FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Image collection with drones

PROJECT DESCRIPTION
The last few years have shown that a critical component in the design of effective image classification systems is the availability of large training datasets. Drones are a new way to collect large numbers of images of objects in a relatively inexpensive manner. We are interested in collecting datasets of objects under many views and in collecting datasets of scenes. The students will develop protocols for the use of drones in data collection and apply those protocols to the assembly of a few datasets. These will then be used to train deep learning systems for object recognition. The development will be for the Intel Aero drone, using the Robotic Operating System (ROS). This project aims for both application and top-tier conference publication.

INTERNS NEEDED
4 BS or MS students

PREREQUISITES
MS or undergraduate. Candidates are expected to have basic knowledge of Python, Linux and computer vision. Knowledge in robotics/control theory would be a plus
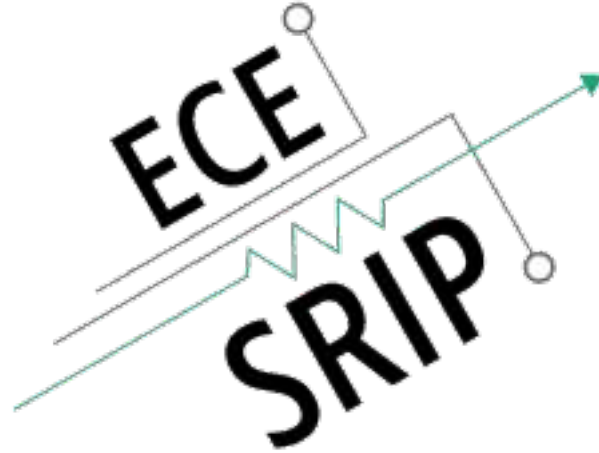
FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Object size estimation from one single real-world image
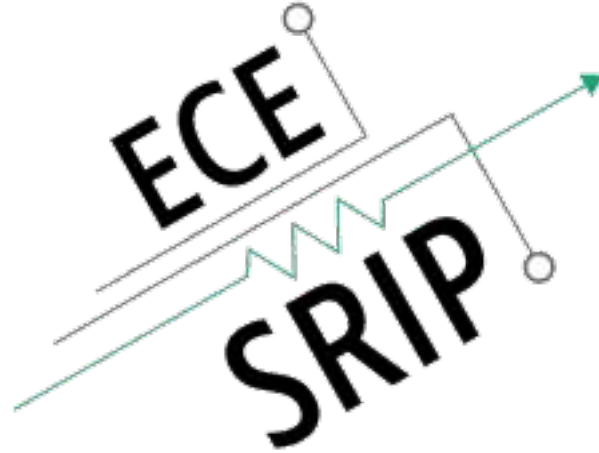
PROJECT DESCRIPTION
Object size estimation from real world images is an interesting, practical but non-trivial problem. Our final goal is to design an algorithm to measure the object size from real world images without providing reference in advance. The students will have two major tasks: collecting a small scale labeled dataset and developing a weakly supervised learning algorithm for size measurement. The data can be collected by downloading labeled images from the Internet or taking new pictures and measuring objects within them. Using these data, a weakly supervised deep learning model will be trained to choose the best reference from images automatically. Finally, this reference can be utilized to estimate object size. This project aims for both application and top-tier conference publication.

INTERNS NEEDED
4 BS or MS students

PREREQUISITES
MS or undergraduate. Candidates are expected to have basic knowledge of mathematics, computer vision and deep learning, and to be adept with at least one commonly used programming language, such as C++, Python, matlab. Mastering one deep learning framework like Pytorch, Tensorflow is a plus.

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Biological Imaging

PROJECT DESCRIPTION
Large scale annotated datasets are critical for learning effective classification networks. To improve the scalability of the collection process, images are typically gathered using online search engines. However, these sources can be biased with respect to characteristics such as the object's pose. In this project, we aim at validating this hypothesis by collecting a large-scale dataset of plankton species with densely sampled poses. The students will learn to operate the imaging apparatus for data collection, design protocols for analysing the resulting datasets, and train deep learning systems to understand how pose variability influences classification performance of plankton images. This is an on-going project in collaboration with the Scripps Institute of Oceanography. This project aims for both application and top-tier conference publication.

INTERNS NEEDED
4 BS or MS students

PREREQUISITES
MS or undergraduate. Candidates are expected to be adept with at least one commonly used programming language, such as C/C++, Java, Python, or Matlab. Stronger candidates will also have some knowledge in Linux, computer vision, image processing, and/or machine learning.
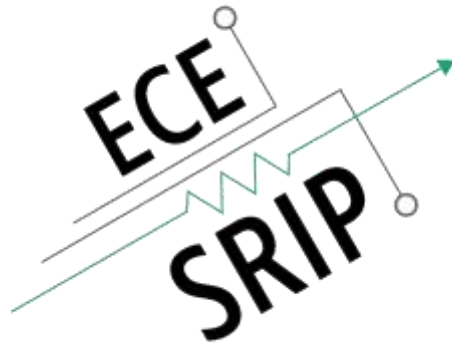
FACULTY MENTOR
Vasconcelos, Nuno

PROJECT TITLE
Self-driving and multi-task learning
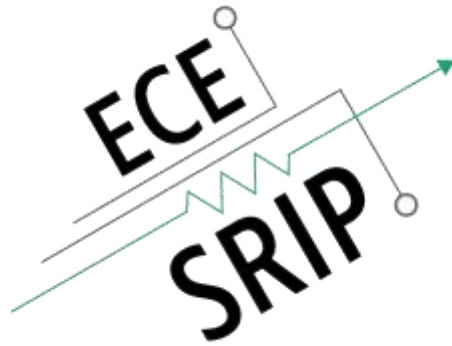
PROJECT DESCRIPTION
There has recently been interest in self driving problems, with the introduction of large datasets, such as DeepDrive and NuScenes. These datasets include several tasks, like line making detection, object detection, etc. and multiple sensors. UCSD is also collecting this data on campus, using cars with 6 - 4k cameras on-board and a 16 channel LIDAR (Velodyne) sensor. In addition we have some GPS data, 16 ultrasonic sonars, and IMU data. We will investigate multitask learning approaches to solve all of these problems simultaneously. This project aims for both application and top-tier conference publication.

INTERNS NEEDED
4 BS or MS students

PREREQUISITES
MS or undergraduate. Candidates are expected to have basic knowledge of Python, Linux and computer vision. Knowledge in robotics/control theory would be a plus.

FACULTY MENTOR
Vasconcelos, Nuno

PROJECT TITLE
Classification of point cloud data
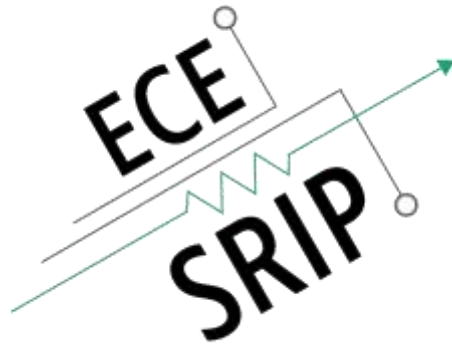
PROJECT DESCRIPTION
Various point cloud datasets have been recently introduced in computer vision. This data is quite important for applications such as smart cars, which rely on LIDAR data and similar sensors to improve sensing performance over what is possible with just cameras. We will investigate techniques for object recognition, detection, and segmentation of this type of data, using deep learning. This project aims for both application and top-tier conference publication.

INTERNS NEEDED
4 BS or MS students

PREREQUISITES
MS or undergraduate. Candidates are expected to have basic knowledge of mathematics, and to be adept with at least one commonly used programming language, such as C++, Python, matlab. Stronger candidates will also have some knowledge in Linux, computer vision, image processing, and/or machine learning. Experience with deep learning is a plus.

FACULTY MENTOR

Vasconcelos, Nuno

PROJECT TITLE

Exploration of the impact of synthesized data for real-world computer vision problems
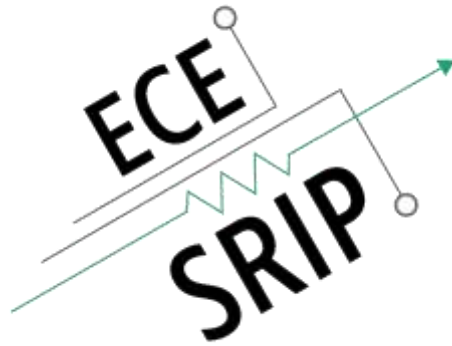
PROJECT DESCRIPTION

The data collection from real world is very expensive. However, there are infinite synthesized data from some simulation game environments, and they are very easy/cheap to collect. We want to explore the impact of synthesized data for real-world computer vision problems. The first step of this project is to collect a large amount of synthesized data from the simulated game engine. The next step is to train a basic model from the synthesized dataset, and see how it performs in real-world computer vision tasks, e.g. object detection. We also want to explore how these synthesized data can be optimally used, in combination with real-world data, and thus improve the performance. This project aims for top-tier conference publication.

INTERNS NEEDED

4 BS or MS students

PREREQUISITES

MS or undergraduate. Candidates are expected to be familiar programming language, such as C++, Python, or Matlab, and have strong qualitative and quantitative analysis skills. Stronger candidates will also have some knowledge in Linux, computer vision, image processing, and/or machine learning.

FACULTY MENTOR

Vasconcelos, Nuno

PROJECT TITLE

Compressed deep learning networks
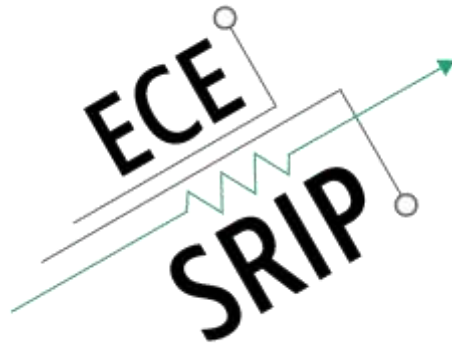
PROJECT DESCRIPTION

The development of slim and accurate deep neural networks has become crucial for real-world applications, especially for those employed in embedded systems like drones and smart phones. We are interested in building light models, capable of making deep learning deployable in real-time on low-computation environments. These models will be used to build object recognition systems. This project aims for both application and top-tier conference publication.

INTERNS NEEDED

4 BS or MS students

PREREQUISITES

MS or undergraduate. Candidates are expected to have basic knowledge of Python, Linux and computer vision. Experience with deep learning is a plus.

FACULTY MENTOR
Vasconcelos, Nuno

PROJECT TITLE
Multi-frame visual recognition

PROJECT DESCRIPTION
In the recent years, the emergence of various new visual recognition algorithms has drastically changed the way computers recognize and segment objects in images. Compared to still images, though, a short video clip consisting of a sequence of frames can potentially contain much more information for us to understand the spatial relationship between object instances and scenes. We intend to realize the most recent image recognition algorithms on an input of consecutive frames and examine the margin of improvement over the conventional single-frame processing. In this project, students will participate in gathering the training data, implementing a recognition algorithm, and analyzing the results. This project aims for both application and top-tier conference publication.

INTERNS NEEDED
4 BS or MS students

PREREQUISITES
MS or undergraduate. Candidates are expected to be proficient in at least one of the programming languages such as Python or MATLAB, and have basic knowledge in deep learning and computer vision. Applicants with knowledge on object detection, recognition or tracking are preferred.
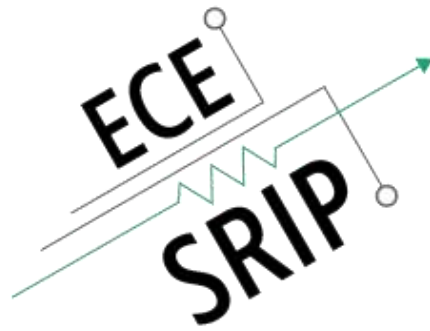
FACULTY MENTOR
Vasconcelos, Nuno

PROJECT TITLE
Underwater microscopy

PROJECT DESCRIPTION
The objective of this project is to design, fabricate, and test a laboratory data collection device for small plankton. The purpose of the device is to allow rapid collection of images from a single specimen at a large number of different orientations relative to the microscope. The group would use our existing plankton microscope and design a fixture to hold a cylindrical cuvette in the field of view of the microscope. The cuevtte should have an inlet port and outlet port for a peristaltic pump to flow water through the cuvette. In parallel with the design and fabrication of the cuevette holder, the students would build on the existing real-time image acquisition software (C++, opencv) and add a tracking algorithm to follow the motion of the plankter in the cuvette. The output of this algorithm should be a track of position in x-y and an estimate of velocity. These data should be displayed in real-time along with the images from the microscope.

Depending on time and interest two possible bonus projects are:

(1) Taking the tracker output and a pose estimator fora known class of plankton, enumerate the poses imaged by the camera and display a graphical representation of these poses

(2) Build a small peristaltic pump controller that takes the output from the tracker and pose estimator and adjusts the flow in the cuvette to change the pose of the plankter in the field of view.

INTERNS NEEDED
1 BS or MS students

PREREQUISITES

MS or undergraduate. Candidates are expected to be adept with at least one commonly used programming language, such as C/C++, Java, Python, or Matlab. Stronger candidates will also have some knowledge in Linux, computer vision, image processing, and/or machine learning.