Bachelor Thesis

Measurement Framework for Outdoor Bike2X Experiments

Recently, we developed our Virtual Cycling Environment (VCE) [1], which integrates a real bicycle into a virtual 3D environment with vehicular mobility and network simulation of V2X. 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.

In order to evaluate the realism of the cycling behavior in our simulation, we need to compare it to cycling behavior from the real-world. Our VCE already allows us to record traces of this behavior, such as positions, speed, and heading of the bicycle. However, we are still lacking a possibility of recording such data in real-world experiments.

Goals

The task of this thesis is to setup a measurement framework for real-world cycling experiments with a real bicycle. This framework should consist of, but is not limited to, sensors for measuring the speed, acceleration, and heading of the bicycle as well as antennas for GPS positions. Using this data, traces similar to the ones from the VCE should be recordable and usable for later evaluation and comparison to the cycling behavior from the VCE. These traces will also help us to develop a simulation model for realistic cycling behavior later on.

Furthermore, the framework should provide a V2X communication interface for doing real-world Bike2X experiments. It should be realized by using our OpenC2X[1] platform and integrating corresponding hardware into the framework. Using this interface, we will be able to study Bike2X communication and test potential ADAS in realistic scenarios.

Relevant Knowledge / Skills

Linux & command-line, Raspberry Pi 3, micro-controller, basic electronics understanding

Keywords

Cycling measurements, traces, sensors, GPS, Bike2X

Literature

[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, D.C.: IEEE, Jun. 2019.

[1] http://www.ccs-labs.org/software/openc2x/

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