Data Management approach for scenario-based validation of autonomous driving functions
Challenges

- Management of the lifecycle of the diverse datasets for the validation of autonomous driving functions by an appropriate data model
- Managed datasets:
  - Recorded or generated traffic situations (e.g. scenarios)
  - Target values (e.g. expected behavior of an assistance function)
  - Measured data (e.g. vehicle status information from CAN, FlexRay)
  - Simulated results (e.g. derived test cases)
  - Meta data (e.g. vehicle setup and ECU software versions)
- Challenge: Different, proprietary descriptions and data formats
Best Practice

Overview

Recorded data (e.g. video) → Varied data formats → Processing Labeling → Test Case Definition → Simulation

Scenario generation

Meta Data, Scenarios, Test Cases
Target Values, Measured Data, Simulation results
openMDM®

Administration

Application model: ASAM ODS compliant test data storage

- Project
  - SubProject
    - Scenario
      - Manoeuvre
        - Test description
          - UnitUnderTest
          - TestSequence
          - TestEquipment
        - Data sets
          - Recorded Data
          - Measured Data
          - Simulated Results

- aoTest
  - aoSubTest
    - aoSubTest
      - aoSubTest
        - aoUnitUnderTest
        - aoTestSequence
        - aoTestEquipment
      - aoSubMatrix
        - aoLocalColumn
        - aoExternalComponent
      - aoMeasurement
        - External Reference
        - aoSubMatrix
        - aoLocalColumn
        - aoExternalComponent
openMDM®

Administration
Definition of metadata by customizing

Customizing

Scenario
Manoeuvre
Test description
Unit Under Test
Test Sequence
Equipment
Data sets

„What is tested“
„How is tested“
„With which is tested“

“With which is tested”

“What is tested”

“With which is tested”

„How is tested“

Fahrgeschwindigkeiten_Phase_1
Name
Beauftrag
Geschwindigkeit_Ego
80.0
Geschwindigkeit_Target1
70.0
Geschwindigkeit_Target2

Header
Manoeuer_Phase_1
Versuchsumfeld

Name
Beauftrag
Anzahl_Spuren
3
Niederschlag
heavy rain
Lichtverhältnisse
Umfeld_Kommentar
Pruefstrecke
freeway
MimeType
application/x-asam
Name
Versuchsumfeld
Fahrbaheinzug
asphalt
Pruefgelaende
Sichtbedingungen
foggy
Fahrbaehrzustand
soiled
Bewoelkung
Sonnenstand
**openMDM®**

**Searching Scenarios by meta data**

<table>
<thead>
<tr>
<th>Global Search Attributes</th>
<th>Value</th>
</tr>
</thead>
</table>
| Project Name | Name =  
| Test | Name =  
| TestStep | Name =  
| Ego_Fahrzeug | Fahrzeug_Typ =  
| Fahrgeschwindigkeiten | Geschwindigkeit_Ego > 40  
| Versuchsumfeld | Fahrhauznzustand = soiled  
| Versuchsumfeld | Niederschlag = heavy rain |

<table>
<thead>
<tr>
<th>Results</th>
<th>Demo_Results</th>
<th>TestName</th>
<th>TestStepName</th>
<th>Fahrgeschwindigkeit Ego</th>
<th>Versuchsumfeld Fahrhauznzustand</th>
<th>Versuchsumfeld Niederschlag</th>
<th>Versuchumfeld Fruefstrecke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>Test</td>
<td>TestStep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario</td>
<td>Template Nr 4 Switch Lane</td>
<td>BT_SWL_001_201910091 05113</td>
<td>80.0</td>
<td>soiled</td>
<td>heavy rain</td>
<td>freeway</td>
<td></td>
</tr>
<tr>
<td>Records</td>
<td>Overtake Car Highway</td>
<td>SwLa_Highway_20191112 6135345</td>
<td>90.0</td>
<td>soiled</td>
<td>heavy rain</td>
<td>highway</td>
<td></td>
</tr>
<tr>
<td>Simulation</td>
<td>Break before Overtake</td>
<td>Sim_Overtake_201911126 135803</td>
<td>90.0</td>
<td>soiled</td>
<td>heavy rain</td>
<td>highway</td>
<td></td>
</tr>
</tbody>
</table>
Solution proposal

Overview

Recorded data (e.g. video) → Varied data formats → Processing Labeling (ASAM openLABEL)

Scenario generation (ASAM openScenario) → Test Case Definition (openMDM)

Simulation

Meta Data, Scenarios, Test Cases
Target Values, Measured Data, Simulation results (ASAM ODS)
Call for action

- Building Working group to develop use cases
- Exchange ideas and knowledge with Eclipse OpenMDM, eclipse OpenADx, etc. working group
- Obvious benefits (a few) of using ODS and openMDM for managing data from the field of ADAS validation
  - ODS is a proven and widely used standard for exchangeability and interpretability in the long-term
  - The ODS data model allows the flexible definition of storage structures, descriptive attributes, and relationships for different datasets
  - ODS offers several possibilities to store data (as external reference, in MDF files, or in the database)
  - The currently upcoming Big Data capabilities of ODS further extend storing possibilities by JSON, Parquet and Avro
  - Additionally, openMDM provides a freely available REST API that simplifies the complexity and details of the ODS interface
Thank you!
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