Key evaluation results

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Automated Driving

CLOSE-DISTANCE SCENARIOS

HUMAN FACTORS

LEGAL ISSUES

EVALUATION

HIGHWAY SCENARIOS

URBAN SCENARIOS

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Evaluation of AdaptIVe functions

Impact Assessment

User-Related Assessment

Technical Assessment

In-Traffic Behaviour Assessment

Real-traffic

Test track

Simulations
## Evaluation of AdaptIVe functions

<table>
<thead>
<tr>
<th></th>
<th>Parking</th>
<th>Urban</th>
<th>Highway</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical Assessment</strong></td>
<td>Ford Daimler</td>
<td>CRF</td>
<td>BMW, Conti, VTEC, VW</td>
</tr>
<tr>
<td><strong>User-related Assessment</strong></td>
<td>-</td>
<td>VCC</td>
<td>VW</td>
</tr>
<tr>
<td><strong>In-traffic Assessment</strong></td>
<td></td>
<td>TNO</td>
<td></td>
</tr>
<tr>
<td><strong>Impact Assessment</strong></td>
<td>Environment: ika</td>
<td>Environment: ika</td>
<td>Enviro.: ika Safety: BMW</td>
</tr>
</tbody>
</table>

### Real-traffic

### Test track

### Simulations
Technical Assessment - Method

Data Source

AdaptIVe demonstrator

Classification of Scenarios

Classifier Scenario 1
Classifier Scenario 2
Classifier Scenario x

Scenario-based Assessment

Assessment

Calculation of:
- Derived Measures
- Performance Indicators

Δ Frequency (Scenario)
Δ Effect (Scenario)

Classification of scenarios by using time series classification algorithms

Assessment of Δfrequency and Δeffect of system in scenario

Reference: euroFOT

► Human driving as a baseline

Δ Frequency

Human driving as a baseline

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The AdaptIVe Highway-Chauffeur is showing a control capability similar to human driving from euroFOT. Two results stand out:

- Top figure: duration of lane change is much more uniform with automation
- Bottom figure: time headway in vehicle following shows much less variability with automation

More details in the presentation of Christian Roesener
User-related Assessment

Method
- Behavioural observations - two observers in the car
- Logging of driving data - e.g. speed, distance, lane keeping

Key Results (21 persons, Highway-Chauffeur as example)
- The drivers used the system as it was intended to be used
- The system affected driving positively in several ways
  + Better speed adaptation to speed limits and conditions, less speed variations
  + Better distance keeping ahead
  + Better lane choice (prescribed use of the right lane)
  + Better indicator usage
  + Fewer dangerous lane changes
- Due to 130 kph system limit, overtaking manoeuvres are longer

More details in the presentation of András Várhélyi
In-traffic Assessment - Method

- Research focus:
  - How is the vehicle interacting with other traffic participants?
  - How do other traffic participants react on the (automated) vehicle?

- In-traffic Assessment used generated real-life scenarios with Monte-Carlo simulations
Traffic Jam Assist (Adaptive Cruise Control)

Function causes less oscillations for its rear traffic when a cut-in is performed.
Environmental Impact Assessment

Method
- Analysing the required parking space for automated vehicle
- Assumption: If the driver is not in the car, it is possible to park more narrow
  1. Parking maneuver analysis to find the optimal trajectory
  2. Required parking lot and road width calculation
  3. Additional parking space determination

Results

<table>
<thead>
<tr>
<th>Vehicle Class</th>
<th>Benefit of automated driving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minis</td>
<td>17%</td>
</tr>
<tr>
<td>Upper Class</td>
<td>5%</td>
</tr>
<tr>
<td>Average Vehicle</td>
<td>10%</td>
</tr>
</tbody>
</table>
### Safety Impact Assessment - Method & Results

#### Identification Top-Scenarios
- Accident data (e.g. GIDAS) / Critical situations (FOT)
- Description of function
- Simulation of traffic scenarios

#### Simulation

#### Analysis & Projection

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Expected Mean Accident Reduction Rate</th>
<th>Accidents within the operation conditions</th>
<th>Change of Accident Risk per Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 1 Cut-In</td>
<td>-83%</td>
<td>72% (92%)</td>
<td>-60% (-76%)</td>
</tr>
<tr>
<td>Top 2 End of Lane</td>
<td>-14%</td>
<td>67% (83%)</td>
<td>-9% (-12%)</td>
</tr>
<tr>
<td>Top 3 Obstacle in the lane</td>
<td>-40%</td>
<td>78% (97%)</td>
<td>-31% (-39%)</td>
</tr>
</tbody>
</table>

1. Identification of Top-Scenarios
2. Simulation of scenarios
3. Analysis & Projection

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More details in the presentation of Felix Fahrenkrog

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Thank you.

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