ME599/CEE501/ROB599 DYNAMICS AND CONTROL OF CONNECTED VEHICLES W 2019

Instructors:

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Lectures: Tu 12:00pm - 1:30pm, CHRYS 151
Th 12:00pm - 1:30pm, CHRYS 151

Recitation: Fr 3:30pm - 5:00pm, CHRYS 151

Office hours: Email to meet with the professor

Prerequisites: You are expected to have knowledge of differential equations, linear algebra, and Laplace or Fourier transform.

Reading: Materials will be provided as the course progresses

Course description: This course focuses on modeling and control of connected vehicle systems consisting of human driven and connected automated vehicles. Models are built in terms of ordinary differential equations and delay differential equations. The stability of uniform flow equilibrium studied at the linear and nonlinear levels. Controllers for connected automated vehicles are designed so that they can ensure stability and disturbance attenuation around the equilibrium. The impacts of utilizing connectivity in order to ensure traffic safety and efficiency are highlighted.

The Engineering Honor Code: http://www.engin.umich.edu/students/honorcode/
No member of the community shall take unfair advantage of any other member of the community.

Homework Assignments: Six homework assignments will be set during the term that will be posted on canvas. Homework sets are due no later than the start of class on Thursdays. Late homeworks are accepted up to 72 hours after the deadline but 50% of the grade will be taken off. The lowest homework score for the term will be dropped. Homework solutions will be available through canvas.

Course Project: The course project will be announced during the first few weeks of the semester. During the middle of the terms there will be some sessions that will occur on the Mcity test track where students will learn about the experimental setup of V2X-based control and driving data will be taken. As part of the project student teams will propose V2X based controllers, analyze their impact using mathematical models and test them using numerical simulations. The controllers will be tested at Mcity during the end of the term and the project grades will be determined based on the experimental performance.

Examinations: Midterm Exam: Mar 8 (Wed), 6:00 - 8:00pm
Final Exam: Apr 27 (Th), 1:30 - 3:30pm

The exams will be closed book. One sheet of notes (8.5” by 11”) will be permitted for the exams (one-sided for the midterm and double-sided for the final).

Grading:

Homework	25%
Midterm Exam	25%
Project	25%
Final Exam	25%

Additional rules: no laptops, cell phones, iPods, iPads, etc. during the class

Course Outline:

1. Modeling human driving behavior
1.1 Car-following models with driver reaction time
1.2 Stability and control of time delay systems
1.3 Plant stability and string stability
1.4 Nonlinear dynamics of car-following

2. Vehicle dynamics and control
2.1 Longitudinal vehicle models
2.2 Stability and string stability under digital control
2.3 Adaptive cruise control design

3. V2X connectivity
3.1 WiFi, LTE, xG
3.2 Collecting driving data via V2X
3.3 Model fitting to V2X data

4. V2X-based vehicle control
4.1 Cooperative vs non-cooperative vehicle control
4.2 Network control systems
4.3 Head-to-tail string stability
4.4 Robust control in V2X environment
4.5 Safety, fuel economy, congestion mitigation