Channel Characterisation and Modeling for Dependable Vehicular Connectivity

Invited Paper Summary at ICMIM2018

Christoph F. Mecklenbräuker
Institute of Telecommunications
Technische Universität Wien
Wien, Austria

SUMMARY

Cooperative Intelligent Transport Systems (C-ITS) promise to enhance the state-of-the-art in the mobility of people and goods by making transport cleaner, safer, and more efficient [2]. To this aim, all road users will be linked to each other and the road infrastructure to make traffic more efficient, cleaner, and safer. For example, Vehicle-To-Vehicle (V2V) and Vehicle-To-Infrastructure (V2I) communication enable coordination of vehicular traffic and advanced route management in transport networks [7]. Some C-ITS services require high data rates, but don't care much about latency, whereas others need to enforce strict demands on reliability and latency for short messages. These contrasting demands drive the diversification of radio access on board of vehicles.

Challenges for C-ITS are posed by the nonstationary time–frequency-selective fading processes in vehicular channels [1,2,3,6]. Fortunately, the nonstationary vehicular fading may be characterized by assuming *local* stationarity for a finite region in the time-frequency plane. For such region, the wide-sense stationarity and uncorrelated scattering assumptions hold approximately [5]. Thus, it makes sense to characterize the channel by a *local* scattering function (LSF). Estimates for the LSF from measurements collected in the DRIVEWAY'09 campaign at 5-6 GHz are discussed focusing on ITS scenarios. Subsequently, the time–frequency-varying power delay profile (PDP) and the time–frequency-varying Doppler power spectral density (DSD) are discussed [4,5]. Based on these, the time–frequency-varying delay and Doppler spreads are evaluated. High delay spreads are observed in situations with rich scattering, whereas high Doppler spreads characterize drive-by scenarios.

Early LSF results for 59.75–60.25 GHz millimetre wave V2V channel measurements in an urban street (Vienna, Austria) are presented [8]. Measurements have been acquired in September 2017 with a time-domain channel sounder. Estimates for delay and Doppler profiles are evaluated from the LSF for overtaking vehicles. Passenger cars are associated with a single Doppler trajectory, whereas lorries show up in the LSF with multiple Doppler trajectories.

These propagation-related channel characteristics translate into packet transmission error sequences exhibiting strong temporal dependencies. Finally, we discuss packet error models of low complexity for large-scale C-ITS emulation.

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