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Review of Channel Estimation over Orthogonal Frequency Division Multiplexing in Communication System

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Abstract
Orthogonal frequency division multiplexing is a approach in which modulation and multiplexing both has been used. It is a very sensitive to frequency offsets that is use to demolish the Orthogonality among number of subcarriers. The OFDM provides the inter-carrier interference and it is also capable of degrading the error performance. The channel estimation plays an important role to make OFDM more efficient. This paper is a general review over the OFDM and the channel estimation. This paper also through some light on pilot carrier.

Keywords: OFDM, Channel Estimation, Pilot Carrier.

1. Introduction

Digital communication system [1, 2] most of the time divided into many small functional units, as shown in Figure 1.1. 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. The bit encryption group and are converted specific codes or the wavelength of the wavelength modulation and mixed with the car to get suitable for transmission through the channel signal. The recipient is performed inverse function. Wu demodulated signals received and are passed to soft or hard values of the corresponding bit to decode. Decoder analyzes the pattern contained a little structure and try to detect or correct errors. Finally, the correct decoding bit source used for the reconstruction of the speech signal or analog input digital data feed.

OFDM is very effective for communication over channels with frequency selective fading (different frequency components of the signal experience different fading). It is very difficult to handle frequency selective fading in the receiver, in which case, the design of the receiver is hugely complex. Instead of trying to mitigate frequency selective fading as a whole (which occurs when a huge bandwidth is allocated for the data transmission over a frequency selective fading channel), OFDM mitigates the problem by converting the entire frequency selective fading channel into small flat fading channels (as seen by the individual subcarriers). Flat fading is easier to combat (compared to frequency selective fading) by employing simple error correction and equalization schemes.

OFDM is being widely applied in wireless communications systems due to its high rate transmission capability with high bandwidth efficiency and its robustness with regard to multi-path fading and delay. WiFi or 802.11 and HIPRLAN/2 uses the OFDM.OFDM has also been available for wireless broadband access standards such as IEEE Std WiMAX and as the core technique for the fourth-generation (4G) wireless mobile communications. The use of differential phase-shift keying (DPSK) in OFDM systems avoids need to track a time varying channel; however, it limits the number of bits per symbol and results in a 3 dB loss in signal-to-noise ratio (SNR). Coherent modulation allows arbitrary signal constellations, but efficient channel estimation strategies are required for coherent detection and decoding.

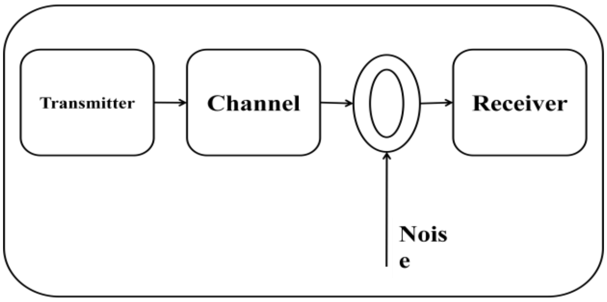

Figure 1 Simple Communication system

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There are two main problems in designing channel estimators for wireless OFDM systems. The first problem is the arrangement of pilot information, where pilot means the reference signal used by both transmitters and receivers. The second problem is the design of an estimator with both low complexity and good channel tracking ability. The two problems are interconnected. In general, the fading channel of OFDM systems can be viewed as a two dimensional signal like time and frequency. The optimal channel estimator in terms of mean-square error is based on 2D Wiener filter interpolation. Unfortunately, such a 2D estimator structure is too complex for practical implementation. The combination of high data rates and low bit error rates in OFDM systems necessitates the use of estimators that have both low complexity and high accuracy, where the two constraints work against each other and a good trade-off is needed. The one-dimensional channel estimations are usually adopted in OFDM systems to accomplish the trade-off between complexity and accuracy. The two basic 1D channel estimations are block-type pilot channel estimation and comb-type pilot channel estimation, in which the pilots are inserted in the frequency direction and in the time direction, respectively. The estimations for the block-type pilot arrangement can be based on least square (LS), minimum mean-square error (MMSE), and modified MMSE. The estimations for the comb-type pilot arrangement includes the LS estimator with 1D interpolation, the maximum likelihood (ML) estimator, and the parametric channel modeling-based (PCMB) estimator. Other channel estimation strategies are also available, such as the estimators based on simplified 2D interpolations, the estimators based on iterative filtering and decoding, estimators for the OFDM systems with multiple transmit-and-receive antennas, and so on.

2. Orthogonal Frequency Division Multiplexing

The rapid growth of data transfer at a high rate makes the need to improve network performance. This can be as easy using Orthogonal Frequency Division Multiplexing. OFDM is the approach that has been the use of transfer of the technology of wireless multicarrier communications. Here was a high use of data for a data transfer rate. These may be high division data in an order different from data. These channels can be transmitted simultaneously by the Sub airlines. It includes the IEEE 802.11a OFDM standards as a criterion for sustainability in the fading light of the multiplicity of the conditions.

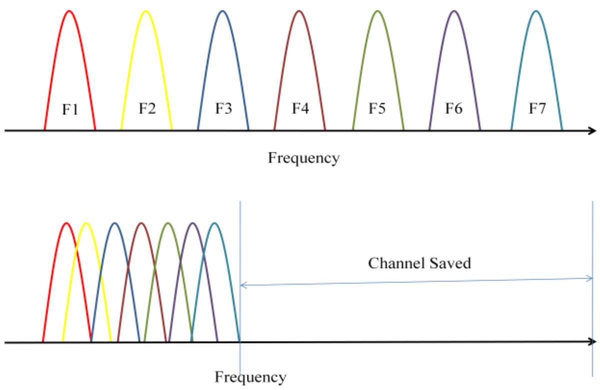

Figure 2 Channel Saving using OFDM

Figure 1 show the basic approach to save the channel using OFDM. As in figure there are 7 different frequencies which can be send to the end user with some different approach known as OFDM. As shown in figure 1 the same channel can be use for some more different frequencies. Figure 2 is responsible to explain the basic block diagram of OFDM transmitter and receiver. There are basic five steps need to follow in OFDM transmission and receive. Here Input will pass through the serial to parallel converter for inverse discreet foriour transmission for cyclic prefix. Parallel to serial converter has been used for transmission.

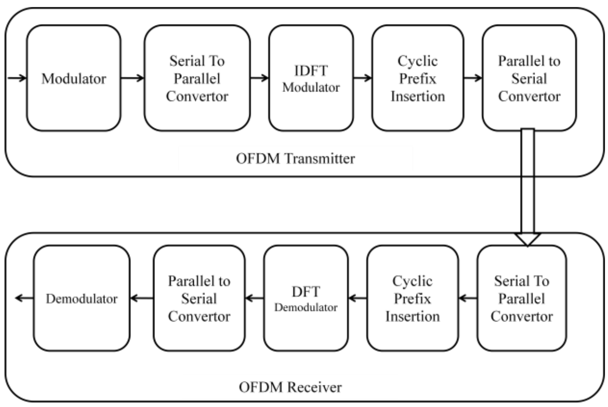

Figure 3 OFDM transmitter and Receiver

The two basic 1D channel estimations in OFDM systems are illustrated in Figure 4 (a,b). The block-type pilot channel estimation, is developed under the assumption of slow fading channel, and it is performed by inserting pilot tones into all subcarriers of OFDM symbols within a specific period. The other one, comb-type pilot channel estimation, is introduced to satisfy the need for equalizing when the channel changes even from one OFDM block to the subsequent one. It is thus performed by inserting pilot tones into certain subcarriers of each OFDM symbol, where the interpolation is needed to estimate the conditions of data subcarriers. The strategies of these two basic types are analyzed in the next sections.

Applications Multiplexing Orthogonal Frequency Division (OFDM) wireless and mobile communications are currently under study. Although several large multi-carrier transmission defects (such as high peak and average rate stringent requirements of carrier) Sync, its advantages in ease severe effects of frequency selective fading without a complicated equation is very attractive features. In order to obtain high spectral efficiencies required by wireless data systems in the future, the use of multiple levels is not constant with adjustable amplitude. This means that the need able to track changes in the channel fading coherent receivers.

3. Limitations of OFDM

There are some obstacles in using OFDM which are as given:

- OFDM signal exhibits very high Peak to Average Power Ratio (PAPR).
- Very sensitive to frequency errors (Tx. & Rx. offset)
- Intercarrier Interference (ICI) between the subcarriers
- It is more sensitive to carrier frequency offset and drift than single carrier systems are due to leakage of the DFT.
- PAPR or Peak to average power ratio get increases.
- In order to transmit High power transmitter there is a need to perform linearization.
- Low noise receiver amplifiers need large dynamic range.
- Capacity and power loss due to guard interval.
- Bandwidth and power loss due to the guard interval can be significant.

4. Channel Estimation Methods

Channel estimation methods based on the pilot insertion can be divided into two classical pilot models, which are block-type and comb-type model. The first model refers to that the pilots are inserted into all the subcarriers of one OFDM symbol with a certain period. The block-type can be adopted for slowly fading channel, that is, the channel can be considered as stationary within a certain period of OFDM symbols. Nevertheless, the second model refers to that the pilots are positioned at some definite subcarriers in each OFDM symbol.

Channel estimation has a extensive and rich history in the communications systems and one carrier. In these systems, usually modeled as CIR varying FIR unknown candidate in a timely manner, and should be estimated coefficients. Many approaches can be applied to individual channel carrier systems for multiple carrier systems appreciated. However, the unique properties of the transfer of multi-carrier achieve additional views allow for the development of new methods for the direct estimation multi-carrier systems. In existing systems OFDM, and modulated data on Orthogonal Frequency companies. For the detection of coherent data transferred, should these responses are estimated frequency sub-channel and removed from the frequency samples. As is the case in a single carrier systems, can channel time domain formed as a FIR filter, where it can estimate the delays and transactions from time domain received samples, which are then transformed into the frequency domain to obtain and CFR. Instead, the radio channel can also be estimated in the frequency domain using the well-known (or disclosure) sub-frequency domain data channel. Instead of estimating FIR coefficients can be estimated faucet CFR.

The classification of channel estimation has been done in two type. The basic category is of comb type and the block type.

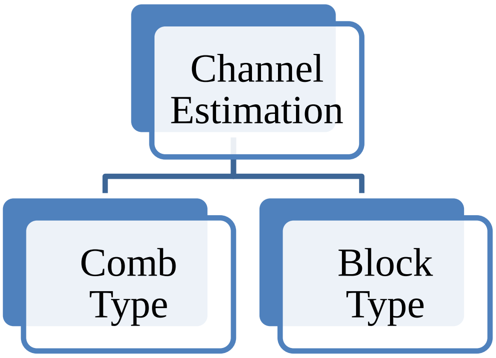

Figure 4 Classification of Channel Estimation

Comb Type: The type comb from the pilot channel estimation is performed by introducing the pilot tones at certain subcarriers of each OFDM symbol where there is a need for interpolation to estimate the history subcarriers circumstances. Compared to the mass of the experimental type, because the character is inserted into the pilot subcarriers with the same interval, is a display comb-type pilot channel estimation to address the need to change the channel equalizer when even a single one OFDM block later.

Figure below shows the Comb Type channel estimation. In such approach the Part of the sub-carriers are always reserved as pilot for each symbol.

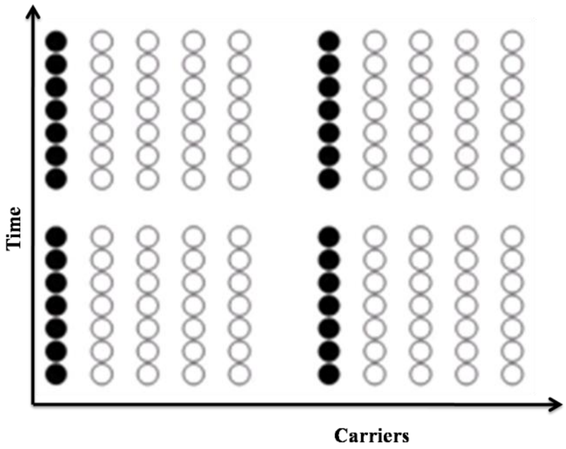

Figure 5(a) Comb Type

Block Type: The block type of pilot channel estimation, is performed by introducing the pilot tones in all subcarriers of OFDM symbols with a specific period of time. Experimental codes, covering all frequencies, can be effective against frequency selective fading, but more sensitive to the effect of fast fading channel. Therefore, development of a block under the experimental course slow fading channel. For the same number of pilots, and decided by changing the speed performance of the channel, known as the coherent time. The figure below shown above is a Block Type channel estimation. Here all sub-carriers is used as pilot in a specific period.

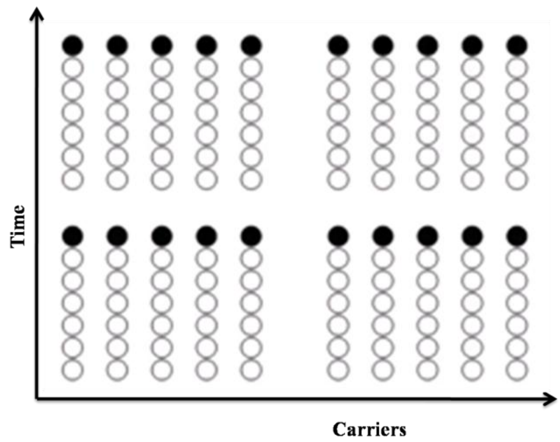

Figure 5(b) Block Type

5. Related Work

The orthogonal frequency division multiplexing (OFDM) [15] scheme is primarily employed in modern and future communication systems such as LTE due to its various advantages; particularly, inserted prefix code prevents the traditional communication nuisance of inter-symbol interference. On the other hand, it has unavoidable inter-carrier interference (ICI) problem caused by carrier frequency offset (CFO) because the symbol timing synchronization may not be perfect at the receiver. Therefore, more accurate symbol timing acquisition and offset estimation are desired in OFDM systems.

In this paper [16], the author has propose based on the OFDM transmission scheme called OFDM time-frequency differently based training (TFT-OFDM), where each TFT-OFDM training symbol has information in both time and frequency domains. Unlike TDS-OFDM or CP-OFDM channel estimation which depends only on either the time interval TS or pilot frequency domain, time and frequency estimate of a common channel used for TFT-OFDM time domain TS without interference cancellation to get just the path delay information channel, while path coefficients estimated using pilot frequency domain statements

In this paper [17], studied a new aspect to the problem of carrier frequency offset (CFO) estimation (FH) orthogonal frequency division multiplexing frequency hopping system (OFDM). Unlike traditional nonhopped OFDM system, the FH-OFDM system is important to check the accuracy should be performed before switching frequency CFO estimation can happen with adequate performance. Evaluating the accuracy of the transformation frequency by synchronizing movement between the offset frequency (FHO) and the phase shift between frequency hopping (FO) between the received signal and the signal produced by the movement of the receiver between the local frequency synthesizer. The system uses the same objective of wideband (UWB) in order to achieve very high data rate of 1.6 Gbit / s. Is an autocorrelation performance algorithms based on the selected multi-fading channel under PHO FHO and simulation, and the results are compared with the performance of ideal frequency conversion and binding corresponding analytical Cramer-Rao.

The proposed orthogonal frequency division multiplexing (OFDM) [18] as a promising technology for high-speed optical communications. In this paper, we provide an analysis of the performance of the direct detection optical OFDM (DDO-OFDM), coherent optical OFDM (CO-OFDM) and self-optical coherent (OCS-OFDM). First, we revisit the theoretical basis for OFDM visual differences between the three systems. Then, the phase noise are compared (PN) the effects of different laser line widths and the effect of light energy received (ROP) in system performance of these optical OFDM systems. In this article, we provide the first comparative analysis of the list optical OFDM three systems, it is a simulation analysis using VPI transmission Maker ™ V8.5. Finally, the best optical OFDM system and high performance display as a trend in the future.

Domain synchronous time division multiplexing orthogonal frequency (TDS-OFDM) [19] has a greater spectrum efficiency and rapid synchronization of classic OFDM cyclic prefix (CP-OFDM). However, TDS-OFDM suffers from performance degradation, especially in light of strongly fading channels with large delay. To solve these problems, the authors of OFDM plan proposes energy efficient is called orthogonal frequency division multiplexing (TFT-OFDM) based on the joint time-frequency channel estimation under pressure (CS) in the frequency sensor training time. Guard interval (GI) in the proposed plan force can be reduced to achieve greater energy efficiency, which is not possible for CP-OFDM. This method is used for the first time in pseudo-noise sequence time domain to obtain the support of the partial channel information and then some pilots are used to estimate the channel frequency domain exactly. The simulation results show that the TFT-OFDM with CS can achieve energy efficiency is much higher than the classical CP-OFDM, and is superior to conventional OFDM schemes both fixed and mobile environments. Moreover, the expansion of the canal with a long delay, the TFT-OFDM scheme with CS can demonstrate the durability and performance is much better than traditional OFDM schemes. Thus, the TFT-OFDM system can use the same length GI to cover the biggest issue and therefore more to achieve greater energy efficiency.

6. Conclusion

Orthogonal Frequency Division Multiplexing has proved (OFDM) suitable for high data rate modulation technique in time dispersive channels. There are some specific requirements in the design of wireless OFDM systems OFDM is an emerging field in the world of wireless communication. In this way there are lots of challenges are also in front of us. This paper is a brief description on the OFDM and their issues. These are lots of problem have to face in the channel offset estimation.

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