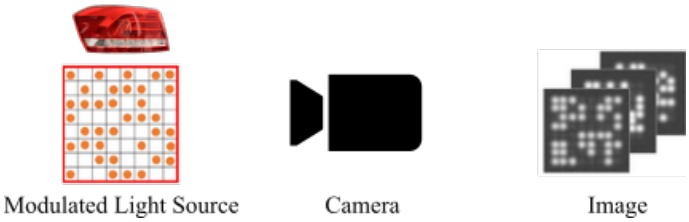
Prof. Dr.-Ing. habil. Falko Dressler
Telecommunication Networks (TKN)

Technische Universität Berlin

Bachelor/Master's Thesis

Channel Modeling for Vehicular Optical Camera Communications (V-OCC)

Vehicular Visible Light Communication (V-VLC) has emerged as a low cost, and secure technology for Inter-Vehicle Communication (IVC). In V-VLC, the desired signal is modulated on the instantaneous optical power of the light transmitted by the LED-based head- and/or taillights, and it is received by photodiode(s) [1].



Alternatively, camera image sensors can be used as receivers [2]. This type of communication is known as Optical Camera Communications (OCC). Cameras are already deployed in modern vehicles for safety applications, like pedestrian detection, lane detection, and parking assist. Therefore, such cameras are ready to use for communication. There are many advantages of using cameras for communication: The rather high spatial resolution of cameras allows separation of noise and signal sources and detection of multiple transmitters and, therefore, enabling efficient MIMO. The fundamental difference in camera-based Visible Light Communication (VLC) is the need to use image processing techniques on the receiver side for the detection/tracking of the transmitters, and for extracting the transmitted signal.

Goals of the thesis

The goal of this thesis is to extend *Veins VLC*[1] with Optical Camera Communications capabilities. This includes an extensive study of the state-of-the-art in Vehicular Optical Camera Communication (V-OCC) simulation. Accurate modeling of the channel and its properties for traditional and high-speed camera receivers; and thorough verification and validation of the developed model. Finally, the developed model should be compared to the existing photodiode-based V-VLC model. This work can further be extended to a Master's Thesis requiring the development of Infrastructure-to-Vehicle (I2V) communication.

Keywords

Vehicular Visible Light Communication (V-VLC), channel modeling, simulation, C++.

[1] A. Memedi and F. Dressler, "Vehicular Visible Light Communications: A Survey," *IEEE Communications Surveys & Tutorials*, vol. 23, no. 1, pp. 161–181, Jan. 2021. DOI: 10.1109/COMST.2020.3034224.

[2] T. Yamazato, I. Takai, H. Okada, T. Fujii, T. Yendo, S. Arai, M. Andoh, T. Harada, K. Yasutomi, K. Kagawa, and S. Kawahito, "Image-Sensor-Based Visible Light Communication for Automotive Applications," *IEEE Communications Magazine (COMMAG)*, vol. 52, no. 7, pp. 88–97, Jul. 2014. DOI: 10.1109/MCOM.2014.6852088.

[1] https://ccs-labs.org/software/veins-vlc/

Contact:
Agon Memedi: <memedi@ccs-labs.org>

Website:
www.tkn.tu-berlin.de