieve a common group objective without explicit coordination and communication between the individual actions. Such cooperative collective behavior is made possible by indirect communications through local information feedback. In this talk, we consider the stability, performance, and robustness of several distributed control examples: formation control, collaborative load carrying by multiple robots, network flow regulation, and CDMA power control. The main tool that we use is the concept of passivity. Passivity is motivated by energy conservation or dissipation in physical systems and has long been used in the stability analysis and design of nonlinear feedback systems, including mechanical structures and electrical circuits. I will review the passivity approach and then present its applications to the distributed control of various problems. Several other current research areas including iterative learning control, microsystem assembly, adaptive optics, and vapor compression systems will also be briefly discussed.

John T. Wen received his B.Eng. from McGill University in 1979, M.S. from University of Illinois in 1981, and Ph.D. from Rensselaer Polytechnic Institute in 1985, all in Electrical Engineering. From 1985-1988, he was a member of technical staff at the Jet Propulsion Laboratory, where he worked on modeling and control problems for large space structures and space robots. Since 1988, he has been with Rensselaer Polytechnic Institute where he is currently a professor in the Department of Electrical, Computer, and Systems Engineering with a joint appointment in the Department of Mechanical, Aerospace, and Nuclear Engineering. He was appointed in 2005 as the Director of a New York State sponsored interdisciplinary research center, Center for Automation Technologies and Systems (CATS). He was an ASEE/NASA Summer Faculty Fellow in 1993, a Japan Society for the Promotion of Science (JSPS) Senior Visiting Scientist in 1997, and an Oversea Assessor by the Chinese Academy of Sciences since 2004. Dr. Wen is a Fellow of IEEE.