EE 5329 Distributed Decision & Control (3-0)

To be offered Spring 2018

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Course Website: [http://www.uta.edu/utari/acs/ee5329/ee5329home.htm](http://www.uta.edu/utari/acs/ee5329/ee5329home.htm)

Topics include cooperative decision and control algorithms for networked teams of dynamical multi-agent systems on communication graphs. Included are local distributed decision protocols that yield global team behavior, synchronization of dynamics including coupled oscillators and chaotic systems, analysis of stability and consensus convergence behaviors, and group decision and adversarial games on graphs.

Applications are to vehicle formation control, satellite coordination, animal behaviors such as swarms, flocks, and schools, and to engineering systems such as dynamical systems on communications networks, networked teams of autonomous systems and vehicles, formation flight, and group consensus decision.

Prerequisites: none.

Motivation for the Course

This course is motivated by recent developments in the study and analysis of naturally occurring biological groups such as herds, flocks, schools, where each individual acts only under the influence of its neighbors, and yet complex synchronized motions of the group appear as emergent behaviors. Teams in disaster relief, reconnaissance, and elsewhere are heterogeneous networks consisting of interacting humans, ground sensors, and unmanned airborne or ground vehicles. By observing animal and other naturally occurring collective behaviors new algorithms for team coordination, decision, and consensus are being developed. The goal is to develop local decision and control protocols that do not rely on a central or global authority, yet result in provable achievement of global performance objectives.

The circadian rhythm is a naturally occurring periodic activity within which many observed species synchronize to diurnal periodic behaviors. Fireflies synchronize in their emission of light and crickets in their chirping, self-propelled particles in fluids interact such as to synchronize their motion. The Internet has emerged as a dynamical interactive system that permits synchronization of the activities and thoughts of widely separated individual nodes. The electric power grid is a large-scale networked system within which each local area must synchronize to the same power generation frequency. A special class of Kuramoto nonlinear oscillators describes the collective motion and phase transitions in distributed chemical mixing systems and animal groups.

Studies of synchronization, distributed decision mechanisms, and cooperative control systems can provide better algorithms for decision and control in distributed networked teams of dynamical agents that lead to guaranteed group achievement of prescribed mission goals.