Content

- Test and Evaluation
- AdaptIVe: SP „Evaluation“
  - Technical Assessment
  - Safety Impact Assessment
### Test and Evaluation

#### Selection of Tools and Methods

<table>
<thead>
<tr>
<th>Tool</th>
<th>Application</th>
<th>R</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Field Operational Test</td>
<td>• Impact assessment in reality</td>
<td>R</td>
<td>R</td>
<td>R</td>
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<tr>
<td></td>
<td>• Assessment of behaviour/components/systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controlled Field</td>
<td>• Assessment of components and systems</td>
<td>R</td>
<td>R</td>
<td>R</td>
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<tr>
<td></td>
<td>• Assessment of driver behaviour</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Dynamic Driving Simulator</td>
<td>• Assessment of driver behaviour</td>
<td>R</td>
<td>V</td>
<td>V</td>
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<td></td>
<td>• Human machine interaction</td>
<td></td>
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<tr>
<td>Simulation</td>
<td>• Virtual layout and assessment</td>
<td>V</td>
<td>V</td>
<td>V</td>
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<tr>
<td></td>
<td>• Potential impact assessment</td>
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</tbody>
</table>

R: Real, V: virtual
AdaptIve Project

- **Duration:** January 1, 2014 - June 30, 2017
- **Coordinator:** Volkswagen Group Research
- **Consortium:** 29 partners from 8 countries - France, Germany, Greece, Italy, Spain, Sweden, The Netherlands, United Kingdom; including 11 OEMs, 4 suppliers, 11 research institutes and universities, and 3 SMEs
- **Research Budget:** EUR 25 million

Legal issues, terminology

Strategies for human-vehicle integration

New evaluation methods, impact assessment

Automated driving close distance manoeuvring

Automated driving in urban environment

Automated driving on highway
AdaptIVe - SP „Evaluation“

- **Main objectives:**
  - Development of an evaluation framework for automated driving systems
  - Methodology for impact analysis of automated driving systems

- **Detailed objectives:**
  - Apply developed methods on selected functions in order to verify the evaluation methods
  - Benefit analysis with focus on safety and environmental impact
    - Derive first recommendations and results on the impact of automated driving applications

- **Partners:**
  - ika, BMW, CRF, BASt, TNO, CTAG, Lund
AdaptIVe - Evaluation Approach

Classification
- Operation time
- Level of automation

Focus of Evaluation
(depending on classification)
- Research Questions
- Hypotheses
- Indicators

Test Methods
(depending on classification)
- Test environment
- Test tools
- Test amount

Impact Assessment
Safety
Environment

Evaluation
User-related
Technical
In traffic

Function / System
Technical Assessment
Evaluation Approach

Classification of automated driving functions:

- **Event based operating**
  - Function that is only active for a short period in time (typically vehicle stands still at the end or the automated driving ends)
  - Examples: Parking, Minimum Risk Manoeuvres

- **Continuously operating**
  - Function that is active for a longer period in time (typically vehicle is still moving at the end of an manoeuvre respectively automated driving is continued)
  - Example: Highway Pilot
Technical Assessment
Evaluation Approach

<table>
<thead>
<tr>
<th>Example</th>
<th>Main focus of the evaluation</th>
<th>Definition of hypotheses</th>
<th>Definition of test scenarios</th>
<th>Evaluation criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Parking</td>
<td>• Performance of the function in a certain scenario/use case</td>
<td>• Hypotheses focus mainly on function performance</td>
<td>• Controlled field tests (/Simulation)</td>
<td>• Relevant Situation detected per driven distance / driving time</td>
</tr>
<tr>
<td>• Highway Pilot</td>
<td>• Similar to the evaluation of ADAS</td>
<td>• Side aspect of the evaluation: function misbehaviour (false positive / negative behaviour)</td>
<td>• Based on use case</td>
<td>• Decide on the severity</td>
</tr>
<tr>
<td></td>
<td>• Objective is a collision free traffic</td>
<td>• The function has to be operated within range of normal driver behaviour (and beyond)</td>
<td>• Small field test in real traffic (/&quot;simulated&quot; field test)</td>
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<tr>
<td></td>
<td>• Operation in mixed traffic conditions (not disturbing normal traffic)</td>
<td>• Driver behaviour needs to be described with respect to e.g. velocity profiles, distance to other vehicles</td>
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</table>

- Relevant Situation detected per driven distance / driving time
- Decide on the severity
Safety Impact Assessment

- Classical approach for ADAS
  - Scenario based approach
  - Accident data are analysed
  - Certain accidents are reconstructed and re-simulated accident considering function under study
  - Effect is determined by comparison of accident consequences with and without the function

- Approach for automated driving
  - Open issues
    - Today’s accident data do not consider collisions of automated vehicles
    - Automated driving function operated already before a critical situation occurs
  - Consider different driving situations and not only accidents
  - Analyse how the traffic flow is affected by means of simulations
    - Identify (new) critical situations and analyse them
Summary

• Different evaluation methods and tools are known today for the evaluation of ADAS

• Evaluation approaches for the technical and safety impact assessment in AdaptIve have been described

• Classification of functions in event-based and continuously automated driving function for the evaluation
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Thank you.