

### **FACULTY MENTOR**

Vasconcelos, Nuno

### **PROJECT TITLE**

Image collection with drones

### **PROJECT DESCRIPTION**

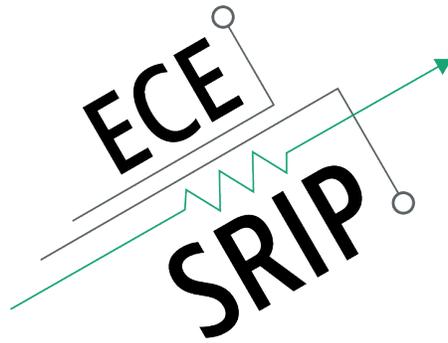
The last few years have shown that a critical component in the design of effective image classification systems is the availability of large training datasets. Drones are a new way to collect large numbers of images of objects in a relatively inexpensive manner. We are interested in collecting datasets 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.

### **INTERNS NEEDED**

MS or undergraduate. As many as apply

### **PREREQUISITES**

Candidates are expected to have basic knowledge of Python, Linux and computer vision.



## **FACULTY MENTOR**

Vasconcelos, Nuno

## **PROJECT TITLE**

Deep learning to measure image quality

## **PROJECT DESCRIPTION**

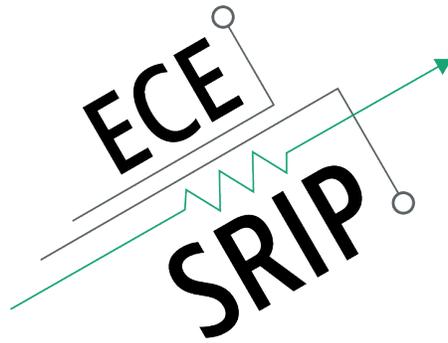
Datasets are an integral component of machine learning, and they are even more powerful if accurately labeled. We will develop an automated method for labeling drone obtained picture based on intuitive, human perceivable qualities such as blurriness, brightness, contrast, noise, and (over/under) exposure. Labels associated with each image will provide a quantitative estimate of an image's characteristics, ultimately to be used in deep learning applications. Methods should be robust, flexible, automated, and scalable so they can adequately process tens of thousands of different drone-taken images.

## **INTERNS NEEDED**

MS or undergraduate. All that apply

## **PREREQUISITES**

Candidates are expected to be adept with at least one commonly used programming language, such as C++, Java, or Python. Knowledge in Linux, OOP, computer vision, image processing, and/or machine learning are a plus, but not essential.



## **FACULTY MENTOR**

Vasconcelos, Nuno

## **PROJECT TITLE**

Deep Learning for Object Size Estimation from Real World Images

## **PROJECT DESCRIPTION**

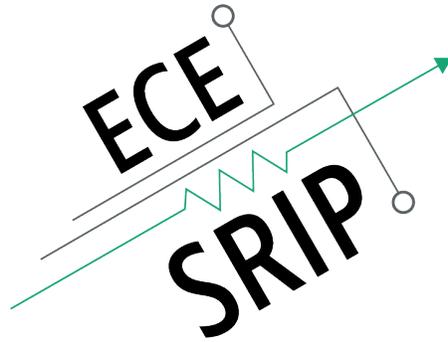
Object size estimation from real world images is an interesting, practical but non-trivial problem. Our final goal is to design an algorithm to measure the object size from real world images without providing reference in advance. The students will have two major tasks: collecting a small scale labeled 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.

## **INTERNS NEEDED**

MS or undergraduate. All that apply

## **PREREQUISITES**

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. Multiple view geometry, machine learning and computer vision are a plus



## **FACULTY MENTOR**

Vasconcelos, Nuno

## **PROJECT TITLE**

Using synthetic data for training deep learning systems

## **PROJECT DESCRIPTION**

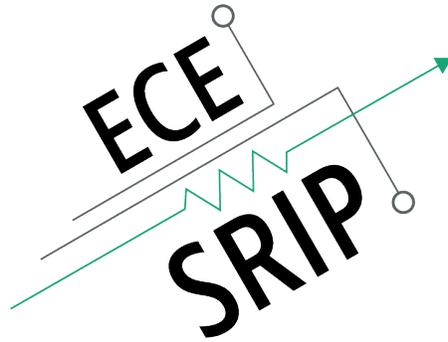
The data collection from real world is very expensive. However, there are infinite synthesized data from some simulation game environments, and they are very easy/cheap to collect. We want to explore the impact of synthesized data for real-world computer vision problems. The first step of this project 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**

MS or undergraduate. All that apply

## **PREREQUISITES**

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**

Efficient Deep Learning for Drones and Smart Phones

### **PROJECT DESCRIPTION**

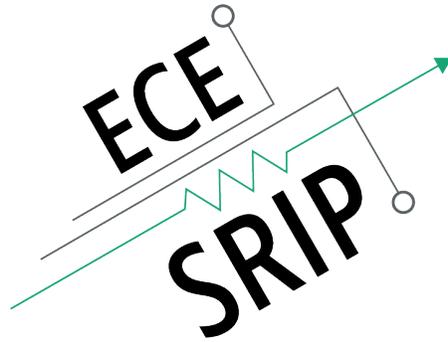
The development of slim and accurate deep neural networks has become crucial for real-world applications, especially for those employed in embedded systems like drones and smart phones. We are interested in building light models, capable of making deep learning deployable in real-time on drones. These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

### **INTERNS NEEDED**

MS or undergraduate. All that apply

### **PREREQUISITES**

Candidates are expected to have basic knowledge of Python, Linux and computer vision. Skills of FPGA will help you but not required.



## **FACULTY MENTOR**

Vasconcelos, Nuno

## **PROJECT TITLE**

The role of context in object detection

## **PROJECT DESCRIPTION**

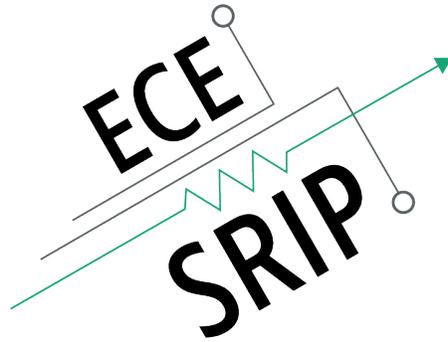
The performance of object detection has improved substantially in the last few years, with the introduction of deep learning systems. Contextual information extracted from scenes is useful for object detection. For example, a car does not show up on top of a tree. This project aims to characterize relationship between the contextual information and the performance of the object detection. This involves collecting images whose objects are not easily detected by the state of art detector, train context sensitive deep learning models, and measure whether contextual information can help improve detection performance.

## **INTERNS NEEDED**

MS or undergraduate. All that apply

## **PREREQUISITES**

Candidates are expected to have basic knowledge of Matlab, Python. Basic knowledge about computer vision is required. It is better to know some famous object detection frameworks e.g rcnn and faster rcnn.



## **FACULTY MENTOR**

Vasconcelos, Nuno

## **PROJECT TITLE**

Deep Learning for Biological Imaging

## **PROJECT DESCRIPTION**

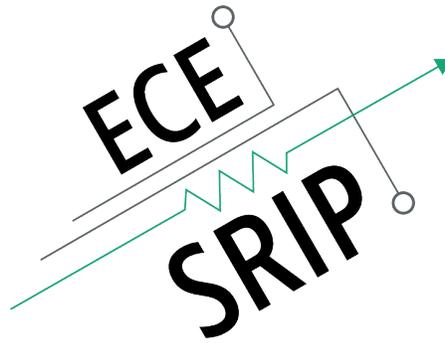
Large scale annotated datasets are critical for learning effective classification networks. To improve the scalability of the collection process, images are typically gathered using online search engines. However, these sources can be biased with respect to characteristics such as the object's pose. 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.

## **INTERNS NEEDED**

MS or undergraduate. All that apply

## **PREREQUISITES**

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**

Multi-frame visual recognition

## **PROJECT DESCRIPTION**

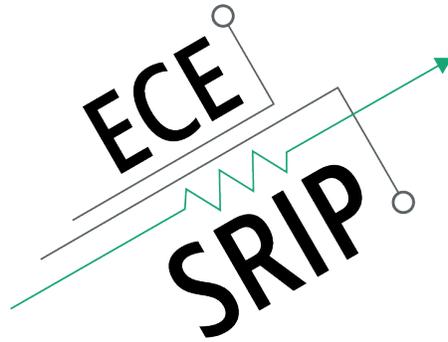
In the recent years, the emergence of various new visual recognition algorithms has drastically changed the way computers recognize and segment objects in images. Compared to still images, though, a short video clip consisting of a sequence of frames can potentially contain much more information for 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.

## **INTERNS NEEDED**

MS or undergraduate. All that apply

## **PREREQUISITES**

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**

Synthesize hand gesture sequences for deep learning

### **PROJECT DESCRIPTION**

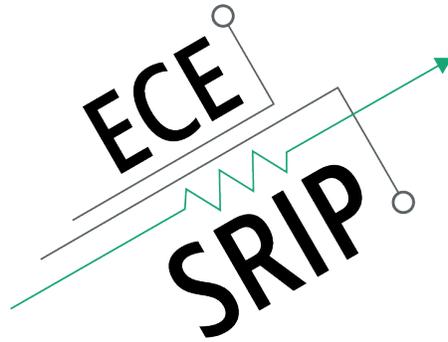
Hand gesture recognition is important for human-computer interaction and communication. However, training data is scarce for this domain. We would like to build a synthesizer based on 3D gaming engines to generate hand gesture video sequences with different backgrounds and extensive gesture classes. In this project, students will be able to learn about 3D engine and deep learning techniques to understand sequential data.

### **INTERNS NEEDED**

MS or undergraduate. All that apply

### **PREREQUISITES**

Candidates are expected to be familiar with python and C++. Knowledge with graphics and machine learning is preferred.



### **FACULTY MENTOR**

Vasconcelos, Nuno

### **PROJECT TITLE**

Action prediction in videos using Convolutional Neural Networks

### **PROJECT DESCRIPTION**

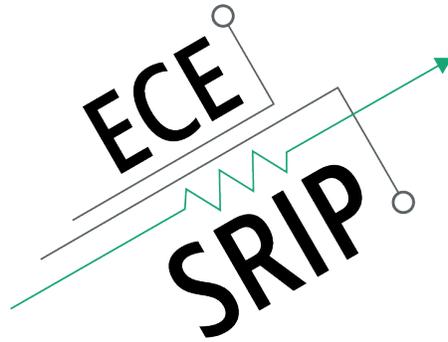
Recent times have seen a lot of work in accurately detecting human actions in videos, but we are still far from making interpretations of those. The next milestone for any computer vision system would be to be able to understand why those actions happened and what the agent intends to do next. We are interested in building a system which can predict what would be an agent's future action in a video based on our current and previous knowledge. The students will work on developing a deep learning system which could perform this task and validate its performance on multiple datasets.

### **INTERNS NEEDED**

MS students

### **PREREQUISITES**

Candidates are expected to have basic knowledge of Python, Linux and computer vision. Experience with CNNs is expected.



### **FACULTY MENTOR**

Vasconcelos, Nuno

### **PROJECT TITLE**

Synthesize hand gesture sequences for deep learning

### **PROJECT DESCRIPTION**

Hand gesture recognition is important for human-computer interaction and communication. However, training data is scarce for this domain. We would like to build a synthesizer based on 3D gaming engines to generate hand gesture video sequences with different backgrounds and extensive gesture classes. In this project, students will be able to learn about 3D engine and deep learning techniques to understand sequential data.

### **INTERNS NEEDED**

MS or undergraduate. All that apply

### **PREREQUISITES**

Candidates are expected to be familiar with python and C++. Knowledge with graphics and machine learning is preferred.