Reaction Time Differences in Real and Simulated Driving

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ABSTRACT

The poster shows initial results at the question to what extent driving simulators can be used to serve as cheap and easy realizable environments for simulating on-the-road behavior. We have conducted two studies comparing the driver's reaction time in real and simulated settings with the aim to provide a metric for the differences in reaction time. The events were triggered trace-driven (simulation) or manually by the experimentor (real driving study) and notifications were forwarded to the driver using the modalities vision, hearing, and touch. We have found that (i) both settings provide similar results for the order of average response using the three modalities and (ii) the simulator experiment performed better, most likely by reason of the simpler setup of the driving simulator compared to the real world setting.

Keywords

Driving experiments, Driver-vehicle interaction (DVI), Feedback modalities, Performance evaluation.

1. MOTIVATION AND APPROACH

The car domain is requested to shorter and shorter time-to-market cycles, with at the same time driver assistance systems and control instruments catching on more and more into the dashboard. To cope with decreasing production cycles, simulation has been successfully applied, for instance to crash or wind tunnel tests. But for user interface evaluation, particularly for experiments measuring reaction times in driver-vehicle communication, simulation has been rarely used to date, e. g. by Santos *et al.* [4] or Panerai *et al.* [2], probably due to the complexity of person behavior representation. Nevertheless, performance and/or usability evaluation of user interfaces for new generations of vehicles in on-the-road experiments is often infeasible – beside economical reasons and the danger for road participants mostly due to the fact of long preparation and execution times.

Our goal was to provide a metric for the difference in response times between simulation and the real world to be used as a conversion table when replacing future on-the-road studies with simulation experiments. This solution can be assumed promising, as it has been shown for the automotive domain that simulation is a useful approach for data collection and driver behavior analysis, e. g. by Adler *et al.* [1] or Baujon *et al.* [3].

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To provide evidence, we conducted two studies measuring the reaction time for notifications via the three sensory modalities vision, hearing or touch in both a simulated and a real-world driving experiment.

Conclusion and Future Work

Initial findings have shown that the reaction times in real world driving are higher (in the range 4.41% to 27.41%, depending on the stimulation modality); however, the simulation has only been done using a simple setting (a car in a garage and a video of the track). In the next experiments a more sophisticated simulator, providing an immersive environment (road vibrations, engine noise, etc.), will be used. With such simulators it should be feasible to analyze the increase in reaction time given the three modalities when transferring settings from the simulation to the real world.

Attribute	Reaction time *(ms)*		Diff. *(%)*	Order
	$\overline{x_{TD}}$	$\overline{x_R}$	$\overline{x_{TD \to R}}$	$_{TD,\ R}$
CI 5% [752 trace-driven (TD), 353 real (R) datasets]				
Combined	889.2	1,003.2	12.82	-, -
Visual	784.3	978.7	24.79	2, 2
Auditory	1,129.6	1,179.5	4.41	3, 3
Vibro-tactile	690.6	879.9	27.41	1, 1

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2. REFERENCES

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