Decreasing car production cycles: Evaluation problems

- Shorter and shorter time-to-market cycles (>4 years → <18 months)
- Increasing number/complexity of driver assistance systems and control instruments
- Simulation (e.g. crash/wind tunnel tests) is required to meet deadlines — no longer time for real tests
- Complexity of person behavior: Problems in using simulation to cover user interface evaluation (however, first approaches are arising; published for instance by Santos et al. or Panerai et al.)

Research question

To what extent can driving simulators be used to serve as cheap and easy realizable environments for simulating on-the-road behavior (e.g. for measuring reaction times)?

- Two similar experiments using either vibro-tactile, auditory or visual driver notification
- Reaction times were measured and compared between the two series

(i) Driving Simulator

Trip length 21km, driving time 30min., 44 events triggered trace-driven

Real Driving Study (ii)

Trip length 26km, driving time 34min., 35 events triggered manually by the experimenter

Preliminary results

- Both settings provide similar results for the order of average response using the three modalities
- Simulation performed better (by reason of the simpler setup compared to the real world setting)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Reaction time (ms)</th>
<th>Diff. (%)</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CI 5% (TD), 353 real(R) datasets</td>
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<tr>
<td>Combined</td>
<td>889.2</td>
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<td>12.82</td>
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<td>Visual</td>
<td>784.3</td>
<td>978.7</td>
<td>24.79</td>
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<td>Auditory</td>
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<td>1,179.5</td>
<td>4.41</td>
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<tr>
<td>Vibro-tactile</td>
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<td>879.9</td>
<td>27.41</td>
</tr>
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</table>

Increased average reaction times and standard deviation for real-driving journeys compared to trace-driven simulation

The shape of the plot (vibro-tactile modality) shows that reaction times are lower with less variation for the case of simulation compared to real-driving studies

Further work

- Experiments with a more sophisticated simulator providing an immersive environment (road vibrations, engine noise, penalty models for speeding, etc.)
- Conducting real-driving studies on test routes with pedestrians and uninvolved cars removed (focus on the task of driving)

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