Master Thesis Defense Swaroop Bhandary

Date: Thursday, 13.08.2020
Time: 10:00 a.m.
Room: Online

Title: Evaluating Uncertainty Estimation Methods on 3D Semantic Segmentation of Point Clouds

Abstract:
Deep learning models are extensively used in various safety critical applications. Hence these models along with being accurate need to be highly reliable. One way of achieving this is by quantifying uncertainty. The uncertainty quantification methods have been extensively studied for deep learning models applied to images but have been less explored for 3D modalities such as point clouds often used for autonomous systems. As part of this work, we adapt and evaluate uncertainty estimation approaches on 3D semantic segmentation models. We perform a state of the art analysis of 3D semantic segmentation models working on point clouds and shortlist two methods: DarkNet21Seg and RandLA-Net based on their performance in the SemanticKITTI dataset. Three uncertainty quantification methods namely Deep ensemble, MC-Dropout and MC-DropConnect for DarkNet21Seg and Deep ensemble, MC-Dropout and Test time augmentation for RandLA-Net are evaluated to study the impact of various parameters such as the number of models in ensembles, dropout/dropconnect value, and the number of forward passes on various metrics which take into account the performance, uncertainty estimates, and reliability of the model.

We find that Deep ensemble outperforms other methods in both performance and uncertainty metric while having lesser parameters that need to be explicitly tuned. For DarkNet21Seg, Deep ensembles outperform other methods by a margin of 2.4% in terms of mIOU, 1.3% in terms of accuracy, while providing reliable uncertainty estimates. For RandLA-Net, Deep ensembles outperform other methods by a margin of 2.2% in terms of mIOU, 0.9% in terms of accuracy while providing reliable uncertainty estimates.