Cooperative Autonomous Systems

Karlsruher Institut für Technologie

At the Group for Cooperative Autonomous Systems, there is an opening for a Master's thesis on the following topic

Cooperative Vulnerable Road Users Protection Systems

or

Schutzsysteme für Kooperative ungeschützte Verkehrsteilnehmer

Idea

We design and perform theoretical as well as experimental performance evaluation of a cooperative vulnerable road user (VRU) protection system. We focus on VRU-VRU communication scenarios, when devices carried by the VRUs (e.g. smartphones, smartwatches) exchange positioning information via the cellular network.

The general context of cooperative VRU protection is provided in [1], but in this thesis we focus only on the vehicular communications (V2X) aspects of the system. The following concrete research questions are suggested (the thesis can concentrate only on one/few of these or suggest other):

- Which freshness of location update information can be provided by the system?
- Which metrics could also take precision of these updates into account?
- What are the strategies of update messages generation for the scenarios of interest?
- Is the approach suggested by the state-of-the-art V2X standards appropriate?
- What is the impact of the system on the battery drain of the mobile devices?
- How can this be taken into account in the update message generation strategies?
- Can the performance of the system be enhanced when not only current positioning information is communicated, but also future VRU intentions?
- Is such a communication supported by the V2X standards?

Approach

Theoretical evaluation

We use age-of-information (AoI) characterization approaches (see [2] as a starting point) and Artery simulation environment[1] (see [3] for the discussion of VRU modeling). For some tradeoffs related to the energy-efficiency see also [4].

Real-world evaluation

We use off-the-shelf devices and a public cellular network. Some VRU-VRU communication use cases are suggested during the V2X standardisation[2]. The implementation of the system is based on the existing mobile application source code[3], which is described in [5]. The communication is handled via MQTT broker[4].

Contact

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References

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[5] Molina, O. A., Ronelöv, E., Boustedt, K., Blidkvist, J., & Vinel, A. (2022, November). Protection of Vulnerable Road Users using Hybrid Vehicular Networks. In *2022 IEEE International Conference on Vehicular Electronics and Safety (ICVES)* (pp. 1-6). IEEE.

[1] http://artery.v2x-research.eu/

[2] https://www.etsi.org/newsroom/news/1852-2020-11-etsi-experts-complete-specifications-for-vulnerable-road-users

[3] https://github.com/oscarmex1986/HH-VRU-App-Android

[4] https://mqtt.org/