Noncoherent Communications for Single-Input Multiple-Output Systems

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Abstract

A single-input multiple-output system employing multi-level amplitude-shift keying (ASK) and noncoherent reception in flat Rayleigh fading with different cases of the channel covariance matrix is considered. These include the case of uncorrelated identical fading, the important case of distributed antennas which exhibit uncorrelated fading with unequal mean-squared channel gains (uncorrelated non-identical fading), and the cases of exponentially correlated and uniformly correlated channels with equal mean-squared channel gains. Two types of receivers are considered: the optimum maximum likelihood (ML) quadratic combining receiver and a suboptimum modified ML deterministic linear combining receiver. The symbol error probability (SEP) of the system is derived in closed form for each of these receivers from the statistics of the receiver decision variable. The problem of determining the optimal amplitude levels that minimize the SEP under a total signal energy constraint is formulated and solved numerically. It is observed that an equally spaced ASK constellation (levels in arithmetic progression) is not optimal in terms of achieving the minimum SEP. At high signal-to-noise-ratios, the optimal signal amplitude levels follow an approximately geometric progression. It is also found that with increase in imbalance amongst the eigenvalues of the channel covariance matrix, the error performance degrades for the ML receiver but improves for the modified ML receiver.

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