Methodology In this chapter, we will discuss the RandlLA-Net used for 3D semantic segmentation, especially about
RandLA-Net utilizes random point sampling among the other sampling methods such as Farthest Point Sampling,
Figure ?? represents the local features aggregation module for the RandLA-Net. This module is applied parallelly
Local Spatial Encoding (LocSE) The local spatial encoding module takes each point (p_i) in the point cloud (P) and

Finding nearest neighbours
Relative position encoding
Feature augmentation

In step 1, neighbouring points for point (p_i) are collected using euclidean distance based K-nearest neighbour (KN

where r_i^k is the relative position of point p_i with respect to p_i^k, here in p_i and p_i^k only the x,y and z positions are used.

Dilated Residual Block Dilated Residual Block is a ResNet inspired module as claimed by authors and represented
To summarize, up to this point, we have studied the unique feature of RandLA-Net. That is how random point san
RandLA-Net architecture RandLA-Net is an encoder-decoder architecture with skip connections as used in various
We chose RandLA-Net because of the following reasons:

Efficient extraction of complex structures progressively using Local Feature Aggregation (LFA) module.
Has fewer parameters (1.24M), making training efficient, as 3D semantic segmentation models are computationally expe
Proven performance over a variety of datasets such as Semantic3D and SemanticKITTI, along with ablation study of ea
No preprocessing such as range image representation as in [?], or farthest point sampling with a computational complex
State of the art performance in point-based methods, consisting of only Multi-Layer Perceptrons (MLP) and without ex

Evaluation metrics-Semantic Segmentation To evaluate the performance of RandLA-Net over the training dataset (
Mean Intersection-over-Union (mIoU) Mean Intersection-over-Union is a widely used metric for performance evalua

Where N is the number of classes, p_k and g_k are predicted mask and ground truth mask of k^{th} class.
Accuracy Accuracy is another widely used metric, which can be quantified as a number of points in the point cloud

Where TP, TN, FP and FN are True Positives, True Negatives, False Positives and False Negatives, respectively, from t
Here, we conclude the study of RandLA-Net, the reason for its effective performance, argue the reasons to chose Ra
Deep ensembles Deep ensembles employ a kind of ensemble learning technique and are proposed in [?]. Similar to b
Despite their performance boosting ability, they are also used to estimate uncertainty as in [?]. [?] proposes that w
Flipout In this thesis, we also employed the Flipout version of the RandLA-Net model for uncertainty estimates, ar

So the node output of the neural network is modified as

Here ϕ is the activation function, and x_n is the n^{th} input example in the mini batch. This whole operation is vectorized

Authors also argue that the Flipout reduces the variance in gradients when compared to shared perturbation but has a
At a glance, these random weight perturbations give us slightly different output estimates for every forward pass. I
[scale=0.5]images/flipout.jpg Illustration of test dataflow in Flipout. Here F_1 represents the flipout trained model and w
OOD estimates In this section, we discuss the two methods used to generate the OOD score for classifying the OOI
Maximum Softmax Probability First proposed in [?], uses the probability of the classification from the Softmax for

Entropy Entropy is defined by [?] as an "ill-defined notion of chaos or uncertainty". Entropy has its roots in therm

In theory, following this formula, if the point in the point cloud is from In Distribution (ID), then the softmax output is
Evaluation metric-OOD detection This section will discuss the metrics used for evaluating OOD detection. Firstly
A ROC curve is generated as follows, given a set of probabilities/scores and their true labels, either positive or nega
Area Under an ROC curve Since the ROC curves are a tow dimensional depiction and we need a single scalar value