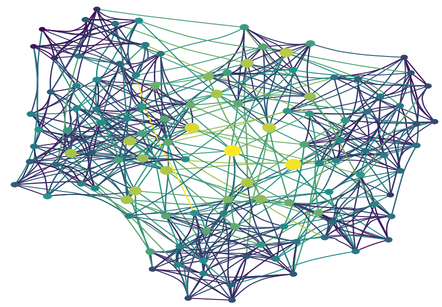
Autonomous Multi-Agent Systems (Spring 2020)



When: Tuesdays & Thursdays 2:40-3:55

Instructor: James Anderson (`ja3451@columbia.edu`)

Course website: `https://tinyurl.com/e6899`

Who: Graduate students (all disciplines) with an interest in mathematical aspects of system theory.

Course Description

This course is an **introduction to the mathematical foundations of control and analysis of networked dynamical systems** (otherwise known as multi-agent systems). The goal of the course is to provide the technical skills needed to model and analyze decision-making problems for networks of interacting dynamical systems (agents) whose goal is to achieve a global behavior using only local interactions.

Core theory to be covered will include:

- Consensus, coordination, and flocking behavior
- Control and performance limitations of vehicle platoons
- Scalable distributed control
- Oscillator synchronization
- Safety and verification of multi-agent systems

Control and dynamical systems provides a rich framework to work from. As such, the potential application areas and case studies we can draw from is vast. Depending on student interest we may examine: **traffic networks, cooperative robotics, power systems and/or smart grids, crowd movement, internet congestion control, cyber-attacks, smart cities, and social networks.** If time permits, we will consider the problem of learning models from data.

Organization

The instructor will provide background lectures on linear dynamical systems, graph theory, and convex optimization, as well as introductory lectures on each of the core topics above. The remainder of classes will be student-led lectures consisting of paper presentations and group discussions. Assessment will be based on class participation, paper presentation, and a course project.

Prerequisites

There are **no specific course prerequisites** for this class beyond mathematical maturity. Students will be expected to read, understand, and present mathematical proofs. **A strong working knowledge of linear algebra and calculus will be assumed**. Previous classes in control (linear systems theory) and convex optimization would be helpful but are not necessary. **The course website will provide further details of the mathematical prerequisites.**