



THE DEPARTMENT OF EECS & FEEDER Center  
Present the Fall 2013 EECS Distinguished Lecture

**Dr. Frank L. Lewis**  
The University of Texas at Arlington

**“Cooperative Control: Stability, Optimality, Learning, and Games on Graphs: Applications to Microgrid”**  
Thursday, October 17, 2013 • 2:00 p.m. • HEC 101

## **ABSTRACT**

Distributed systems of multiple agents linked by communication networks only have access to information from their neighboring agents, yet must achieve global agreement on team activities to be performed cooperatively. Examples include networked manufacturing systems, wireless sensor networks, networked feedback control systems, and the internet. Sociobiological groups such as flocks, swarms, and herds have built-in mechanisms for cooperative control wherein each individual is influenced only by its nearest neighbors, yet the group achieves consensus behaviors such as heading alignment, leader following, exploration of the environment, and evasion of predators. It was shown by Charles Darwin that local interactions between population groups over long time scales lead to global results such as the evolution of species. Natural decision systems incorporate notions of optimality, since the resources available to organisms and species are limited.

In this talk we present design methods for cooperative controllers for distributed systems. The developments are for general directed graph communication structures. Cooperative control design is complicated by the fact that the graph topology properties limit what can be achieved by the local controller design. Thus, local controller designs may work properly on some communication graph topologies yet fail on other topologies. The relations between stability and optimality are far more intriguing for cooperative control systems than for standard control systems due to the intertwinings between agent dynamics and graph topology. We will discuss Optimality on Graphs, Graphical Games, Reinforcement Learning on Graphs and Applications to Microgrid.

## **BIOGRAPHY**

Dr. Lewis was born in Würzburg, Germany, subsequently studying in Chile and Gordonstoun School in Scotland. He obtained his BS degree in Physics/Electrical Engineering and an MS degree in Electrical Engineering at Rice University in 1971. He spent six years in the U.S. Navy, serving positions as Navigator, Executive Officer and Acting Commanding Officer. In 1977 he received an MS degree in Aeronautical Engineering from the University of West Florida. In 1981 he obtained the Ph.D. degree at The Georgia Institute of Technology in Atlanta, where he was employed as a professor from 1981 to 1990. He is a Professor of Electrical Engineering at The University of Texas at Arlington, where he was awarded the Moncrief-O'Donnell Endowed Chair in 1990 at the UTA Research Institute. Fellow of the IEEE, Fellow of IFAC, Fellow of the U.K. Institute of Measurement & Control, Member of the New York Academy of Sciences. Registered Professional Engineer in the State of Texas and Chartered Engineer, U.K. Engineering Council. Charter Member of the UTA Academy of Distinguished Scholars and Senior Research Fellow of the UTA Research Institute. IEEE Control Systems Society *Distinguished Lecturer*. Founding Member of the Board of Governors of the Mediterranean Control Association.

Current interests include intelligent control, distributed cooperative control on graphs, nonlinear systems, reinforcement learning, manufacturing process control, condition-based maintenance, and neurobiological systems.

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