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A survey of BER Performance of Generalized MC DS-CDMA System

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Abstract

In today's era multiple access interference in multicarrier direct sequence-code division multiple access (MC DS-CDMA) is the most important difficulty that depends mainly on the correlation properties of the spreading sequences as well as the shape of the chip waveforms. In this paper we present a survey on BER performance of generalized MC DS-CDMA. We study and analysed the performance measurement with their advantages and limitations. Based on study we also suggest some future suggestions which are useful for future research.

Keywords

CDMA, DS-CDMA, BER, multicarrier

1. Introduction

This multipath propagation causes arbitrary time dispersion, attenuation, and phase shift, known as fading, in the received signal [1], [2]. Fading is caused by interference between two or more versions of the transmitted signal which arrived at the receiver at slightly different times [3]. DS-CDMA technique has the advantages of increasing the channel capacity along with the immunity against jamming [4]. In multi-user CDMA systems, multiple access interference (MAI) is considered one of the main sources of performance degradation. Adaptive filtering techniques have been successfully used to equalize the channel and thus reduce the MAI in the DS-CDMA system [5]. Several two-dimensional (2-D) wavelength-hopping time spreading codes have been reported to improve the performance of optical code-division multiple access (O-CDMA) systems [6]–[9]. These codes can increase the number of subscribers and simultaneous users rather than conventional one dimensional O-CDMA codes, namely unipolar time-spreading codes. Basic one-dimensional asynchronous codes are optical orthogonal codes (OOCs)[10] and prime sequence codes (PSCs)[11], also known as prime codes.

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We provide here an overview of MC DS-CDMA. Other sections are arranged in the following manner: Section 2 introduces BER; Section 3 describes about Related Work; Section 4 shows the problem domain. Section 5 shows the analysis; Section 6 describes Conclusion.

2. BER [12]

The bit error rate or bit error ratio (BER) is the number of bit errors divided by the total number of transferred bits during a studied time interval. BER is a unit less performance measure, often expressed as a percentage. The bit error probability pe is the expectation value of the BER. The BER can be considered as an approximate estimate of the bit error probability. This estimate is accurate for a long time interval and a high number of bit errors. Measuring the bit error rate helps people choose the appropriate forward error correction codes. Since most such codes only bit-flips, but not bit insertions or bit detection, the hamming distance metric is the appropriate way to measure the number of bit errors.

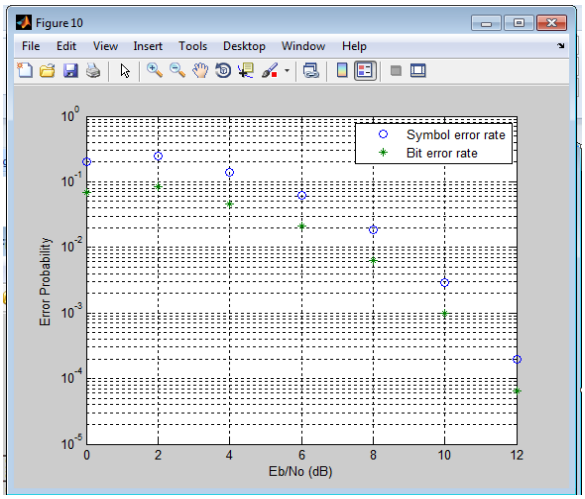

Figure 1: Error Probability

The BER may be improved by choosing strong signal strength by choosing a slow and robust modulation scheme or line coding scheme, and by applying channel coding schemes such as redundant forward error correction codes. As the name implies, a bit

error rate is defined as the rate at which errors occur in a transmission system. This can be directly translated into the number of errors that occur in a string of a stated number of bits. The definition of bit error rate can be translated into a simple formula

BER = number of errors / total number of bits sent

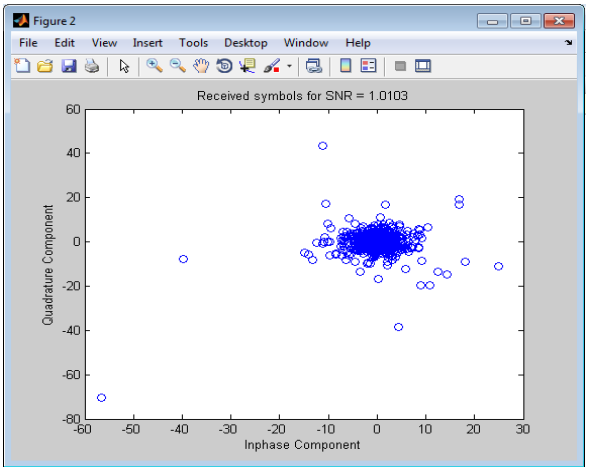

Figure 2: BER for 1.0103 SNR

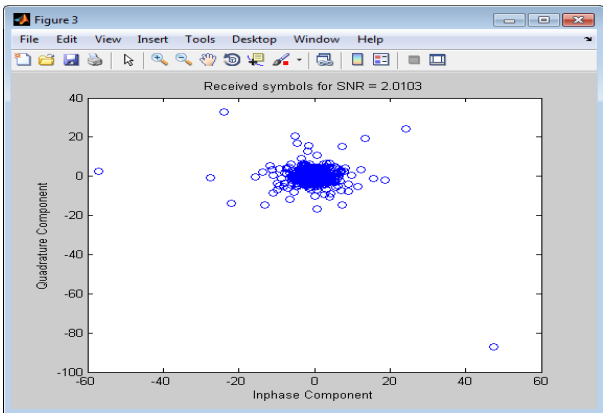

Figure 3: BER for 2.0103 SNR

3. Related Work

In 2009, Mohammed El-Hajjar et al. [13] present a novel tri-functional Multiple-Input Multiple-Output (MIMO) scheme that intrinsically amalgamates Space-Time Spreading (STS), the Vertical Bell Labs Layered Space-Time (V-BLAST) scheme and beam forming with generalized Multicarrier Direct Sequence Code Division Multiple Access (MC DS-CDMA). Further system performance improvements can be attained by employing channel coding, where the source bits are serial-to-parallel converted to two layers, each constituted by a serial concatenation of an outer code amalgamated with a unity-rate code for the sake of improving the convergence behaviour of the proposed system. Additionally, the convergence behavior of the iteratively detected scheme is evaluated with the aid of Extrinsic Information Transfer (EXIT) charts. They also propose a novel Logarithmic Likelihood Ratio (LLR) post processing technique for improving the iteratively detected system's performance.

In 2010, Mohammad Torabi et al. [14] investigate the combination of different techniques, resulting in user scheduling schemes for multiuser MIMO-OFDM systems employing orthogonal space–frequency block coding (OSFBC) over multipath frequency selective fading channels. Our contribution is a performance analysis framework that evaluates the advantages of employing user scheduling in MIMO-OFDM systems employing OSFBC in conjunction with adaptive modulation schemes. They derive analytical expressions for the average spectral efficiency (ASE), the average bit error rate (BER), the outage probability, and the average channel capacity for different scheduling and adaptive modulation schemes. Discrete-rate and continuous rate adaptive modulation schemes are employed to increase the spectral efficiency of the system. They assume a signal to-noise-ratio (SNR)-based user-selection scheme and the well-known proportional fair scheduling (PFS) scheme.

In 2011,Ashutosh Dubey et al. [15] proposed a Modernize SLM (MSLM) scheme to reduce the PAPR by using the complex signal separate into real & imaginary parts and individually phase sequence multiple real as well as imaginary part of complex signal then select minimum PAPR signal of real & imaginary and these are combine. The simulation show achieves good PAPR, which is a strong candidate for Future wireless communication.

In 2011, George A. Ropokis et al. [16] present an analytical bit error rate (BER) performance study of three detect-and-forward (DaF) policies under a common framework. More specifically, the direct, threshold and link-adaptive schemes are studied, which differ in the way the decision on the transmitted symbol is forwarded from the relay to the destination. The analysis is carried out for a single relay DaF transmission protocol and takes into

account the symbol decision errors that may occur at the relay. Simple closed-form analytical BER expressions are derived for all three schemes, which are completely verified by simulations.

In 2011,Vikas Gupta et al. [17] present a comprehensive analysis of MC-CDMA system over the AWGN (Additive White Gaussian Noise) and Raleigh channel for different number of subcarrier and different number of users, system analysis is performed by simulating the MC-CDMA using MATLAB program, and finally they also presents a comparison between simulated and theoretical results.

In 2012, Rekha et al. [18] proposed algorithm which extends the CM criterion to blind equalization using complex exponential basic expansion model (CEBEM) and the channel is assumed as time varying MIMO-FIR. The methods only employ the Second order statistics (SOS) and finally, it estimates only one pulsation. In this way, the system increases the SNR of the transmitted symbols and produces most beneficial result in time-varying channels. The fast convergence is also achieved through zero forcing equalization.

In 2012, Santanu Kumar Sahoo et al. [19] proposed an adaptive model for a digital communication system based on RLS algorithm with binary input signal. Also, the LMS (Least mean Square), RLS (Recursive Least Square) structures are simulated for linear and nonlinear channels. Convergence characteristics, along with bit-error-rates are analyzed for better performance of these equalizers than the standard equalizers.

In 2012, Mohamed Samir et al. [20] proposes an enhancement to the performance of a Direct Sequence Code Division Multiple Access (DS-CDMA) system by utilizing an adaptive filter in the presence of different jamming techniques. In order to combat the impact of such jamming, the adaptive filter utilizes three adaptive algorithms which are the Variable Step-Size Affine Projection (VSS-APA) algorithm, the Generalized Normalized Gradient Descent (GNGD) algorithm, and the Generalized Square-Error-Regularized (GSER) NLMS algorithm. According to the authors these algorithms have the advantages of fast convergence, low steady state mean squared error and the ability to improve the bit error rate (BER) performance of the conventional CDMA system, in the presence of multi-path, multiple-access, and different jamming signals. Results show that the VSS-APA outperforms other algorithms in the presence of barrage jamming. Whereas in the presence of partial band jamming the GSER-NLMS adaptive filter gives the best performance.

4. Problem formulation

In multicarrier direct sequence-code division multiple access (MC DS-CDMA) transmitted data are first split in the lower sequences\lower rate sequences for transmission. They modulated different subsystem of a different sub carrier of the orthogonal multi carrier system. When the sampling rates increases the timing jitters may be correlated. So effective analysis of different degree of correlation is needed.

5. Analysis

Computer simulations are done to simulate SNR vs. BER performance of MC-CDMA for different channel noise conditions, different number of subcarriers and to analyse the effect of number of users in BER. To make the results more useful, the results are generated for varying number of users and for different number of subcarriers. So the information symbol is BPSK modulated at the transmitters and detected by using the maximum likelihood method in the demodulation at the receiver. A cyclic prefix can be added to protect the symbol. Walsh codes can be chosen as the spreading codes of the system.

6. Conclusion

In this paper we survey several aspects of multicarrier direct sequence-code division multiple access (MC DS-CDMA). We also analyse the BER. We discuss several related study in the direction of the survey and present the analysis based on the study and discussion.

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