Department of Electrical & Computer Engineering
Concordia University

ENGR 6121: Control of Multi-Agent Systems

Winter 2022

Lectures: Mondays: 5:45 pm – 8:30 pm (LS 110) and on-line (Zoom link in the Moodle)

Instructor: Dr. Rastko Selmic (rastko.selmic@concordia.ca)

Office Hours: Mondays: 4:00 pm – 5:00 pm (EV 5.169) or by appointment (Zoom: https://concordia-ca.zoom.us/j/93607323322?pwd=ZEZGejBtZG5BQU9vdXpQUjJoNk92QT09)

Teaching Assist.: Mr. Amir Moradi (amir.94.eng@gmail.com)

URL: http://users.encs.concordia.ca/~rselmic/teaching/ENGR6121

Description:
Review of stability and systems theory. Basics of nonlinear systems, Lyapunov theory, and graph theory related to multi-agents. Spectral graph theory, Voronoi diagrams and Delaunay triangulations, cooperative control, formation control, coverage control, distributed estimation over multi-agents, cooperative localization, and leader-follower networks. A project is included involving a simulation development and coding.

Topics:
Lecture 1, 2: Review, fundamentals of Lyapunov theory
Lecture 3: Introduction to graph theory
Lecture 4: Spectral graph theory
Lecture 5: Voronoi diagrams and Delaunay triangulations
Lecture 6, 7: Cooperative control of multi-agents
Lecture 8, 9: Formation control of multi-agents
Lecture 11: Distributed estimation over multi-agents
Lecture 10: Coverage control of multi-agent systems
Lecture 12: Cooperative localization, leader-follower networks
Lecture 13: Project presentations

Prerequisites: Linear Systems (ENGR 6131)

Reference Texts:

1. M. Mesbahi and M. Egerstedt, *Graph Theoretic Methods for Multiagent Networks*, Princeton University Press, Princeton, NJ, 2010.
2. F. Bullo, J. Cortes, and S. Martinez, *Distributed Control of Robotic Networks: A Mathematical Approach to Motion Coordination Algorithms*, Princeton University Press, Princeton, NJ, USA, 2009.

Other Course Material:

Homework and reading assignments will be distributed either during the lectures in classroom or posted on the course website.

Grading Scheme:

Each student will be awarded a letter grade based on the following weighting of grades:

- Homework: 15%
- Final Exam: 50%
- Project and Presentation: 35%

Homework:

Homework will provide hands-on experiences related to the theoretical concepts covered in the class. Homework should be submitted before the start of the lectures. No late homework will be accepted.

Project and Presentation:

The project will be assigned in class that will include coding in MATLAB or other simulation environment. The project proposal is due on Monday, February 21. Based on the project results, students will write a report in IEEE format and present it in class. The project report is due on Monday, April 11. The report should be 4 pages long, double column, following the strict IEEE formatting standard including references.

Expectations of Originality Form:

The students are required to review, complete, and submit the Expectations of Originality form:
https://www.concordia.ca/encs/students/sas/expectation-originality.html