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PERFORMANCE OF MULTICARRIER DS-CDMA SYSTEMS USING CHAOTIC SPREADING CODES WITH ARBITRARY CARRIER SPACING

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Abstract. *The multicarrier (MC) direct-sequence (DS) code division multiple access (CDMA) system employing chaotic spreading sequences is considered in this paper. Firstly, the multiple access interference (MAI) of the MC DS-CDMA system using chaotic spreading sequences with arbitrary amount of carrier spacing is theoretically analyzed. The investigation of optimum parameters of autocorrelation together with the optimum spacing between subcarriers is carried out in order to minimize the MAI. The average bit error probability (BEP) derived from the resultant minimized MAI is compared with that for conventional independent and identically distributed (i.i.d.) binary sequences. Numerical examples show the superiority of chaotic spreading sequences to i.i.d. codes in terms of the average BEP.*
Keywords: Chaos, Spreading codes, Multicarrier DS-CDMA, Carrier spacing

1. **Introduction.** Recently, a demand for high date rate and multimedia traffic transmission has grown up in wireless mobile radio system. A combination of direct sequence code division multiple access (DS-CDMA) system and multicarrier (MC) modulation, which is referred to as MC DS-CDMA, is expected to support such a future broadband wireless communication [5, 17]. DS-CDMA scheme has been considered as attractive multiplexing system especially for mobile radio systems, because of higher multiple access capacity over conventional multiplexing techniques such as frequency division multiple access (FDMA) and time division multiple access (TDMA). Multicarrier (MC) modulation such as orthogonal frequency division multiplexing (OFDM) plays a key role in a high date rate wireless transmission because it has robustness against multipath fading. In the MC DS-CDMA, the original data stream is firstly serial to parallel converted to a number of lower rate streams. Then narrow-band DS waveforms are transmitted in each frequency band. The frequency selective multipath fading effect is mitigated in the system because of increasing symbol duration.

As for the conventional single-carrier (SC) CDMA systems, performance of MC DS-CDMA system mainly suffers from multiple access interference (MAI) due to the lack of orthogonality among spreading sequences associated with active users. Therefore, spreading sequence design is also very important in MC DS-CDMA. An independent and identically distributed (*i.i.d.*) sequence and linear feedback shift register (LFSR) codes such as M sequences and Gold sequences are commonly used as spreading sequences in CDMA. However, it has been proven that sequences with slightly negative autocorrelation profiles generated by a one-dimensional chaotic map outperform *i.i.d.* codes in terms of