Testing Scenarios for Assessing Human Performance in Take-over Situations

MOTIVATION

- The changing role of the driver in conditionally automated driving brings along multiple new research questions from a human factors perspective.
- In order to evaluate human performance in take-over situations the design of the testing scenario is essential.
- Clear guidance on how to specify suitable testing scenarios is missing.

TAXONOMY OF TESTING SCENARIOS

Within Ko-HAF we identified 4 main factors determining driver’s response and behavior:

- **Urgency**: How much time is available to intervene?
- **Predictability**: How predictable is the take-over situation?
- **Criticality**: How severe are the consequences if the driver does not take-over in time?
- **Drivers’ Response**: How complex is the required driver intervention?

All factors were scored from 1 (low) to 3 (high) for various testing scenarios.

CLASSIFICATION OF DIFFERENT TESTING SCENARIOS

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Urgency</th>
<th>Predictability</th>
<th>Criticality</th>
<th>Driver Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sensor Failure (subsystem)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Sensor Failure (Total)</td>
<td>3</td>
<td>1</td>
<td>2-3</td>
<td>1-2</td>
</tr>
<tr>
<td>3</td>
<td>End of Highway</td>
<td>1</td>
<td>3</td>
<td>1-2</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>Lane change to deceleration lane not possible (e.g. because of traffic on target lane)</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Lane change from entrance ramp not possible</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Road narrows (known from backend)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Road narrows (detected by on-board sensors)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Danger zone / obstacle ahead (known from backend)</td>
<td>1</td>
<td>3</td>
<td>1-3</td>
<td>1-3</td>
</tr>
<tr>
<td>9</td>
<td>Danger zone / obstacle ahead (detected by on-board sensors)</td>
<td>3</td>
<td>1</td>
<td>1-3</td>
<td>1-3</td>
</tr>
<tr>
<td>10</td>
<td>Loss of reference signals (e.g. lane markings missing)</td>
<td>3</td>
<td>1</td>
<td>2-3</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Predictable loss of reference signals (known from backend)</td>
<td>1</td>
<td>3</td>
<td>2-3</td>
<td>1</td>
</tr>
</tbody>
</table>

CLASSIFICATION OF DIFFERENT TESTING SCENARIOS

Depending on the research focus, testing scenarios should be adjusted according to the following classification.

<table>
<thead>
<tr>
<th>Human performance limits</th>
<th>Urgency</th>
<th>Predictability</th>
<th>Criticality</th>
<th>Driver Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Medium-high</td>
<td>Low</td>
<td>High</td>
<td>Medium-high</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time demand for unplanned transitions</th>
<th>Urgency</th>
<th>Predictability</th>
<th>Criticality</th>
<th>Driver Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Driver comfort for planned transitions</th>
<th>Urgency</th>
<th>Predictability</th>
<th>Criticality</th>
<th>Driver Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Ko-HAF work on the selection and design of test scenarios is continued in the context of ISO 21959 Part 2.