

Abstract

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On the performance of adaptive hybrid MQAM-MPPM scheme over Nakagami and log-normal dynamic visible light communication channels

In this paper, we introduce the idea of using adaptive hybrid modulation techniques to overcome channel fading effects on visible light communication (VLC) systems. A hybrid M-ary quadrature-amplitude modulation (MQAM) and multipulse pulse-position modulation (MPPM) technique is considered due to its ability to make gradual changes in spectral efficiency to cope with channel effects. First, the Zemax optics studio simulator is used to simulate dynamic VLC channels. The results of Zemax show that Nakagami and log-normal distributions give the best fitting for simulation results. The performance of MQAM–MPPM is analytically investigated for both Nakagami and log-normal channels, where we obtain closed-form expressions for the average bit-error rate (BER). The optimization problem of evaluating the hybrid modulation technique settings that lead to the highest spectral efficiency under a specific channel status and constraint of outage probability is formulated and solved using an exhaustive search. Our results reveal that the adaptive hybrid scheme improves system spectral efficiency compared to ordinary QAM and MPPM schemes. Our results reveal that the adaptive hybrid scheme improves system spectral efficiency compared to ordinary QAM and MPPM schemes. Specifically, at low average transmitted power, -32 dBm, the adaptive hybrid scheme shows 280% improvement in spectral efficiency compared to adaptive versions of ordinary schemes. At higher power, -20 dBm, 6.5% and 725% improvement are obtained compared to ordinary QAM and ordinary MPPM, respectively. Also, the adaptive hybrid scheme shows great improvement in average BER and outage probability compared to ordinary schemes. The hybrid scheme shows 28%, 34%, and 38% improvement, respectively, for $m = 1, 2, 3$ for Nakagami channels at $BER = 10^{-3}$. Also, the outage probability of hybrid schemes of $BER = 10^{-3}$ shows 30% and 14% better performance than ordinary MQAM and MPPM schemes, respectively.