FACULTY MENTOR
Nikolay Atanasov

PROJECT TITLE
Python Robotics

PROJECT DESCRIPTION
Description: This project focuses on developing a python simulation of a 3-D environment with two mobile robots: an autonomous racecar and a quadrotor, equipped with onboard sensors (camera, Lidar, IMU, etc.). The project also focuses on implementation of core robotics algorithms for localization, mapping, planning, and control in python. Particular examples include occupancy-grid mapping, particle-filter localization, A* motion planning, and proportional-derivative control. The project emphasizes the creation of demos, visualization, and documentation.
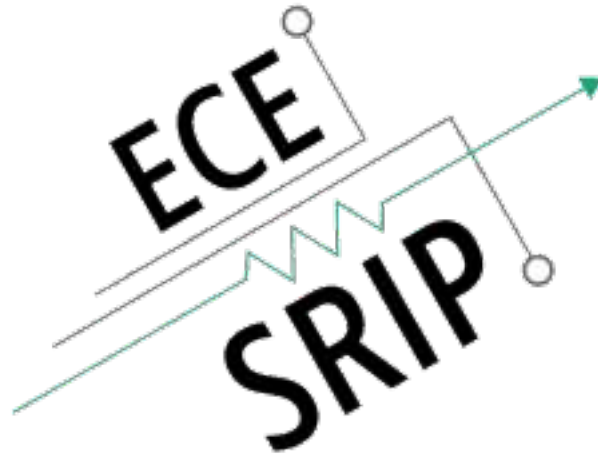
This project can accommodate both remote and in-person students

INTERNS NEEDED
2 Students

PREREQUISITES
1. Experience with object oriented programming, data structures, and algorithms is required. Experience in robotics, e.g., at the level of Probabilistic Robotics by Thrun, Burgard & Fox is preferred but not required.

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PROJECT TITLE
Hardware Design for Autonomous Quadrotor Robots

PROJECT DESCRIPTION
Description: This project focuses on building a fully functioning autonomous quadrotor robot, including sensors (cameras, inertial measurement unit, lidar), a flight controller, a computer, motors, and battery. The project requires experience with laser cutting, 3D printing, electrical design and CAD modeling to connect and power all robot components. Once the hardware is in place, the project will focus on installation of the robot operating system (ROS) and relevant drivers on the onboard computer to enable communication with the sensors and flight controller. Sensor calibration and synchronization may be considered as well.
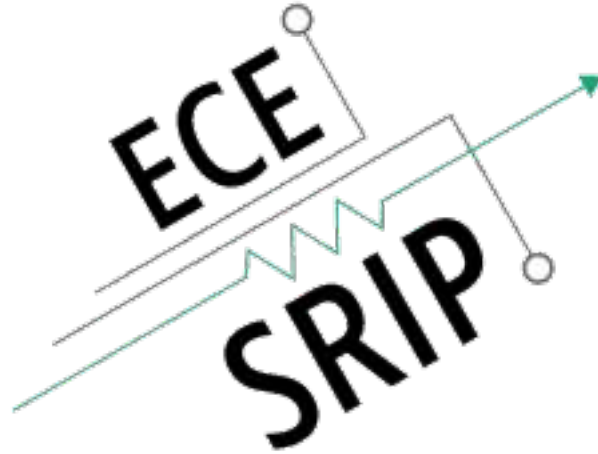
This project will be in person.

INTERNS NEEDED
1 Student

PREREQUISITES
1. Candidates are expected to have experience with CAD software, soldering, 3D printing, and PCB design. Experience with C++ programming is preferred but not required.

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PROJECT TITLE
Semantic Segmentation and Terrain Mapping

PROJECT DESCRIPTION
Description: This project involves depth estimation and semantic segmentation for terrain mapping of an outdoor environment using an aerial robot. The project will focus on semi-supervised learning and domain adaptation for classification of rare semantic categories using RGB and thermal images. This requires design and training of neural network models, which transfer features from one sensing modality to another and from one semantic category to another.
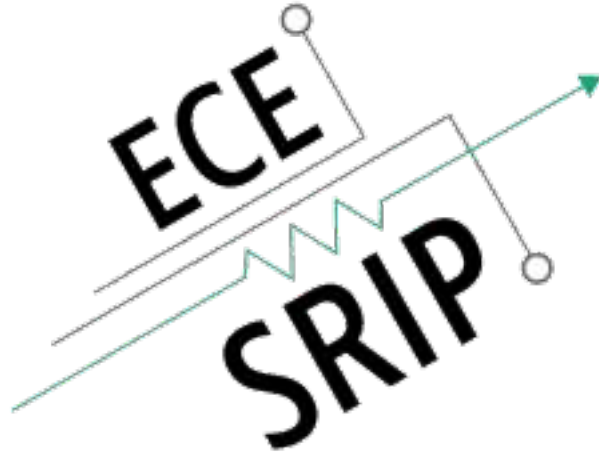
This project can accommodate both remote and in-person students

INTERNS NEEDED
1 Student

PREREQUISITES
1. Experience with supervised machine learning, deep learning, and python programming is required.

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PROJECT TITLE
Inverse Reinforcement Learning

PROJECT DESCRIPTION
Description: This project focuses on teaching a robot from demonstration to navigate or pick objects up in an unknown environment. The objective is to develop an inverse reinforcement learning algorithm that infers the cost function used by the expert who provided the demonstrations. The project will focus on the same setting as the ManiSkill challenge: https://sapien.ucsd.edu/challenges/maniskill2021/.
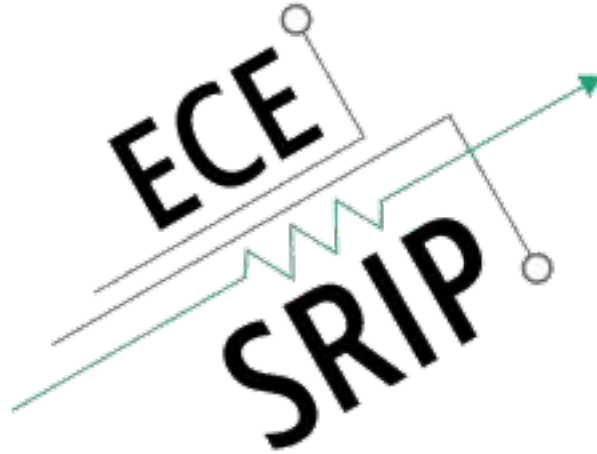
This project can accommodate both remote and in-person students

INTERNS NEEDED
1 Student

PREREQUISITES
1. Experience with machine learning and reinforcement learning is required. Proficiency with Python or C++ is required. Experience with OpenAI Gym (https://gym.openai.com/) is preferred but not required.

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PROJECT TITLE
Multi-agent Simultaneous Localization and Mapping

PROJECT DESCRIPTION
Description: The goal of this project is to enable multiple robots to map an unknown environment collaboratively. The project will consider either sparse object-level mapping or dense occupancy mapping. Probabilistic estimation techniques such as Kalman filtering or Gaussian Process regression will be emphasized. The developed algorithms will be implemented in C++ and ROS (https://www.ros.org/) with emphasis on real-time performance.

This project can accommodate both remote and in-person students

INTERNS NEEDED
1 Student

PREREQUISITES
1. Experience with object-oriented programming, data structures, and algorithms as well as proficiency in C++ is required.