Special Topics Courses

RBE 595 Special Topics courses are arranged by individual faculty with special expertise, these courses survey fundamentals in areas that are not covered by the regular Robotics Engineering course offerings. Courses are not always offered each semester.

RBE 595 courses offered in Fall 2023:

Hands-On Autonomous Aerial Robotics (In-Person, A-Term)

This course will discuss and apply computer vision, planning, AI and control on aerial robots. Students will show mastery of the subject through hands-on activities which include developing real-time computing algorithms for the realization of autonomous aerial systems. Topics include rigid body transformations, attitude estimation, Bayesian filters, linear and unscented Kalman filters, camera models, Gaussian mixture models, image processing, visual feature detection and tracking, projective geometry, optical flow, stereopsis, quadrotor dynamics and controls, and structure from motion/SLAM. Prerequisites: Undergraduate-level linear algebra, calculus, and programming. Graduate-level robot dynamics and controls are helpful but not required.

Reinforcement Learning (Online, Fall Semester)

This course will provide a solid introduction to the field of Reinforcement Learning (RL). Students will learn about the core challenges and approaches including Markov decision processes, model based and model free control, on-policy and off-policy learning as well as exact and approximate solution techniques. Through a combination of lectures and coding assignments, students will become well versed in key ideas and techniques in RL and its application in robotic systems. To get students familiarized with the state-of-the-art RL algorithms in robotics, research papers are provided, and students are required to give a presentation about the papers. In addition, end of the term team project would allow the students to apply mastery of the subject to a real-world robotics application. Prerequisites: Basic knowledge of probability and programming languages such as python/MATLAB.

Robotic Materials (In-Person, Fall Semester)

Robots are typically comprised of discrete components including sensors, actuators, electronics, and power supplies and are housed inside a chassis. Although such robots are typically self-sufficient (untethered) and capable of increasingly autonomous behaviors, they possess a low degree of integration, standing in explicit contrast to biological systems. For example, humans possess 100s of skeletal muscles (robots possess 10s of actuators), a vasculature (vs. centralized power), a nervous system (vs. centralized control), and are grown (vs. assembled). In robotic materials research, we develop composites that combine sensing, actuation, computation, and power. Robotic materials do not only differ from traditional robots in their degree of integration, but also their compliance. Robotic materials are typically flexible allowing for new types of robotic applications including wearables for healthcare, foldable structures for aerospace, and expandable structures for aquatic environments. In this course, students will be introduced to the fabrication techniques, the characterization, and control of robotic materials. We will focus on fluidically and electromagnetically driven robotic materials.