

Use-Case in Delta Learning

Developing a Deep-learning based Lidar 3D object detector requires a lot of annotated data. When moving to a new sensor, the question arises, what performance gap can we expect, when running the detector on the new data. In particular, here we investigate the gap caused by different sensor resolution (see example data in Fig. 1).

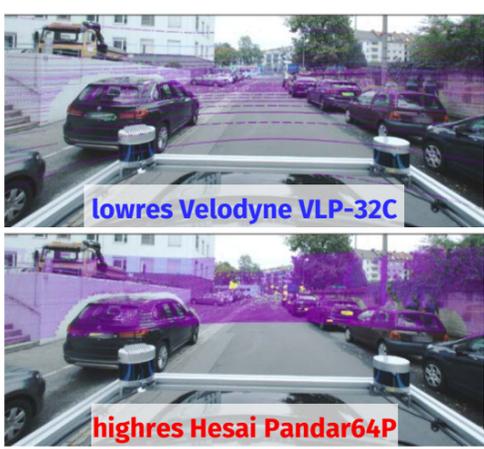


Figure 1: Example data of employed sensors.

Technical Problem

Typically, the domain gap is quantified on completely different datasets, e.g., Kitti vs. nuScenes. However, using different datasets, we likely have an inseparable mixture of multiple gaps, including different country/time context, labelstyle (boxes might be labeled differently), and processing specs such as ego motion compensation.

Technical Solution

We conduct a gap analysis on an internal dataset, which includes simultaneously recorded data of two highres and lowres sensors respectively (setup shown in Fig. 2). This way, we can tightly focus on the delta-sensor gap. In doing so, we analyze the detection performance with respect to the spatial location to the measuring sensor (Fig.3). In addition, it lets us compare the gap on an object/feature level (Fig. 4).

Evaluation

Main insights (wrt. our setup):

- 1) Training a dedicated detector with annotated data from the target domain increases the performance by >5%,
- 2) Inference with highres data instead of lowres data improves the performance for a given detector by >10%.
- 3) The domain gap is visible in the features of the intermediate layers of the detector.

Future work includes implementing approaches to close the gap and study their effects.

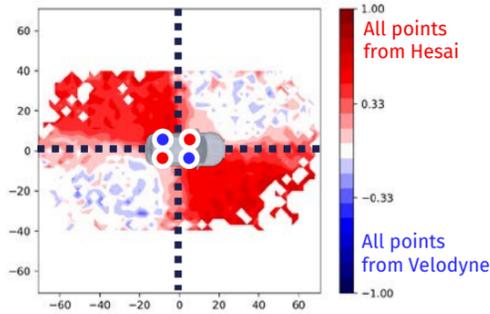


Figure 2: Ratio of points in annotated boxes.

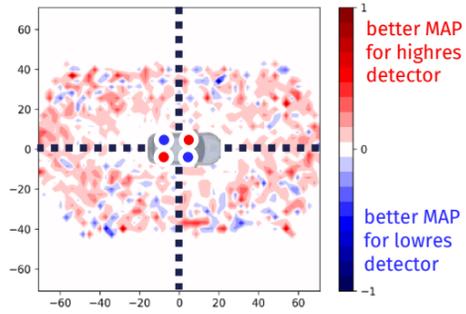


Figure 3: Visualization of the gap observed in the experiment from Fig. 5 top-right.

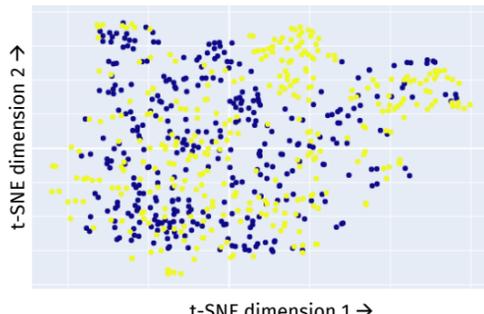


Figure 4: t-SNE plot for the object-related features in a single frame of source (blue) / target (yellow) domain.

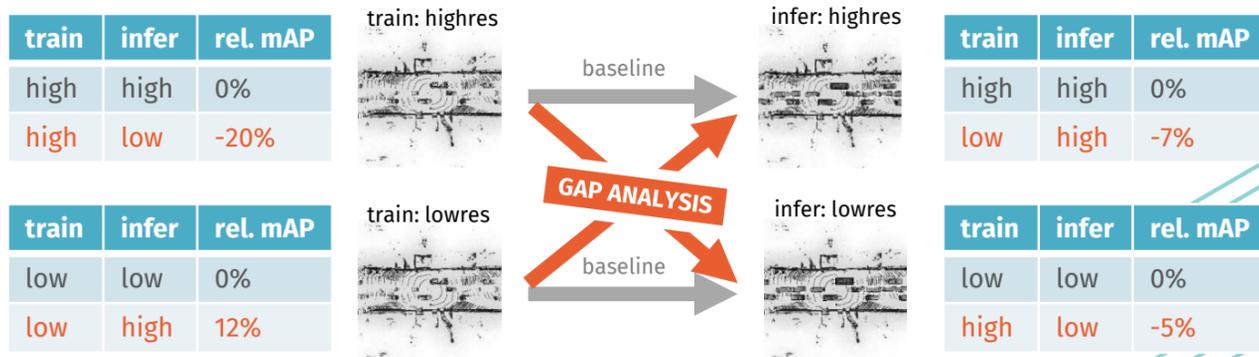


Figure 5: Highlevel gap analysis to quantify the gap in the overall performance.



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Partners



External partners



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