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A Worst-Case Comparison of Generalized and Ordinary DSSS in a Multipath Environment

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ABSTRA CT

Direct sequence spread spectrum (DSSS) is a common modulation scheme used in numerous wireless devices. Due to the spectrum spreading characteristics of DSSS modulation, it can be utilized to combat multi-user/multipath interference. It has been previously shown that DSSS is a simple special instance of a random modulator, and that the asymptotically optimal random modulator for combating arbitrary interference is one that uniformly distributes any message vector on the surface of an N-dimensional sphere. While this result is only a theoretical benchmark lacking implementation, a practical generalization of DSSS in the direction of optimal random modulation, the so called generalized DSSS, has been shown to possess significantly better worst-case performance than ordinary DSSS in the presence of an arbitrary but uncorrelated interference.

In this thesis, we are interested in investigating the worst -case performance of generalized DSSS when the interfering signal is correlated with the transmitted signal. To accomplish this, we consider a channel corrupted by multi-user/multipath interference and additive white Gaussian noise (A WGN). We concentrate on multipath interference to emphasize the correlated nature of the interference, and explore the worst-case error probability, over several parameters of the interfering signal, of a generalized DSSS system. We obtain a numerically-evaluated Chernoff-type upper bound to, and a Monte Carlo simulation of, the worst-case error probability of this system. We compare these results with similar bounds and simulations obtained for ordinary DSSS. We find that in a multipath channel, generalized DSSS exhibits an appreciable improvement over ordinary DSSS in worst-case performance, both in terms of a comparison of upper bounds, and a comparison of Monte Carlo simulations.