

A Realistic Simulation System for Environmental Understanding of Autonomous Driving Vehicles

Akari Minami, Zhiqian Qiao, John M. Dolan

Kyushu University, Carnegie Mellon University, Carnegie Mellon University

Introduction

Problem: The behavior of autonomous vehicles tends to be unpredictable, which could affect the behavior of other vehicles around them.

Goal: Make autonomous vehicles drive as human do using Inverse Reinforcement Learning (IRL).

➔ Need for a realistic simulation system

- A simulator is required to collect human driving data and to simulate human driving policies.

- We target urban areas for this work.

➔ Collecting human driving data

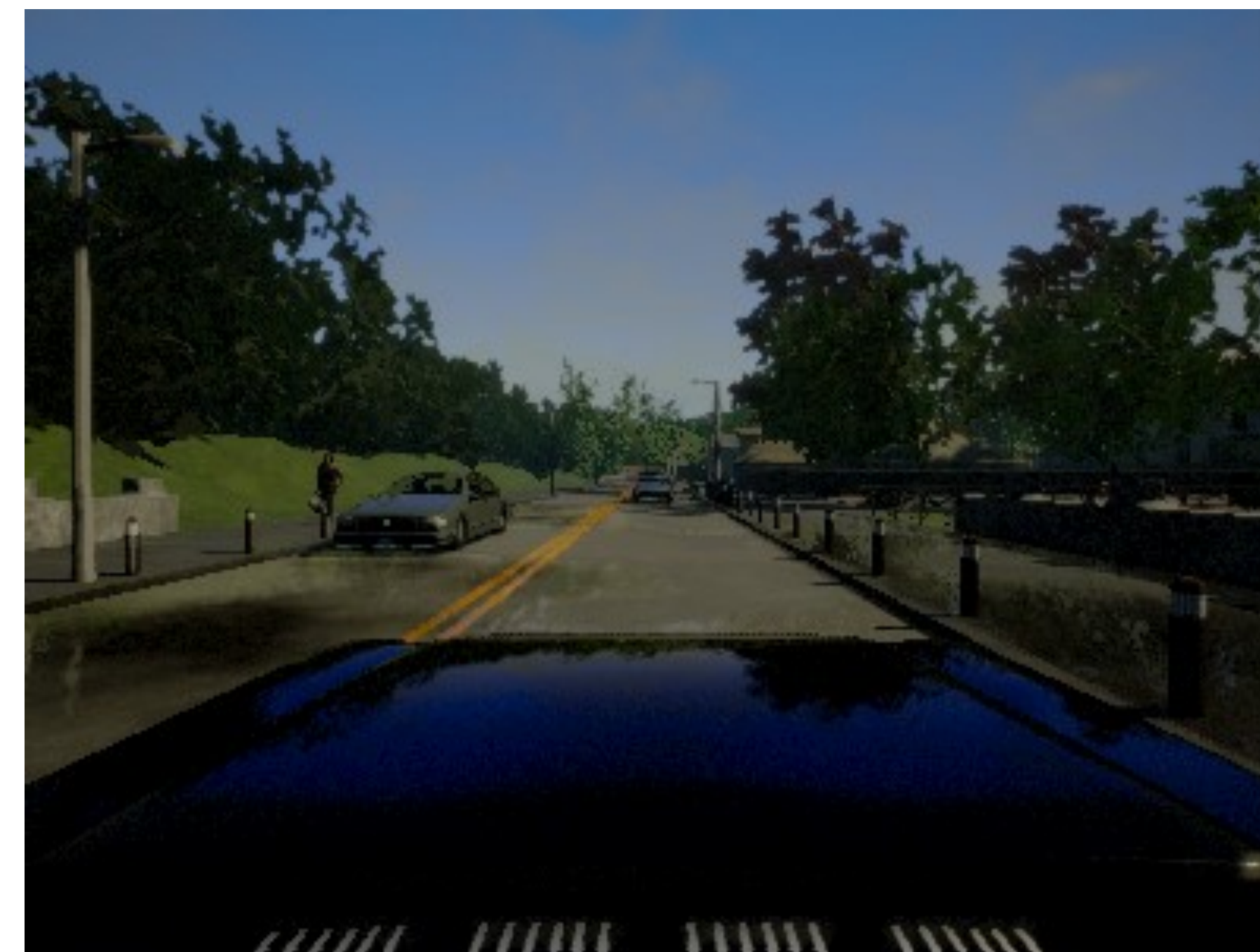
Method

Collect human driving data by letting subjects drive in simulation with steering wheel and pedals.



Figure 1: Driving in simulation

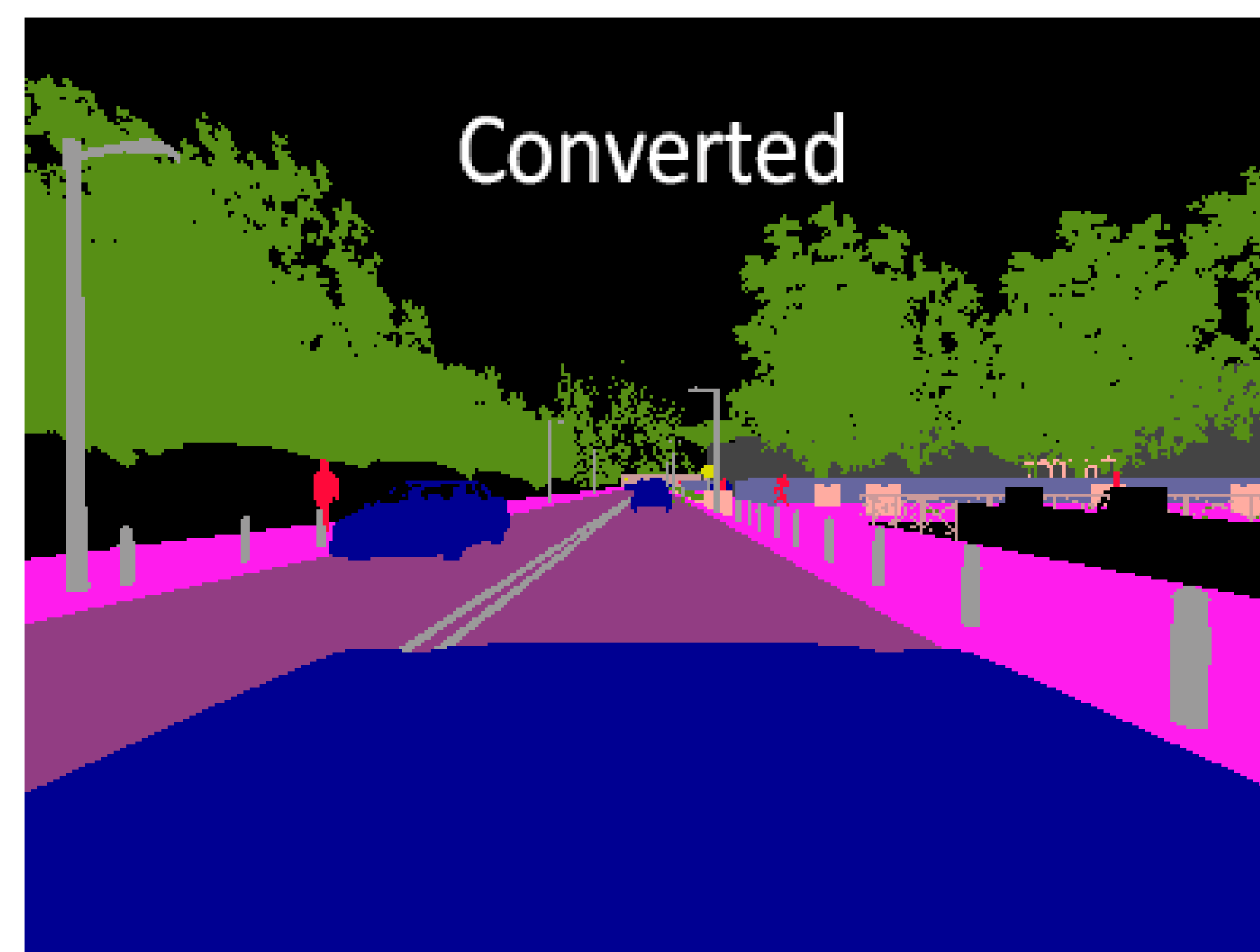
Data Collection



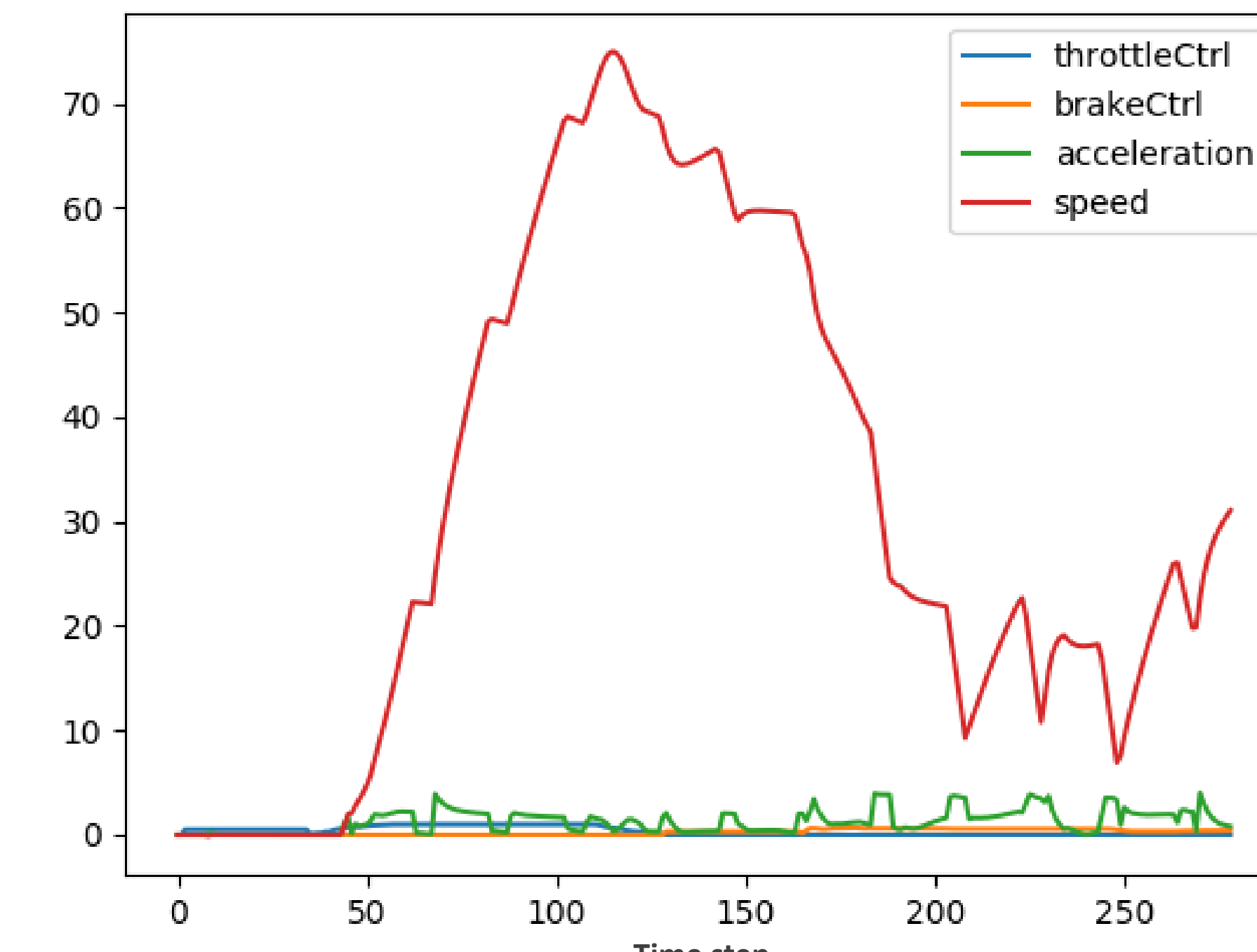
(a) Normal vision camera



(b) Depth map camera



(c) Semantic segmentation camera



(d) Human driving data

Figure 2: (a) - (c) are images obtained from three cameras on the front of the car, (b) and (c) are images converted to a more human readable palette of colors [2], (d) shows speed and acceleration of the human-driven vehicle corresponding to throttle/brake pedal input against time.

We collected the following data at each step: three types of images in Figure 2, sensor data from a ray-cast based rotating LIDAR, and driving data of both the human-driven vehicle and vehicles around it. The depth map image and LIDAR sensor tell us how far the objects are, and semantic segmentation tells us what the objects are.

Images & Sensor Data ➔ Vehicle Detection & Tracking
Human Driving Data ➔ Learn Human Driving Behavior

Future Work

- Collect more human driving data
- Generalize human driver's behavior model
- Find preferred reward function
- Mimic human driver's behavior for autonomous vehicles

References

- [1] Dorsa Sadigh, Shanker Sastry, Sanjit A. Seshia, Anca D. Dragan. Planning for Autonomous Cars that Leverage Effects on Human Actions. In Proceedings of the Robotics: Science and Systems Conference (RSS), June 2016.
- [2] Alexey Dosovitskiy, German Ros, Felipe Codevilla, Antonio López, and Vladlen Koltun. CARLA: An open urban driving simulator. In Conference on Robot Learning (CoRL), 2017.

Acknowledgments

I am grateful to Dr. John M. Dolan for his mentorship and guidance throughout the summer, and to Zhiqian (Carolyn) Qiao and other lab members for their help. Huge thanks to Rachel Burcin for everything she's done for us and making this amazing RISS program happen, and to the entire RISS cohort for immense support. Lastly, I would like to thank TOBITATE! Young Ambassador Program for supporting me.

