

# Vehicle Lane Merge Visual Benchmark

<http://www.vlmv.viscodas.com>

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## Cooperative and Automated Driving

V2X use case: automated driving, cooperative maneuvers [1]

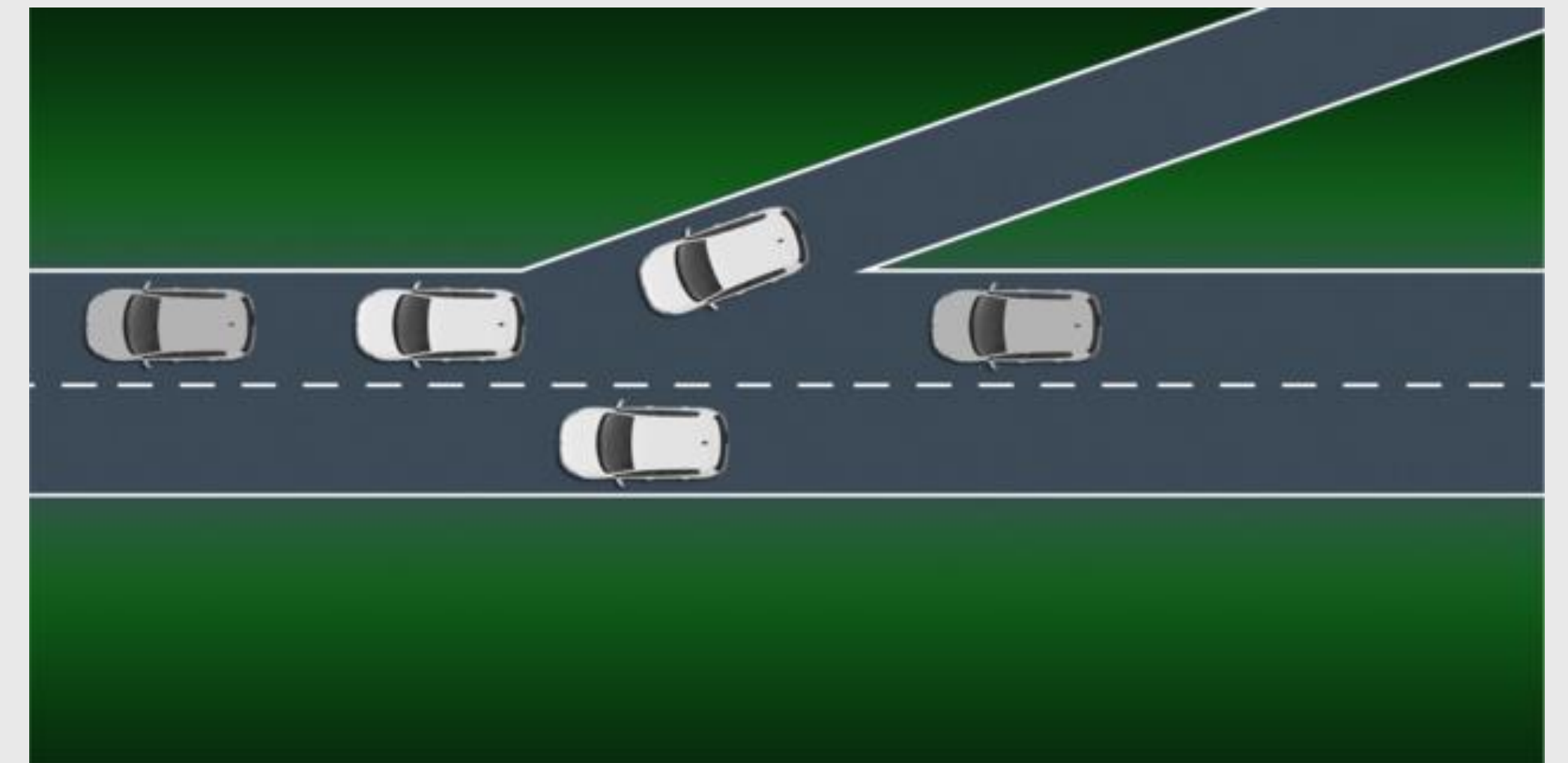
- Coordination of trajectory recommendations

### Localization of vehicles

- GNSS RTK vs. camera-based localization
- Evaluation of localization accuracy

### Study of cooperative maneuvers to infer automated driving

- Various lane merge maneuvers performed by human drivers
- Trajectories as input for machine learning [2]



## Vehicle Lane Merge Data

Camera setup

- 4 cameras (1824x1536)
- 10 m height
- Highly-accurate calibration [3]

85 data sets

- 3-5 cars
- 7 recording days
- Ground truth measures:
  - GNSS-RTK: localization
  - In-vehicle: heading, speed
- Vision-based localization



Lane merge of entering vehicle over time



Camera views 1-4, cameras mounted pairwise on two masts

## Example Evaluation

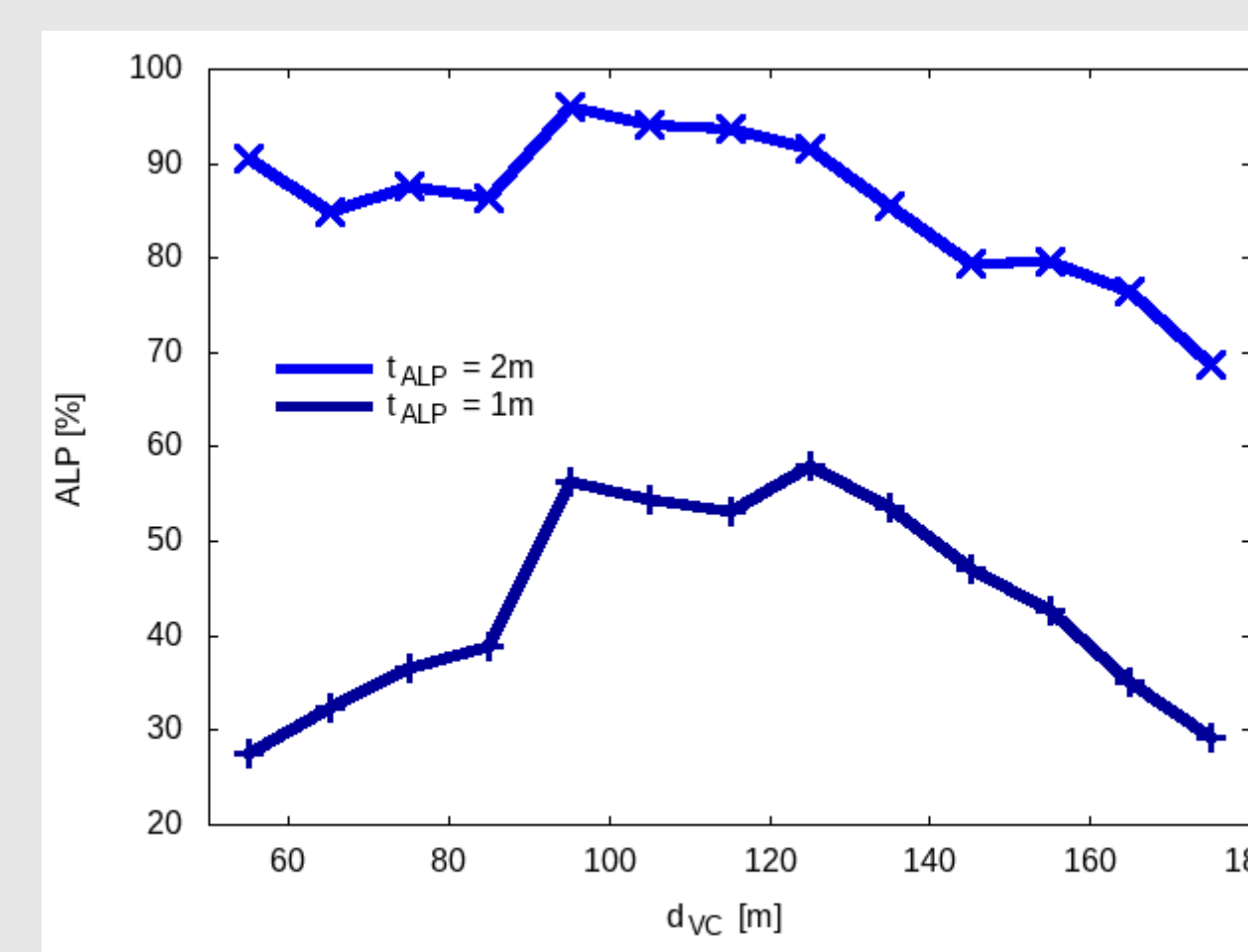
### Vehicle localization [4] (realtime approach)

ALP: percentage of localization errors below  $t_{ALP} = 1m, 2m$

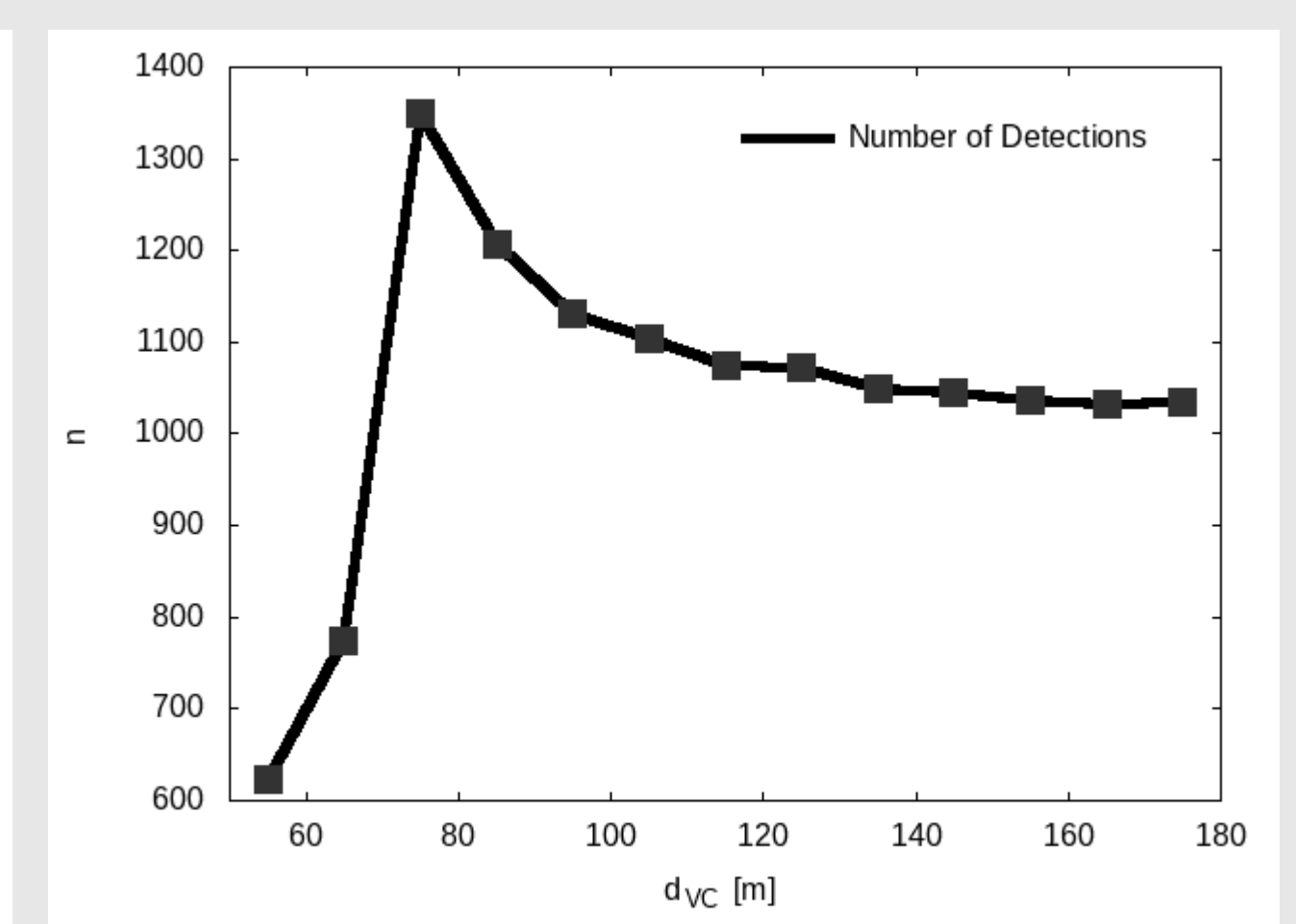
$d_{VC}$ : vehicle camera distance

### Localization accuracy:

- Decreases for large distances
- Results serve as a baseline



ALP: Average localization precision



n: absolute number of detections

## Conclusions

**Vehicle Localization Benchmark:** Evaluation of localization accuracy

- Accurate ground truth data from GNSS RTK

**Lane Merge Maneuver Data:** Human driven lane merge maneuvers

- Valuable data for the learning of automated cooperative driving

[1] <https://sgcar.eu/>

[2] O. Nassef, L. Sequeira, E. Salam, and T. Mahmoodi (2020) "Building a Lane Merge Coordination for Connected Vehicles Using Deep Reinforcement Learning", *IEEE Internet of Things Journal*

[3] K. Cordes and H. Broszio (2019) "Constrained Multi Camera Calibration for Lane Merge Observation", *SciTePress, VISAPP*

[4] K. Cordes, N. Nolte, N. Meine, and H. Broszio (2019) "Accuracy Evaluation of Camera-based Vehicle Localization", *IEEE ICCVE*