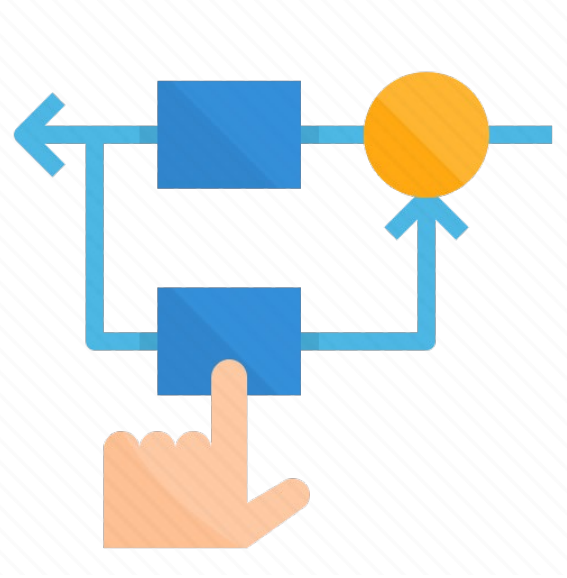
Estimation and Control Laboratory

AAE 590

Offered Every Fall Semester



Course Information

- Course number and title: AAE 59000 Estimation and Control Laboratory
- Meeting time and location:

  Laboratory Preparation: M 1:30 pm - 2:20 pm at Neil Armstrong Hall of Engr 1021
  Group ½ LAB: T 1:30 pm - 4:20 pm Potter Engineering Center 237
  Group ¾ LAB: R 1:30 pm - 4:20 pm Potter Engineering Center 237
- Course credit hours: 3
- Name of the instructor: Dr. Ran Dai
- Office Location: ARMS 3227
- Phone number: 765-496-5243
- Purdue Email Address: randai@purdue.edu

Course Description and Resources

- The primary goal of the course is to provide students with hands-on experience to practice fundamental knowledge in core areas of autonomy:
  - Estimation
  - Control
  - Optimization
  - Integration of above areas

- Introduction to common mathematical and software tools required in the experimental design and performance evaluation of autonomous systems

- No textbook is required. Relative materials will be prepared and distributed throughout the semester.

- Software: Matlab, Python, Simulink

- Brightspace page: All course-related materials will be available at Brightspace.

Learning Outcomes

On completing this course, the student shall be able to:

1. Design and implement estimation schemes to estimate the motion of a mobile object.

2. Develop and implement classical control laws for a mobile robotic system.

3. Develop and implement optimal control laws to optimize a designated performance index for a mobile robotic system.

4. Design and Implement numerical optimization algorithms in path planning problems of a mobile robot.

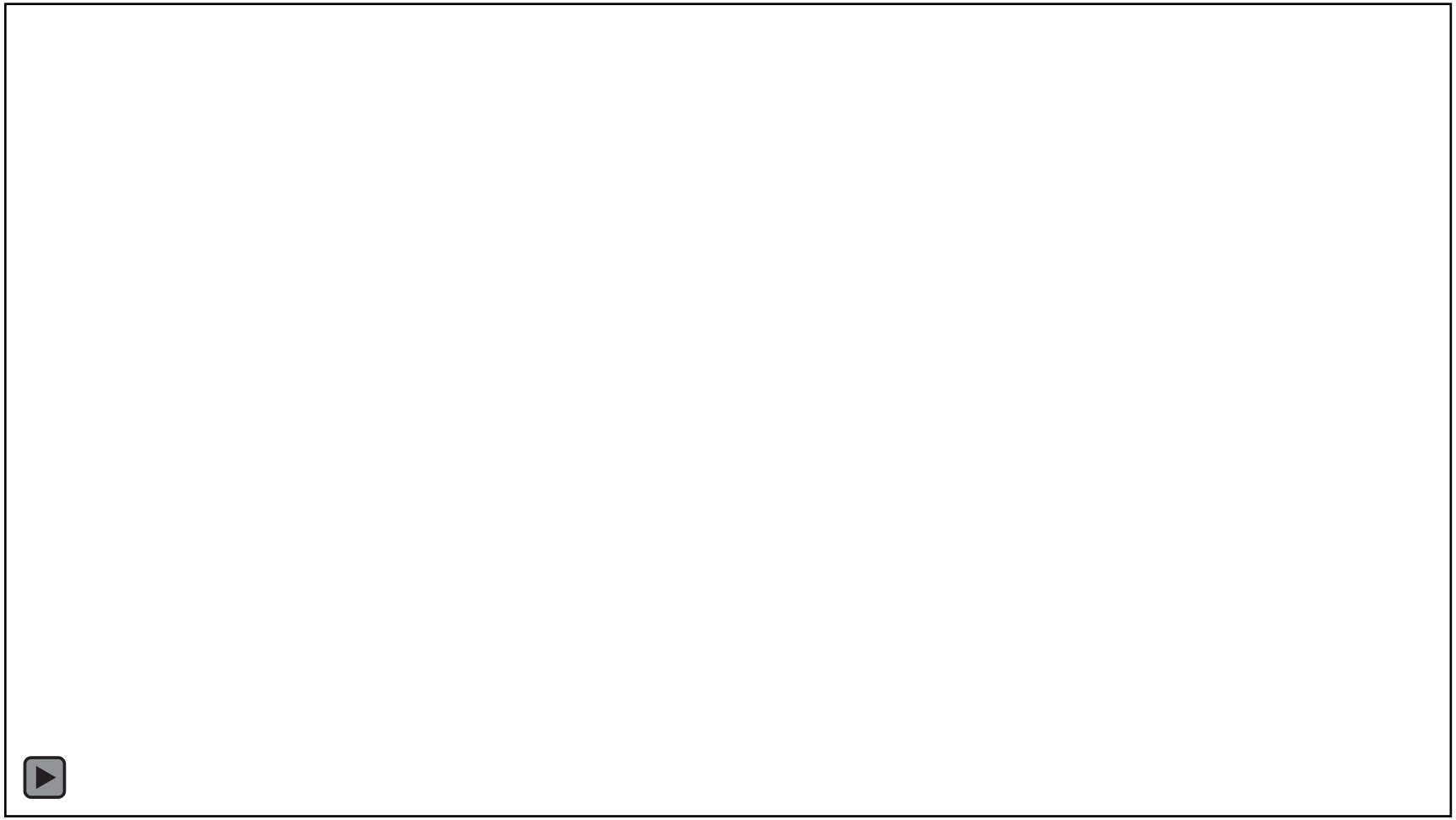
5. Construct, program, and test the operation of a robotic system to perform a specified task.

Assignments

Your learning will be assessed through a combination of six labs and one final exam spread throughout the academic period. Details on these assignments and the exam, including a schedule of due dates, rubrics to guide evaluation, and guidelines on discussion participation and evaluation will be posted on the course website throughout the semester. Assignments submission links will be provided at Gradescope.

Labs (85%): There will be 6 lab assignments throughout the semester. Lab grades will be determined using the grading rubric provided with each lab assignment.
Lab 1: Design and implement an estimation algorithm to estimate the speed of a mobile ground robot given its dynamics and location measurements.
Lab 2: Develop and implement control laws to control the motion of a mobile ground robot.
Lab 3: Develop and implement an optimal path planning algorithm for a mobile ground robot to travel between two objective points with obstacles.
Lab 4: Develop and implement a formation control algorithm for a multiagent system.
Lab 5: Develop and implement control laws to control the motion of an aerial robot.
Lab 6: Develop and implement an LQR controller to track a moving object using an aerial robot to minimize the distance error.
Final (15%): The final lab is a culmination of all the material learned through the course. The goal is to estimate the motion of a moving object and develop an algorithm to intercept the object with minimum time. The final lab will have its own grading rubric provided with the assignment.

Examples: Formation Control



Examples: Blimp Tracking