**Goal of PEGASUS:** development of a method to generate an evidence regarding the safeguarding of a Level-3-system (Autobahnchauffeur, max. 130 km/h)

**Other HIGHLY Automated Driving Functions relevant topics covered by OEM, Suppliers or regulations:** (examples)

- Testing according ISO26262
- Direct safeguarding of the sensor performance
- Safeguarding of
  - Interaction with driver
  - Meet traffic rules
**Goal:** Collection of all relevant scenarios (e.g. cut-in) metrics (e.g. TTC) and pass criteria (e.g. no accident)

**Input:** Data from field, derived test cases from knowledge, certification, automation risks

**Output:** Scenarios and parameters (incl. distributions), pass criteria

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**Goal:** Testing of all scenarios from the data base including variation of parameters (e.g. speed, duration of cut-in) Identification of scenarios with risk of collision

**Number of test cases:** >> ~10,000

**Input:** Scenarios and parameters (incl. distributions), pass criteria/metrics for criticality

**Output:** Original OEM-SW Code as system under test

Evaluated Scenarios and the probability for accident scenarios

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**Goal:** Test of selected scenarios

A) Special or critical test cases, e.g. derived from automation risks or certification

B) critical test cases identified in simulation to validate the result of the simulation

**Number of test cases:** ~30

**Input:** Vehicle Trajectories derived from scenarios, pass criteria, original vehicle as system under test

**Output:** Evaluated Scenarios and data for the validation of the simulation

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**Goal:** Test of the AD-function in real world traffic (e.g. long term testing at OEM), but no guidance regarding scenarios or test cases, data collecting for data base

**Input:** Guidance of routes or surrounding conditions (if possible), pass criteria, original vehicle as system under test

**Output:** Evaluated real world test drive, measurement data as input for data bases
**Test case allocation:**
- **Simulation:**
  - All logical test cases regarding scenario based testing with a high number of scenarios but a low relevance regarding real sensor performance
- **Proving ground:**
  - Pre selected tests, e.g. certification tests
  - Test with a high relevance regarding drive dynamics and real sensor performance
  - Rare events which can hardly be seen in field tests
- **Field tests:**
  - Tests with a high relevance regarding real system performance under a high variation of surrounding conditions

**Deviations of test cases for simulation** by stochastic parameter variation and test automatization respectively, for the test ground based on manual selection or identification of relevant scenarios within the simulation

Starting from the space of test cases, the test cases get assigned to the PEGASUS test platforms. Hereby "all" logical scenarios within the space of logical test cases get tested in the simulation. (refer to column on the left side)

Based on the automatized/stochastic variation of the logical scenarios parameter, concrete test cases are created. These test cases get evaluated regarding the Pass/Fail Criteria. For end conditions refer to the bottom of this poster)

Critical cases (i.e. not fulfilled or close fulfilled Pass criteria) get retested in real cars on a proving ground (PG). In addition, manually selected concrete test cases can be evaluated on the test ground (i.e. accident scenarios, rating or certification tests).

Within field tests it is not possible to test specific test cases. Instead, the behavior of drive features get tested in real traffic. The major target is to find "surprises" (i.e. new scenarios, new parameters). These surprises may be enforced by different guidelines in route (i.e. tunnel) or time (i.e. low sun).

**Test result:**
Based on Pass/Fail criteria evaluated concrete scenarios for simulation, test ground and field test Probability for accident scenarios

**Test end criteria regarding simulation (suggestion):**
- Create transfer function between scenario parameters (input) and test result (output, e.g.accident yes/no, distance between ego-vehicle and relevant target):
  Target value for quality of transfer function (e.g. $R_Qd$-value) ≥ 80%*
- Calculate standard deviation $\sigma$ of computed probability for accident scenarios: Target value for $\sigma \leq 20\%$*

*according state of the art
**BASICS FOR TESTING – Booth No. 16**

**TEST CONCEPT**

**Test concept: Detailed illustration**

- **Test object**: Functional implementation of Autobahnchauffeur
  - **Test step**: Functional test
  - **Test platform**: Simulation

- **Test object**: Complete system of Autobahnchauffeur incl. vehicle
  - **Test step**: Vehicle test
  - **Test platform**: Proving ground / field

**Examples for PASS-/FAIL-Criteria**

- **No accident** → distance to surrounding traffic etc. >0
- **Correct distance to ahead driving traffic**
  - Not leaving Ego lane (except for a lane change)
- **Meet with speed limits or other traffic regulations**

**Main criteria for Simulation / Proving ground in Pegasus**

**Additional criteria for field testing**

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