Fraunhofer IESE

Fraunhofer-Institut für Experimentelles Software Engineering IESE

AI Automated Testing of Autonomous Vehicles

RevoAI GmbH and Fraunhofer IESE

RevoAI GmbH

The testing of autonomous vehicles requires to cover all important possible **scenarios**. This requires the scenarios to be extracted using both **engineering methods** and **natural driving data**. The **ISO 34501-34504** standards are to be implemented as a reference framework.

The scenarios are used to:

- Analyze and improve the **development of autonomous vehicles**
- **Achieve approval** through a suitable validation process
- Identify unknown scenarios in **field observations** and feed them back into the development process

The engineering office RevoAI GmbH and the safety department of Fraunhofer IESE have developed an AI-based **tool FastLoop+AutoTestReduction** to generate and execute the scenarios fully automatically.

The features of the tool are:

- The **definition and management** of abstract scenarios
- **Unsupervised learning** of logical scenarios with use of auto-encoders and clustering
- **Parameterized execution** of logical scenarios for testing
- Reinforcement based **test optimization** of scenario execution
- Integration of **risk metrics**

This enables **fully automated AI-based generation and execution of tests** for autonomous vehicles based entirely on data. AI optimization keeps **virtual validation** in driving simulators efficient and serves as a means of proving safety. An extension to include **requirements management with LLMs** and the automatic generation of functional scenarios is planned as a future feature.

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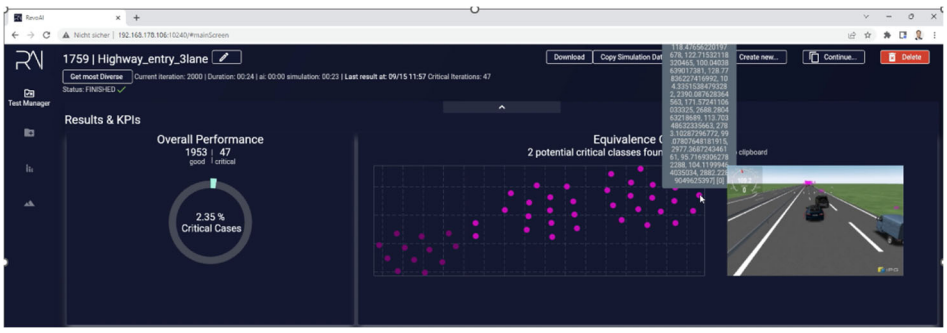

Screenshot of FastLoop+AutoTestReduction for the scenario-based analysis and test execution. The tool allows insight details for analysis as well as parallel execution for regression testing.

The tool identifies critical executions by various simulation runs. The clustering of scenarios defines different cause-effect relations. The replay and visualization complement test reports.

We provide:

- The **Tool FastLoop +AutoTestReduction for Management and Execution of scenarios** to test autonomous vehicles in simulators
- Scientific methods for the **management of scenarios and risks** in the context of autonomous driving
- Engineering support for **standard compliant safety evidence** and integration to safety argumentation