## FACULTY MENTOR
Michael C. Yip

## PROJECT TITLE
Development of Reinforcement Learning Environments for Surgical Robotics

## PROJECT DESCRIPTION
Description: To develop and improve simulation and sim to real world transfer for surgical robotics. The simulations will be utilized to explore Reinforcement Learning strategies for automating of surgical tasks such as needle passing, suturing, and soft tissue interaction.
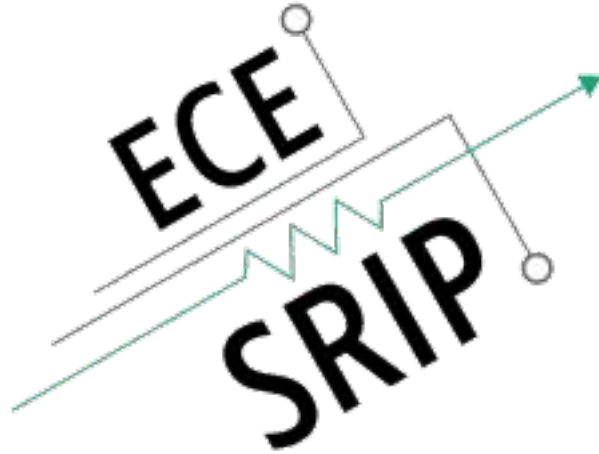
## INTERNS NEEDED
2 MS

## PREREQUISITES
Required Qualifications:
1. Must have taken ECE 276C

## FACULTY MENTOR
Michael C. Yip

## PROJECT TITLE
Machine Learning for Robot Planning and Control

## PROJECT DESCRIPTION
Description: The project will focus on leveraging machine learning techniques to speed-up the robot sampling-based motion planning algorithms.
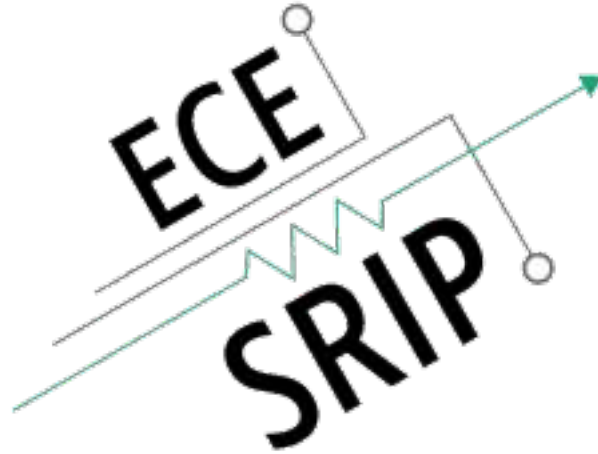
## INTERNS NEEDED
3 MS and 1 BS

## PREREQUISITES
Required Qualifications:
1. Strong programming skills in C++ & Python, Deep Learning Libraries (Pytorch, etc.)
2. Knowledge of ROS is a plus

## FACULTY MENTOR
Michael C. Yip

## PROJECT TITLE
Machine Learning for Task and Motion Planning

## PROJECT DESCRIPTION
Description: The project will develop and explore the deep learning techniques that can infer the relational information between different objects from expert video demonstrations. The motion planning algorithms will exploit the relational knowledge graph for task and motion planning.
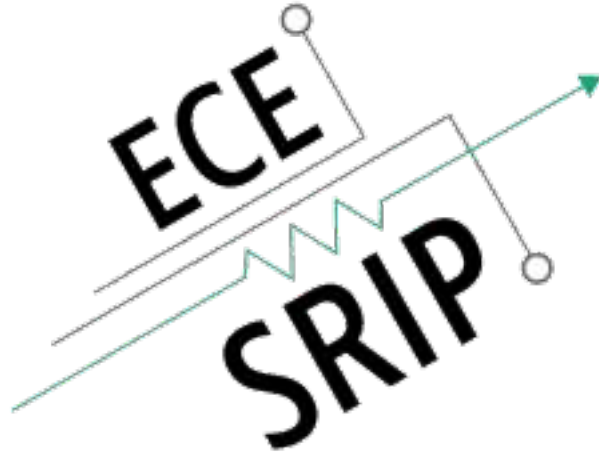
## INTERNS NEEDED
2 MS

## PREREQUISITES
Required Qualifications:
1. Strong programming skills in C++ & Python, Deep Learning Libraries (Pytorch, etc.)
2. Knowledge of Graph Convolutional Networks is a plus

## FACULTY MENTOR
Michael C. Yip

## PROJECT TITLE
Hierarchical Reinforcement Learning for real-world Robotics problems

## PROJECT DESCRIPTION
Description: The project will explore and develop hierarchical deep reinforcement learning methods that can leverage expert demonstrations and robot primitive skills to extract a robot policy for complex robot manipulation tasks.
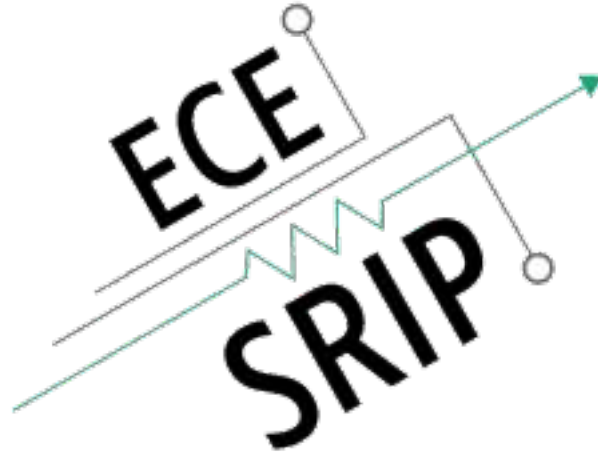
## INTERNS NEEDED
2 MS

## PREREQUISITES
Required Qualifications:
1. Strong programming skills in C++ & Python, Deep Learning Libraries (Pytorch, etc.)
2. Knowledge of Reinforcement Learning is a plus

## FACULTY MENTOR
Michael C. Yip

## PROJECT TITLE
Integration of Learning-based Motion Planners with standard motion planning libraries

## PROJECT DESCRIPTION
Description: The project aims to integrate a new class of learning-based motion planning methods into existing motion planning libraries such as OMPL. The main objectives will be to parallelize the data-generation heuristic of existing learning-based planners and to release an OMPL integrated learning-based planning library.
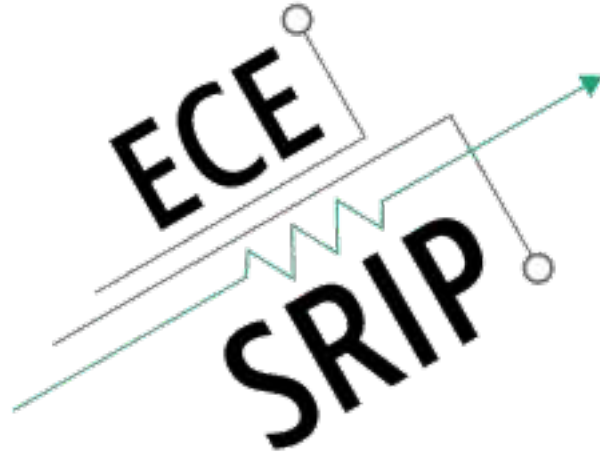
## INTERNS NEEDED
2 MS

## PREREQUISITES
Required Qualifications:
1. Professional level skills in C++ and Python
2. Knowledge of ROS/OMPL is a plus

## FACULTY MENTOR
Michael C. Yip

## PROJECT TITLE
Bayesian Reinforcement Learning for Needle Insertion Task In Robot Surgery

## PROJECT DESCRIPTION
Description: Finding a set of needle poses that allows maximum maneuverability to the surgeon operating through robot is a challenging problem. In this project, we aim to explore Bayesian Optimization to sample such poses under uncertainty.
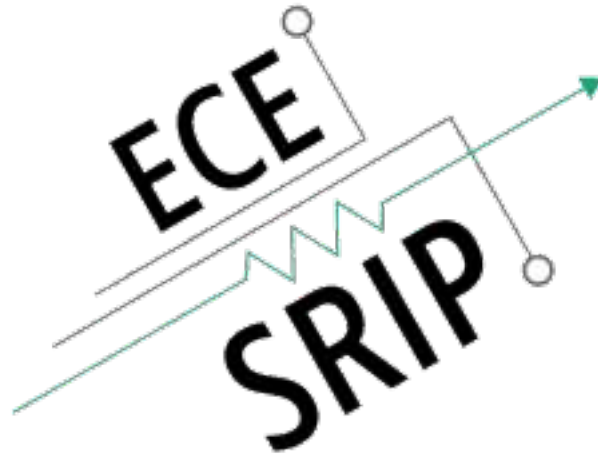
## INTERNS NEEDED
1 MS

## PREREQUISITES
Required Qualifications:
1. Experience in C++, Python, and Statistical Learning

## FACULTY MENTOR
Michael C. Yip

## PROJECT TITLE
Surgical Robotic System Tracking within an MRI Scanner

## PROJECT DESCRIPTION
Description: This project involves the development of a surgical robotic system tracking system. There are two aspects to this system:
using external cameras for system tracking
using the MRI scanner itself for system tracking
This project will use a combination of electromagnetics and circuits, statistical image processing, computer vision, and deep learning.

## INTERNS NEEDED
2 MS and 2 BS

## PREREQUISITES
For Camera Tracking:
1. Students should have experience with computer vision
2. Experience programming in C++/Python and work with OpenCV
3. Experience with camera selection, electromagnetics, and circuits will be beneficial
4. Experience with machine learning and statistical image processing is useful
For MRI Scanner:
1. Strong experience with circuits and RF
2. Experience with programming will be needed for data processing (Matlab/Python/C++)