PERFORMANCE ENHANCEMENT OF CHANNEL ESTIMATION OF WCDMA WITH SYNCHRONIZED OFDM

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ABSTRACT

In this paper to improve the capacity and coverage of the channel in WCDMA with OFDM, a concatenation of Wideband Code Division Multiple access (WCDMA) and Orthogonal Frequency Division Multiple Access (OFDM) is used as spreading code. Synchronization error which degrades the OFDM system performance is reduced by implementing Synchronization Algorithm which is used to estimate the offset and by using compensation technique these offsets are reduced which improves the system performance. This concept is implemented in Multi-input Multi-output (MIMO) antenna to boost the capacity of the channel for high data rate transmission.

Keywords: *WCDMA; OFDM; Spreading Technique; Synchronization Algorithm andMIMO.*

INTRODUCTION

Global System for Mobile Communication (GSM) is a 2G mobile communication standard. It has many features like voice telephony, short messaging system (SMS), downloading ring tones, logos, and picture messages but its data rate is only 9.6 kbps. For to achieve a high data rate, 3G technology is introduced. WCDMA is a approved 3G technology in which the data rate begins at 384 kbps providing more features like video calls and TV applications. The move from GSM to WCDMA is a short global technological revolution representing another development challenge that is more complex than GSM. WCDMA is a spread spectrum modulation technique whose channel bandwidth is much greater than that of the data to be transferred [1]. Generally it has 5 MHz bandwidth and carries both voice and data simultaneously. From the year of 2006 there was a rapid increase of using WCDMA in mobile communication. Between 2006 and 2007 around 75 million WCDMA subscriptions were added and represented over 70% of commercial 3G, with over 190 networks in 83 countries, more than 160 million subscriptions.OFDM is a technique used for high data rate transmission having advantages like good spectral efficiency and effective elimination of multipath fading effect. It is a parallel transmission scheme in which high rate serial data stream is split into low rate sub-stream sets which are modulated on a separate sub-carrier. Thus the sub-carrier bandwidth becomes small compared to the channel coherence bandwidth by this the individual sub-carrier experience flat fading, allowing for simple equalization. A set of orthogonal carrier frequencies is selected to achieve high spectral efficiency, since in the frequency domain the signal spectra corresponds to the different sub-carrier overlap, avoiding the mutual interference among the sub-carriers (2-3).

However, is it sensitive to synchronization error which is caused by carrier frequency offset (CFO) and sampling clock offset (SCO). These offsets cause loss in orthogonality which increases the error rate, thus degrades the system performance. For overcoming the synchronization error these offsets should be eliminated. In this paper channel estimation of WCDMA with OFDM is obtained for MIMO communication. And it is seen to have better performance in wireless transmission

limiting challenges such as frequency selective fading and ISI for high data transmission. Synchronization Algorithm is implemented for estimating and compensating the synchronization error to improve the performance of OFDM system [4]. MIMO channel undergoes frequency selective due to multipath characteristic of the environment. In MIMO-OFDM this frequency selective MIMO channel can be transformed into a set of parallel frequency flat MIMO channels, and thus the receiver complexity is decreased. Thus MIMO-OFDM has become a most promising broadband wireless access scheme.

WCDMA

In WCDMA all users use same frequency for transmission and they are differentiated by their unique scrambling code. For identifying user, user channel and carrier, orthogonal codes almost zero cross-correlation are used.

OFDM: OFDM is becoming the preferred modulation scheme for both high bit rate digital wireless protocols and broadband since it has good spectral efficiency and robustness against multipath interference [5]. It makes the receiver simpler by converting the frequency selective channel into a set of parallel flat fading sub-channels.

SYNCHRONIZATION ALGORITHM In Joint Weighted Least Square algorithm is one of the or a QPSK mapped symbol sequence {d0, d1, d2…} is given by, N proposed technique for reducing the synchronization error [6-8]. In this algorithm for estimating the CFO and SCO the phase offset is estimated by the phase difference between two consecutive OFDM symbols in which channel noise is introduced and system performance is degraded.

$$X(t)=\mathrm{Re}\left\{\sum_{k=0}^{N-1} d_k \exp\left(\frac{j2\pi kt}{T}\right) \text{ for } 0 \le t \le T\right\}$$

$$= \sum_{k=0}^{N-1} d_k \exp\left(\frac{j2\pi Kt}{T}\right), \text{ when } d_N = K = d_K^*$$

To overcome this problem the algorithm is modified, that is instead of estimating phase difference for two consecutive OFDM symbols phase difference is estimated for OFDM pilots of same symbol.

MIMO COMMUNICATION

In MIMO system the spectral efficiency is increased for a given transmit power. Spectral efficiency is the total number of information bits per second per hertz transmitted from one array to the other. It effectively takes advantage of random fading and multipath delay spread [fig. 1-3]. Since it has several transmitter and receiver antenna it exploits spatial diversity. Thus the capacity is increased by introducing additional spatial channel exploited by using space-time coding (9). Since the number of antennas at the transmitter and receiver are increased its computational complexity also increases thus the performance is degraded with the estimation error.

RESULTS

Using MATLAB simulation work, the graph has been plotted between power in (dB) and frequency in (Hz) on both the AWGN and Rayleigh channel. Fig.4. represents the modulated signal spectrum, fig.5. shows the output signal spectrum. Fig.8. represents the constellation output from the signal before and after the channel which is used to recognize the type of interference and distortion in a signal. In fig.6. the channel is estimated for both AWGN and Rayleigh channel. In fig.7 the performance analysis of 2×2 with different users is shown.

NT transmitters and *NR* receivers, there are *NT* □ *NR* channels

CONCLUSION

From the obtained results it is known that the channel estimation of WCDMA with OFDM have better performance in wireless communication. By the implementation of synchronization algorithm the error due to offsets are reduced which improves the OFDM system performance. The data transmission rate is increased by the implementation of WCDMA-OFDM concept in MIMO communication.

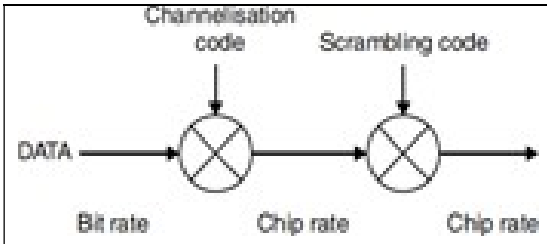

Figure 1. Relation between spreading and scrambling

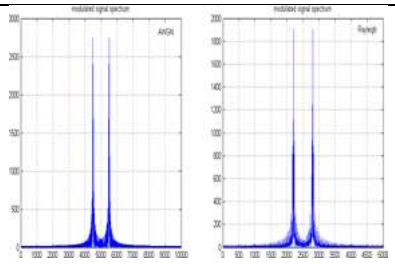

Figure.3. Modulated signal spectrum AWGN (left) and Rayleigh (right)

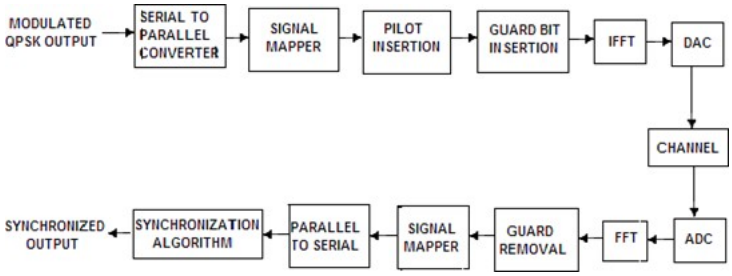

Figure 2. Block Diagram of an OFDM Transceiver.

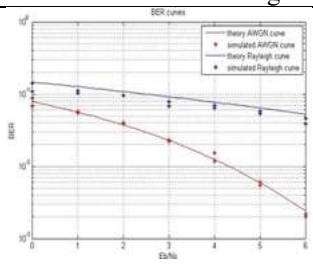

Figure.4. Output signal spectrum for received signal

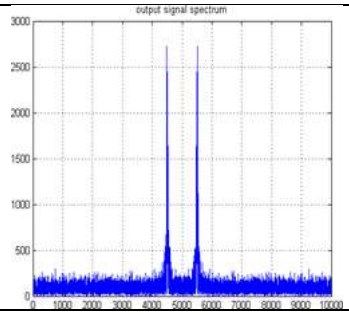

Figure.5. Constellation output for the signal before and after the channel

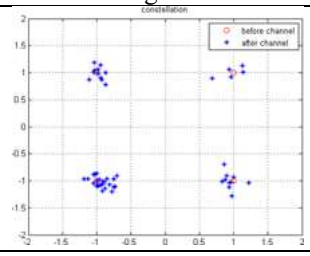

Figure.6. BER analysis of AWGN and Rayleigh channel

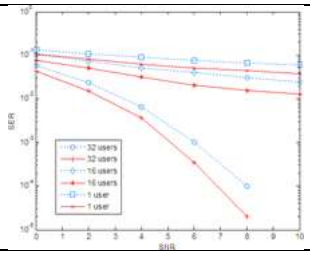

Figure.7. Performance analysis of 2×2 MIMO antenna with different users

REFERENCES

1. Hamdi,K. "Theoretical analysis of the orthogonality factor in WCDMA downlinks," *IEEE Transactions on Wireless Communications*, vol. 8, Nov. 2009, pp. 5394-5399.
2. Bauch, G "Differential modulation and cyclic delay diversity in orthogonal frequency-division multiplex," *IEEE Transactions on Communications*, vol. 54, May. 2006, pp. 798-801.
3. Borgmann, M and H. Bolcskei, "Noncoherent space-frequency coded MIMO-OFDM," *IEEE Journal on Selected Areas in Communications*, vol. 23, Sep. 2005, pp. 1799-1810.
4. Juntti, K. Hooli, K. Kiiskila, and J. Ylioinas, "Space-Time Equalizers for MIMO High Speed WCDMA Downlinks," *IEEE Transactions on Wireless Communications*, vol. 6, Jul. 2007, pp. 2582-2592.
5. Rohling, T. May, K. Bruninghaus, and R. Grunheid, "Broad-band OFDM radio transmission for multimedia applications," *Proceedings of the IEEE*, vol. 87, 1999, pp. 1778-1789.
6. lun Lin and C.-dir Chung, "Adaptive differentially coherent orthogonally multiplexed orthogonal phase modulation over flat fading channels," *IEEE Transactions on Wireless Communications*, vol. 8, Mar. 2009, pp. 1062-1066.
7. Lin, P.-H. Chiang, and H.-J. Li, "Performance of Noncoherent Maximum-Likelihood Sequence Detection for Differential OFDM Systems With Diversity Reception," *IEEE Transactions on Broadcasting*, vol. 52, Mar. 2006, pp. 62-70.
8. Chin and S.-G. Chen, "On the Analysis of Combined Synchronization Error Effects in OFDM Systems," *VTC Spring 2009 - IEEE 69th Vehicular Technology Conference*, Apr. 2009, pp. 1-5.
9. Marabissi, R. Fantacci, and S. Papini, "Robust Multiuser Interference Cancellation for OFDM Systems With Frequency Offset," *IEEE Transactions on Wireless Communications*, vol. 5, Nov. 2006, pp. 3068- 3076.