KI DELTA LEARNING
Scalable AI for Automated Driving

3D Detection and Tracking From LiDAR Point Clouds As a Pre-Processing Step for Active Learning

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Sensors / Active Learning

Use-Case in Delta Learning
The labeling of data is time and resource-consuming, especially in the case of 3D data. The task of optimally choosing few training samples to be labeled while maintaining similar performance to models trained on the full dataset is called active learning. A possible approach is selecting data points where the model shows high uncertainty. Good picks enable more effective deep learning pipelines and may enable their application in areas where there only exist small or even no labeled datasets.

Technical Problem
2D detection is a well-studied problem. The detection from 3D points clouds, especially in the autonomous driving setting, is a much more challenging task. We need to cover a wide range of shapes and sizes from trucks to pedestrians. This is complicated by the fact that the data is sparse. Nonetheless, LiDAR data is a common and helpful source of information for autonomous driving algorithms such that the effort to pre-process data as to give an indication of which frames should be labelled next is worthwhile goal.

Technical Solution
We base our detection and tracking method on Centerpoint [1], which we successfully adapt to the project's dataset. The basic idea is to detect only the centers of objects at first. Other necessary metrics like the bounding box's pose are regressed to in a second step. The outputs are labeled 3D bounding boxes and inter-frame tracking. As each detected instance includes a confidence, one can easily derive an algorithm that computes a metric for overall frame confidence.

It is noteworthy that the model is only trained on the nuScenes dataset. We expect further performance improvements once we can incorporate labeled project data.

Evaluation
We evaluate the results on the existing project data (figures 1, 3). Figure 1 shows the generated 3D bounding boxes next to the raw data. Figure 2 demonstrates consistent tracking even in complicated scenes. Even though the model has only been trained on nuScenes data as no labeled project frames were available yet, we achieve promising qualitative results.

References:
[1] Tianwei Yin, Xingyi Zhou and Philipp Krähenbühl. Center-based 3D Object Detection and Tracking. CVPR, 2021.

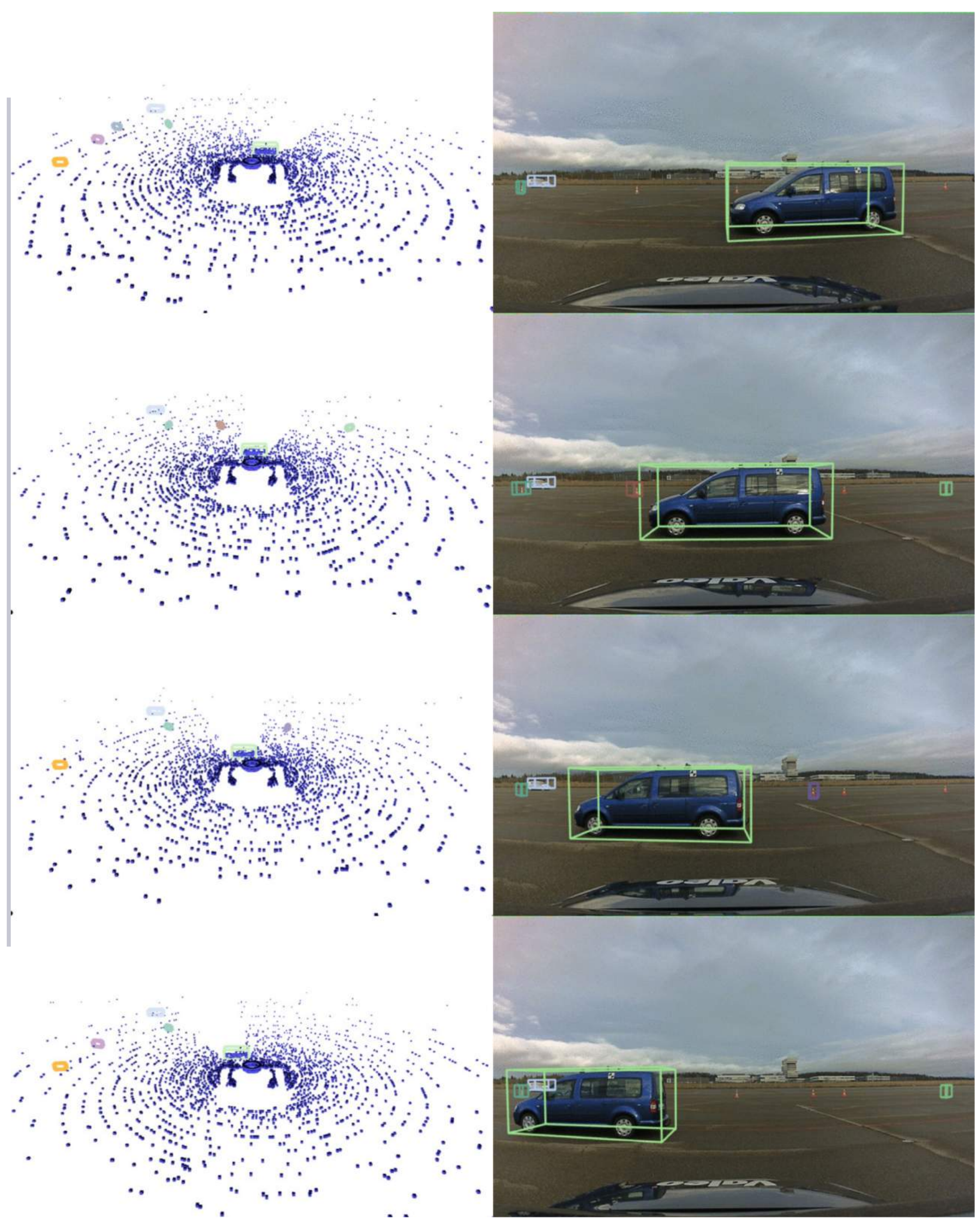

Figure 1: Original data and results projected into RGB image (© TUM)

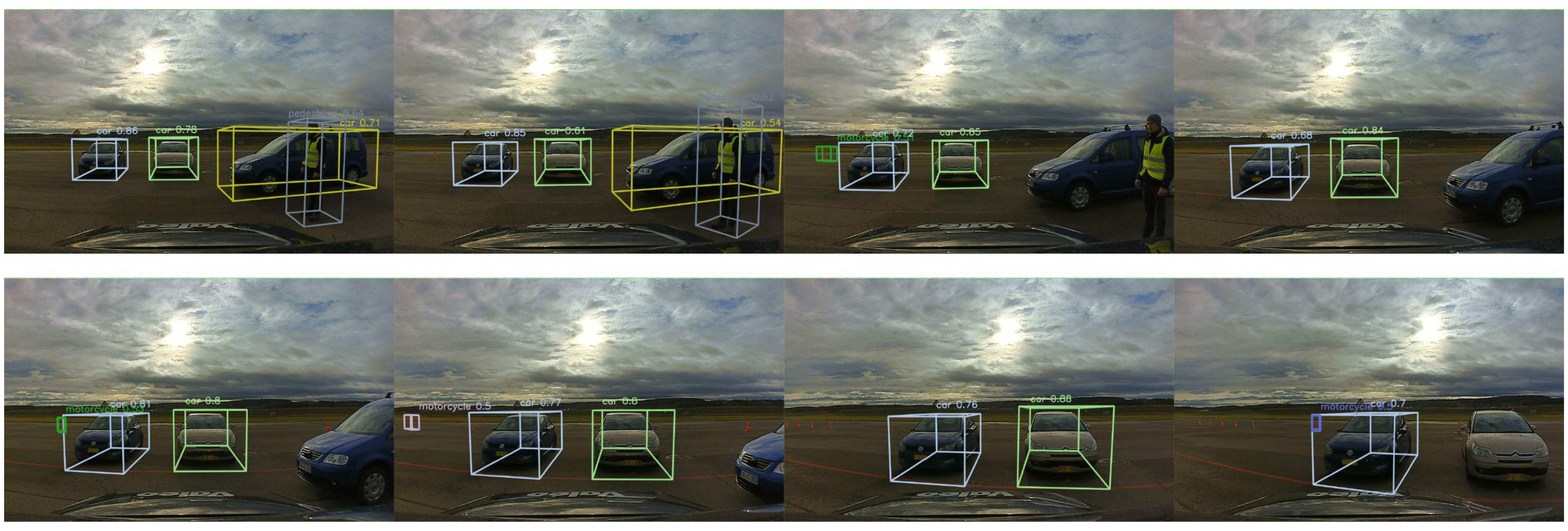

Figure 2: Qualitative evaluation of detection and tracking on project data (© TUM)

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