Safe and Interactive Robotics

Logistics

Autumn Quarter, 3-4 Units

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Lectures: Tue, Thu 3:00 PM - 4:20 PM, McMurtry Building 360

Office Hours: Gates 142 (by appointment)

Description

Once confined to the manufacturing floor, robots are quickly entering the public space at multiple levels: drones, surgical robots, service robots, and self-driving cars are becoming tangible technologies impacting the human experience. Our goal in this class is to learn about and design algorithms that enable robots to reason about their actions, interact with one another, the humans, and the environment they live in, as well as plan safe strategies that humans can trust and rely on.

This is a project-based graduate course that studies algorithms in formal methods, control theory, and robotics, which can improve the state-of-the-art human-robot systems. We focus on designing new algorithms for enhancing safe and interactive autonomy.

Format

The course is a combination of lecture and reading sessions. The lectures discuss the fundamentals of motion planning, formal methods applied in robotics, learning from demonstration, intent inference, and shared control required for modeling and design of safe and interactive autonomy for human-robot systems. During the reading sessions, students present and discuss recent contributions in this area. Throughout the semester, each student works on a related research project that they present at the end of the semester.

Prerequisites

There are no official prerequisites, but an introductory course in artificial intelligence and robotics is recommended.

Learning Objectives

At the end of this course you will have gained knowledge about applications of various topics in designing safe and interactive autonomous systems: temporal logics, reactive synthesis, planning and control, learning and human modeling, game theoretical foundations of interactive systems, safe learning, etc.

You will also have hands-on experience working on a research project and it is expected that you will gain the following research skills: analyzing literature related to a particular topic, critiquing papers, and presentation of research ideas.

Grading

Final Project (50%) Each student is required to work individually or in groups of two on a research project. The project requires a 2-page proposal including the relevant literature survey, a 6-10 page-long final report, and a final presentation/demo. Students who are taking the class for 4 units are required to work individually on their projects.

Student Presentations & Paper Reviews (30%) All students will get a chance to present multiple papers throughout the class during the reading days. Each paper will have two presenters each discussing the pros or cons of the paper. The presenters need to send the reviews (conference style) of their reading assignments 48 hours before the class. The presentation grade is based on how well the material is presented, how well it is connected to the rest of the papers or class, and how prepared the student is in answering questions from the class.

Scribing & Class Participation (20%) Students take turns to scribe the lecture notes of each lecture. The scribe notes are due within a week of every lecture. Students are also encouraged to participate in class as well as Piazza discussions.

Project Instructions

The research project throughout the class should study a new research problem, i.e., design a new algorithm, study a new application, etc. Literature surveys are not acceptable. The main deliverables of the project are:

Project Proposal (5%) A 2-page proposal that has identified the problem definition, literature survey, and a timeline.

Project Proposal Presentation (10%) A short presentation discussing the proposal, limitations, and challenges.

Project Presentation, Possibly with Demo (15%) A 15-min presentation reporting the final findings of the project.

Final Project Report (20%) A 6-10 page-long project report.