Abstract

The work reported in this thesis is divided into two parts. In the first part, we report a closed-form bit error rate (BER) performance analysis of orthogonal frequency division multiple access (OFDMA) on the uplink in the presence of carrier frequency offsets (CFOs) and/or timing offsets (TOs) of other users with respect to a desired user. We derive BER expressions using probability density function (pdf) and characteristic function approaches, for a Rician faded multi-cluster multipath channel model that is typical of indoor ultrawideband channels and underwater acoustic channels. Numerical and simulation results show that the BER expressions derived accurately quantify the performance degradation due to non-zero CFOs and TOs.

Ultrawideband channels in indoor/industrial environment and underwater acoustic channels are severely delay-spread channels, where the number of multipath components can be of the order of tens to hundreds. In the second part of the thesis, we report low complexity equalization algorithms for cyclic-prefixed single carrier (CPSC) systems that operate on such inter-symbol interference (ISI) channels characterized by large delay spreads. Both single-input single-output and multiple-input multiple-output (MIMO) systems are considered. For these systems, we propose a low complexity graph based equalization carried out in frequency domain. Because of the noise whitening effect that happens for large frame sizes and delay spreads in the frequency domain processing, improved performance compared to time domain processing is shown to be achieved. Since the graph based equalizer is a soft-input soft-output equalizer, iterative techniques (turbo-equalization) between detection and decoding are shown to yield good coded BER performance at low complexities in convolutional and LDPC coded systems. We also study joint decoding of LDPC code and equalization of MIMO-ISI channels using a joint factor graph.