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Delay Estimation in Long-Code Asynchronous DS/CDMA Systems Using Multiple Antennas

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Abstract

The problem of propagation delay estimation in asynchronous long-code DS-CDMA multiuser systems is addressed. Almost all the methods proposed so far in the literature for propagation delay estimation are derived for short codes and the knowledge of the codes is exploited by the estimators. In long-code CDMA, the spreading code is aperiodic and the methods developed for short codes may not be used or may increase the complexity significantly. For example, in the subspace-based estimators, the aperiodic nature of the code may require subspace tracking. In this paper we propose a novel method for simultaneous estimation of the propagation delays of several active users. A specific multiple-input multiple-output (MIMO) system model is constructed in a multiuser scenario. In such model the channel matrix contains information about both the users propagation delays and channel impulse responses. Consequently, estimates of the delays are obtained as a by-product of the channel estimation task. The channel matrix has a special structure that is exploited in estimating the delays. The proposed delay estimation method lends itself to an adaptive implementation. Thus, it may be applied to joint channel and delay estimation in uplink DS-CDMA analogously to the method presented by the authors in 2003. The performance of the proposed method is studied in simulation using realistic time-varying channel model and different SNR levels in the face of near-far effects, and using low spreading factor (high data rates).

Keywords

code division multiaccess, multipath channels, delay estimation