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Analysis of Inter Carrier Interference for Optimized Data Allocation

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ABSTRACT

Symmetric symbol repeat (SSR) intercarrier interference (ICI) self cancellation scheme has proved to be a simple and convenient technique to reduce ICI caused by frequency offsets. It utilizes data allocation and combining of (1,-1) on two symmetrically placed subcarriers to mitigate the effect of ICI. However, the data allocation factors (1,-1) are not an optimum. In this paper,an optimum data allocation and Combining scheme is proposed to maximize CIR performance for an estimated normalized frequency offset. But, this requires continuous CFO estimation and feedback circuitry. A sub-optimal scheme utilizing sub-optimal pair (so, so) is also proposed to completely eliminate the requirement of CFO estimation.Simulation results confirm the outperformance of the proposed optimal scheme over conventional SSR ICI self cancellation scheme. Sub-optimal scheme can be applied for the any range of and a sub optimum value can be calculated using proposed sub-optimal scheme. The CIR of SSR ICI self cancellation scheme using the proposed sub-optimal approach is also found to be better than conventional SSR ICI self cancellation.

1. INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) is being used for high data rate wireless applications. It is a multicarrier modulation technique which incorporates orthogonal subcarriers[1]. High Peak to Average Power ratio and Inter carrier Interference (ICI) are two main disadvantages of the OFDM systems. Tehcniques for OFDM frequency division multiplexing have been shown in [2]. In OFDM systems ICI occurs due to frequency offset in between the transmitter and receiver carrier frequencies or Doppler Effect. Many techniques have been developed to reduce the effect of ICI; ICI cancellation is a simple and convenient technique. ICI self cancellation scheme proposed by Zhao [3] utilizes data allocation and combining of (1,-1) on two adjacent subcarriers i.e. same data is modulated at the sub carriers using (1,-1) as data allocation and are combined at the receiver with weights 1 and -1. It is one of the most promising techniques to reduce ICI; however, its performance degrades at higher frequency offsets. Another technique known as conjugate cancellation had been proposed by Yeh, Chang and Hassibi [4]. In this scheme, OFDM symbol and its conjugate are multiplexed, transmitted and combined at the receiver to reduce the effect of ICI. However, this scheme shows a significant improvement in CIR at very low frequency offsets and its performance degrades as carrier frequency offset increases. At higher frequency offset >0.25 its CIR performance is worse than standard OFDM system. Extension to conjugate cancellation is Phase Rotated Conjugate Cancellation (PRCC) [5] in which an optimal value of phase is multiplied with the OFDM symbol and its conjugate signal to be transmitted on different path. The optimal value of the phase depends on the frequency offset and hence requires continuous carrier frequency offset (CFO) estimation and feedback circuitry, which increases the hardware complexity.

In recent years, direct conversion receiver has drawn a lot of attention due to its low power consumption and low implementation cost. However some mismatches in direct conversion receiver can seriously degrade the system performance, such as in-phase and quadrature-phase (I/Q) imbalance and carrier frequency offset (CFO). The I/Q imbalance is due to the amplitude and phase mismatches between the I and Q-branch of the local oscillator whereas the CFO is due to the mismatch of carrier frequency at the transmitter and receiver. It is known that the I/Q imbalance and CFO can cause a serious inter-carrier interference (ICI) in orthogonal frequency division multiplexing (OFDM) systems. As a result, the bit error rate (BER) has an error-flooring. In assuming that the channel frequency response is smooth, a frequency-domain estimation method has been proposed to jointly estimate the I/Q imbalance and channel frequency response. Recently, exploiting the fact that the size of the DFT matrix is usually larger than the channel length in OFDM systems, a time-domain method was proposed for the joint estimation of I/Q and channel response. Both the frequency-domain and time-domain methods need only one OFDM block for training and can achieve a good performance. For CFO estimation, a low The joint estimation of CFO and I/Q imbalance was investigated .The authors combined the techniques to jointly estimate the I/Q and CFO parameters using two repeated training blocks. The Cramer-Rao bound of CFO

Digital Communication Systems

A digital communication system is often divided into several functional units. The task of the source encoder is to represent the digital or analog information by bits in an efficient way. The bits are then fed into the channel encoder, which adds bits in a structured way to enable detection and correction of transmission errors. The bits from the encoder are grouped and transformed to certain symbols, or waveforms by the modulator and waveforms are mixed with a carrier to get a signal suitable to be transmitted through the channel. At the receiver the reverse function takes place. The received signals are demodulated and soft or hard values of the corresponding bits are passed to the decoder. The decoder analyzes the structure of received bit pattern and tries to detect or correct errors. Finally, the corrected bits are fed to the source decoder that is used to reconstruct the analog speech signal or digital data input. The main question is how to design certain parts of the modulator and demodulator to achieve efficient and robust transmission through a mobile wireless channel. The wireless channel has some properties that make the design especially challenging: it introduces time varying echoes and phase shifts as well as a time varying attenuation of the amplitude.

2. FUNDAMENTALS OF OFDM

In this chapter, the basic principles of OFDM systems are discussed based on a basic system model of OFDM modulation. In addition to this the problems that make the implementation difficult are discussed and analyzed.

Basic principles of OFDM systems

Introduction

OFDM is a multi channel modulating technique that makes use of Frequency Division Multiplexing (FDM) of orthogonal multi carriers being modulated by a low bit rate digital stream. In FDM, inter channel interference is diminished by the deterrence of the spectral overlapping of sub-carriers but it guides to an inadequate use of spectrum. To prevail over this obstacle OFDM uses orthogonal sub-carrier that helps an efficient use of the spectrum. · Emitter and receiver are efficiently implemented with IFFT/FFT · Throughput maximization · Effectiveness against channel distortion Multi-path delay spread tolerance Even though OFDM has numerous advantages it has some disadvantages on the quality of the analogue radio frequency front end of both transmitter and receiver:

· Sensitiveness to carrier frequency errors

· To maintain the orthogonality between subcarriers, the amplifiers need to be linear

· OFDM systems have high peak-to average ratio which may require large amplifier.

Generation of OFDM signals

To put in practice the OFDM transmission method, the message signal has to be digitally modulated. To maintain orthogonality between the sub carriers the carrier is split into lower frequency sub carriers.

Transmitter

Modulating schemes such as Quadrature amplitude modulation (QAM) (16QAM or 64QAM for example) or some form of phase shift keying (PSK) are used to modulate the message signal. Before passing to the IFFT block the modulated signal has to be converted to parallel signals. The IFFT operation will take place to form a single combined signal that can be transmitted. These combined signals are orthogonal subcarriers.

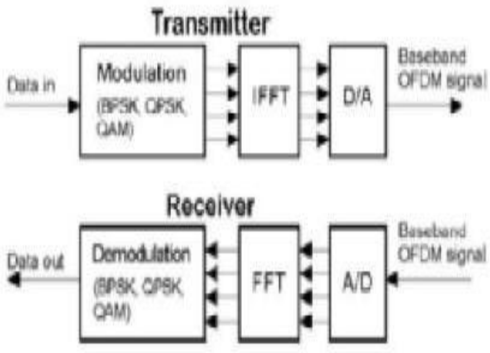

Fig1: An OFDM system in Frequency Domain

Guard period

When OFDM signals are transmitted multipath delay could affect the transmission. The inter symbol interference (ISI) caused by multipath propagation can be avoided by inserting guard interval between every OFDM symbol. The insertion of the guard period between transmitted symbols is vital if the signals in subcarriers are to hold on to the orthogonality during transmission process. The guard period allows multipath components from previous symbol to die out before information from the next OFDM symbol is recorded.

3. MIMO OFDM SYSTEMS

MIMO System

MIMO signaling is a groundbreaking development pioneered by Jack Winters of Bell Laboratories in his 1984 article [2]. Several different antenna configurations are used in defining space-time systems.

Basic Structure of MIMO System

There exist several communication transmission models as follows (see Fig.2):

1. Single-input-and-single-output (SISO) system: It is uses only one antenna both at the transmitter and receiver.
2. Single-input-and-multiple-output (SIMO) system:
It uses a single transmitting antenna and multiple receiving antennas [3].
3. Multiple-input-and-single-output (MISO) system:
It has multiple transmitting antennas and one receiving antenna.
4. Multiple-input-multiple-output (MIMO) system: It uses multiple antennas both for transmission and reception. Multiple transmitting and receiving antennas will achieve antenna diversity without reducing the spectral efficiency.

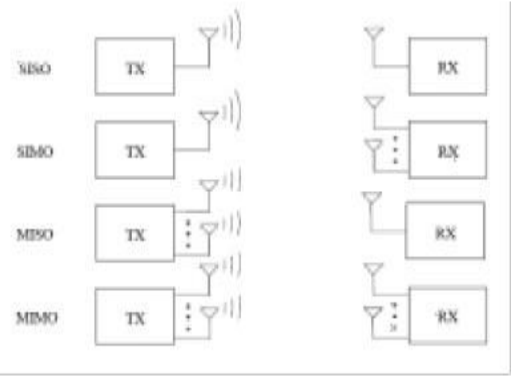

Fig2. Multi-transmitting and receiving antennas

MIMO-OFDM System

In high-speed wireless communication, combining MIMO and OFDM technology, OFDM can be applied to transform frequency-selective MIMO channel into parallel flat MIMO channel, reducing the complexity of the receiver, through multipath fading environment can also achieve high data rate robust transmission. Therefore, MIMO-OFDM systems obtain diversity gain and coding gain by space-time coding, at the same time, the OFDM system can be realized with simple structure. Therefore, MIMO-OFDM system has become a welcome proposal for 4G mobile communication systems.

Basic Structure of MIMO-OFDM System

At the transmitting end, a number of transmission antennas are used. An input data bit stream is supplied into space-time coding, then modulated by OFDM and finally fed to antennas for sending out (radiation). At the receiving end, in-coming signals are fed into a signal detector and processed before recovery of the original signal is made. Fig.3 shows the basic structure of a MIMO-OFDM system.

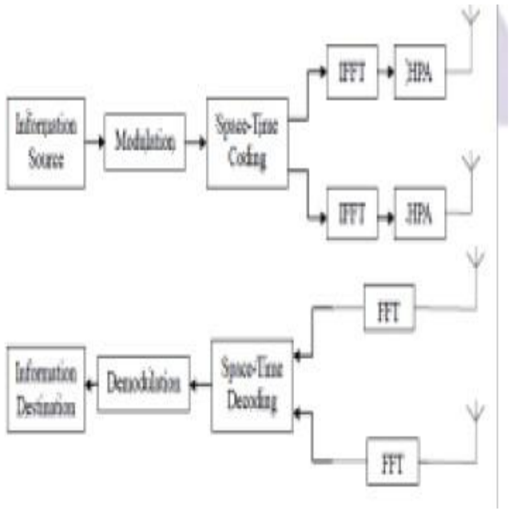

Figure3 Basic structure of MIMO-OFDM system.

Presently, many companies and research institutions have developed MIMO-OFDM experimental systems.
Airbust –production of Iospan Company that first used MIMO and OFDM technology in the physical layer at the same time for wireless communication systems.

CONCLUSIONS

The proposed scheme very well improves the CIR performance of the OFDM system without increasing hardware complexity. The proposed sub optimal scheme completely removes the requirement of CFO estimation. However, the proposed scheme is slightly less efficient than conventional SSR ICI self cancellation in terms of BER.

REFERENCES

[1]. Y.Wu and W. Y. Zou, “Orthogonal frequency division multiplexing: A multicarrier modualtion scheme”, IEEE Transaction on Consumer Electronics, vol. 41, no. 3,pp 392-399, Aug. 1995.

[2]. P.H.Moose, “A Technique for orthogonal frequency division multiple xing frequency offset correction,’’IEEE Trans. Commun., vol.42, pp 2908-2914, Oct. 1994.

[3]. Y. Zhao and S.G. Haggman, “Intercarrier Interference Self-Cancellation Scheme for OFDM Mobile Communication Systems ’’,IEEE Trans.Commun., vol. 49, no. 7, pp. 1185-1191, Jul. 2001.

[4]. H.-G. Yeh, Y.-K. Chang, and B. Hassibi, “A scheme for cancelling intercarrier interference using conjugate transmission in multicarrier communication systems," IEEE Trans. Wireless Communication., vol. 6, no. 1, pp. 3-7, Jan. 2007.

[5]. Chin-Liang Wang and Yu-Chih Huang, “Inter carrier Interference Cancellation Using General Phase Rotated Conjugate Transmission for OFDM Systems” IEEE Transactions on Communications, vol. 58, no. 3, pp. 812-819, March 2010.

[6]. K.Sathanantham , R.M.A.P.Rajatheva and Slimane Ben Slimane “Analysis of OFDM in the Presence of Frequency Offset and a Method to

Reduce Performance Degradation” Global Telecommunications Conference, 2000. GLOBECOM '00. IEEE,vol. 1,pp. 72-76, 2000.
[7]. Yu Fu and Chi Chung Ko, “A New ICI Self –Cancellation Scheme for OFDM Systems based on a Generalized Signal Mapper”, 5th
International Symposium on Wireless Personal Multimedia Communications, vol. 3, pp. 995-999, Oct. 2002.
[8]. J. H. Mathews, K. K. Fink, Numerical Methods using Matlab, 4th edition, Prentice-Hall Inc. , 2004
[9]. Olanrewaju B. Wojuola, Stanley H. Mneney, “Performance of even- and odd-degree Gold codes in a multi-user spread-spectrum system”
Wireless Communications, Vehicular Technology, Information Theory and Aerospace & Electronic Systems (VITAE), 2014 4th International
Conference, 23 October 2014.
[10]. Olanrewaju B. Wojuola, Stanley H. Mneney, Viranjay M. Srivastava, “CDMA in signal encryption and information security”