OPENPASS
**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 functions

- **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
Platform Concept

Agent Components *
- Driver
- Vehicle
- Sensor
- Function

Standardized Interfaces

Scenario and Map *
- Accident data
- Traffic data
- Synthetic data

Standardized Formats

* Simple examples are provided

OpenSCENARIO Engine

Mantle API

Simulation Core

Safety Performance Assessment
Virtual Testing / Homologation
Accident Research
Functional Development

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PLATFORM STRUCTURE

- **User-Specific Plugins**: Implemented by the user
- **Platform Delivered Plugins**
  - Component Generator
  - Traffic Simulation
  - Agent Configuration
  - System Editor
- **GUI (Plugin Manager)**
- **Simulation Core**
  - Open SCENARIO Engine
  - Mantle API
- **Simulation Components**
  - Spawner
  - Observer
  - Detectors
  - Manipulators
  - World State
- **Exemplary Agent Components**
  - Sensors
  - Algorithms
  - Dynamics
  - Observers
  - World State
- **Component Interfaces**

* Implemented by the user

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

Configuration through GUI

Configuration files

Simulation execution

Output files

Evaluation in GUI
USE CASE
TRAFFIC-SCENARIO SIMULATION

Features:
- Closed loop simulation of traffic scenarios
- Stochastic variation of the scenarios
- Intervention through detection of events and triggered actions
- Faster-than-real-time execution of the simulation

Example: AEB intervention triggered by passive cut-in manoeuvre

- Highway scenario with random surrounding traffic
- Ego vehicle with simple AEB system and abstract sensors
- Time-based event trigger
- Trajectory controlled lane change for scenario vehicle
EXEMPLARY SIMULATION RESULTS
TRAFFIC-SCENARIO SIMULATION

Traffic-scenario simulation without AEB

No AEB intervention

Traffic-scenario simulation with AEB

AEB intervention triggered by passive cut-in manoeuvre
USE CASE
CRASH RE-SIMULATION

Features:

▪ Create openPASS configuration files from GIDAS-PCM accident scenario database via xml-writer
▪ Stochastic variation of the scenarios (positions, velocities)
▪ Basis components for re-simulation: trajectory follower, vehicle dynamics model, impact calculation
▪ Agent setup prepared for flexible counterfactual simulation, e.g. with user-specific AEB system
▪ Store results in csv files in case folders and plot results in GUI

Example: re-simulation of GIDAS crash trajectories at urban intersection
EXEMPLARY SIMULATION RESULTS
CRASH RE-SIMULATION

Crash re-simulation

Oncoming collision at intersection (LTAP – “left turn across path”) with post-crash behaviour
<table>
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<tr>
<th>Project duration:</th>
<th>09/2017 – 10/2021</th>
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| Project objectives: | Largest European Project on automated driving  
Largely based automated driving  
Piloting, collecting data and conducting impact assessment for automated driving |
| Application of openPASS: | Simulation of different scenarios concerning typical motorway situations |

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<tr>
<th>Project duration:</th>
<th>06/2018 – 11/2021</th>
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| 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 |

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<th>03/2019 – 10/2022</th>
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| 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 function, …)  
Exemplary application for running a criticality analysis |

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<th>Project duration:</th>
<th>07/2019 – 06/2023</th>
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| 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 |
openPASS is an open source platform for scenario-based traffic simulation of advanced driver assistance systems and automated driving functions

- Open source platform for high level of acceptance and transparency by using open standards
- Modular structure for easy platform extension und inclusion of user-specific models
- Support for standards and standardized interfaces for a flexible simulation setup
- Exemplary applications of openPASS:
  - Traffic-scenario simulation
  - Crash re-simulation
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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