3D Obstacle Detector: YOLO and LiDAR

Autonomous Motorsports Purdue: Computer Vision

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Research Question

What are the performances of 3D obstacle detection models that incorporate the YOLO object detector and LiDAR depth perception?

Background - datasets and models

Our model incorporates the YOLOv5 object detection models and the LiDAR models, YOLOv5 models output object locations and classifications with efficient runtime speed and comparable accuracy

Background-Data:

KITTI: driving dataset of city roads and highways by Karlsruhe Institute of Technology and Toyota Technological Institute at Chicago

BDD100k: Urban street object detection dataset from Berkeley Deep Drive.

Small Obstacle Detection: Road Dataset with unexpected small obstacles-Robotics Researc h Center (IIIT-H)

Background-Models:

1. **YOLOv5(object detection):**
   - YOLOv5 divides an image into grids, each of which identify things within itself—higher efficiency
2. **Normal Lidar**
   - Generate point clouds from reflections of laser pulses from objects
   - Feature encoding (Region proposal)

Background-Models(Fusion network):

CLOCs(Camera-Lidar):

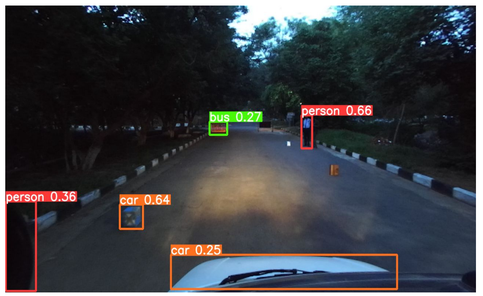
- CLOCs helps combining multi detection model with **low-complexity**
- CLOCs fuses the results of 2D and 3D detectors

Results

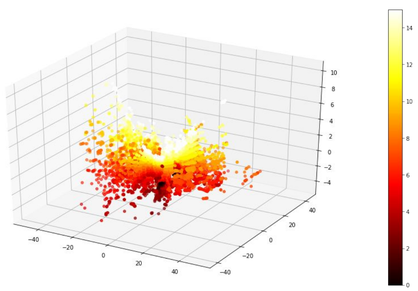
SOD - YOLOv5s

SOD - YOLOv5n

Object detection and classification performance of YOLOv5 with different Pretrained weights



SOD - Low Light (YOLO)



SOD - Low Light (Lidar)

Combating image processors' limits in low light settings using lidar point cloud data

BBD100K

KITTI

Accuracy and Runtime

Conclusion

Performed qulatative analysis on the YOLOv5 model results, and yielded that faster runtimes and higher recalls could be achieved.

Noticed the considerable benefit that Image and Lidar Models add to accuracy and runtime..