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Grouped discrete Hartley transform precoding for low-complexity PAPR reduction in ACO-OFDM visible light communication systems

Roland Niwareeba Denise Joanitah Birabwa and John Bosco Ssemakula

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Article

Abstract

The high peak-to-average power ratio (PAPR) remains one of the major challenges affecting asymmetrically clipped optical orthogonal frequency division multiplexing (ACO-OFDM) systems used in visible light communication (VLC). Although transform precoding techniques such as discrete Hartley transform (DHT) precoding can effectively reduce PAPR, their computational complexity increases significantly as the number of subcarriers increases, limiting practical implementation in large-scale systems. In this paper, a grouped discrete Hartley transform (G-DHT) precoding scheme is proposed for low-complexity PAPR reduction in ACO-OFDM systems. The proposed technique partitions the input symbol vector into smaller groups and independently applies DHT precoding within each group before OFDM modulation. This significantly reduces computational complexity while preserving the PAPR reduction capability of conventional DHT precoding. Simulation results show that the proposed scheme achieves measurable PAPR reduction without noticeable bit error rate (BER) degradation. At a complementary cumulative distribution function (CCDF) of 10^{-3}, the proposed G-DHT scheme with group size $G = 128$ achieves approximately 0.95 dB PAPR reduction relative to conventional ACO-OFDM while reducing computational complexity by about 50 % compared with full DHT precoding. The results indicate that grouped DHT precoding provides an effective trade-off between PAPR reduction performance and implementation complexity in optical OFDM systems.

Keywords: ACO-OFDM; grouped DHT; optical OFDM; PAPR reduction; visible light communication

Corresponding author: Roland Niwareeba, Electrical and Electronics Engineering Department, Kyambogo University, Kampala, Uganda, E-mail: rniwareeba@kyu.ac.ug

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