FACULTY MENTOR
Dey, Sujit

PROJECT TITLE
Deep Learning Enabled mmWave Communications for Connected and Autonomous Vehicles

PROJECT DESCRIPTION
The next generation of vehicles will produce and consume massive amounts of data due to the vast array of sensors, both on the vehicle, and distributed throughout the city, as well as through more traditional communications such as downloading HD Maps or passenger broadband. Current V2X communications technologies are focused around reliably exchanging small packets of information and simply aren't built for the potential gigabit connections to vehicles needed; however, enabling mmWave V2X communications could satisfy these data needs and enable vehicles and cities to collaboratively perceive the environment in order to enhance roadway safety and efficiency. One key issue with mmWave communications is their need to employ directional beams in order to overcome the increased path loss at higher frequencies — maintaining beam alignment with highly mobile vehicles is thought to incur a large overhead in communications. This project centers around using data driven techniques to discover efficient, site specific, control schemes for mmWave V2X communications by leveraging the sparsity of the RF environment in order to greatly reduce the control overhead. UCSD has created a mmWave testbed for evaluating the developed algorithms but the project is currently centered around simulated results due to reduced access to campus.

This project can accommodate both remote and in-person students

INTERNS NEEDED
5

PREREQUISITES
We can accommodate two BS students and one MS student for this project. The ideal candidate will have completed a large scale software design project, as part of a team of developers, during a course project, industry internship, or prior research experience. Beyond that, the candidate should have prior experience, or a desire to learn, a subset of the following skills:
* Machine Learning
* 5G Wireless Communications (mmWave, V2X)
* Autonomous Driving Simulators (CARLA)
* Wireless Communications Simulators (ray tracing)
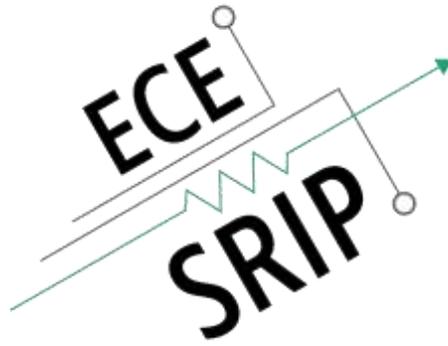
FACULTY MENTOR
Dey, Sujit

PROJECT TITLE
Personalized Effect of Health Behavior on Blood Pressure: Machine Learning Based Prediction and Recommendation

PROJECT DESCRIPTION
The aim of project is to investigate the relationship between blood pressure and health behavior (e.g. sleep and exercise) and to develop personalized health analytics and recommendations. Using off-the-shelf wearable devices (which provide detailed health behavior like walking, exercise, stress, heart rate and sleep) and wireless blood pressure monitors, we will collect data from volunteers and use machine learning models (e.g. linear regression, ensemble models, neural networks) and other data science techniques to address the challenges.
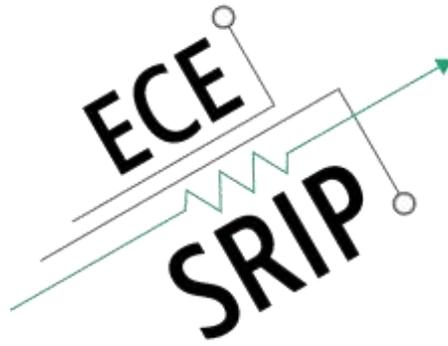
This project can accommodate both remote and in-person students

INTERNS NEEDED
1

PREREQUISITES
We can accommodate one MS student for this project. The ideal candidate will have experience with machine learning/deep learning projects and be skilled in Python. Experience using 3rd party APIs is a plus.

FACULTY MENTOR
Dey, Sujit

PROJECT TITLE
Driver's State of Mind and Intent Detection using Multiple Sensors and Machine Learning

PROJECT DESCRIPTION
In this project, based on machine learning (ML) and deep learning (DL) techniques, we plan to develop a system for driver's state of mind (emotions, distraction, fatigue, etc) and intent detection. Towards this goal, we need to collect data from human subjects in laboratory experiments, using sensors such as 3D and infrared cameras and wearable devices. And ML/DL models will be trained on the collected data. Video sequences and physiological signals will be fed into the model to detect the driver's state of mind. Besides, vehicle telemetry data will also be used to determine the driver's intent. Early detection of negative states of mind and the driver's intent would be helpful to improve traffic safety.
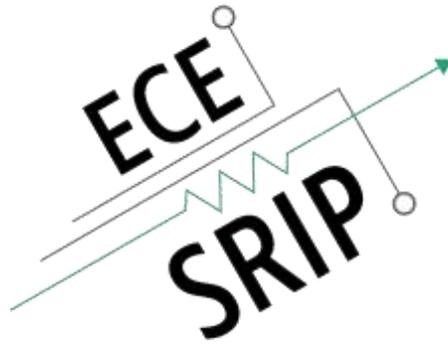
This project can accommodate both remote and in-person students

INTERNS NEEDED
1

PREREQUISITES
We can accommodate one MS student for this project. The intern is expected to be skilled in ML/DL in Python. Candidates who have experience with image processing and computer vision are preferred.

FACULTY MENTOR
Dey, Sujit

PROJECT TITLE
Sustainable Wireless Communications with Optimal Utilization of Renewable Energy and Storage

PROJECT DESCRIPTION
The aim of this project is to maximize the utilization of harvested renewable energy at the BSs with minimal use of energy storage and enable deployment of a network of small cell BSs that are powered only with renewable energy. Currently, this project is aimed at maximizing the longevity of the operation of the renewable energy powered small cell BSs. We will collect data from an outdoor small cell testbed and develop a machine learning based algorithm which is capable of predicting the energy availability of the renewable energy powered small cell BSs and then operates the small cell BSs based on the prediction for maximal the longevity of the BS operation.
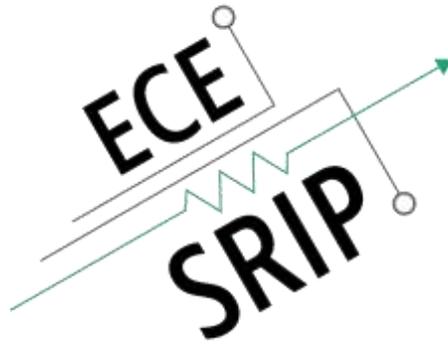
This project can accommodate both remote and in-person students

INTERNS NEEDED
2

PREREQUISITES
The interns are expected to be skilled in any of the following: Python/C++/Matlab. Candidates who have experience with wireless communication system and machine learning, especially in reinforcement learning, are preferred.

FACULTY MENTOR
Dey, Sujit

PROJECT TITLE
GPS-free Object Tracking and Trajectory Prediction in Smart Transportation

PROJECT DESCRIPTION
Object detection, localization, tracking and trajectory prediction are critical components in Autonomous Driving and Smart Transportation. Previous works tried solving the aforementioned tasks separately with cumbersome and expensive devices including Lidar, Radar, GPS, Depth Camera, Stereo Camera, while no works proposed an efficient system dealing with all the tasks simultaneously and altogether with an affordable single device. In addition, all previous trajectory prediction works only assume a static source view and take the location information labeled from datasets as the input, and no works consider a moving source view and only take image sequences as the input, e.g., a camera installed on a moving vehicle. In this project, we build a system that takes image sequences only from a monocular camera on the moving ego-vehicle as the input, to track the motion and predict the trajectory of both ego vehicle and surrounding vehicles. Our algorithm enables the system to be GPS-free and totally Vision based, all we need is a monocular camera installed on the ego-vehicle.
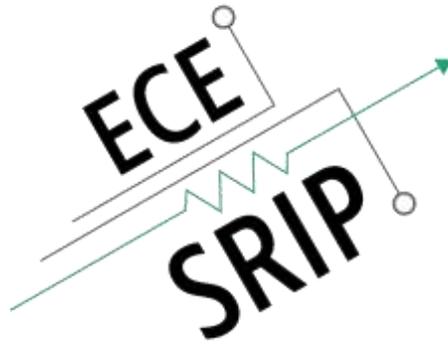
This project can accommodate both remote and in-person students

INTERNS NEEDED
1

PREREQUISITES
Computer Vision, Machine Learning

FACULTY MENTOR
Dey, Sujit

PROJECT TITLE
Exploring Edge Computing in 5G and future directions towards 6G

PROJECT DESCRIPTION
Edge Computing is an evolving computing paradigm that is becoming an indispensable choice for real-time applications. In the realm of IoT with rapidly proliferating devices and their increasing computing demands necessitates the edge computing framework to be intelligent and efficient to satisfy the quality of service of the serving applications. In this project we will investigate the evolution of edge computing starting from 4G LTE advanced to 5G and beyond to future 6G. The project will involve some literature survey on edge computing and creating a hybrid edge computing emulator based on SrsLTE/OpenAirInterface using Software defined radios. A thorough empirical analysis of the edge computing performance will be studied on the emulator and any improvement in the protocol stack will be investigated.

This project can accommodate both remote and in-person students

INTERNS NEEDED
2

PREREQUISITES
Cellular Wireless Communications and Networks (Layer 1, 2 and 3), some Linux System knowledge, C/C++ programing, knowledge of software defined radios/Gnuradio.