

State of the Art This chapter will discuss the 3D LiDAR datasets available and classify them based on the type of . In this section, we will discuss the available LiDAR datasets for the 3D semantic segmentation task and classify the Most of the popular autonomous driving datasets are sequential, but these datasets come with a drawback of sparse

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 from The datasets belonging to the each acquisition type are summed up in Table ?? . Most of the datasets from Table ?

acquisition mode	dataset	frames	points (in million)	classes	scene type	
[h!] 7*static	Oakland[?]	17	1.6	44	outdoor	3D LiDAR datasets clas
	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	
	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	
1*sequential	SemanticKITTI[?]	43552	4549	28	outdoor	
	SemanticPOSS[?]	2988	216	14	outdoor	
	Sydney Urban[?]	631	-	26	outdoor	
	Toronto-3D[?]	4	78.3	8	outdoor	
	SynthCity[?]	75000	367.9	9	outdoor	

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 majorly utilize fully connected layers or trac The other flavours of point-based methods include projection onto a d-dimensional lattice or making the point clou Let us first discuss the models that project the data onto a 2D range image in projection-based models. First, of th 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 along with the number of parameters. Finally, graph neur 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 iterates over the multiple local optima in the optimization lan Bayesian methods Existing neural networks are trained in maximum likelihood, resulting in point estimates for the

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

Here  $\theta$  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 This section will discuss the existing OOD detection methods for 2D The most widely used benchmarked datasets used for 2D classification dataset are CIFAR-10 vs SVHN [?], CIFAR-

[?] 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 over ID samples, which allows us to use the uncertainty estimation In recent years, OOD detection for the task of 2D semantic segmentation has been getting into the limelight. [?] pr