International Journal of Scientific Research & Engineering Trends
Volume 3, Issue 2, Mar.-2017, ISSN (Online): 2395-566X

# Comparative Study on Pilot Tone based Approach for Channel Offset Estimation in OFDM Systems

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***Abstract* – The wireless system for communication uses the orthogonal frequency division multiplexing in these days. The rapid growth of high data rate transmission makes a need to improve the performance of a network. This can be made easy by using Orthogonal Frequency Division Multiplexing. OFDM is an approach in which the multicarrier transmission technique has been used for wireless communication. Here the high data rate has been use to transmit the data. This high data can be divided into various sequences of the data. However, OFDM is sensitive to the receiver synchronization errors such as carrier Channel offset (CCO) that causes inter carrier interference (ICI), and exacerbated by motion-induced Doppler shifts and local oscillator instability. This paper gives a bird eye over OFDM , channel and frequency offset estimation and their recent research .**

***Keywords* – OFDM, Inter Carrier Interference, Channel Estimation, Frequency Estimation, Data Driven Blind Estimation.**

## I. INTRODUCTION

The rapid growth of high data rate transmission makes a need to improve the performance of a network. This can be made easy by using Orthogonal Frequency Division Multiplexing. OFDM is a approach in which the multicarrier transmission technique have been used for wireless communication. Here the high data rate has been use to transmit the data. This high data can be divided into various sequences of the data. These sequences can be concurrently transmitted by the sub carriers. The IEEE 802.11a includes the OFDM as a standard due to its robustness under multipath fading conditions [1].

The history of OFDM say that it was first introduced in the 1950s. Initially the OFDM techniques were used in defense or military systems around in 1960s. The 1980s was the time where high-speed modems, digital mobile communications, high-density recording etc were in used. So OFDM was involved in improving the performance of these systems. Finally in the 1990s, OFDM was drastically user in the mobile communications. Here it was use for the wideband as a FM channel. DSL, ADSL, VDSL, DAB were the implementation area of OFDM.

Today's mobile communications aims at providing voice and low data rate services, such as GSM, IS-136, and JDC etc. However they cannot efficiently meet the growing demand for mobile services such as multimedia broadband services. Because multimedia communication has a rather large demand on bandwidth and quality of service (QoS) compared to what is available today, alternate ways to transmit large bit stream through the channel with sufficient QoS guaranties are sought. Orthogonal Frequency Division Multiplexing (OFDM) is an efficient modulation scheme proposed as a solution to this problem. OFDM is a multiple carrier modulation technique. It distributes data over a large number of sub-carriers spaced apart at precise frequencies, such that they are orthogonal to one another.

OFDM has been successfully applied to a wide variety of digital communication applications over the past several years including digital TV broadcasting, digital audio broadcasting, Asynchronous Digital Subscriber Line (ADSL) modems and wireless networking worldwide. Its application in mobile communication is more complex especially because of the mobility of the mobile user; thus more exact symbol timing and frequency-offset control must be used to ensure that sub-carriers remain orthogonal.

However, the difference between the frequency of the oscillator in the transmitter and the receiver causes frequency offset which if not estimated and compensated for could ruin the orthogonality of the sub-carriers thereby causing large bit errors in the received signal. Also the distortion of the signals while traveling through the channel and the movement of the mobility user causes synchronisation problems.

## II. DIGITAL MOBILE COMMUNICATION

Digital Communication has been one of the most needful technologies for the human society in the present scenario. It plays an important role in order to build the social, to educating the youth, and to express needs. Initially the communication technologies were introduces as separate networks. As these technologies grew a mobile communication has come into existence in a different branch of communication system. As the time passes the mobile communication has been divided in different generations, depending on the services provided. Fist generation systems include analog frequency division multiple access, such as NMT and advanced mobile phone services (AMPS) [2]. The second generation of digital mobile communication systems composed, such as the division of time of arrival of the multi-world system based on mobile communications (GSM) The availability of these systems mainly voice communications but also data communication is limited to less than the speed of transmission. Finally the third generation of mobile communication began operations on October 1, 2002 in Japan. Digital communication system [2,3]most of the time divided into many small functional units, as shown in Figure 1. Task Scheduler source is a representation of bits of digital or analog information efficiently. The bits are fed in the channel coder that adds a bit structured in a way to enable the detection and correction of transmission errors.

## III. Frequency Offset Estimation Taxonomy

The frequency offset estimation [28, 29] is a challenging task due to its complexity. So there are two basic approaches by which the frequency estimation in OFDM is possible. In contrast to conventional Frequency Division Multiplexing, the spectral overlapping among subcarriers are allowed in OFDM since orthogonality will ensure the subcarrier separation at the receiver, providing better spectral efficiency and the use of steep band pass filter was eliminated. Superior requirement data rate wireless systems in future communications, and important information capacity of MIMO systems theory gains, durability and suitability of OFDM to transmit data at high speed to highlight the great potential of MIMO OFDM systems. However, MIMO OFDM inherits the high sensitivity of OFDM frequency offset error. Therefore, a high degree of precision frequency synchronization is a major problem in OFDM MIMO. Estimate the growing number of channels in MIMO systems offers another challenge in implementing MIMO OFDM systems

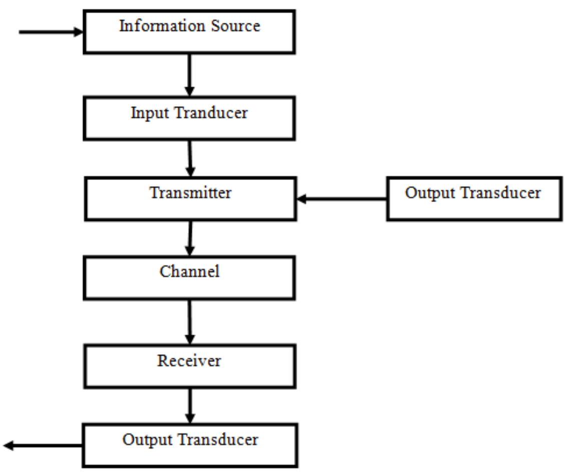


**Fig.1. Simple Communication systems**

In the latest development of the orthogonal frequency division communication system (OFDM), and can distract system performance frequency Ofsets (OA) that can demolish orthogonality subcariers, and therefore lead to a number of shortcomings in the received signal In this work estimation algorithm based on the frequency threshold OFSETv new systems of orthogonal frequency division (OFDM) is proposed. Through detailed analysis and simulation in AWGN Chanel, Ben has shown that the proposed method shows the performance of the god, ie contrast is low offers error on behalf of SNR (signal to noise ratio) increases.

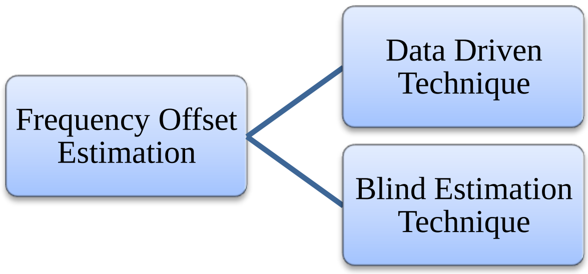


Fig.2. Classification Of Frequency Offset

## IV. Data Driven Technique

The effects of frequency offset [4] will appear on the performance of OFDM systems. The frequency of more than 0.4% of the spacing frequency shifts resulting system performance is unacceptable. The estimated This technique is based on the data and the rate of compensation of repeating the same data maximum likelihood framework. OFDM signal is given at the reception.

$$r_n = (1/N) \sum_{k=-K}^{K} X_k H_k e^{2\pi jn\,(k+\varepsilon)/N}$$

Where n=0,1,2…..N-1
Where X = Transmitted Signal,
H= Transfer Function over carrier

$$\varepsilon = Frequency\ Offset$$

There is need to calculate the difference of data frames in order to get the frequency offset

## V. Blind Estimation

This technique is blind and focus [5] on identifying the frequency and the time offset. The timing of compensation is another important issue for OFDM systems. This technique is frequency shift signals blind analysis and estimated at the receiver. QPSK signal, if there is any compensation and no noise, just the QPSK receiver signal is received. If there is a shift in the frequency channel constellation is rotated according to the phase displacement.

## VI. Channel Estimation

Channel estimation [6] is the process of characterizing or analysing the effect of the physical medium on the input sequence (transmitted data). The basic channel block diagram of channel estimation procedure is shown in

Figure 3. The primary importance of channel estimation is that it allows the receiver to take into account the effect of channel on the transmitted signal, secondly channel estimation is essential for removing ISI, noise rejection techniques etc. In wideband mobile communications systems, a dynamic estimation of the channel is essential before the demodulation of OFDM signals because the radio channel is time-varying and frequency selective. There are two main types of channel estimation methods, namely blind methods and training sequence methods. In blind methods, mathematical or statistical properties of transmitted data are used. This makes the method extremely computationally intensive and thus hard to implement on real time systems. In training sequence methods or non-blind methods, the transmitted data and training sequences known to the receiver are embedded into the frame and sent through the channel.

Generally, the length of the training sequence [7] is twice or thrice the order of the channel and it is computationally simple compared to blind methods. One of the popular methods is to make use of the training bits (pilot symbols) known to the receiver. The transmitter periodically, inserts the symbol from which the receiver derives its amplitude and phase reference. Although training sequence method is much less computationally intensive than the blind methods, the channel bandwidth is not put into effective use by the transmission of training sequences.

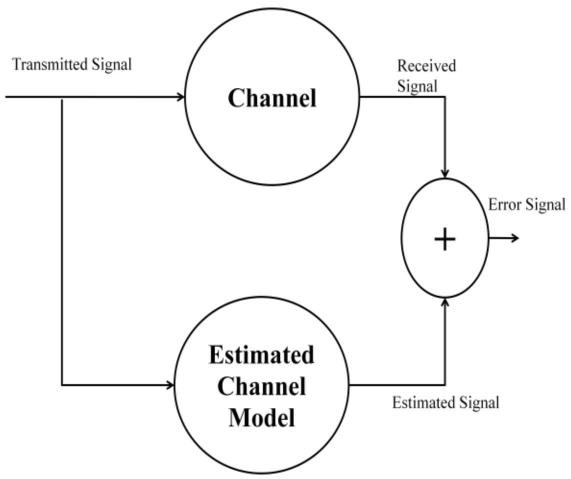


Fig.3. Channel Estimation Sequence

The sensitivity of OFDM systems [6,7] for frequency compensation, compared to a vehicle are the main return systems. In general, the frequency shifts of the difference between the nominal and real definition pace of output frequency. In OFDM the carrier frequency, which is uncertain due to the difference in frequency of the local oscillators in the transmitter and receiver, and it leads to a change in the frequency domain. This is also known as frequency shift processing. It can also be caused by the Doppler shift in the channel. Demodulation signal with an offset in the vehicle can cause a large8bit error rate and performance can degrade synchronized symbol rate. It is therefore important to estimate the frequency offset and reduce / eliminate the influence

## VII. Current Scenario

**Ying-Che et al [8]** has proposed an algorithm to estimate the offset (CFO) in multi-cell networks OFDM carrier frequency. In 3GPP LTE single-cellular systems, and CFO can be estimated by applying the algorithm Schmidl. However, it is the act of a multi-cell interference (MCI) in multi-cellular environments. Accordingly, MCI estimation accuracy degrades. One solution to ease the MCI can be through training sequence properly design. In this paper, They propose a way to create a training sequence with a good orthogonal in time and frequency domain.

Therefore, MCI can be suppressed effectively and CFO estimation algorithms developed for environments and single user or a single cell can be modified slightly and its application in multi-cellular environments. **Donghua Zhang et al [9]** have proposed a frequency offset estimation method in three stages using the framework of training specially designed for the cable channel in OFDM systems. By leveraging the preambles training framework sequence PN, and reaches the rough estimate frequency offset by two initial steps. To estimate the frequency shift end, we use the method of the fourth degree to eliminate the influence of the change on the part of the data load training. By configuring the estimate in three steps with precision, the proposed method allows to obtain a wide range of frequency offset estimated up to half the bandwidth of the system, and has a high degree of estimation accuracy. **Patel, V.U.; et al [10]** has shown that the Sensitivity offset (CFO) carrier frequency is a known issue in Orthogonal Frequency Division Multiplexing (OFDM). Recent wireless standards, which provides that the OFDM modulation technique, preferably used with the adaptive modulation and coding (AMC). Things carrier interference (ICI) created by the CFO, disrupting choose to modify and channel coding rate in the CMA. The study of the impact of CFO on OFDM with AMC in this work. **Linglong Dai [11]** proposes a new signal frequency to improve performance TDS-OFDM system of channels through time-varying quickly time structure. Each TDS-OFDM symbol depends on the time in the field and shot a sample training sequence (TS) and frequency domain pilots grouped as information on the frequency of training time. The adoption of scalable orthogonal sequence (MOS) with a perfect autocorrelation property as TS, while each pilot group that has only one central pilot nonzero surrounded by many drivers from scratch. Interview time-frequency channel estimation is used to estimate the time delay TS track and field field frequency drivers together to achieve the path estimation gains, and thus accurate monitoring of wireless channel rapidly changing over time can be achieved. **Simsir, S, et al [12]** has proposed a channel estimation on the basis of neural network trained by the Levenberg-Marquardt algorithm for estimating channel coefficients in Orthogonal Frequency Division Multiplexing systems overlap section (IDMA-OFDM) Multiple Access. And using experimental channel estimation algorithms such as traditional basic minimum mean square error (MMSE) and squares (LS) also make a comparison with the way we proposed using rates error (BER) and the squared error (MSE) Average graphics.

## VIII. CONCLUSION

OFDM is an emerging field in the world of wireless communication. In this way there are lots of challenges in front of us. This dissertation gives a brief description on the OFDM and their issues. It also explore problem faced in the frequency offset estimation over OFDM. Existing Gaussian particle filtering approach for carrier frequency offset estimation suffer from particle impoverishment problem that statistically select higher weight particles for frequency estimation. This selection is inappropriate for performance enhancement.

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