Hochschule
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Out of distribution detection in 3D semantic segmentation

Master thesis

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Out of distribution (OOD) detection

- Deep neural network training assume closed world scenario where the predictions are over fixed set of classes
- In case of deployment in real world, the deep neural network (DNN) encounter classes outside its training set
- These classes which are outside of DNN semantic space (training set) are called OOD samples
- Detection of these OOD samples by the DNN during inference is called OOD detection

Out of distribution (OOD) detection

- Figure 1 represents the semantic space of the deep neural network (DNN) along with decision boundaries of four classes (Vegetation, Buildings, Car and Trunk) from training set
- During inference if DNN observe **pole**, since pole and trunk look structurally similar, the DNN classify pole as tree trunk.
- In this scenario pole is OOD class which doesnt́ exist in training set of classes
- In this thesis we want to detect these OOD classes in the setting of 3D semantic segmentation using uncertainty quantification

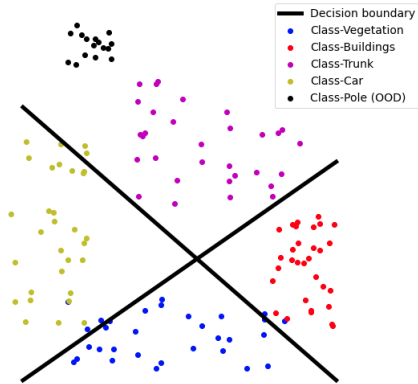

Figure 1: Semantic space of a deep neural network with decision boundaries for four classes (Vegetation, Building, Trunk, Car) from training set and class Pole observed during inference

Research questions

The research questions answered in this thesis are:

RQ1 How to create a benchmark over 3D segmentation datasets for the out of distribution(OOD) setting? i.e., create the in and the out distribution datasets.

RQ2 How to extend the current OOD detection methods from 2D semantic segmentation task to 3D semantic segmentation?

RQ3 Is uncertainty quantification an effective approach in 3D semantic segmentation models for OOD detection?

RQ4 How to evaluate the OOD detection over the 3D semantic segmentation task?

Deliverables

Minimum Viable

- Systematic literature survey of
  - Datasets in LiDAR semantic segmentation.
  - Existing out of distribution detection methods.
  - Semantic segmentation on LiDAR data.
- Proposal of benchmarking datasets for out of distribution detection in 3D semantic segmentation.
- Study of uncertainty quantification in 3D semantic segmentation models.
- Implementation of method which uses quantified uncertainty for OOD detection.
- Systematic evaluation of the implemented OOD detection method over the proposed dataset.

Deliverables

Expected

- Extension of the state of the art model for OOD detection.
- Evaluation and comparison of the extended state of the art model to baseline algorithm.

Desired

- Draft a research paper with the insights/findings from thesis.
- Proposal of a refinement over the current OOD model for higher performance.