VALIDATION SCENARIOS FOR VRU – RESULTS OF THE PROSPECT PROJECT

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Applus IDIADA, on behalf of the PROSPECT project consortium

Session SIS45 – Challenges on Testing and Validation of Automated Driving
## PRINCIPLES OF OPERATION

<table>
<thead>
<tr>
<th>Navigation layer</th>
<th>Guidance layer</th>
<th>Stabilization layer</th>
</tr>
</thead>
</table>

### Principle of operation A
- **Information and warning**
  - Indirect influence on the vehicle via the driver.
    - Status information
    - Warning (abstract hazard)
    - Warning (concrete hazard)

### Principle of operation B
- **Continuously automating**
  - Take direct influence on vehicle guidance (conscious activation by the driver, divided responsibilities in the driving task)

### Principle of operation C
- **Temporally intervening in accident-prone situations**
  - Preventive intervention in case of negative situation prediction
    - Driver does not react or is inaccessible
    - Driver cannot handle due to performance limitations

### SAE levels

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According to the 3-level hierarchy of the driving task (Donges, 1982)
SAFETY EVALUATION FOR CONSUMERS

About Euro NCAP

To eliminate road trauma by encouraging safer vehicle choices
### Automated Driving Test Matrix (under discussion)

#### Longitudinal Control

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Distance</th>
<th>Test Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary</td>
<td>&gt; sensor range</td>
<td>50-130 km/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 km/h</td>
</tr>
<tr>
<td>Moving</td>
<td>&gt; sensor range</td>
<td>80-130 km/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20, 60 km/h</td>
</tr>
<tr>
<td>Braking</td>
<td>closest setting</td>
<td>50, 80, [130] km/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50, 80, [130] km/h</td>
</tr>
<tr>
<td>Cut-in</td>
<td>closest setting</td>
<td>50, 130 km/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10, 80 km/h</td>
</tr>
<tr>
<td>Cut-out</td>
<td>closest setting</td>
<td>70, 100 km/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50, 80 km/h</td>
</tr>
</tbody>
</table>

#### Lateral Control

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Distance</th>
<th>Test Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steering capabilities (highway radius)</td>
<td>90-130 km/h</td>
<td>-</td>
</tr>
<tr>
<td>Lane change (ELK)</td>
<td>closest setting</td>
<td>72 km/h 80 km/h</td>
</tr>
<tr>
<td>Override effort</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Speed Control

<table>
<thead>
<tr>
<th>Test Conditions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed Limit Detection</td>
<td>Weather Time, Distance, Arrows, Vehicle Category, Implicit Speed Limits, Dynamic Speed Limits, [Advisory Speed Limits]</td>
</tr>
<tr>
<td>Speed Control Test</td>
<td>Speed Limit Detection Test</td>
</tr>
<tr>
<td>Traffic Sign Recognition</td>
<td>Lane closure, Warning signs, Traffic lights etc.</td>
</tr>
</tbody>
</table>
AD EVALUATION FOR CONSUMERS

A. Aparicio, Validation scenarios for VRUs – results of the PROSPECT project
### HOW DO WE DEFINE SCENARIOS?

<table>
<thead>
<tr>
<th>Project title</th>
<th>PROactive Safety for Pedestrians and CyclisTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acronym</td>
<td>PROSPECT</td>
</tr>
<tr>
<td>Objective</td>
<td>To significantly improve the effectiveness of active VRU safety systems compared to those currently on the market</td>
</tr>
<tr>
<td></td>
<td>• by expanding scope of scenarios addressed by the systems</td>
</tr>
<tr>
<td></td>
<td>• and improving overall system performance</td>
</tr>
<tr>
<td>GA number</td>
<td>634149</td>
</tr>
<tr>
<td>Coordinator</td>
<td>IDIADA Automotive Technology, SA</td>
</tr>
<tr>
<td>Starting date</td>
<td>1(^{st}) May 2015</td>
</tr>
<tr>
<td>Ending date</td>
<td>31(^{st}) October 2018</td>
</tr>
</tbody>
</table>
WHAT TO TAKE INTO ACCOUNT?

1. Study
2. Specification
3. Advanced VRU sensing
4. Actuation and control strategies
5. Integration
6. Validation
• Macro-statistical accident research
• In-depth accident research
• Field Operational Tests

Car-to-VRU Use Cases:
• Crossing scenarios
• Longitudinal scenarios
• Turning scenarios
RESULTS

- Detailed scenarios
- Reference data for advanced perception
- Testing tools
- Evaluation protocols
• A wholistic approach is needed for the definition of validation scenarios for ADAS and AD

• Special emphasis is needed for safety critical scenarios (accidentology)

• PROSPECT has compiled a relevant database of scenarios for VRUs
A. Aparicio, Validation scenarios for VRUs – results of the PROSPECT project
THANK YOU VERY MUCH FOR YOUR KIND ATTENTION
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