OFDM BASED VISIBLE LIGHT BROADCASTING SYSTEMS

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Introduction. Visible light communication (VLC) involves the use of light emitting diode (LED)-based illumination infrastructure for communication purposes [1]. Recent experimental studies on VLC have demonstrated data speeds more than 3 Gigabits per second [2]. Although indoor spaces usually have more than one light source, most of the existing works on VLC in the current literature consider point-to-point communication and few efforts have been made on the scenarios with multiple transmitters. In this work, we consider a broadcasting scenario in which multiple transmitters (light sources) simultaneously emit the same information using orthogonal frequency division multiplexing (OFDM).

Materials and methods. In order to model the wireless channel, we have created a three dimensional model of the office space under consideration in Zemax® and integrated the multiple lighting sources and photodetectors in the model. Using the non-sequential ray tracing features of Zemax®, we have computed the received optical power and the delays of direct/indirect rays. This information has then been imported into Matlab® and the corresponding channel impulse responses have been obtained through proper normalizations. Under the obtained channel characteristics, bit error rate (BER) performance of the considered communication scenario has been assessed through Monte Carlo simulations. In addition to the communication performance of the multiple light sources, we have also investigated the lighting performance of the considered multi-source VLC system. In assessing the lighting performance, illuminance uniformity has been considered as the performance metric which has also been obtained though ray tracing simulations in Zemax®.

Results and discussion. Performance of the multi-source VLC system has been compared with the single transmitter case. In comparisons, the total number of LEDs is kept the same in both multi-source and single source scenarios. In terms of illumination, the minimum-to-average uniformity is found 0.21 and 0.42 respectively for a single source and multi-sources cases. This satisfies the recommended minimum uniformity level of at least 40% for balanced brightness between near and far surroundings. Furthermore, employing multiple light sources provides a gain of 1.82 dB for a targeted BER of 10^{-2} as compared to the single source case.

Conclusions. We have presented the opportunities and design constraints for optical OFDM based visible light broadcasting systems. The future direction of research will include synchronization issues in rich artificial multipath environments for optical OFDM based VLC systems.

References.

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