

Introduction

The development of Deep Neural Networks (DNNs) made tasks such as object classification [?] and object detection. The DNNs utilized in perception module need to be trained on the dataset which should be similar to area of its deployment. Figure ?? and Figure ?? depicts the misdetections from the Tesla autonomous driving system. The problem in the OOD/Anomaly/Distributional shift [h!] 0.333 [height=0.15width=0.95]images/intro_o_d_a_nomaly/old_s_{hip}.jpg 0.333 Let us time travel back to 18th century and assume that we had implemented a DNN model to detect ships, the data. Anomaly can be defined as the patterns that doesn't conform to the expected training behavior as proposed in [?]. The input for out of distribution (OOD) is drawn from an unknown distribution of unknown data, which is not near the training data. Problem Statement In this thesis, we study the application of out-of-distribution (OOD) detection over the 3D semantic segmentation. The other major issue, we address in this thesis is the OOD detection methods themselves. Existing OOD detection methods

The research questions answered by this thesis are:

- R1**How to create a benchmark over 3D segmentation datasets for the OOD setting?, i.e., create the in-distribution and out-of-distribution datasets.
- R2**How to extend current OOD detection methods from 2D classification task to 3D semantic segmentation?
- R3**Is uncertainty quantification an effective approach to classify OOD detection in 3D semantic segmentation models?
- R4**How to evaluate the OOD detections over the 3D semantic segmentation task?

Contributions The contributions made in this thesis are

- A complete survey on the available 3D LiDAR datasets
 - A detailed survey on existing 3D semantic segmentation models
 - Benchmarking of 3D LiDAR datasets for OOD detection. Proposed two benchmark datasets Semantic3D vs S3DIS and SemanticKITTI vs KITTI
 - A survey on the uncertainty estimation methods and classical OOD methods.
 - An evaluation of OOD on benchmarked datasets over RandLA-Net model using Deep ensemble technique for uncertainty estimation.
- To summarize this chapter, we discussed the motivation behind the problem of OOD detection like how errors in perception affect the downstream tasks.