International Journal of Advanced Computer Research (ISSN (print):2249-7277 ISSN (online):2277-7970)
Volume-3 Number-2 Issue-10 June-2013

Performance Analysis of Generalized MC DS-CDMA System

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Abstract

After studying several researches in the direction of Multicarrier direct sequence-code division multiple access (MC DS-CDMA) which is a novel radio access scheme that combines time domain spreading and multicarrier modulation suffer from the interference among users. This phenomenon is called multiple access interference. Our paper is devoted for reducing the above problem as well as discussing the performance result analysis.

Keywords

CDMA, DS-CDMA, multicarrier, interference

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 MC DS-CDMA; Section 3 describes about Related Work; Section 4 shows the performance analysis; Section 5 describes Conclusion.

2. MC DS-CDMA

Space-Time Spreading (STS) [12] was proposed as an extension of Space Time Block Coding (STBC) [13, 14] for the downlink of Wideband Code Division Multiple Access (WCDMA) [15]. STS is capable of providing a spatial diversity gain, which results in an improved BER performance. On the other hand, the Vertical Bell Labs Layered Space-Time (V-BLAST) scheme was proposed in [16] for providing a multiplexing gain for providing an increase of a specific user's effective bandwidth efficiency without the need for any increase in the transmitted power or in the system's bandwidth.

Multi-carrier direct sequence code division multiple access (MC/DS CDMA) method is optimum for the mobile transmission link. But, because of multi-carrier property, large PAPR (peak to average ratio) may be generated in MC/DS CDMA system. It is known that in MC-DS-CDMA is its stringent power control requirements which limit its performance so there is the need of cross correlation properties. Multiple techniques are suggested for the separation and the removal of the impact of jamming using adaptive filtering [17]. Time-frequency domain filtering [18], subspace processing [19] and amplitude domain filtering [20].

3. Related Work

In 2010, Mohammad Torabi et al. [21] 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. [22] 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. [23] 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. [24] 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. [25] 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. [26] 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. [27] 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. Performance Analysis

The different properties of a MIMO System are analysed and the advantages and disadvantages of this system are understood. Its performance is analyzed with the help of powerful simulation tool MATLAB. The simulation results show that the Compact MIMO scheme reduce the bit error rate about 0.25dB to 1dB as compared to conventional MIMO method. The below figure represent spectrum of transmitted signal as well as message signal in discrete form.

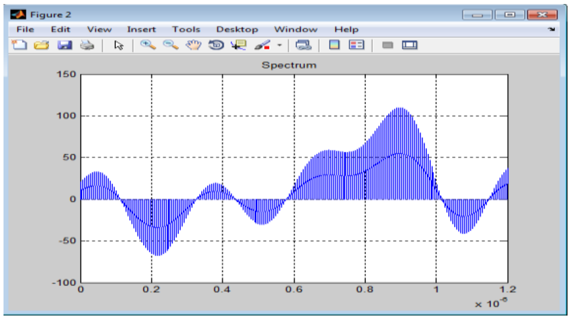

Figure 1: Spectrum of transmitted signal

The figure 2 represents noise as well as transmitted signal.

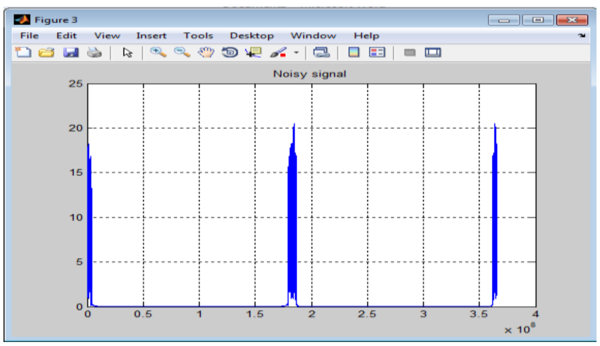

Figure 2: Noise signal

The figure 3 represent PSD(power spectrum density) or energy spectral density (ESD),which is a positive real function of a frequency variable associated with a stationary process which is stochastic which has dimensions of power per hertz(Hz), or energy per hertz.

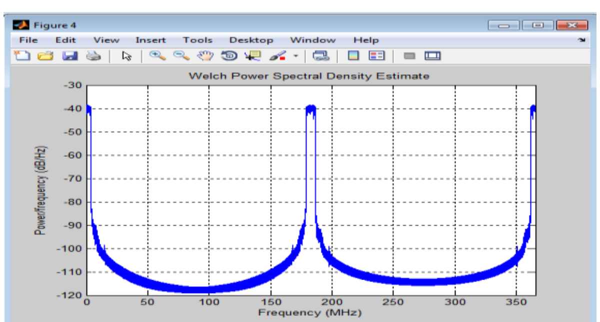

Figure 3: Power spectrum densities

We were taking samples of original message signals which represent in the form of discrete message signal. This is for fast sampling rates.

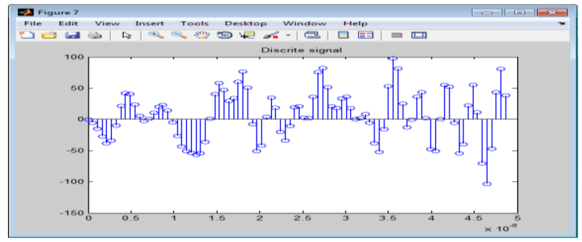

Figure 4: Discrete signal

The figure 5 represents spectral density of digital signal which is generated from discrete signal of our message signal.

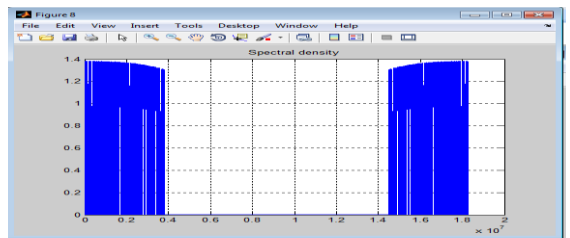

Figure 5: Spectral Density

5. 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.

References

[1] S. Stein, “Fading channel issue in system,” IEEE Trans. J. Select. Areas Commun., vol. SAC-5, no. 2, pp. 68-89, Feb. 1987.

[2] M. Schwartz, W. R. Bennett, and S. Stein, Communication Systemsand Techniques, New York: Mcgraw-Hill, 1966.

[3] Tanvir Ahmed, M. M. Ali and M. Z. I. Sarkar,” BER Performance Analysis of Rayleigh Fading Channel in an Outdoor Environment with MLSE Equalizer”, International Conference on Electrical and Computer Engineering, Dhaka, Bangladesh, 20-22 December, 2012.

[4] Rodger E. Ziemer “Fundamentals of Spread Spectrum Modulation,” Synthesis Lectures on communications 3, University of Colorado at Colorado Springs.

[5] A.M.A. Filho E.L. Pinto J.F. Galdino, “Simple and robust analytically derived variable step-size least mean squares algorithm for channel

estimation," Published in IET communications Journal, 22nd April 2009.

[6] L.Tancevski and I.Andonovic, "wavelength-hopping/time spreading code division multiple access systems," Electron. Lett., vol.30, no.17, pp.1388–1390, Aug. 1994.

[7] N.Wada, H.Sotobayashi and K.Kitayama, "2.5Gbit/s timespreading/wavelength-hop optical code division multiplexing using fibre Bragg grating with supercontinuum light source," Electron. Lett., vol.36, no.9, pp.815–817, Apr. 2000.

[8] S.P.Wan and Y.Hu,"Two-dimensional optical CDMA differential system with prime/OOC codes," IEEE Photon. Technol. Lett., vol.13, pp.1373–1375, Dec. 2001.

[9] W.C.Kwong, G.-C.Yang, V.Baby, C.-S.Bres and P.R.Prucnal,"Multiple wavelength optical orthogonal codes under prime-sequence permutations for optical CDMA," IEEE Trans. Commun., vol.53, no.1, pp.117–123, Jan. 2005.

[10] F.R.K.Chung, J.A.Salehi and V.K.Wei,"Optical orthogonal codes: Design,analysis, and applications," IEEE Trans. Inf. Theory, vol.35, no.3, pp.595–604, May. 1989.

[11] G.-C.Yang and W.C.Kwong,"Prime codes with applications to CDMA optical and wireless networks," Artech House mobile communications series, 2002.

[12] B. Hochwald, T.L. Marzetta and C.B. Papadias, "A transmitter diversity scheme for wideband CDMA systems based on space-time spreading,"IEEE Journal on Selected Areas in Communications, vol. 19, no. 1, pp. 48–60, 2001.

[13] S.M. Alamouti, "A simple transmit diversity technique for wireless communications," IEEE Journal on Selected Areas in Communications ,vol. 16, no. 8, pp. 1451–1458, 1998.

[14] V. Tarokh, H. Jafarkhani and A.R. Calderbank, "Space-time block codes from orthogonal designs," IEEE Transactions on Information Theory,vol. 45, no. 5, pp. 1456–1467, 1999.

[15] L. Hanzo, L.-L. Yang, E.-L. Kuan and K. Yen, Single and multi-carrier DS-CDMA: Multi-user detection, space-time spreading, synchronisation, networking and standards. Chichester, England: John Wiley and Sons Ltd and IEEE Press, 2003.

[16] P.W. Wolniansky, G.J. Foschini, G.D. Golden and R.A. Valenzuela, "VBLAST: an architecture for realizing very high data rates over the richscattering wireless channel," in International Symposium on Signals, Systems and Electronics, (Pisa), pp. 295–300, September 1998.

[17] A. Haimovich, and A. Vadhri, "Rejection of Narrow Band Interferences in PN Spread Spectrum Systems Using an Eigen analysis Approach," IEEE Seventh SP Workshop on Statistical Signal and Array Processing, pp.383-386, 1994.

[18] Robert C. DiPietro, "An FFT Based Technique for Suppressing Narrow-Band Interference in PN Spread Spectrum Communications Systems," ICASSP-89", pp.1360-1363, vol. 2, May 1989.

[19] Zhang, Yimin, Moeness G. Amin, and Alan R. Lindsey. "Anti-jamming GPS receivers based on bilinear signal distributions." In Military Communications Conference, 2001. MILCOM 2001. Communications for Network-Centric Operations: Creating the Information Force. IEEE, vol. 2, pp. 1070-1074. IEEE, 2001.

[20] R. Abimoussa, R.J. Landry, "Anti-jamming solution to narrowband CDMA interference problem," Canadian Conference on Electrical and Computer Engineering, pp. 1057-1062, vol.2, 2000.

[21] Mohammad Torabi, David Haccoun and Wessam Ajib, "Performance Analysis of Scheduling Schemes for Rate-Adaptive MIMO OSFBC-OFDM Systems", IEEE Transactions on Vehicular Technology, VOL. 59, NO. 5, JUNE 2010.

[22] Ashutosh K. Dubey, Yogeshver Khandagre, Ganesh Raj Kushwaha,Khushboo Hemnani, Ruby Tiwari, and Nishant Shrivastava," PAPR Reduction in OFDM by Using Modernize SLM Technique", WiMo/CoNeCo, CCIS 2011.

[23] George A. Ropokis, Athanasios A. Rontogiannis, and Kostas Berberidis, "BER Performance Analysis of Cooperative DaF Relay Networks and a New Optimal DaF Strategy", IEEE Transactions on Wireless Communications, VOL. 10, NO. 4, April 2011.

[24] Vikas Gupta, Ruby Tiwari," Performance Analysis and Simulation Result of MC-CDMA for AWGN Channel and Raleigh Based on SNR/BER", International Journal of Advanced Computer Research (IJACR), Vol 1, Sep 2011.

[25] Rekha," Constant Modulus Blind Equalization for Time-Varying MIMO-FIR Channels with Pulse Estimation", International Journal of Advanced Computer Research (IJACR) Volume-2, Number-4,Issue-6, December-2012.

[26] Santanu Kumar Sahoo and Mihir Narayan Mohanty," Effect of BER Performance in RLS Adaptive Equalizer", International Journal of Advanced Computer Research (IJACR), Volume-2, Number-4, Issue-6, December-2012.

[27] Mohamed Samir, Ehab M. Shaheen and Ahmed Abd El Wahab," Performance Analysis of DS-CDMA System Using Fast Adaptive Filtering Under Different Jamming Techniques", IEEE 2012.

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