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A STUDY OF MULTICARRIER DS-CDMA EMPLOYING CHAOTIC SPREADING CODES WITH DIFFERENT CHIP WAVEFORMS

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Abstract. *In this paper, a multicarrier direct sequence (DS) code division multiple access (CDMA) using chaotic spreading binary sequences having exponentially vanishing autocorrelations together with three classes of time-domain chip waveforms including rectangular, half-sine and raised-cosine chip waveforms is considered. The closed-form equations allow us to evaluate the optimum autocorrelation parameters of spreading sequences associated with different chip waveforms in order to minimize bit error probability (BEP) of the multicarrier DS-CDMA with partially spectral overlapping subcarriers.*
Keywords: Code-division multiple access (CDMA), Spreading sequences, Multicarrier, Chaos

1. **Introduction.** A novel class of multiple access schemes known as multicarrier direct sequence (DS) code division multiple access (CDMA) has received a lot of attention for the future wireless broadband communications [1]. As one of multicarrier DS-CDMA, a generalized multicarrier DS-CDMA system is introduced in [2], which includes the multitone DS-CDMA [3] and orthogonal multicarrier DS-CDMA [4] as special cases.

In DS-CDMA, the multiple access interference (MAI) causes the bit errors. Therefore, the variance of MAI called the average interference parameters (AIP) is used as a merit figure for evaluation of bit error probability (BEP) [5]. The AIP is a function of autocorrelation of spreading sequences, which can be minimized by using slightly negative autocorrelation parameters [6]. Such correlated sequences can be easily designed by means of one-dimensional chaotic maps [6]-[8].

In the case of multicarrier DS-CDMA, the carrier spacing between two adjacent carriers also affects the amount of the AIP as argued in [9]. Therefore, a joint optimization of autocorrelation of spreading sequences and carrier spacing between two adjacent carriers in order to minimize the amount of AIP is carried out in [11] by considering the multicarrier DS-CDMA employing chaotic sequences with exponentially vanishing autocorrelations and rectangular chip waveforms. As mentioned in several works, the chip waveforms also influence the multiple access interferences [10]. The aim of this paper is to extend our investigation presented in [11] to include two additional time-limited chip waveforms such as the time-domain half-sine and raised-cosine chip waveforms.

This paper is organized as follows. Section 2 describes the system model of multicarrier DS-CDMA. The closed-form expressions of the AIP are obtained in Section 3, which allow us to evaluate the optimum autocorrelation parameters of spreading sequences for various chip waveforms in order to minimize bit error probability (BEP) of the multicarrier DS-CDMA. Finally, concluding remarks are drawn in Section 4.