

Bachelor / Master's Thesis

Virtual Cycling Experiments

This thesis is supposed to build upon previous work on the Virtual Cycling Environment (VCE) [1], which integrates a real bicycle into a virtual reality provided by vehicular mobility and network simulation. Our bike on a stationary bicycle trainer (exercise rollers) is equipped with a number of sensors to enable the user to drive within this environment. In a first empirical study, we investigated how the VCE can be used to evaluate modern Advanced Driver Assistance Systems (ADAS) integrated with both cars as well as the bicycle.



■ The engineering part

As with many tools, our simulation environment is not yet perfect. We use the SUMO simulator for mobility simulation of other road users and Unity 3D for the visualization part. Depending on the situation, it may happen that cars seemingly ignore traffic rules, drive through one another, or just visually jump. The engineering part is to work on such shortcomings to enable higher quality empirical studies.

■ The psychological part

Driving in the virtual environment as well as simple cycling tasks have already been designed and tested. The central psychological task of the present thesis is to substantially increase the perceived realism of driving in the environment. This may include (depending on empirical tests) the behavior of the bike (e.g., smoothness of steering, acceleration, braking), the behavior of the cars (e.g., their trajectories), the visual appearance of the simulation, and, as an independent variable, the difficulty of driving. Difficulty may be operationalized by, e.g., the amount of traffic or the amount to which other road users comply with traffic rules. Students will be able to choose among these. The thesis includes at least one experimental study in cooperation with PsyLab.

■ In-cooperation

This thesis is being offered (and will be conducted) in cooperation with PsyLab (Prof. Scharlau).

■ Keywords

Cycling simulator, empirical studies, usability

■ Relevant knowledge/competencies

- experiment design (2nd and 3rd semester); basic knowledge of usability and evaluation (canonical knowledge)
- understanding of cycling behavior (literature search and evaluation; here you will need your reading and thinking skills).

- [1] J. Heinovski, L. Stratmann, D. S. Buse, F. Klingler, M. Franke, M.-C. H. Oczko, C. Sommer, I. Scharlau, and F. Dressler, "Modeling Cycling Behavior to Improve Bicyclists' Safety at Intersections – A Networking Perspective," in *20th IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM 2019)*, Washington, DC: IEEE, Jun. 2019.