KI DELTA LEARNING
Scalable AI for Automated Driving

Unsupervised Detection of Abnormal Driving Behavior

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Overview

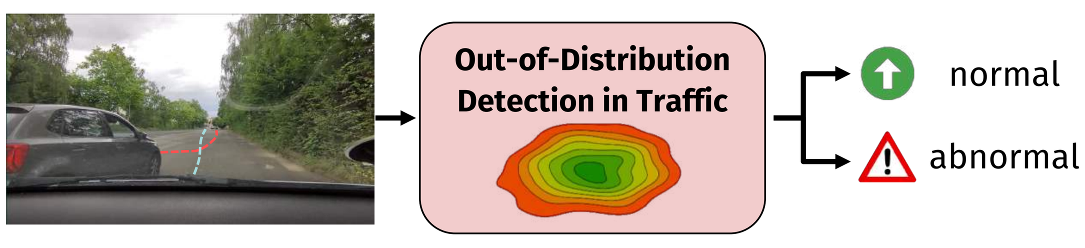


Figure 1: Concept Overview. (© Mercedes-Benz AG)

- Human drivers recognise abnormal driving behavior and react accordingly to avoid critical situations.
- Similar, automated vehicles (AVs) need anomaly detection capabilities.

Objective and Contribution

We propose a method for unsupervised multi-agent anomaly detection.

Threefold Contribution:

1) Unsupervised traffic scene encoding.
2) Kernel density estimation (KDE) for anomaly detection.
3) Dataset in **R**ealistic **U**rban settings for **M**ulti-**A**gent **A**nomaly **D**etection, **R-U-MAAD**

Method: STGAE + KDE

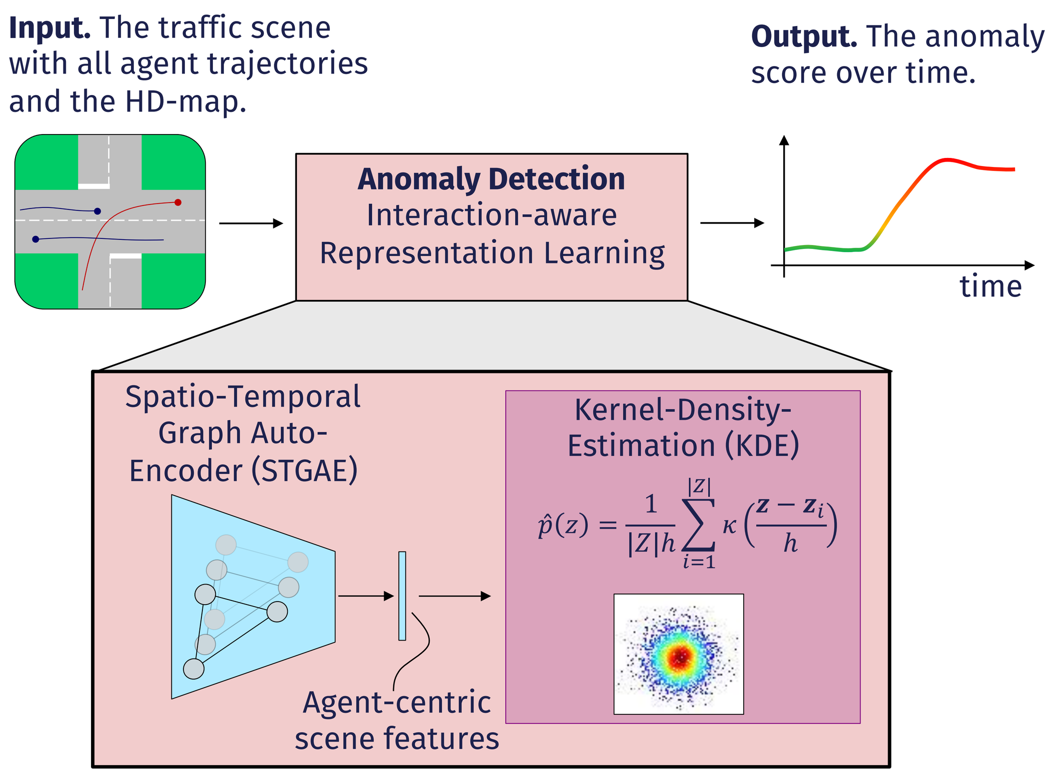


Figure 2: Method Overview. (© Mercedes-Benz AG)

- STGAE for multi-agent trajectory representation learning.
- KDE for density estimation of the normal trajectories.
- Anomalies occur in low-density with the anomaly score $\alpha = \hat{p}(z)$.

Paper & Code

For more details on our papers check our github projects!

MAAD GET CODE

R-U-MAAD GET CODE

Hybrid-Simulation for Dataset Generation

We **replay real-world scenarios** in the simulation (blue vehicles + map) and **manually control a target vehicle** (red) to drive diverse abnormal scenarios. All scenes are manually annotated

→ R-U-MAAD

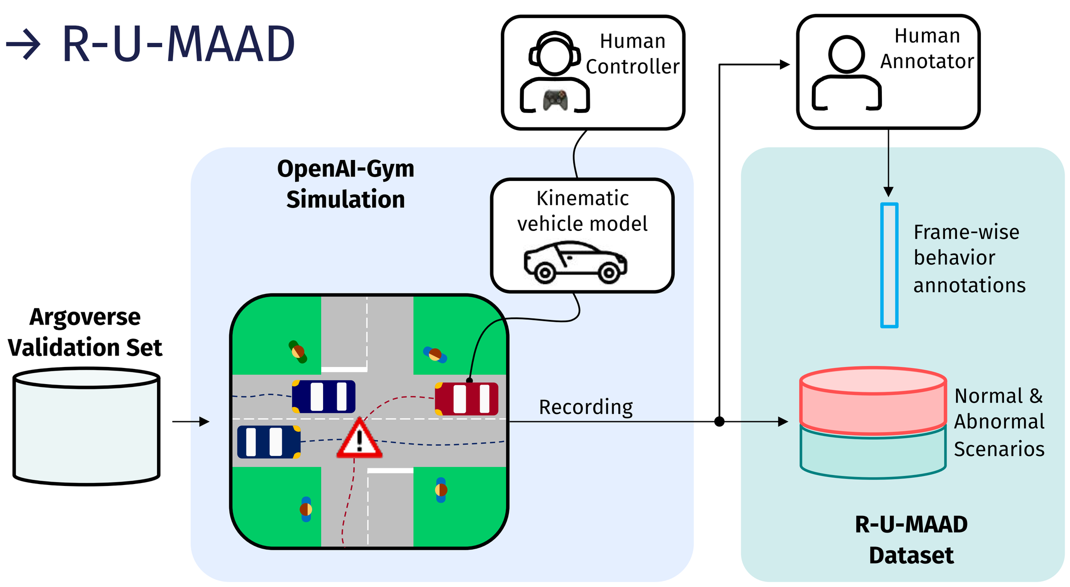


Figure 3: Data Generation Pipeline including the hybrid simulation and the data annoation. (© Mercedes-Benz AG)

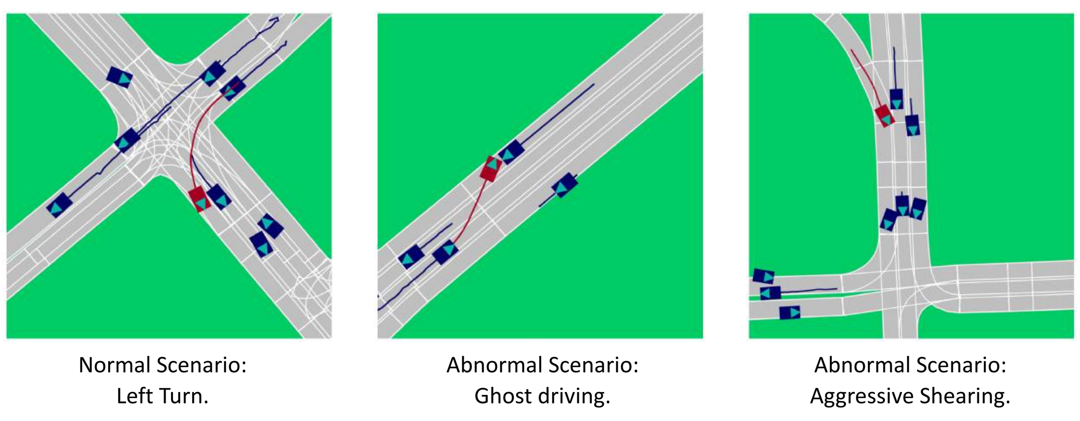
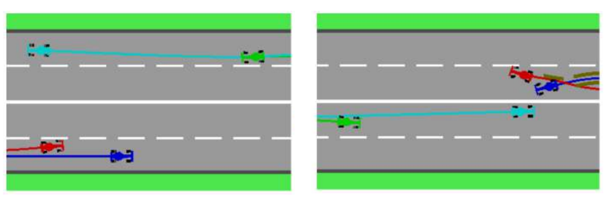


Figure 4: A normal and two abnormal scenarios from the R-U-MAAD dataset. (© Mercedes-Benz AG)

Ablation: N-Agent Highway Scenario

- Simulate highway scenarios to analyse the dependency on the number of agents.
- Our method remains stable with the # of agents, $N = \{2, 4\}$.



# Agents	Model	AUROC ↑	AUPR-Abnormal ↑
$N = 2$	STGAE	69.08	39.28
$N = 2$	STGAE + KDE	92.34	66.75
$N = 4$	STGAE	52.42	17.95
$N = 4$	STGAE + KDE	89.41	60.52

Figure 5: Ablation results. (© Mercedes-Benz AG)

Real World Robustness

Qualitative Results

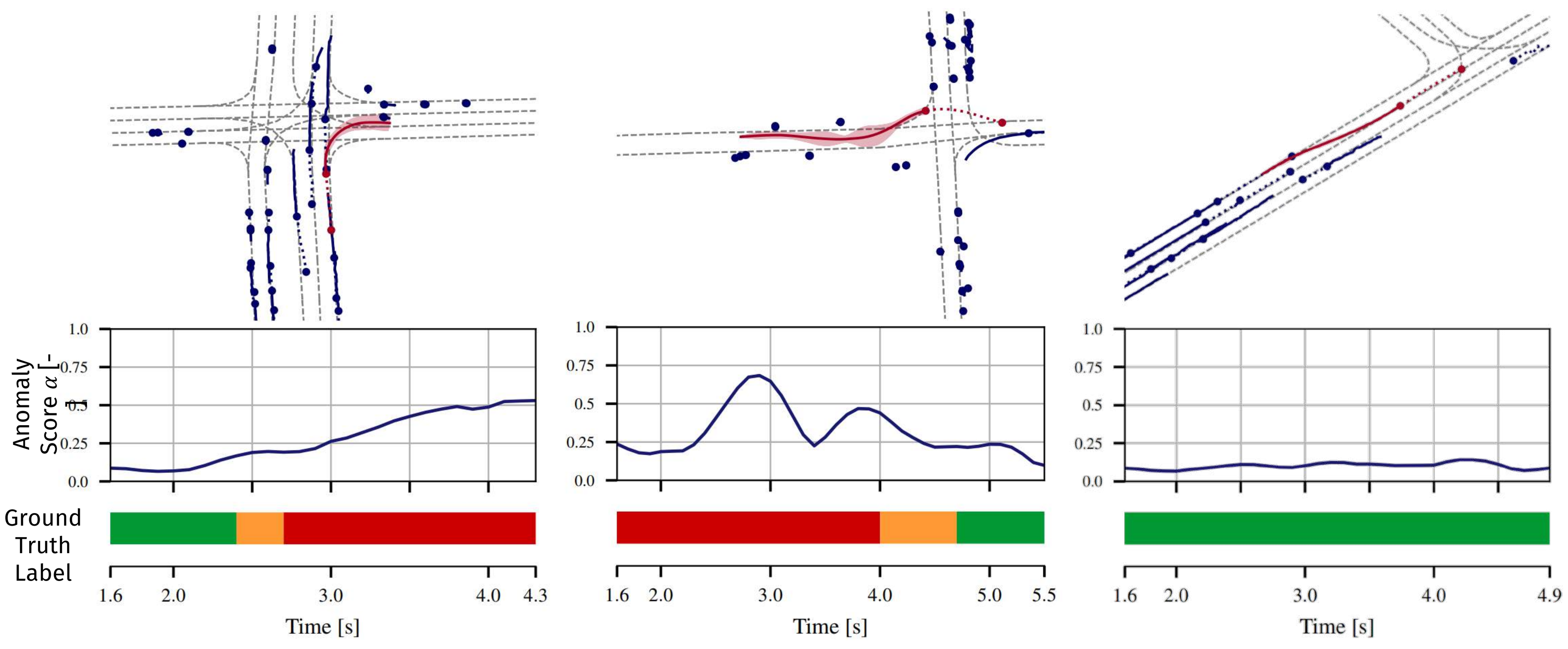


Figure 6: Qualitative Results on our R-U-MAAD test scenarios. We observe the increasing anomaly score in the abnormal scenarios (last minute turn, cancel turn). The anomaly score remains low for the normal lane change on the right. (© Mercedes-Benz AG)

Partners

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External partners

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