On the Design of Performance Testing Methods for Active Safety Systems

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Performance Testing – Why and How?

- To be able to compare different systems
- To show value to customers
- To push development and fitting of active safety systems
Examples of Test Scenarios

**Test B1: Driving towards rear of slower driving car:**
- [ADAC]

<table>
<thead>
<tr>
<th>Test-Nr.</th>
<th>v_ego [kph]</th>
<th>v_target [kph]</th>
<th>s_start [m]</th>
<th>a_co [m/s²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1_1</td>
<td>50</td>
<td>20</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>B1_2</td>
<td>100</td>
<td>60</td>
<td>200</td>
<td>0</td>
</tr>
</tbody>
</table>

**CCR3: Approaching a moving target at 20km/h**
- Speed differential starting at 10km/h and increased in 10km/h increments if system avoids collision with car target
- Speed increased in 5km/h increments if collision occurs

**A1B: Urban scenario**
- Lead vehicle speed: 10 km/h
- Subject vehicle speed: 50 km/h
- Initial distance based on TTC >> 3 s
- 50% lateral offset

**Velocities**

<table>
<thead>
<tr>
<th>Velocities [km/h]</th>
<th>( V_0 )</th>
<th>( V_{rel} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test vehicle</td>
<td>72</td>
<td>40</td>
</tr>
<tr>
<td>Target</td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>

[AEB] [vFSS]
### Test Scenarios – Comparison

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ADAC</th>
<th>AEB</th>
<th>ASSESS</th>
<th>eVALUE</th>
<th>vFSS</th>
<th>NHTSA</th>
<th>SAE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TV speed [km/h]</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>100</td>
<td>10+10n (n=0…5)</td>
<td>50</td>
<td>70</td>
<td>72</td>
<td>72</td>
<td>60</td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td>50</td>
<td>70</td>
<td>90</td>
<td>72</td>
<td>50</td>
</tr>
<tr>
<td><strong>LV speed [km/h]</strong></td>
<td>20</td>
<td>20</td>
<td>10</td>
<td>30</td>
<td>32</td>
<td>32</td>
<td>10</td>
</tr>
<tr>
<td>60</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>30</td>
<td>32</td>
<td>32</td>
<td>30</td>
</tr>
<tr>
<td><strong>Offset</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>50%</td>
<td></td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Curvature</strong></td>
<td>Straight</td>
<td>Straight</td>
<td>Straight</td>
<td>Curve</td>
<td>Straight</td>
<td>Straight</td>
<td>Curve</td>
</tr>
<tr>
<td><strong>Reaction</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Slow Fast</td>
<td>No Slow Fast</td>
<td>No Slow Fast</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Harmonization platforms have been established in Europe
Driver Models

Expected driver population

- **Realistic driver:** reaction times: 1s after acoustic warning / 0.7s after brake jerk, 80% deceleration
- **Best driver:** reaction times: 0.7s after acoustic warning / 0.4s after brake jerk, 100% deceleration
- **Lethargic driver:** reaction times: 2s after acoustic warning / 1.5s after brake jerk, 60% deceleration

[ISO]
Targets (1)

- Dummy Vehicle composed of inflatable cushions
- Rollover Protection for Control System
- Controllers: Shock-resistant
- Lightweight Aluminium Chassis
- GPS-Corrected Inertial Navigation System
- Rear Axle Assembly: Electric Drive Motor & Electromagnetic Park Brake
- Lithium Iron Phosphate Battery Pack
- Front Axle Assembly: Electric Steering Actuator with Manual

[ABD]

- photograph of a rear end
- reflectors for Lidar systems
- real license plates
- small corner reflectors in the middle of the car
- 3 dimensional shape of the bumper
- realistic shadow under the car

[ADAC]
Targets (2)

[ASSESS]

[DRI]

[EVITA]

[Bertrand]
Targets (3)

[NHTSA]

[AEDesign]

[Idiada]

[DRI]
ActiveTest’s 3rd Workshop

Confirmed speakers from:
e.g.
ASSESS
AsPeCSS
OEMs
Research organizations
Suppliers

Demo at Autoliv’s CarsonCity

Workshop on Vulnerable Road Users

25 and 26 September 2012

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Borås, Sweden