CATS: CYCLIST-AEB TESTING SYSTEM

Verification of a cyclist dummy and test setup for the evaluation of Cyclist-AEB systems

VDI Wissenforum: Fahrzeugsicherheit 2015, November 25th and 26th 2015, Berlin
Sjef van Montfort, TNO
Cyclist safety growing issue in Europe:

Total number of road fatalities and cyclist fatalities over the period of 2001 to 2012 for: France, Germany, Italy, the Netherlands, Sweden and the UK
CATS: OBJECTIVES & TIMING

Objectives CATS project:

• Prepare the introduction of a protocol for consumer tests of cyclist-AEB systems on board passenger cars.

• Propose a test setup (incl. hardware) and test protocol for cyclist-AEB systems based on technical/scientific considerations.

• Base the tests on analysis of most relevant cyclist accident scenarios in EU countries (with check to US and Japan).

Timing:

• Start : 2014 Q2
• Finish : 2016 Q1
CATS: APPROACH

1 Accident Analysis
2 Test scenario definition
3 Dummy development
4 Propulsion system development
5 Verification & Testing

A: Partners
B: Test-houses
CATS: WP1 ACCIDENT ANALYSIS

• Study databases for 6 European countries;
• Select severe car-to-cyclists accidents → fatalities and seriously injured;
• Provide overview of distinguished accident scenarios;
• Determine the distribution of scenarios in the different countries;
• Prioritize scenarios & indicate how many fatalities and seriously injured are covered.
Prioritization of scenarios:
Weight the results according to # cyclist fatalities per million inhabitants*:

Note: Italy not included due to limited amount data sets not being representative.
CATS: WP1 ACCIDENT ANALYSIS

Conclusion:
C1, C2 and L in all countries dominant.
The scenarios C1, C2 and L together cover already between 78% and 63%.

Note: Italy not included due to limited amount data sets not being representative.
More detailed information on accident analysis results can be found on www.tno.nl/cats
CATS: WP2 TEST SCENARIO DEFINITION

Relevant accident parameters for C1, C2 and L. Various available data sources are considered, including; accidentology, observation study and simulations.

Topics considered:

<table>
<thead>
<tr>
<th>Accident scene</th>
<th>Accident partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation</td>
<td>Cyclist speed</td>
</tr>
<tr>
<td>Lighting conditions</td>
<td>Cyclist age</td>
</tr>
<tr>
<td>Location</td>
<td>Cyclist size</td>
</tr>
<tr>
<td>Road layout, obstruction</td>
<td>Helmet use</td>
</tr>
<tr>
<td>Speed limit</td>
<td>Cyclist gender</td>
</tr>
<tr>
<td>Season</td>
<td>Vehicle speed</td>
</tr>
<tr>
<td></td>
<td>Vehicle braking</td>
</tr>
<tr>
<td></td>
<td>Hit point</td>
</tr>
</tbody>
</table>
**CATS: WP2 TEST SCENARIO DEFINITION (DRAFT MATRIX JUNE 2015)**

<table>
<thead>
<tr>
<th></th>
<th>CVNBU</th>
<th>CVNBO</th>
<th>CVFB</th>
<th>CVLB*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario</strong></td>
<td>Near side</td>
<td>Near side</td>
<td>Far side</td>
<td>Longitudinal</td>
</tr>
<tr>
<td><strong>Vehicle speed</strong></td>
<td>20 – 60 km/h</td>
<td>10 – 40 km/h</td>
<td>20 – 60 km/h</td>
<td>30 – 60 km/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>65 - 80 km/h</td>
<td></td>
</tr>
<tr>
<td><strong>Cyclist speed</strong></td>
<td>15 km/h</td>
<td>10 km/h</td>
<td>20 km/h</td>
<td>15 km/h</td>
</tr>
<tr>
<td><strong>Obstruction</strong></td>
<td>Without</td>
<td>With D1=3.55m, D2=4.80m</td>
<td>Without</td>
<td>Without</td>
</tr>
<tr>
<td><strong>Overlap hitpoint</strong></td>
<td>0 %</td>
<td>50 %</td>
<td>50 %</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td><strong>AEB / FCW</strong></td>
<td>AEB</td>
<td>AEB</td>
<td>AEB</td>
<td>AEB</td>
</tr>
<tr>
<td><strong># tests [36]</strong></td>
<td>9</td>
<td>7</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>Layout sketch</strong></td>
<td><img src="image1" alt="Sketch" /></td>
<td><img src="image2" alt="Sketch" /></td>
<td><img src="image3" alt="Sketch" /></td>
<td><img src="image4" alt="Sketch" /></td>
</tr>
</tbody>
</table>

*To be eligible for scoring points in AEB VRU Cyclist Longitudinal, the AEB system must reduce speed in CVLB - [30-60] km/h scenario with 20 % overlap.*
CATS specifies requirements on bicyclist and bike target wrt:
- Dimensions
- Features
- Sensing properties (camera, LIDAR, radar)
- Impactability/durability

More details on target definition can be found in VDI paper.

4activeSystems develops bicyclist and bike target meeting requirements.
CATS: WP3 DUMMY DEVELOPMENT

Various development sessions with CATS partners

<table>
<thead>
<tr>
<th>CATS partner 1</th>
<th>CATS partner 2</th>
<th>CATS partner 3</th>
<th>CATS partner 4</th>
<th>CATS partner 5</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Target Bike and Bicyclist target vs. Real Bike and Bicyclist

<table>
<thead>
<tr>
<th>Static</th>
<th>Dynamic</th>
<th>Optical Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCS</td>
<td>RCS</td>
<td>Micro-Doppler</td>
</tr>
<tr>
<td>270.0</td>
<td>90.0</td>
<td>112.5</td>
</tr>
<tr>
<td>135.0</td>
<td>157.5</td>
<td>180.0</td>
</tr>
<tr>
<td>0.0</td>
<td>90.0</td>
<td>0.0</td>
</tr>
<tr>
<td>90.0</td>
<td>0.0</td>
<td>90.0</td>
</tr>
<tr>
<td>0.0</td>
<td>90.0</td>
<td>180.0</td>
</tr>
</tbody>
</table>

- Definition: Real bike is the reference e.g. in this case the dummy RCS is bit to low compared to the Holland bike.
CATS: WP3 DUMMY DEVELOPMENT

- Impactability/durability: Crossing at 30km/h
CATS: WP3 DUMMY DEVELOPMENT

- Impactability/durability: Longitudinal at 40km/h
CATS: WP3 DUMMY DEVELOPMENT

4a bicyclist and bike target v5

More details on target specifications can be found in VDI paper.
CATS specifies requirements on:

- General requirements
- Dimensions
- Dynamic properties

4activeSystems develops propulsion systems meeting requirements.
Various verification test sessions are being performed to verify both target and complete test protocol to ensure realistic representation of target and feasibility of test protocol.

Also impactability/durability has been assessed.
Note: specially prepared vehicle that brakes at fixed TTC, no vehicle controlled AEB
Longitudinal

Note: specially prepared vehicle that brakes at fixed TTC, no vehicle controlled AEB
CATS: NEXT STEPS

Next steps:

• November-December  Verification tests with bicyclist target to test feasibility of protocol and target performance.

• January-February  Final verification testing by CATS partners.

• March  CATS agreement on final CATS test matrix and final CATS target definition.

• End Q1 2016  Delivery of final CATS protocol including test matrix and target definition.
Thank you for your attention

For more details: [www.tno.nl/cats/](http://www.tno.nl/cats/)
Sjef van Montfort, TNO
• Telephone: +31 88 866 09 32
• E-mail address: sjef.vanmontfort@tno.nl