Speed Recommendations During Traffic Light Approach.  
A Comparison of Different Display Concepts.

**Challenge**

In order to increase comfort and potentially reduce CO2-emissions, drivers approaching an intersection are given a recommendation at which speed they need to travel to avoid unnecessary stops at traffic lights. This could be achieved by Car2Infrastructure-communication.

500m - 200m

As the vehicle will not effect any speed changes autonomously, an intuitive and easy-to-read human machine interface is needed to present the speed recommendations to the driver:

- **Countdown for green/red phase (seconds)**

- **Coloured areas in speed indicator**

- **Min/Max speed in textual representation**

**Methodology**

27 subjects were asked to participate in a driving experiment in a static driving simulator. Effectiveness, intuitivity, distraction and acceptance were tested.

- **Training session** 5-10 min
- **First contact session** 5 min
- **Short interview**
- **4 main sessions** 10-12 min each
- **Questionnaire**

Participant becomes familiar with the driving simulator (No HMI shown). Participant passes four traffic lights with one of the three HMI displays without previous explanations.

For each HMI type and a baseline, participant passes approx. 12 traffic lights. Visual behaviour and driving data is recorded.

6 different scenarios where evaluated:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>$\Delta v$ [km/h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>No speed change necessary</td>
<td>0</td>
</tr>
<tr>
<td>Stopping at red light unavoidable</td>
<td>-60</td>
</tr>
<tr>
<td>Pass by slight deceleration</td>
<td>-5</td>
</tr>
<tr>
<td>Pass by stronger deceleration</td>
<td>-15</td>
</tr>
<tr>
<td>Pass by slight acceleration</td>
<td>+5</td>
</tr>
<tr>
<td>Pass by stronger acceleration</td>
<td>+15</td>
</tr>
</tbody>
</table>

**Results**

Speed profiles were analyzed to evaluate the effectiveness of the HMI. The following two profiles show the baseline and the same scenario with the speed indicator HMI:

To get an objective measure for the effectiveness, the integral over the absolute value of $dv/dt$ was calculated for each traffic light pass. Lower values indicate better performance:

Further results:
- The instrument cluster display has the highest acceptance.
- The countdown has a slight advantage concerning visual behaviour (visual demand).