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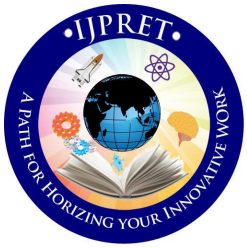

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SYNCRONIZATION METHOD FOR CARRIER FREQUENCY OFFSET IN OFDM

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Abstract

Orthogonal frequency division multiplexing is the modulation technique use in digital communication systems. OFDM is multicarrier system in which available spectrum divided into many narrow bands .Data is transmitted on these band parallelly It has been adopted in today's radio communications, in the Wi-Fi arena , DAB digital radio. In spite of having the large advantages, OFDM is very sensitive to the Carrier frequency offset (CFO) problem. Orthogonality defines as the peak of each signal coincides with minima of other signals. Carrier frequency offset which is the difference between the transmitter frequency and the receiver frequency, damages this orthogonality and reduces the systems performance. This paper discusses the effect of carrier frequency offset and its estimation method in OFDM system. Here we discuss the fractional frequency offset estimation method in the time domain and the integer frequency offset estimation method in frequency domain. Finally Carrier frequency offset can be estimated as the sum of fractional frequency offset estimation and the integer frequency offset estimation. This methods use a complex training signal, improves the frequency offset estimation range and accuracy.

INTRODUCTION

OFDM is the multipath Modulation system(MCM).It uses FFT Fast fourier transformer and IFFT inverse fourier transformer. In single carrier system signal representing each bit uses all of the available spectrum. Orthogonal frequency division multiplexing (OFDM) is an effective transmission scheme to combat multipath fading. The fading is frequency flat and there is no inter symbol interference in time domain.. It is a parallel transmission scheme. ,which divides available bandwidth into many narrow bands like ~2000-8000 for digital TV ~48 for Hiperlan 2.Data is transmitted in parallel on these bands. Data is transmitted in parallel on these bands the basic principal of OFDM is .there a mathematical relationship between the subcarriers .In OFDM ,each subcarriers has exactly an integer number of cycles in the FFT interval. The number of cycles between the adjacent subcarriers differs by exactly one.

Ofdm is very popular technique because most broadband systems are subject to multipath transmission. The conventional solution to multipath is an equalizer in the receiver side. But high data rates - equalizers are too complicated..Ofdm is the simple way of equalizer problem.

Main problem of OFDM is the synchronization in terms of frequency offset. OFDM is highly sensitivity to frequency offset errors which damages orthogonality among subcarriers. Various effect of OFDM is that it decrease the amplitude of each sampled value and introduction of intercarrierinterference(ICI).Therefore, Carrier frequency offset (CFO)estimation in OFDM systems is essential to improve communication system performance.

CFO can be estimated in two steps ,first find the integer CFO and then find the fractional CFO. Integer CFO Causes a cyclic shift of subcarriers and a phase change proportional to the OFDM symbol number. This needs to be corrected perfectly. Fractional CFO Attenuates the desired signal, adds phase, and causes an inter-carrier interference (ICI),reduces the signal to noise ratio (SNR),increases the bit error rate (BER).Many methods for carrier frequency offset has been developed so far.

II OFDM SYSTEM MODEL

Various operation s are performed in transmitter as shown in fig 1.

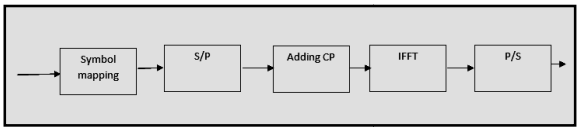


Fig (1) OFDM Transmitter

The mapping the information bits onto the signal plays a important role in determining the properties of the modulation. An OFDM signal is a sum of sub-carriers, each of which contains phase shift keyed (PSK) or(QAM) quadrature amplitude modulated signals.

After the signal generated at transmitter side it transmit through the channel .At receiver side serial to parallel conversion is done, as shown in fig2. In a conventional serial data system, the symbols are transmitted serially, the frequency spectrum of each data symbol allowed to occupy the entire available bandwidth. Several adjacent symbols may be completely distorted over frequency selective fading when the data rate is sufficient high. A small part of available bandwidth is normally occupied by the spectrum of an individual data element. As an entire channel bandwidth is divided into many narrow subbands, the frequency response is relatively flat over each individual subchannel. A parallel transmission system offers solution to this problem .

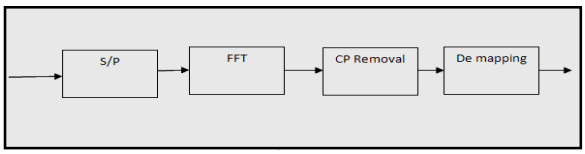
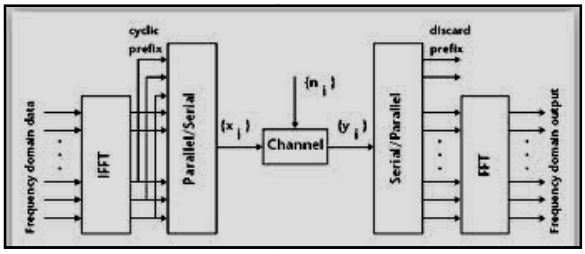


Fig (2)OFDM Receiver

OFDM system as shown in fig 3 has cyclic prefix added at transmitter side and removal of cyclic prefix at receiver side. For the purpose to eliminate the effect of ISI, the guard interval or cyclic prefix is used in OFDM systems to combat against multipath fading. IDFT and DFT units are used at transmitter and receiver side to reduce the complex calculation of modulation and demodulation.

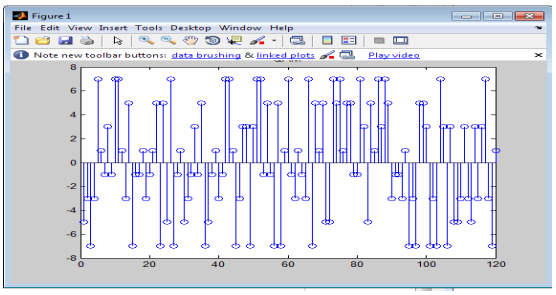


Fig(3)OFDM system

(i) OFDM SIGNAL GENERATION

Here we represent the OFDM system implemented by Inverse fast Fourier Transform (IFFT) and Fast Fourier Transform As shown in fig 1 and in fig 2. Here the data is transmitted in parallel that is N parallel streams .Now the parallel data is converted into serial data .Cyclic Prefix(CP) is added to avoid residual Inter symbol interference (ISI).Parallel data are used as inputs to an IFFT.IFFT output is the sum of signal samples. Modulation and multiplexing is done in one step by IFFT. At receiver side FFT then CP removal is performed. Finally conversion of digital to analog results in baseband signal.

OFDM Signal at receiver are as follows:



Fig(4) Result of OFDM signal at receiver

Due to Doppler shift [4]and instabilities at the transmitter and receiver oscillators carrier frequency offset(CFO) occurs in OFDM system. This carrier frequency offset causes degradation of the systems performance as it increase the noise level in the system.CFO also result in introduction of Inter Carrier Interference.

This paper discuss the carrier frequency offset estimation method to improve the system's performance.

III. RELATED WORK TO ESTIMATE CARRIER FREQUENCY OFFSET

An improved method to deal with both IFO(integer frequency offset) and FFO(fractional frequency offset) estimation problems is presented by T. M. Schmid [7]. A training sequence with two OFDM symbols are used. The fractional part ranged between $1/s - NT$ and $1/s\ NT$. The first symbol whose first half is identical to the second half is use to estimate Fractional frequency offset in time domain. Using differential information of the two symbols an auxiliary sequence is constructed. Then frequency-domain correlation is carried out to calculate IFO.

Other related work in OFDM system[4], to estimate frequency offset is use of cyclic prefix(CP). CP always exists in OFDM symbol and using CP can be simply designed to auto-correlation. Also auto-correlation is usable irrespective of data contents and modulation schemes. Accordingly using CP for auto-correlation is widely used to estimate frequency offset.

However this auto-correlation method has an undesirable defect. The defect is that the method cannot precisely estimate Doppler frequency.

In conventional method to estimate the carrier frequency offset, two repetitive training symbols are used and then compare of the phases between the successive identical symbols is a simple, useful technique, which was first proposed in 1994 by P.H.Moose.[3]. This method gives the simple correlation of two identical signals to find the Signal to Noise ratio (SNR) and Bit error ratio (BER).

In this method the phase variation between the two identical OFDM symbols is observed, at the receiver side the frequency offset can be estimated within the range of half a subcarrier spacing. Because each subcarrier is shifted in frequency by a constant amount of $2\pi\epsilon/N$, due to offset ,where ϵ is frequency offset and N are the samples. Here the acquisition range for Fractional frequency offset is limited due to correlation length N is equal to the subcarrier number. Solution to this is to use training sequences with smaller N . But that result in less estimation accuracy. The disadvantages of this method are it uses two symbol and estimation range is less than half subcarrier spacing .Other problem is of security since the repetitive structure may be used by undesired users.

IV CARRIER FREQUENCY OFFSET ESTIMATION METHOD

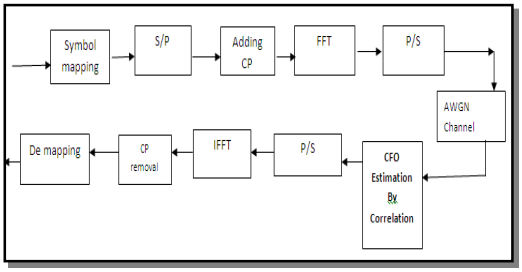
In this method carrier frequency offset estimation is done in two ways

1. Integer carrier frequency offset estimation.

2. Fractional frequency estimation.

Fractional frequency offset and the integer frequency offset both damages orthogonality among subcarriers. Estimating both frequency offset gives large

accuracy in calculation of total frequency offset. Both the steps are discussed here with some methods. The block diagram used in CFO Estimation.



Fig(5) CFO Estimation

1. Fractional carrier frequency offset estimation.

A complex training signal can be use to estimate offset frequency denoted as C .It is a periodic signal with length N, N is the number of carrier. Add some frequency offset and channel noise in the complex training signal.

Flow for fractional frequency Estimation is as follows:

C(n) represent the complex training signal, r is the received signal after adding offset frequency and channel noise .R is the correlation result of complex training signal and received signal. Finally frequency offset is to be calculated.

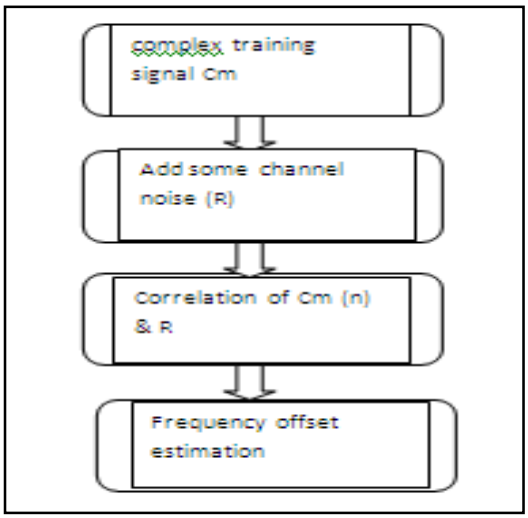
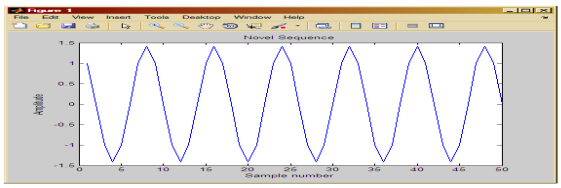
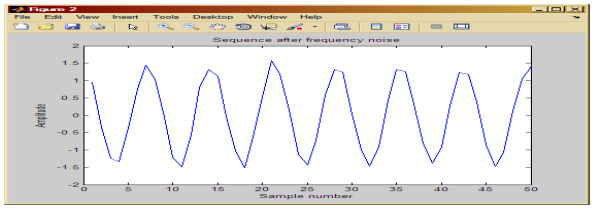


Fig (6) Flow of fraction frequency estimation

RESULTS



Fig(7) A complex training signal



Fig(8) A received signal after frequency offset

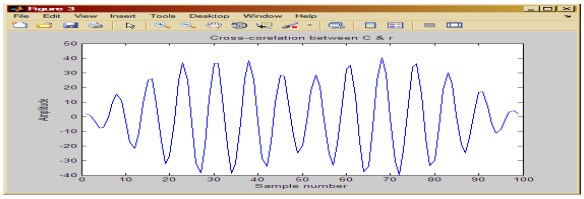


Fig (8) A cross correlation of complex signal &received signal.

Integer carrier frequency offset estimation

After FFT, use frequency domain pilot to estimate the integer frequency offset. If the fractional frequency can be corrected the only integer frequency offset has to calculate.The correction range is |m| < N/2. Total frequency offset can be estimated as the sum of fractional frequency & integer frequency.

V. CONCLUSIONS

In conventional method only integer frequency offset is estimated in frequency domain. Estimation range is limited. This method can effectively estimate course and fine frequency offset in OFDM system. It can effectively improve the frequency estimation accuracy. The frequency offset can estimate very closely with wide range which will improve the system performance to a large extent It provides a wide acquisition range for the carrier frequency offset with low complexity. Instead of using the training signals, the complex signal can reduce the overhead

REFERENCES

1. Tangdi Zhang, Caixiang Wang and XiaowenLi" Frequency Offset and Channel Estimation in OFDM Systems by BlindAdaptiveFilter" School of Communication and Information Engineering Chongqing University of Posts and Telecommunications Chongqing, China. IEEE 978-1-4244-9003-5/10/2010.

2. Min Ho Jin, Young Min Cho, Janghoon Yang, Dong Ku Kim, "Pilot aided carrier frequency offset estimation for OFDM systems," IEEE Signal Processing and Communication Systems, pp. 1–6, April 2009.

3. PH Moose," A technique for orthogonal frequency division multiplexing frequency offset correction," IEEE Trans. Commu. vol.42, no. 10, pp. 2908-2914, 1994.

4. "Doppler Frequency Offset Estimation in OFDM systems" Hyungu Hwang and

Hyoungjun Park Mobile Telecommunication research Division, ETRI.IEEE 2009.

5. Blind Adaptive Scheme for Joint Frequency Offset and Channel Estimation in OFDM system" Tangdi Zhang, Caixiang Wanand Xiaowen Li School of Communication and Information Engineering.2010 2nd International Conference on Signal Processing Systems.

6. An Efficient Algorithm for Joint Carrier Frequency Offset and Channel Estimation in IEEE 802.16 OFDM systems" Balamurali. N Telecommunications and Networking Group, Indian Institute of Technology, Madras

7. T. M. Schmidl and D. C. Cox, "Robust frequency and timing synchronization for OFDM," IEEE Trans. Commu., vol. 45, no. 12, pp. 1613-1621, 1997

8. Carrier Frequency Offset Estimation for OFDM Systems Using Null Subcarriers" Defeng (David) Huang, Member, IEEE, and Khaled Ben Letaief, Fellow, IEEE2006 IEEE 814 IEEE transaction on communications, vol. 54, no. 5, may 2006