Channel Estimation by using Pseudo-Pilot in OFDM System

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Abstract:- *The aim of this paper is to share novel paradigm of channel estimation for orthogonal frequency division multiplexing (OFDM) systems. OFDM is used to improve spectral efficiency and spatial diversity in wireless communications systems. This paper provides a review of channel estimation techniques (blind and pilot-aided) and its performance on data-aided channel. After comparison with known techniques the blind channel estimation perform better as compare to pilot aided system. In addition pilot cost overhead in wireless communications system. By evaluate pseudo-pilot concept, overhead cost overcome which offer identical performances as conventional pilot system.*

Keywords- *Blind channel estimation, channel estimation, intersymbol, interference, LS, MMSE, OFDM, orthogonality, pseudo-pilot.*

I. INTRODUCTION

Content-based OFDM is a multi-carrier technique which has very wide area in wireless communication system. In OFDM, each channel has many sub-channels having different frequencies which are further found in parallel transmission at lower rate. Now a days, OFDM is found in very innovative and universal multimedia broadcast system like Digital Video and Audio Broadcasting i.e. (DVB), (DAB) , it is further found in many different wireless application like High end Wireless local area network (HYPERLAN), Wireless Fidelity (WiFi) and Worldwide Interoperability for Microwave Access (WiMAX) etc. OFDM is one of the special case of multi carrier transmission. The place where data stream transmit over numerous lower rate subcarrier is a single data stream. So OFDM is mentioning here as whether modulation technique or multiplexing technique. The basic technique found in OFDM is Frequency Division Multiplexing (FDM). In FDM there are many channels, which are separated by a guard band of frequency to reduce adjacent channel interference. These channels of FDM are employed for the mapping of information of different streams. While OFDM is vary from FDM in following ways the following:

- Multiple carriers are found in former to carry the information data streams.
- Most of the subcarriers are orthogonal to each besides later one.
- A guard time is included with each symbol to reduce the full time delay spread and intersymbol interferences.

In OFDM, signals having multiple-information over a common channel allows perfect transmission with orthogonality. Due to the orthogonality between the two signal, detection without interference and it ensure that two co-existing signal are independent in specific time interval and they will never communicate with each other. The two periodic signals are reported to be orthogonal when their integral product over one period is add up to zero and they will have integer quantity of cycles in fundamental period. In communication system, signal is distorted due to the inter-symbol interference (ISI). In the signal transmission ISI effects symbol interferes with its succeeding symbol and this may makes the communication less reliable. ISI is normally caused as a multipath propagation problem and non-linear frequency response blur the successive symbols together. As a result of intersymbol interference, errors are occurred at the output of receiver. Hence, to combat this problem transmitter and receiver filters should be produced in such a way that minimum error rate could be obtained. In OFDM system, by making all subcarrier orthogonal to each other we eliminate the ISI.

OFDM signals may be optimized using various components such as for example coding [1], adaptive loading [2] and portioning [1]. Due to criticism of modeling and estimation, all of the optimization depends upon the channel. In OFDM, channel estimation use the pilot which needed for the synchronization and find the state of channel when signal transmitted. Channel estimation used for the suppression of interference and to ensure the transmitted signal detection at receiver side same as the transmitter side. Due to the accurate channel estimation, OFDM is able to use the coherent detection technique for 3dB SNR gain over differential detection. There are different way to achieve the channel estimation but main two methods are: by using pilot symbols and Blind manner.

In time or frequency domain of pilot symbol channel estimation method we enables estimate the channel state by using the pilot position, pilot are added either training sequence pilot or carrier pilot. In other side channel response could be estimate by interpolation. Pilot scheme can boost the complexity of transmitters and receivers which may have prior familiarity with pilot arrangement. Both transmitters and receivers to process the available payload capacity, rather then reduce the capacity it required an extra processing to implement the pilot scheme. As a result of more rapidly variation (time or frequency) in the channel denser pilot are required.

Blind channel estimation which used for OFDM is deterministic or statistical. For mobile radio channels statistical blind channel estimation is not suitable. In the transmission of signal due to slow convergence it is not fair for burst transmission. There are many statistical channel estimation like correlation methods [3], cumulant fitting [4] and iterative blind channel [5]. For OFDM system blind deterministic approach can be used which is based on maximum likelihood (ML) [6].

This method can provide a route for every individual symbol of OFDM for channel estimation. In this algorithm complexity is the one of the maximized issue introduced and their required the additional pilot to complete a recovered phase. To cope with this problem of complexity a modification is applied in maximum likelihood method described in [7]. In maximum likelihood method to resolve the phase ambiguity in the adjacent subcarriers different modulation schemes applied. Compared of both the techniques, later you've high complexity, which will increase since the constellation order increase. However, payload capacity is reduced as the numbers of pilots are increased.

As the pilots are used for channel estimation, by comparing pilot sequence at the receiver side we find the channel state. So as the pilots are transmitted with the payload symbol with time domain it cost and count as the overhead in communication system [18]. Overhead problem, due to pilot can be overcome by performing blind channel estimation. Payload symbol at the receiver in blind approach has some advantages in their statistical properties. To overcome this overhead problem pseudo-pilot is the one of the effective approach which has the identical performances as that of the conventional pilot approach.

II. LITERATURE SURVEY

In this section we describe the previous work and their methodology of OFDM system with different types of channel estimation technique with pilot and pseudo pilot approach. There are several researchers proposed OFDM system with different types of feature extraction technique and simulate the proposed work. There are different studies based on OFDM is given below:

M. K. Ozdmir, et.al [8] in this paper, to propose a technique for multimedia based wireless communication system that required high data rate. In his work approach which used for wireless system is multi-carrier transmission called as OFDM. It is the one of the multiplexing technique which used for transmission of multiple signals with same channel. He also explained channel estimation is associated with OFDM system and to find the channel state it is the most appropriate method. In this article, techniques used for channel estimation for OFDM system is examined. In addition he also discussed advantages, drawbacks, and analyzed of these estimation techniques with each other. It show that channel estimation can affected by three basic blocks: by using pilot pattern, estimation method, detection of signal part. In many system each part have provide the better performance with additional resources.

Vineetha Mathai et al (2013), [10] in this paper, propose a technique for 4G wireless communication systems where high bit-rate transmission, using extremely expensive bandwidth. As the bandwidth is expensive, large number of user with in small allocated bandwidth met with lots of challenges. In their work OFDM technique is explained which a multicarrier technique. This technique is much sufficient to handle the multipath fading environment which effected data streams with intersymbol interference (ISI) at top speed of data streams. To avoid the ISI effect in top speed data streams, cyclic prefix is added. Channel estimation concept used in OFDM where estimation technique used in receiver side to analyzing the channel. In their article, two main methods are explained for channel estimation 1) blind channel estimation and 2) pilot-based channel estimation. In blind estimation to find channel state a wide range of data required and the convergence rate is tremendously slow. So for real time channel estimation it goes. In block pilot estimation transmitted signal is famous at receiver end. There are two mode which you can find i.e. block and comb pilot mode. In block mode, all subcarrier in OFDM system are specialized in the known pilots. In the comb pilot mode only a few subcarriers are useful for estimation process.

T. Hwang, et.al [13] proposed the technique to remove the intersymbol interference ISI due to the delay spread in wireless channel. Inside their work they present a survey to overcome the ISI effect in OFDM system which adopted by various wireless standards. They address the basic OFDM system model and modulation technique. They present the

technique, how to boost the OFDM system performance for wireless communication by using concept of channel estimation and signal detection. Peak to average power ratio reduction (PAPR), and multiple input multiple output (MIMO) techniques also discussed regarding the performance of system. His work, describe application, advantages, frequency and time offset estimation for current standards.

Z.Yang and X. Wang et.al in 2005 [11] provide a review of channel estimation techniques used in OFDM System in which channel current state find to calculate the effect of noise like fading, multipath effect, ISI etc. in transmitted signal. His work review pilot based channel estimation technique in orthogonal frequency-division multiplexing (OFDM) system. Pilot based estimation have different algorithm to find channel estimation i.e. block type, comb type etc. On the basis of simplicity, computational cost and suitability these algorithm are compared. In this comparing various techniques we come to an conclusion that between both blind and pilot aided system, the blind channel estimation is more efficient for simulated channels. It conclude blind channel estimation is more robust than pilot aided system.

Ye (Geoffrey) Li [9] in propose study, a new simple technique for system having multiple transmit antennas. To find channel state for multiple antennas a Channel Estimation technique for OFDM Systems examined. The proposed channel estimation system improved the communication quality and capacity. They present two techniques optimum training sequence design and simplified channel estimation to improve performance and reduce the complexity of channel. The optimal training sequences are considers as best estimation in term of performance. The channel estimation reduces the complexity at the expense of a negligible performance degradation.

Akash Kumar Shrivas (2015), [17] The aim of this article is up channel estimation correctness in OFDM system. Channel state information is required for signal detection at receiver. The accuracy of signal affects the performance of system. They present, for lots of reliable communication it is essential to enhance the channel estimation. OFDM has been wide used nowadays due to its high rate of knowledge. In OFDM system , pilot were inserted among subcarrier in transmitter side with equal spaced distance by using sampling theory and for initial channel estimation Least square (LS) and minimum mean square error (MMSE) technique was chosen. In OFDM frequency selective channels used which have acceptable performance due to these reasons it was widely chosen in the field of study. In OFDM system , pilot were inserted among subcarrier in transmitter side with equal spaced distance by using sampling theory and for initial channel estimation Least square (LS) and minimum mean square error (MMSE) technique was chosen.

Zachaeus K. Adeyemo et al (2016), [15] In wireless communications many techniques used to reach high data rates but channel estimation is one of the most popular to get high data rate and low bit error. In communication system we transmitted multiple signal from a single transmitter and received multiple signal at single receiver for the signal transmission. This system is generally known as multiple-input and multiple-output Orthogonal Frequency Division Multiplexing (MIMO-OFDM). When signal travel through channel signal effect due to channel properties causes the received signal to be distorted. To find the channel properties with which it effect the signal is called as channel estimation where state of channel find using different techniques. There are different channel estimation techniques which use pilot to find the channel state for example Least Square Error (LSE), Minimum Mean Square Error (MMSE) and Best Linear Unbiased Estimation Algorithm (BLUE). In this paper, performances of Constant Modulus Algorithm (CMA) and MMSE are evaluated and all technique is conducted at SNR of 5dB, 10dB, 15dB. In their work they evaluate the Mean Square Error (MSE) and simulation using MATLAB. Simulation result conclude CMA has small converges as compared to MMSE and also gives lower error. Therefore, the analysis shows the substantial decrease in computational intricacy and can be utilized by wireless design

M. Imani, et.al. [14] present a new method for channel estimation based on a combination of pilots and pseudo pilots in OFDM system. In his work the history of research and development on OFDM is reviewed and also performance and implementation are examined. Analysis is given allow the choice of important elements for meeting the constraints of the mandatory applications. In line with the channel amount of pilot signals to insert is decided and correspondingly appended to the information signal, thus by varying the amount of pilots based upon the channel environment, it improves the channel estimation and reduces the amount of pilots. He also proposed a pseudo-pilot algorithm without increasing the pilot density in fast-varying channels. In his work they used some pseudo pilots instead of eliminated pilots and also present two methods for determining of pseudo pilot values.

A. Lozan, et.al. [16] in this paper the pilot aided system for wireless fading channel which shows optimization of the pilot overhead in the system. The dependence of overhead on system parameters studied for faded channel. The study of system parameters interested to calculate fading rate and the

SNR. The elaboration of fading rate is about to no fading point during the transmission to find the pilot overhead. In the paper, spectral efficiency also examined with respect to a reference system with CSI and block fading model in terms of pilot-based spectral efficiency. In their work they evaluate for multiple antennas based system, only normalized Doppler frequency multiplied for transmission and overhead optimization for multi-antenna systems is identical as single antenna systems.

Yi Ma, et.al. [12] present the new concept of pseudo pilot for channel estimation which is offers a simple and effectual approach. The basic concept is to transmitted number of pseudo random symbol (PRS), generated by bank of interleavers at the transmitter side. Output of the interleavers selected by a selector which match one of the PRS. Selected PRS already known at receiver side and thus know as pseudo-pilots. These PRS symbol then used for the purpose of channel estimation. In estimation technique where pilot used for channel estimation and synchronization, replaced with pseudo-pilot symbol. It has been resulted that pseudo-pilot-assisted systems can offer the same performance as pilot-assisted systems with reduced (or even zero) pilot overhead.

III. CONCLUSION AND FUTURE WORK

In this paper, the various channel estimation techniques for OFDM are studied. By comparing various techniques we come to an conclusion that the blind channel estimation is more efficient as compare to pilot aided system. The blind technique has more optimum than pilot, while the sensitivity of former is less than later one but technique also capable to operate for the data which have very worse error performance. The main purpose of this proposes work is to improve the overhead problem due to pilot in communication system. The study shows pilots are used in channel estimation and also for synchronization. In OFDM system pilot cost overhead in wireless communication. To overcome overhead a new concept introduced called as pseudo pilot, which resultant same as the conventional pilot system. In future work pseudo-pilot system can be developing with the hybrid optimization algorithm to achieve better simulation accuracy of channel estimation in OFDM system.

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