KI DELTA LEARNING
Scalable AI for Automated Driving

Active learning for semantic segmentation in realistic driving scenarios

Joshua Niemeijer*, Sudhanshu Mittal*, Jörg Schäfer and Thomas Brox

* Indicates equal contribution

Realistic active learning for driving scenarios

Motivation: In large-scale data applications like autonomous driving, data can be collected in abundance as videos. One of the major challenge lies in annotating the data, especially for dense prediction tasks.

Goal: In active learning (AL), the objective is to mitigate the annotation cost by selecting those samples for annotation that most increase the model's performance.

Technical Problem

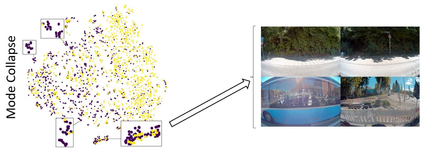

Figure 1: TSNE plot shows unlabeled images in yellow and labeled images in violet. If clusters are selected, this yields redundant samples.

- Proposed active learning methods fail for highly redundant datasets like autonomous driving data. The underlying reason for the failure is the issue of mode collapse, i.e., the acquisition function collapses to selecting only similar samples in a cycle.
- This problem is ignored due to the absence of realistic benchmarks for active learning for semantic segmentation.
- Integration of AL and semi-supervised learning (SSL) can be crucial; however, it remains unstudied.

Technical Findings

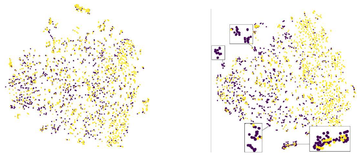

Figure 2: Left batch-based aquisition, Right Single sample aquisition

- Data distribution is decisive for the performance of the AL method. Redundancy in the data, as it appears in most video datasets, plays a large role.
- Integration of SSL with AL can improve performance when the two objectives are aligned.
- Current AL benchmarks for segmentation in driving scenarios are unrealistic since they operate on data already curated for maximum diversity.
- We propose a realistic evaluation scheme.

Results overview

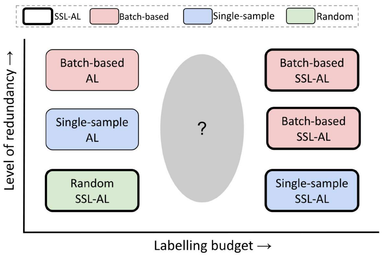

Figure 3: The axes characterize dataset redundancy and the labeling budget during the acquisition. For each combination, the best acquisition strategy is depicted.

- Single-sample-based AL method is suitable for diverse datasets, whereas batch-based diversity-driven AL methods are suited for redundant datasets.
- SSL always successfully integrates with batch-based diversity-driven AL methods.
- Random acquisition with SSL integration is best for small labeling budgets on diverse datasets.

Results on reaslistic driving task

Batch-based AL method with SSL integration performs the best on realistic driving A2D2 dataset.

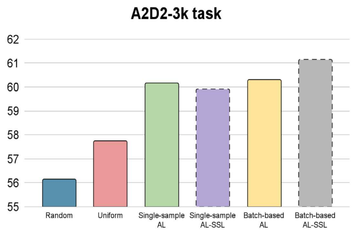

Figure 4: Results for sampling 3000 images from the 40000 images A2D2 Dataset are shown.

References:

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Active Learning / Environment

Partners

External partners

For more information contact:
Joshua.Niemeijer@dlr.de
mittal@cs.uni-freiburg.de

paper

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