3D Object Detection for Autonomous Vehicles

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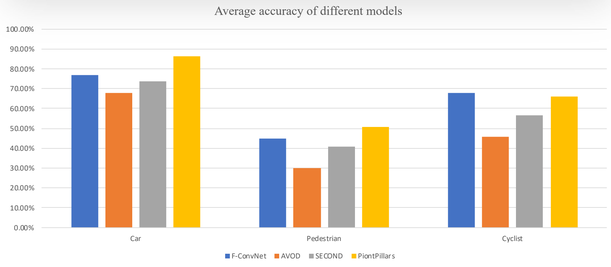
Introduction

Our task is finding the location and size of cars, bicycle, pedestrian, and other moving objects on the road.

- Task: 3D Object detection
  - Box regression
  - Classification
- Training on Lyft level-5 AV dataset

Model Comparison



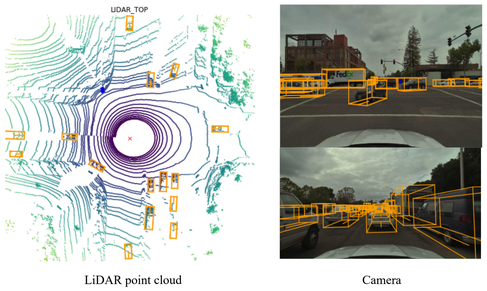
Note: Result on KITTI 3D Detection Competition. Fusion: FConvNet, AVOD. LiDAR Only: SECOND, PointPillars.

Datasets

The dataset is from Kaggle and Lyft.

- 9 categories
- 10 sensors
  - 7 cameras
  - 3 LiDAR
- 180 scenes
  - Training on subset, 40 for training, 10 for evaluation.

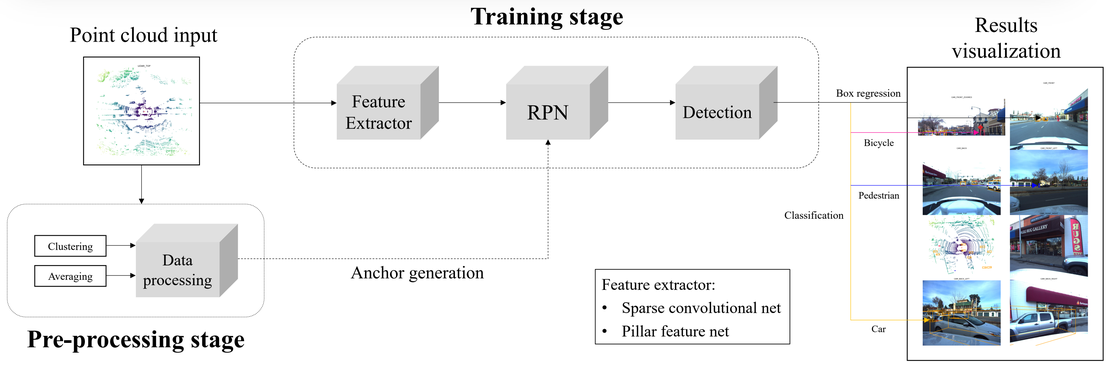
Data visualizing samples



LiDAR point cloud

Camera

System Architecture



Prediction Visualization

Evaluation Results

Medium Voxel - Pillar

Category	Average Precision (0.50*)
Bicycle	0.0621
Bus	0.2375
Car	0.5819
Other vehicle	0.3459
Pedestrian	0.0310
Truck	0.1036

Tall Voxel - Pillar

Category	Average Precision (0.50*)
Bicycle	0.0388
Bus	0.2247
Car	0.5845
Other vehicle	0.3412
Pedestrian	0.0295
Truck	0.1192

Medium Voxel – Sparse ConvNet – Half Epochs

Category	Average Precision (0.50*)
Bicycle	0.0198
Bus	0.0539
Car	0.4189
Other vehicle	0.2839
Pedestrian	0.0596
Truck	0.0112

Medium Voxel – Pillar – Half Epochs

Category	Average Precision (0.65*)
Bicycle	0.0638
Bus	0.2061
Car	0.5863
Other vehicle	0.3359
Pedestrian	0.0364
Truck	0.0708

Note: *: threshold of mean Average Precision

Challenges

- New dataset, published in 2019
- More sensors and categories
- Complex scenes
- Computational complexity – large size

Future works

- Improve small object detection: combine the RGB images and LiDAR.
- Enhance sparse info from LiDAR: Use images only to predict depth of information and reconstruct of 3D objects.

Reference

- Lang, Alex H., et al. "PointPillars: Fast encoders for object detection from point clouds." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2019.
- Yan, Yan, Yuxing Mao, and Bo Li. "Second: Sparsely embedded convolutional detection." Sensors 18.10 (2018): 3337.
- SECOND.pytorch -- https://github.com/traveller59/second.pytorch
- Lyft dataset -- https://level5.lyft.com/dataset/