

Cognitive and Autonomous Test (CAT) Vehicle

PI: Jonathan Sprinkle, PhD, Associate Professor, Electrical and Computer Engineering

Co-I: Gregory Ditzler, PhD, Assistant Professor in Electrical and Computer Engineering

Coordinator: Nancy Emptage, **Sponsors:** University of Arizona, National Science Foundation REU award #IIS-1950359

Savannah Ball

Monmouth College; Economics, Mathematics

Mentor: Dr. Jonathan Sprinkle – Electrical and Computer Engineering

Partners: Emily Baschab and Audrey Vazzana



Safer adaptive cruise control for traffic wave dampening

ABSTRACT: The goal of this project is to develop an adaptive cruise controller for vehicles at low speeds in stop-and-go traffic. Current adaptive cruise controllers can use radar sensors to follow a vehicle ahead at high speeds (40+ mph), but reach their limits if the vehicle ahead must slow down or stop, requiring the driver to resume control over the car's speed. Another issue with current adaptive cruise controllers is their lack of ability to steer the car, meaning that this task is still required of the driver. Very few cars have adaptive cruise controllers capable of control at speeds less than 18 miles per hour. Our cruise controller will be capable of following cars at low speeds, which will allow for the controller to remain in control in stop-and-go traffic. This project has the potential to interest automobile companies who could implement this technology in future models. If our technology were to be implemented in future automobiles, it would make driving a lot more convenient for drivers. This could also potentially reduce the number of traffic accidents as well as making drivers feel safer when navigating traffic. However, if errors were to occur, they could potentially put the car's passengers at risk, as well as the passengers in nearby vehicles.

Calvin Barrett

Haverford College; Computer Science

Mentor: Dr. Gregory Ditzler and David Schwartz – Electrical and Computer Engineering

Partner: Tomo Bessho



Hyperparameter Optimization using Grid Search for use in Monocular Depth Estimation

ABSTRACT: Autonomous vehicles use a myriad of sensors to observe and monitor its surroundings. Current research incorporates static digital images that are used to train and optimize deep neural networks. These deep neural networks are used to identify and determine the distances of objects from the autonomous vehicle. Unfortunately, the hyperparameters used to train these networks were chosen arbitrarily. We explored the hyperparameter space through a two-step grid search in order to recognize the optimal combination of losses before continuing to train the rest of the system to understand the trade offs between constant parameters. Specifically, the research focuses on finding the optimal relation between the left-right consistency, appearance, disparity losses in generating accurate feature edges in our output images. The trade off between costs allows for the neural network an increased performance at edge detection.

Emily Baschab

University of Alabama; Physics

Mentor: Dr. Jonathan Sprinkle – Electrical and Computer Engineering

Partners: Savannah Ball and Audrey Vazzana



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Tomo Bessho

University of Nebraska-Lincoln; Computer Science,
Mathematics

Mentor: Dr. Gregory Ditzler and David Schwartz – Electrical
and Computer Engineering

Partner: Calvin Barrett



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Iris Jones

Washington State University; Computer Science

Mentor: Dr. Jonathan Sprinkle and Rahul Bhadani –

Electrical and Computer Engineering

Partner: Megan Walter



Generative modeling of driving profiles

ABSTRACT: The validity of simulation testing for autonomous vehicles depends on the ability to accurately simulate human driving behavior. This project seeks to train a model on an individual's driving data, and to test the ability of the model to predict trajectories that replicate the driver's style by using the model in a realistic simulated environment.

Specifically, we deployed Recurrent Neural Network (RNN) modeling techniques to create a black-box model of an individual's driving behavior. We use our RNN-trained model to simulate a human-driven vehicle in the Robot Operating System (ROS) based CAT Vehicle simulator for autonomous vehicle validation. We hope this work is a step to improve testing environments for validating human behavior replicating car-following models and thereby improve testing environments for autonomous vehicles in general.

Rachel Koziel

Purdue University; Electrical Engineering

Mentor: Dr. Jonathan Sprinkle and Safwan Elmadani –

Electrical and Computer Engineering

Partner: Naeemah Robert



Real-Time Traffic Light Identification using YOLOv3 Algorithm For Autonomous Vehicles

ABSTRACT: Safety has always been a priority in automobile manufacture. Traffic light detection plays a major role in regards to safety in autonomous vehicles. Previous methods involved utilizing a combination of image processing and training a neural network model. Those methods were not fully successful as they presented limitations such as trouble detecting yellow and arrow traffic lights, the inability to identify a traffic light from a few pixels due to long distances, and the obstruction of traffic lights causing failure of detection. This project uses a new method to identify traffic lights and their states in both urban and suburban areas by developing a deep learning model utilizing a YOLOv3 model. Additionally, we will use the large dataset of traffic light images from the 'Bosch Small Traffic Lights Dataset' to train the YOLOv3. Our proposed method will be successful because a better processed dataset indicates traffic lights in busier environments, and a balanced dataset allows the model to be better trained at identifying traffic signals and their status. The success of our proposed method will benefit autonomous vehicles' feasibility by improving safety at intersections. The risks of this method include missing potential traffic signals which could lead to potential accidents. We will use a camera that will record the data that will later be processed. The mid-term check for success is accurate detection of traffic lights in ROS simulations, and the final check for success is the successful test drive of University of Arizona's CAT Vehicle by detecting traffic lights at intersections.

Naeemah Robert

New York Institute of Technology; Electrical and Computer Engineering

Mentor: Dr. Jonathan Sprinkle and Safwan Elmadani – Electrical and Computer Engineering

Partner: Rachel Kozel



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Audrey Vazzana

Rose-Hulman Institute of Technology; Computer Science

Mentor: Dr. Jonathan Sprinkle – Electrical and Computer Engineering

Partners: Savannah Ball and Emily Baschab



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Megan Walter

University of Oregon; Computer and Information Science

Mentor: Dr. Jonathan Sprinkle and Rahul Bhadani –

Electrical and Computer Engineering

Partner: Iris Jones



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