KI DATA TOOLING
The Data Kit for Automotive AI

About the Ambiguity of Data Augmentation for 3D Object Detection

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Acquisition, Curation & Refinement of Real Data

Introduction

In this work the influence of data augmentation methods are investigated. Data augmentation allows existing datasets to be artificially enlarged and made more diverse. The focus is set on the task of 3D object detection on point cloud data as an important task in the pipeline towards autonomous driving.

Ambiguity of Data Augmentation

Data augmentation is considered an important step in the training strategy of 3D object detectors on point clouds to increase the overall performance and robustness. The question arises as to the impact as well as the transferability of different augmentation policies.

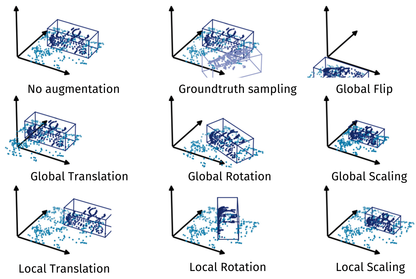

Figure 1: Sketch for most commonly used augmentation methods is shown

A series of elaborate experiments with four different networks, namely PointPillar, PointRCNN, PartA2 and 3DSSD [1-4], were performed on the KITTI dataset [5]. The applied augmentation methods are depicted in figure 1. Table 1 shows an exemplary excerpt of the results on KITTI. It can be seen, that the influence of data augmentation is clearly dependent on the network architecture. Thus, some networks benefit greatly from a full augmentation, while for others the effect is negligible. The same goes for the impact of single augmentation methods, where some yield a large positive effect for one network and a negative effect for another. The same ambiguity was seen in other experiments as well. By the experiments it was concluded that there is no general optimal augmentation policy, but the policy depends on the network and dataset at hand.

Datasize Reduction

The amount of training data is one of the most critical factors for good results of a deep learning approach. Therefore, in this experiment the ability of the GT sampling augmentation to compensate for the lack of data was investigated by using only a portion of the available data.

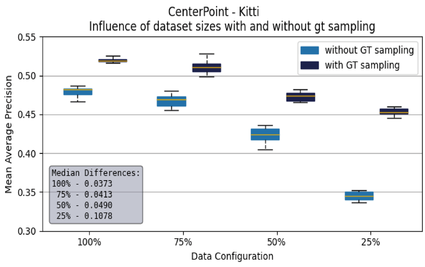

Figure 2: Non official mAP evaluation results for KITTI for car and pedestrian classes.

The results performed with CenterPoint [6] can be seen in figure 2. It can be observed, that the groundtruth sampling method cushions the effect of less data.

References:

[1] Lang, Alex H., et al. "Pointpillars: Fast encoders for object detection from point clouds." Proceedings of the IEEE/CVF conference on computer vision and pattern recognition. 2019.
[2] Shi, Shaoshuai, Xiaogang Wang, and Hongsheng Li. "Pointrcnn: 3d object proposal generation and detection from point cloud." *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*. 2019.
[3] Shi, Shaoshuai, et al. "From points to parts: 3d object detection from point cloud with part-aware and part-aggregation network." *IEEE transactions on pattern analysis and machine intelligence* 43.8 (2020): 2647-2664.
[4] Yang, Zetong, et al. "3dssd: Point-based 3d single stage object detector." *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*. 2020.
[5] Geiger, Andreas, et al. "Vision meets robotics: The kitti dataset." *The International Journal of Robotics Research* 32.11 (2013): 1231-1237.
[6] Yin, Tianwei, Xingyi Zhou, and Philipp Krahenbuhl. "Center-based 3d object detection and tracking." *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*. 2021.

Augmentation Method	PointPillars	PointRCNN	PartA2	3DSSD
no Augmentation	58.72	78.24	75.43	61.51
	0.00	0.00	0.00	0.00
full Augmentation	**76.71**	**78.73**	**79.62**	**78.69**
	17.99	0.49	4.18	17.18
only groundtruth sampling	59.85	78.04	76.00	75.73
	1.13	-0.20	0.57	14.22
only local translation	54.40	77.70	78.08	55.71
	-4.32	-0.54	2.64	-5.80

Table 1: Results for KITTI moderate Car mAP on validation split with no augmentation and some augmentation methods applied on its own. The best results for each network are marked in bold. Colored values are the difference to no augmentation.

Partners

External partners

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