Automation and Systems Design Lab

14:540:383 Automation and Systems Design Lab
Department of Industrial & Systems Engineering · 2021 Fall

Location/Room: CoRE 106
Meeting Days/Time:
Section 1: Monday 9:00 AM - 12:00 PM
Section 2: Wednesday 9:00 AM - 12:00 PM
Section 3: Thursday 9:00 AM - 12:00 PM

Lab Instructor: Lichuan Ren
Email: lr629@soe.rutgers.edu
Office Hours: TBD

Course Overview

This course introduces students to the practical applications of automation and systems design through hands-on lab projects. Students will engage in designing, programming, and operating robotic systems and autonomous vehicles, focusing on two main case studies: a robotic arm and a JetRacer. The course emphasizes developing computer vision, control algorithms, and system integration skills. By completing weekly lab assignments, students will learn to apply theoretical knowledge to real-world systems.

Learning Outcomes

By the end of this course, students will be able to:

- Apply basic concepts of automation and control systems to robotics platforms.
- Utilize computer vision, machine learning, and control algorithms for robotics manipulation and racer car path tracking.
- Collaborate in teams to complete system challenges, including competition-based tasks.
- Produce detailed technical reports documenting the design and performance of the systems.

Grading Policy

- **50%** In-class assignments
- **50%** Lab reports

Course Schedule *(Subject to Change)*

Week	Topic	Details
1	Course Overview	Introduction to the course, expectations, and two case studies: Robot Arm and JetRacer. Overview of control schema, system requirements, and project roadmap.
2	Image Processing Basics	Introduction to image processing for object detection using camera inputs. Students will implement techniques to locate objects using a robot-mounted camera (Project 1 Subtask 1).
3	Inverse Kinematics	Introduction to inverse kinematics for robotic arms. Students will learn to calculate joint angles based on object positions and program the robot arm accordingly (Project 1 Subtask 2).
4	Project 1 - Robot Arm	Challenge 1: Rearranging blocks with the robot arm based on calculated joint angles. Students will begin implementing their solutions.
5	Project 1 - Robot Arm	Challenge 2: Tower of Hanoi problem using the robot arm. Students will design and implement solutions to this complex stacking problem.
6	Introduction to JetRacer	Overview of the JetRacer platform and control framework. Students will set up the environment and begin familiarizing themselves with basic controls and path tracking algorithms.
7	Project 2 - JetRacer	Students will tune control parameters and experiment with different path tracking controllers to optimize performance.
8	Midterm Review	Recap of key concepts from Projects 1 and 2.
9	Project 2 - JetRacer	Challenge 1: Students will tackle a complex track, requiring precise path tracking and control parameter optimization.
10	Project 2 - JetRacer	Challenge 2: Implementing traffic signal detection and response. Students will program the JetRacer to react to traffic lights and other road signals.
11	Project 2 - JetRacer	Challenge 3: Competition between student teams. Each team will compete on a set track to demonstrate their control strategies and JetRacer’s performance.
12	Lab Report Submission	Final lab reports documenting project challenges, solutions, and performance evaluations are due.

Academic Integrity

Students are expected to adhere to the highest standards of academic integrity. Any form of cheating or plagiarism will not be tolerated and will result in disciplinary action.

Attendance Policy

Attendance is mandatory. Active participation in all lab sessions is required for successful completion of the course.