TARGET OBJECTIVES

openPASS – open Platform for Assessment of Safety Systems

Harmonized and flexible platform for scenario-based traffic simulation of advanced driver assistance systems and automated driving systems

Traffic simulation

Stochastic variation

Modularity and flexibility

Reproducibility through determinism

Standardized interfaces

High level of transparency and acceptance through publicly available open source platform by using open standards and building up a modular ecosystem
TIMELINE

Eclipse openPASS opSimulation

- 03/2017 Initial Commit
- 09/2017 PCM mod.
- 02/2018 V0.5 PCM
- 02/2020 V0.6 OSI
- 06/2020 V0.7 Urban
- 11/2021 V0.8 CI
- 06/2022 V0.9 Quality I
- 08/2022 V0.10 FMI
- 07/2023 V0.11 Quality II
- 11/2023 V1.0 OSE

Eclipse openPASS subprojects

- 03/2021 Initial Commit mantle-api
- 10/2021 Initial Commit open scenario1-engine
- 01/2022 Initial Commit yase
- 10/2022 Initial Commit V3.0 opVisualizer
- 08/2023 Initial Commit opGUI
Agent Components *

Driver  Vehicle  Sensor  Function

Standardized Interfaces

Scenario and Map *

Accident data  Traffic data  Synthetic data

Standardized Formats

* Simple examples are provided

Simulation Core

OpenSCENARIO Engine  Mantle API

Safety Performance Assessment
Virtual Testing / Homologation
Accident Research
Functional Development

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The modular architecture based on the Mantle API allows for the exchangeability of scenario engines, map converters and environment simulators.
SUPPORTED STANDARDS

ASAM OpenSCENARIO®

ASAM OpenDRIVE®

ASAM OSI®

openPASS®

fmi Functional Mock-up Interface

SSP System Structure & Parameterization
SIMULATION PROCESS

Simulation Process

Configuration through GUI → Configuration files → Simulation execution → Output files → Evaluation in GUI

- Configuration files: xml, xodr, xosc
- Output files: csv, xml
SCENARIO MODELLING APPROACHES

**Crash Re-Simulation**
- Pre-specified behavior through trajectories
- Low degree of interaction
- Evaluation of driving systems in short, fixed scenarios

**Event based scenario modelling**
- Mixture of pre-specification and model based behavior
- Manipulative interventions to force certain behavior (e.g. Cut In)
- Longer and dynamically evolving scenario spaces

**Stochastic Traffic Simulation**
- Sophisticated behavior models
- No pre-specified behavior / manipulation in the scenario
- Strong, model based interactions between traffic participants
- Evaluation of driving systems in dynamically evolving (yet unknown) scenarios

Low
Medium
High

Level of interaction between traffic participants
EXAMPLE FOR CRASH RE-SIMULATION

- Re-simulation of recorded / reconstructed trajectories from real-world scenarios
- Extension to “what-if simulation” e.g. with user-specific AEB system
- Evaluation of impact without and with safety systems
- **Outlook “Replay2Sim”: conversion of any trajectory to OpenSCENARIO**

**GIDAS database**
- Sketches
- Reconstructions

**Tool-based conversion to OpenSCENARIO**

**OpenSCENARIO** defining the traffic participants and their behavior

**GIDAS sketch of accident**

**Simulation with openPASS**
Strong stochastic influence on many levels:
- Initialization of traffic (e.g. positions, velocities, system equipment)
- Scenario parameters (e.g. traffic volume)
- Stochastic agent behavior models (e.g. Stochastic Cognitive Model)

Interaction between traffic participants in a realistic manner
- Evaluation of system behavior and traffic safety
- Discovery of new, yet unknown critical scenarios
EXAMPLE USAGE OF OPENPASS IN PUBLIC PROJECTS - I

Project duration:
- 09/2017 – 10/2021
Project objectives:
- Largest European project on automated driving at the time
- Piloting, collecting data and conducting impact assessment for automated driving
Application of openPASS:
- Simulation of different scenarios concerning typical motorway situations

Project duration:
- 06/2018 – 11/2021
Project objectives:
- Analysis of occupant vehicle safety requirements for HAVs
- Prediction of remaining crashes / future ODD-specific relevant crash configurations
Application of openPASS:
- Simulation with motorway traffic model including human imperfection
- Realistic collision frequency to validate motorway test case

Project duration:
- 03/2019 – 10/2022
Project objectives:
- Simulation-based engineering and testing for automated driving
- Standardization of interfaces
Application of openPASS:
- Embedding of simulation models (e.g. pedestrian, driver, automated driving system, …)
- Exemplary application for running a criticality analysis

Project duration:
- 07/2019 – 12/2023
Project objectives:
- Development of a methodical approach to proof safety for HAVs in urban environment
- Significant shift from real-world testing to simulation
Application of openPASS:
- Using openPASS as an exemplary simulation tool for the criticality analysis
- Scenario-based simulation with openPASS
Project duration:  
- 09/2021 – 08/2025

Project objectives:  
- Develop technology to enable a longer and less defragmented automated drive (follow up of L3Pilot)  
- Code of practice & evaluation

Application of openPASS:  
- Simulation of different scenarios for the safety impact assessment (motorway and urban)

Project duration:  
- 10/2022 – 09/2025

Project objectives:  
- Safety assessment framework by simulation  
- Covering different safety solution (in-vehicle, infrastructure, behavioral)

Application of openPASS:  
- Application in at least one use case
OpenPASS has evolved from an open source platform to a modular ecosystem for scenario-based traffic simulation for advanced driver assistance systems and automated driving systems.

**Status Quo:**
- Standardization of simulation configuration
- Standardization of simulation model interfaces (e.g. OSI, FMI)

**Remarks:**
- One big simulation core
- No reuse of core components

**We are taking the next steps:**
- Enable reuse of tool-internal components
- Share development efforts through open source collaboration
- Generate common understanding for interpretation of standards (e.g. OpenSCENARIO)
- Align tool-internal interfaces
PARTICIPATION IN THE WORKING GROUP

The company should be at least an Eclipse Solution Member
- Networking and learning
- The annual membership fee for Solutions Members is tiered based on revenue

Working Group participation agreement
- Contribution in development of openPASS
- Discussion of the roadmap
- Active collaboration with the working group

For more information, look at the openPASS charter:
https://www.eclipse.org/org/workinggroups/openpasswg_charter.php
COMMUNICATION WITH THE WORKING GROUP

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