State of the Art This chapter will discuss the 3D LiDAR datasets available and classify them based on the type of a

Static datasets are advantageous because they can produce highly dense point clouds leading to rich geometric repr
The last type of 3D LiDAR dataset is the synthetic dataset. As the name suggests, these datasets are generated fro
The datasets belonging to each acquisition type are summed up in Table **??**. Most of the datasets from Table **??** ar

[h!]

acquisition mode	dataset	frames	points (in million)	classes	scene type
7*static	Oakland[**?**]	17	1.6	44	outdoor
	Paris-lille-3D[**?**]	3	143	50	outdoor
	Paris-rue-Madame[**?**]	2	20	17	outdoor
	S3DIS[**?**]	5	215	12	indoor
	ScanObjectNN[**?**]	-	-	15	indoor
	Semantic3D[**?**]	30	4009	8	outdoor
	TerraMobilita/IQmulus[**?**]	10	12	15	outdoor
	TUM City Campus[**?**]	631	41	8	outdoor
7*sequential	DALES[**?**]	40 (tiles)	492	8	outdoor
	A2D2[**?**]	41277	1238	38	outdoor
	AIO Drive[**?**]	100	-	23	outdoor
	KITTI-360[**?**]	100K	18000	19	outdoor
	nuScenes-lidarseg[**?**]	40000	1400	32	outdoor
	PandaSet[**?**]	16000	1844	37	outdoor
	SemanticKITTI[**?**]	43552	4549	28	outdoor
	SemanticPOSS[**?**]	2988	216	14	outdoor
	Sydney Urban[**?**]	631	-	26	outdoor
	Toronto-3D[**?**]	4	78.3	8	outdoor
1*synthetic	SynthCity[**?**]	75000	367.9	9	outdoor

3D LiDAR datasets clas

We chose the Semantic3D dataset as the in-distribution (ID) training dataset from the available datasets. S3DIS is
3D semantic segmentation models
This section will discuss the methods available for 3D semantic segmentation. The discussion includes a brief peek
Traditional approach Traditional methods involve a complex features extraction and passing these features to a clas
Deep learning approach Deep learning based models are efficient at segmentation and can be divided into three typ
Let us look briefly into the point-based methods. Point-based methods usually utilize fully connected layers or trad
The other flavours of point-based methods include projection onto a d-dimensional lattice or making the point clou
In projection-based models, let us discuss the models that project the data onto a 2D range image. The first of this
We now discuss the projection-based models which involve bird eye view projection. These models are relatively ne
Table **??** illustrates the detailed summary of each model and the number of parameters. Finally, graph neural netw
Uncertainty estimation methods This section will discuss existing methods to estimate uncertainty in deep neural n
[**?**] argues that there are two kinds of uncertainties, they are epistemic and aleatoric uncertainty. Epistemic uncerta
Because of the higher computational complexity and resource intensiveness, there exist multiple flavours of the deep
Other methods include snapshot ensembles [**?**] which iterate over the multiple local optima in the optimization land
Bayesian methods Existing neural networks are trained in maximum likelihood, resulting in point estimates for the

Here θ represents network parameters (weights), $p(\theta)$ represents prior distribution over θ, and x and y represent the inp

Here θ represents trained network parameters, x and y represent the training set, and x_t and y_t represent the test set. T
VI is an approximation method where the posterior probability $p(\theta|x, y)$ is approximated by specific distributions r
Another widely known example for VI is Monte Carlo Dropout (MC-Dropout), in which the dropout layers are refo
Out-of-distribution (OOD) detection methods
OOD/Anomaly/Distributional shift [h!] 0.333 [height=0.15width=0.95]images/intro$_o$od$_a$nomaly/old$_s$hip.jpg 0.333
Let us time travel back to 18^{th} century and assume that we had implemented a DNN model to detect ships. The d
Where as an anomaly can be defined as the patterns that do not conform to the expected training behaviour as pro
In the case of OOD, the input is drawn from an unknown distribution of unknown data, which is not near to the tr
This section will discuss the existing OOD detection methods for 2D classification and 2D semantic segmentation ta
The most widely used benchmark datasets for 2D classification are CIFAR-10 vs SVHN [**?**], CIFAR-10 vs LSUN [**?**]

[**?**] has proposed a threshold-based OOD detection method using the Mahalanobis distance as a confidence score. The M

where $h(x)$ is final layer activations, c is the constant and $h^{-}(x)$ is ReAct output of $h(x)$. The score from this ReAct fu
The OOD data samples have higher uncertainty than ID samples, allowing us to use the uncertainty estimation me
In recent years, OOD detection for the task of 2D semantic segmentation has been getting into the limelight. [**?**] pr