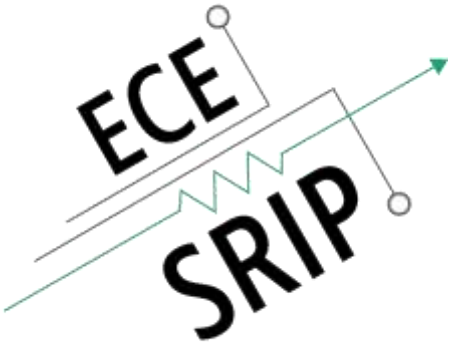


FACULTY MENTOR
Vasconcelos, Nuno

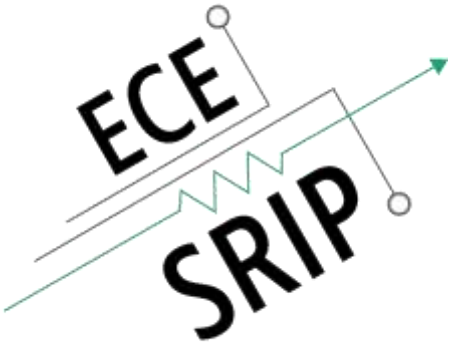
PROJECT TITLE
Natural World 3D Computer Vision

PROJECT DESCRIPTION
3D computer vision has become increasingly important with uses in VR and robotic navigation, and autonomous driving. We are interested in training deep learning systems for 3D vision tasks such as 3D classification and single-view 3D reconstruction. Specifically, we will investigate how to make representations (eg meshes, voxels, or multiview images) more effective in different scenarios, such as environmental domains changes and viewpoint shifts. Students will use large 3D datasets like ShapeNet and Pix3D, along with our internal datasets, towards the training of deep neural networks. The project aims for top-tier conference publication.

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

PREREQUISITES
Undergraduate and MS. Ideal candidates would have knowledge of one or more of the following: Python, Linux, computer vision, machine learning. Experience with deep learning and/or computer vision is a plus.

MENTOR
John Ho [John Ho <chh279@eng.ucsd.edu>], Brandon Leung [b7leung@ucsd.edu]



FACULTY MENTOR
Vasconcelos, Nuno

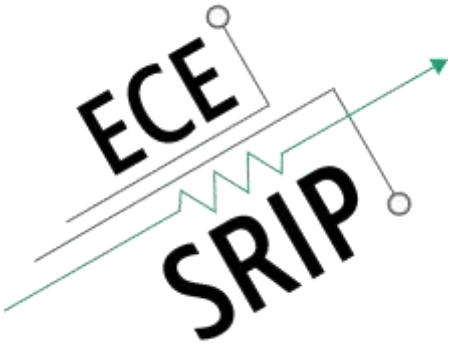
PROJECT TITLE
Long-tailed recognition of visual relationships

PROJECT DESCRIPTION
Detecting visual relationships in images of the form of triplets t= (subject, predicate, object), such as “person eating an apple” or “person cutting an apple” is an important computer vision problem. It requires more reasoning and substantial training data compared to object detection. The long-tailed distribution of relations in existing datasets make this problem even harder. We will investigate on detecting meaningful visual relationships for unbalanced datasets, especially semantic relationships with very few examples. This project is part of an on-going collaboration with Intel Research. The project aims for top-tier conference publication.

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

PREREQUISITES
Undergraduate and MS. Ideal candidates would have knowledge of one or more of the following: Python, Linux, computer vision, machine learning. Experience with deep learning and/or computer vision is a plus.

MENTOR
Tz-Ying Wu <tzw001@eng.ucsd.edu>



FACULTY MENTOR
Vasconcelos, Nuno

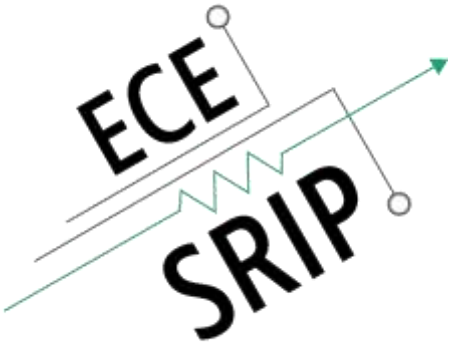
PROJECT TITLE
Visualization guided machine teaching

PROJECT DESCRIPTION
Deep learning has achieved great performance in many computer vision tasks in the recent past. However, it is still too hard to train systems for expert domains, such as medicine or biology, due to the limited ability of labeled training data. While platforms like Amazon Turk could solve this problem, the human labelers that they use frequently lack the expertise to annotate domain specific data. This project will focus on how to leverage visualization based explanations from deep networks to teach humans to label images from domains where they have no expertise. We will develop training algorithms algorithms, a platform to do this training on, and conduct experiments with human labelers to determine the effectiveness of machine teaching. This project aims for both application and top-tier conference publication..

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

PREREQUISITES
MS or undergraduate. Candidates are expected to have basic knowledge of mathematics, machine learning and computer vision, have APP and Web development experience. Experience with PyTorch is a plus.

MENTOR
Pei Wang [pew062@eng.ucsd.edu]



FACULTY MENTOR
Vasconcelos, Nuno

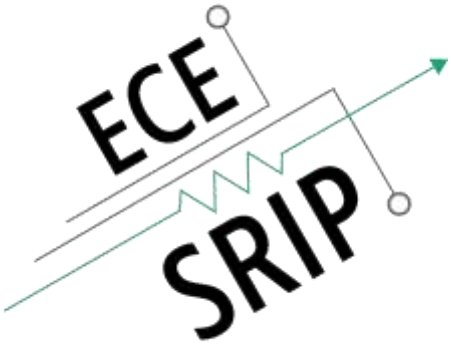
PROJECT TITLE
3D object detection with monocular images and radar data in Autonomous driving

PROJECT DESCRIPTION
Accurate 3D object detection is critical for many autonomous driving tasks such as behavior planning and motion control. Past efforts have been exploiting accurate depth information in point cloud data collected from expensive LiDAR sensors or inferring depth using visual cues in RGB images obtained with ubiquitous low-cost cameras. However, neither method is both practical and reliable to deploy in mass production. Millimeter-wave automotive radar is a sensor equipped in many modern cars that can provide sparse yet accurate depth information. In this project, we aim to gain better 3D understanding of the autonomous driving environment by performing 3D object detection with both camera and radar data. The students will learn about current state-of-the-art methods in 3D object detection and the characteristics of automotive radar data. They will leverage deep learning systems and computer vision to effectively fuse the complementary information in camera and radar for 3D object detection. The project will explore the recently released public dataset with radar data NuScenes. This project aims for both application and top-tier conference publication.

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

PREREQUISITES
Master students. Candidates are expected to be adept with Python, Linux operating system and at least one popular deep learning framework such as PyTorch, TensorFlow or MXNet. Stronger candidates will also have some knowledge in computer vision and image processing.

MENTOR
Yunsheng Li [yul554@eng.ucsd.edu]



FACULTY MENTOR
Vasconcelos, Nuno

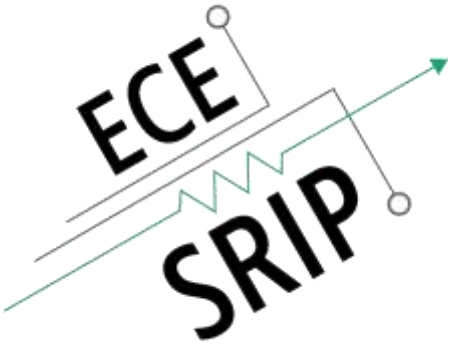
PROJECT TITLE
Computational Cancer ImmunoPathology

PROJECT DESCRIPTION
Biomarkers for cancer immunotherapy remain flawed, in part due to lack of spatial context and inability to profile immune cell populations in situte. Large scale annotated datasets are critical for learning effective classification networks. We will utilize novel spatial microscopic methods that incorporate transcriptional and proteomic information to isolate structural and functional information about immune cell populations from cancer specimens and utilize deep learning frameworks to train algorithms to understand the tumor immune microenvironment. 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 immune cell populations in the tumor micro environment. This is an on-going project in collaboration with the UCSD Moores Cancer Center. This project aims for both application and top-tier conference publication.

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

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 computer vision, image processing, and/or machine learning. Familiarity with statistical software such as R may be beneficial.

MENTOR
Jiacheng Cheng [jicheng@eng.ucsd.edu]



FACULTY MENTOR

Vasconcelos, Nuno

PROJECT TITLE

Multi-view machine learning for identifying underwater organisms from recorded data

PROJECT DESCRIPTION

In using Machine Learning and CNNs to identify sea animals from pictures, the use of multi-view techniques come to the forefront. This is because there are ambiguities in what the animals look like from a small set of views. In this study students will be asked to both create 3D models of a variety of small microscopic animals in addition to processing data from a new multi-view system. Having models and real data we will use views from both of them from a variety of view angles to use standard CNNs to see if the net can be trained to identify them. The more views in angle, the better the net can perform, The results of the project will be to validate the success of multi-view vs single and help us to decide whether the multi-view systems will provide an advantage. To view single projected view of organisms you can check Dr. Jaffe's web site: spc.ucsd.edu (available only from inside UCSD these days but in repair now). The project aims for top-tier conference or journal publication.

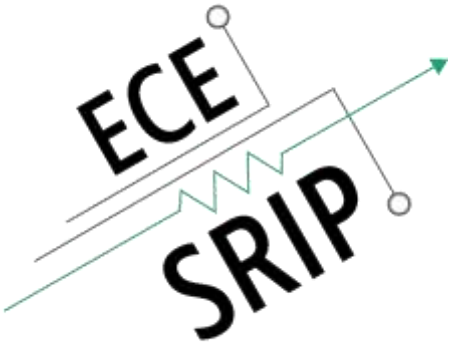
This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

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.

MENTOR

Joe Walker [jlwalker@ucsd.edu]



FACULTY MENTOR

Vasconcelos, Nuno

PROJECT TITLE

Self-Supervised Learning for Plankton Image Classification

PROJECT DESCRIPTION

Large-scale annotated datasets are critical for learning effective classification networks. Acquiring such large-scale datasets can be expensive, if not impossible. However, it is often the case that unlabeled domain data is easily accessible. Researchers at the Scripps Institution of Oceanography have collected over 1 billion images of marine plankton, but only a small subset of this data (~37,000 images) has been annotated. In this project, we aim to improve machine classification of marine plankton by leveraging the remaining unlabeled data. To do this, we will borrow techniques from the field of self-supervised learning. Self-supervised learning techniques involve the construction of a pretext task, which can be formulated and solved using only unlabeled data, but requires the network to learn higher-level semantics in order to be solved. Students will have the opportunity to explore the emerging field of self-supervised learning and the opportunity for top-tier conference publication in this field. This project will allow students to design novel network architectures and/or pretext tasks, and to learn about the application of deep learning in biological oceanography. Interested students are encouraged to explore the plankton image data, which can be found here: spc.ucsd.edu (VPN to UCSD network is required). The project aims for top-tier conference publication.

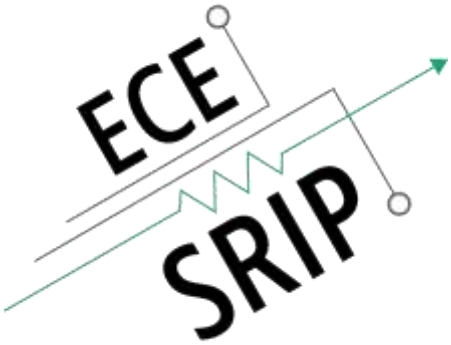
This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

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 computer vision, image processing, and/or machine learning.

MENTOR

Joe Walker [jlwalker@ucsd.edu]



FACULTY MENTOR
Vasconcelos, Nuno

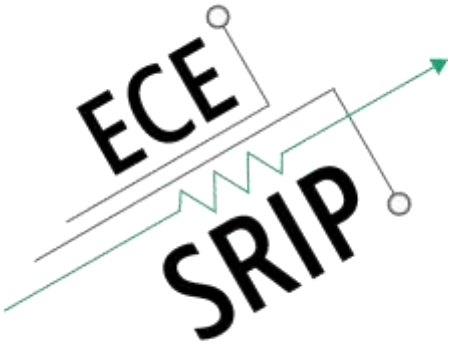
PROJECT TITLE
Explainable AI for self-supervised learning

PROJECT DESCRIPTION
Many explainable AI techniques have been explored for several years in order to open the black-box nature of deep neural networks. However, most of them address supervised learning, a learning paradigm that dominates computer vision. In recent years, there have been numerous novel algorithms proposed for self-supervised learning, like contrastive learning, which aims to solve the problem with less or no data annotation. Although the performance of these algorithms is approaching that of supervised learning, there is still a gap regarding the ability of the learned networks to understand high level concepts. This project aims to leverage state of the art explainable AI methods to seek sensible explanations for this gap. The long-term goal is to come up with a solution to reduce the performance gap, enabling self-supervised learning to be applicable to a wider array of vision tasks. The project aims for top-tier conference publication.

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

PREREQUISITES
Self-motivated MS or undergraduate. Candidates are expected to have basic knowledge of machine learning and deep learning. Stronger candidates should also have some knowledge in computer vision, experience on PyTorch or TensorFlow and work hard.

MENTOR
Pei Wang [pew062@eng.ucsd.edu]



FACULTY MENTOR
Vasconcelos, Nuno

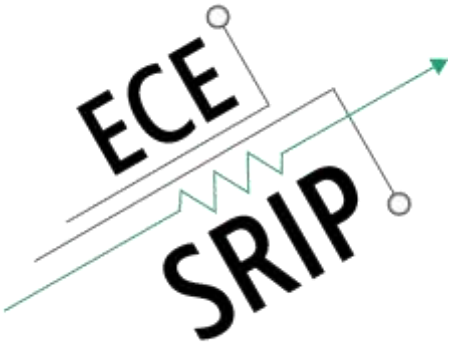
PROJECT TITLE
An iterative framework for dataset collection

PROJECT DESCRIPTION
While a wide spectrum of automated tools have been created for building deep learning models in the past decade, dataset collection has remained a largely manual process with little systematic effort to account for bias in raw data or human annotations. This goal of this project is to build an iterative framework for dataset collection, annotator teaching and model training. Under this unified framework, new examples are automatically cleaned for bias and added to the dataset progressively. Neural network models are trained on each iteration of data, and model explanation techniques are used to create teaching examples that reduce the bias of crowd-source annotators. The whole framework aims to produce datasets that are optimal for machine learning, under multiple objectives, including classification accuracy and fairness. The project aims for top-tier conference publication.

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

PREREQUISITES
MS or undergraduate. Candidates are expected to have basic knowledge of machine learning, and to be adept with at least one commonly used programming language, such as C ++, Python and deep learning platform such as PyTorch, TensorFlow. Experience with web development is preferred

MENTOR
Yi Li [yil898@eng.ucsd.edu], Pei Wang [pew062@eng.ucsd.edu]



FACULTY MENTOR
Vasconcelos, Nuno

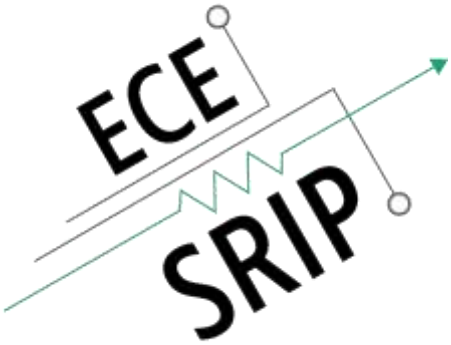
PROJECT TITLE
Sound source localization in 360 video

PROJECT DESCRIPTION
Visual events are usually accompanied by sounds in our daily lives. The goal of this project is to localize sound sources by listening to audio spatial cues and observing the corresponding visual scene. To accomplish this, we will develop machine learning algorithms to address the problem of localizing sound sources from 360 video and spatial sound. We will also collect a 360 video dataset and gather human annotations to identify the spatio-temporal location of salient sound sources in the video. The project aims for top-tier conference publication.

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

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. Stronger candidates will also have some knowledge in deep learning (PyTorch or TensorFlow), and/or Web development..

MENTOR
Pedro Morgado



FACULTY MENTOR
Vasconcelos, Nuno

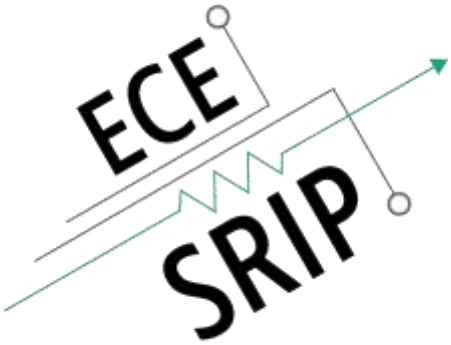
PROJECT TITLE
Fusing RGB and thermal images for improved computer vision

PROJECT DESCRIPTION
In recent years, we have seen a trend to integrate more sensing modalities on mobile phones, for example, depth sensors have become a normal for most flagship phones. We believe sensors that covers more light spectrum beyond visible, such as far infrared (FIR) sensors, or often so called thermal sensors, will become a new sensing modality on phones in the near future. Each of such sensors will bring different information, and how to fuse the information provided by these sensors for achieving better perception of the world remains mostly open. In this proposal, we'd like to look into fusing thermal and RGB images for better vision tasks. Some example topics include unsupervised image alignment, 3D face reconstruction, facial/expression analysis etc. The project is part of a collaboration with Qualcomm and aims for top-tier conference publication.

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

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. Stronger candidates will also have some knowledge in deep learning (PyTorch or TensorFlow), and/or computer vision.

MENTOR
John Ho [John Ho <chh279@eng.ucsd.edu>], Brandon Leung [b7leung@ucsd.edu]



FACULTY MENTOR
Vasconcelos, Nuno

PROJECT TITLE
Understanding group activity in public spaces

PROJECT DESCRIPTION
Computer vision enables the design of systems to understand the activity of the population in public spaces. Several problems are already commonly studied in the field, such as crowd-counting, anomaly detection, or social distancing monitoring. In this project, we will investigate the design of systems that monitor the activity levels of park users. This is important for public health research and raises interesting vision problems, such as recovering the geometry of a scene from the walking patterns of the people in it. The solution of this problem could have many ramifications for automated 3D vision in many other contexts. The project aims for top-tier conference publication.

This project is remote, in principle. There may be an opportunity for returning to UCSD, depending on COVID. However, students will always be able to work remotely, if preferred.

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. Stronger candidates will also have some knowledge in deep learning (PyTorch or TensorFlow), and/or computer vision. Experience in the geometric aspects of computer vision is a plus.

MENTOR
Bo Liu [boliu@eng.ucsd.edu], Yi Li [yil898@eng.ucsd.edu]