

## Introduction

- Autonomous vehicles need to identify key objects like cars and pedestrians quickly and accurately
- Methods being developed to detect these objects using 3D data
- Professor Govindan's Networked Systems Lab researches wireless networking systems, including for autonomous driving
- We collect KITTI-formatted 3D data from the Carla simulator and run inference on it using existing 3D models

## Background

- Point cloud: 3D data as a set of points in Cartesian space
- Recent works on object detection and segmentation on point clouds
- USC NSL: works such as CarMap created crowdsourced 3D feature maps for autonomous vehicles
- Carla: simulator for autonomous vehicle research
- KITTI: benchmark driving dataset captured from car cameras



Image + bounding box captured from Carla (PC: Tanvi Deshpande)

## Methodology

### Point Cloud Generation

- Determined camera locations at the corners of an intersection in the Carla simulator
- Placed RGB + depth cameras at these locations and synchronously captured ~300 frames of data
- Ran scripts to convert RGB + depth images to point clouds and stitch them from different viewpoints

### Model Inference

- Worked with mentors to extract point clouds, images, and bounding boxes from Carla and save in KITTI format
- Read about different methods used to detect objects in point clouds
- Ran inference on point clouds using existing ML models (eg. Point-GNN)

## Skills Learned

- Synchronously capture RGB/depth images from the Carla simulator
- Generate and visualize point clouds using tools like Open3D
- Register point clouds from different viewpoints
- Set up and run models from GitHub repositories using tools like CUDA, PyTorch, and Tensorflow to reproduce results on KITTI data

## Results

### RGB and Depth Images



PC: Tanvi Deshpande

### Single Point Cloud



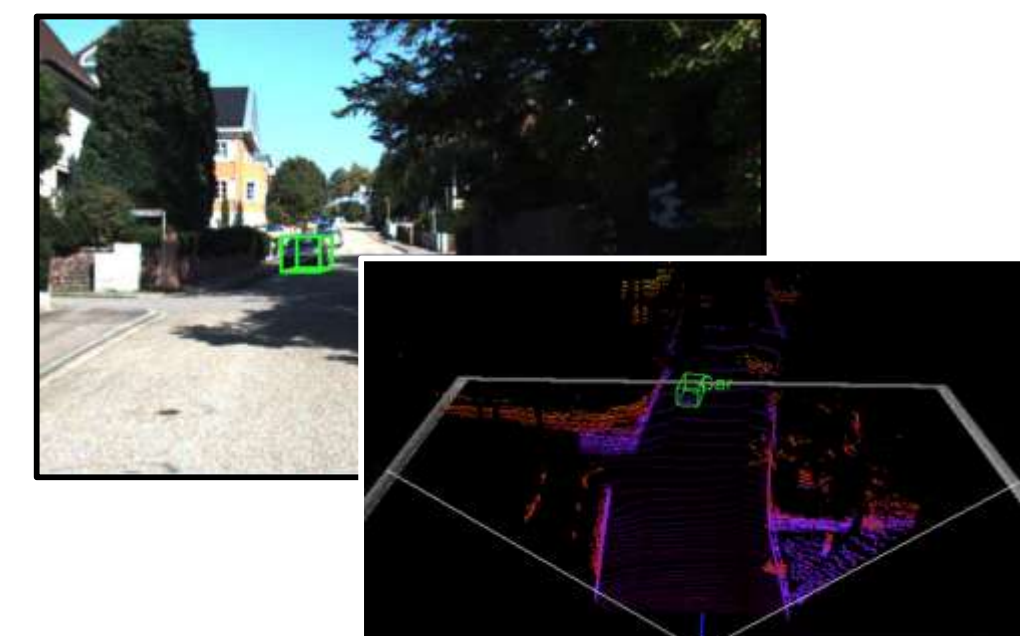
PC: Tanvi Deshpande

### Stitched Point Cloud



PC: Rajrup Ghosh

### Point-GNN Prediction on KITTI Data



PC: Tanvi Deshpande

## Further Steps

- Create Carla dataset in KITTI format with images from intersection corners rather than vehicle camera
- Run benchmarks of pre-existing point cloud models for tasks like object segmentation and tracking to see how they generalize to the Carla data
- Optimize 3D models for stitched point clouds or detection at high-risk intersections

## Acknowledgements

Thank you to Rajrup Ghosh, Aastha, and Professor Ramesh Govindan for mentoring me throughout SHINE. Thank you to Dr. Katie Mills, Cassandra, and Monica for making SHINE enriching and engaging.

## References

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