Synthetic Data for Development and Validation of autonomous Vehicles

20. Mai 2021

Data Science: Industrieerfahrung und Praxistipps
Virtueller Workshop der Gesellschaft für Informatik e.V. (GI) und der Plattform Lernende Systeme (PLS)
On the Future of Autonomous Systems
Where we are and what we need …

● By 2030 – driverless systems will have emerged, especially for trucks and Robotaxis
● Level 5 – Autonomy is going to yield benefits, e.g. for special mobile robots, transportation etc.
● Level 3 – Automation and assistance functions pose great challenges to drivers

Synthetic data is needed for development, verification and validation

To demonstrate that fully autonomous vehicles have a fatality rate of 1.09 fatalities per 100 million miles (R=99.9999989%) with a C=95% confidence level, the vehicles would have to be driven 275 million failure-free miles.
Autonomous Systems Validation and Homologation

Safety of Autonomous Systems: Brute Force Will Not Help

<table>
<thead>
<tr>
<th>Known</th>
<th>Unknown</th>
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<tbody>
<tr>
<td><strong>SOTIF:</strong></td>
<td>Methods to identify (and reduce) <strong>unknown</strong> unacceptable residual risks.</td>
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<tr>
<td><strong>Safety:</strong></td>
<td>Methods to identify and mitigate <strong>known</strong> unsafe situations</td>
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Prepare for the Unknown

Unsafe

Safe

- Automated Driving
- Robotics
- Off-road Vehicles
- Mobile Platforms

Quality matters: Anticipate the Unthinkable. Specify the Unknown Unknowns.

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Data for Autonomous Driving Safety

Development and Validation of autonomous Vehicles requires a bunch of new capabilities to create safe functionalities

Compliant Development according to ASPICE, Functional Safety (e.g. ISO 26262 SOTIF) and EU Artificial Intelligence Act

Data Acquisition ➔ Scene Selection and AI based Analytics ➔ Data Enrichment, Labeling and Augmentation ➔ Training of Algorithms / Machine learning ➔ Simulation ➔ Validation in HiL ➔ Test Drive

Synthetic Data / Hybrid Data / Real Data required

Data Loop
New offerings of Data provision are required ... Training and test of various algorithms such as Neural Networks, Bayesian Networks are required for image processing and action planning.

Reproduce reality in simulation:
Environment and traffic Simulations as realistic as possible.

Source: www.automotive-ai.com/

Turn raw data automatically into annotated data: create Bounding-Boxes and implement Semantic Segmentation.

Source: understand.ai/

Reveal Cognition Gaps of Neural Networks: Automatically create scenarios which produce malfunction in image processing.

Source: https://www.ias.uni-stuttgart.de/forschung/publikationen/

Scenario Databases:
ASAM OpenDrive, SHRP2 NDS, highD-dataset, inD-dataset etc.

Exchange Formats:
ASAM OpenSCENARIO, MSDL (SISO), …
The RoboTest Approach ...

Provide for efficient and transparent validation, certification and homologation for safe and reliable behavior of autonomous systems.

Robo-Test is the solution for cognitive testing through AI-optimized specification, selection and traceability of test requirements and associated scenarios:

- Test-Driven Requirement Engineering with traceability in a seamless validation and verification process
- Maximum test coverage and optimized test plans based on AI
- Testcase selection and automatic scenario specification based on real-world KPI feedback

Indexing based on principal component analysis of corner cases and Bayesian Networks

Source: www.robo-test.com
Vielen Dank!

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