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Review for LS and LMMSE Channel Estimator Algorithm in MIMO OFDM

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Abstract

In Communication system MIMO system plays an important role it gives high performance as it is a MIMO system we are using antennas in both the transmitter and receiver side. In this paper studies and implementation of the hybrid channel estimation algorithm in MIMO OFDM..In today's world high speed is an important factor to be taken care in wireless communication systems. This is because high speed is required for access of video, images and many others multimedia operation .One way to achieve high data rate is OFDM. It is a technique where data is transmitted is parallel and the data are orthogonal to each other , hence results in high data rate in wireless transmissions as large number of data is transmitted at same time. OFDM may be combining with multiple transmitter and receiver antenna so which results in the MMO OFDM. It has the capability to enhance the data rate transmission and robustness against multipath fading . In this paper we are going to propose the hybrid channel estimation algorithm in MIMO OFDM .In communication systems MIMO OFDM plays a major role .In this a 2 by 2 MIMO system is developed and cyclic prefix length is inserted in each symbol and a guard band interval is provided so that the data do not interfere each other . Here we are using channel estimation algorithms LS , LS modified , LMMSE and hybriding all of these algorithm and result is compared with respect to BER vs SNR .

Keywords: MULTIPLE INPUT MULTIPLE OUTPUT (MIMO), ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING(OFDM) , LINEAR SQUARE ESTIMATOR(LS) , LINEAR MINIMUM MEAN SQUARE ERROR ESTIMATOR(LMMSE) , Channel esimation.

INTRODUCTION

Over the last few decades, due to the increase in demand for high speed data and distributed network access in mobile communications, there has been research is going in the field of wireless communication. The goal of the wireless communication is to give the high quality wireless multimedia services, and so the high data rate communication must be transmitted reliably. For higher data rate, more bandwidth is required . OFDM has high spectrum efficiency. One of the advantages of OFDM system is to convert the frequency selective channels to several flat sub channels.[2]

In OFDM transmission, the problem of the inter symbol interference is avoided by the addition of cyclic prefix . The combination of MIMO and OFDM is a strong candidate for the wireless communication systems.

MIMO technology is one of the major attracting techniques in wireless communication. It offers significant increase in data throughput and coverage without additional bandwidth or transmitted power . It also provide high spectral efficiency and link reliability .because of these properties, MIMO is an important part of the modern wireless communication standards such as IEEE 802.11n ,4G,3GPPLTE, WiMAX and HSPA+. In Mobile communication systems prior to transmit the information bits. At the receiving end the information bits are received accurately, if the channel characteristics are known. The channel may vary instantaneously because of propagating medium , which leads to the signal degradation . The channel state information (CSI) provides the known channel properties for a wireless link. CSI estimated at the receiver fed back to the transmitter If it is not estimated accurately at the receiver , leads to the system degradation. It can be estimated by using different channel estimation algorithm. This estimation can be done with a set of well known transmitted bits and corresponding received samples. This paper describes the fundamentals of MIMO OFDM systems and study of various channel estimation techniques and their performance. [5]

LITERATURE REVIEW

In the paper [1] reported it has studied the performance of L1 regularized turbo channel estimation algorithm in broadband MIMO wireless channels. it is designed by Yasuhiro Takano and Tad Matusumoto titled "L1 LS and L2 MMSE – Based Hybrid Channel Estimation for Isolated Wireless Connections" and according to this paper they proposed a new algorithm which is hybrid of L1 regularized least square (LS) and L2 MMSE channel estimation techniques .the hybrid algorithm proposed in this paper solves the tracking error problem completely. Therefore , the

receiver with the proposed algorithm achieves a significant BER gain over the l2 MB technique in the PB-VA scenario, while obtaining the BER performance bound asymptotically in the VA-VA scenario .it is noted here that the computational complexity order required for the hybrid algorithm is equivalent to that of the l2 MB if the number of the maximum iteration of the AAD algorithm is set at 1. simulation results shows that the receiver with the proposed algorithm algorithm achieves a significant BER gain over that of the L2 MB technique in the intermittent TX scenarios .

The paper [2] it is designed by Kunjesh s.Patel and prof Hitesh L. Desaithe main purpose of this paper is to study the performance of two linear channel estimator for LTE down link system. they proposed the enhancement the performance of LS and LMMSE estimation technique for LTE downlink system under the effect of channel length .the cyclic prefix inserted at the beginning of each OFDM symbol length , simulation results shows for the 2 by 2 system .here in this QPSK and QAM modulation technique is involved in the case if CP length is equal to or longer than the channel length than the ISI and ICI are completely suppressed and it shows ,the LMMSE performs better than LS estimator but at the cost of complexity because it depends on the channel and noise statistics .in the other case , when cyclic prefix length is shorter than the channel length it shows that LMMSE provides better performance only for low SNR values and begins to lose its performance only for low SNR values and begins to lose it performance in terms of BER and MSE, LS estimator seems to better than LMMSE for this range of SNR values.

In 2015 [3] a paper designed by Yoojinchoi, Jung Hyun Bae and Jungwon Lee they proposed a novel method of reducing the complexity of a pilot based a 2dimensional linear minimum mean square error channel estimation technique for OFDM systems .according to the simulations results they compared 2D LMMSE channel estimation with 1D+1D approximation. They consider channel estimation using demodulated reference signaling 3Gpp LTE. In LTE 14consecutive OFDM symbol makes one sub frame and 12 subcarriers within one sub frame makes one resource block. resource blocks are basically the unit of resource allocation .DMRS is a user specific pilot signal that is embedded only in the RB located to the user For simulation they perform channel estimation by RB. after descrambling and dispreading the received DMRS they observed six DMRS per RB three per each of two OFDM symbols . they also compared the channel estimation MSE normalized by the channel power channel for 2D LMMSE and its 1D+1D approximation in the EVA that is extended vehicular A channel model with the maximum Doppler shift of 30 hz. so from this they proposed the low complexity method of 2DLMMSE shows no performance degradation whereas the 1D+1D approximate have some loss they provide the number of multiplications required for the DMRS-based channel estimation in one RB. They are having k=12 , L=14 ,P=6 and n=2.the number of multiplications of 2D LMMSE decreases more than one half by using low complexity algorithm. in this paper basically they proposed a low complexity implementation method of pilot-based 2D LMMSE channel implementation scheme .they showed that the 2D LMMSE scheme can be coupled into the following three components a. pilot denoising b. frequency-domain processing and c. time-domain interpolation .the 2D LMMSE can be implemented in low complexity by processing these three components separately .the scheme which is proposed in the paper it reduces the computational complexity is compared to the one shot of 2D l shot LMMSE without loosing its optimality. the technique in this paper achieves the optimal LMMSE performance while comparing to the suboptimal 1D+1D approximation .In the following paper the channel interpolation is performed in two steps along the frequency domain first and then in time domain and then by taking advantage of this separation they reduce the complexity of 2D LMMSE considerably while still achieving the performance of it.

In 2013 [4]a paper designed by Hevan Patel ,Vijay K . Patel, Dr.D.J.Shah according to them the performance of LS and LMMSE channel estimation is compared for LTE downlink system. The channel estimation algorithm like Least square and Linear Minimum Square Error .for the simulation process they take the first case when cyclic prefix is greater than channel length than the ISI and ICI will not be present and from the result it is cleared that the LMMSE performs better than LS and they performed the simulation results in terms of BER and MSE. Similarly in the second case when the cyclic prefix is shorter than the channel length so the presence of ISI and ICI is noted .from the results it shows that the channel length increases than the cyclic performance lowers in terms of BER. And from the results it shows that LMMSE gives better performance only for the low value of SNR. As SNR increases , LMMSE performance degrades as compared to LS .To overcome the effect of ICI and ISI, cyclic prefix is inserted at the beginning of each OFDM system when cyclic prefix is shorter than channel length, LMMSE performs better for low value of SNR .as SNR increases, LMMSE performance is degraded and LS shows better performance.

In 2014 [5] it is designed by P.Venkateshwarlu , R.Nagendra in this the various channel estimation algorithm in orthogonal frequency division multiplexing has been studied. performance of the SIMO-OFDM and MIMO-OFDM system performance is evaluated in terms of the BER and MSE for various SNR values were generated. The performance of the single input multiple output OFDM is evaluated using BER and MSE for different values of SNR. Similarly for the multiple input and multiple output the system performance is also evaluated .again they

compared BER vs. SNR and MSE vs. SNR .The performance analysis shows that the proposed method has better performance when SNR increase and from the above it is concluded that MSE values are almost same for LS and MMSE for both the SIMO-OFDM and MIMO –OFDM case. The proposed method is when compared to LS and MMSE estimation algorithms the following results has made. And from the BER curves it is find that the proposed algorithm performance is superior to other technique..and from the proposed method that has good performance when compared to the LS and MMSE technique in both the method.

The paper [6] which is designed by Li Guo-min ,Liao Gui sheng an improved pilot pattern is proposed there are basically two conclusions are drawn here in the first conclusion it is observed that the double symbol scheme is better than the single symbol scheme its because the number of pilots of the double symbol scheme is four times that of single symbol scheme ,the interpolation is unnecessary and can be avoided . now the second observation which is drawn here the trade off scheme does not need interpolation and it is better than the single symbol scheme .the number of pilot is just half of that of the double symbol. the trade off method is worst than the double symbol scheme .basically here in this paper there is a study of channel estimation in terms of MIMO-OFDM based on the STBC algorithm there is a comparison is done between the double symbol scheme and single symbol scheme . an improved pilot scheme is proposed here and this algorithm is more effective in approaching some performance and overhead tradeoffs. The performance of the channel estimation can be improved by combining the optimal pilot scheme and the best criterion of estimation.

In paper [7]which is designed by Wenwen Liu and Xiolin Li .in this paper they studied LS and LMMSE algorithm .to improve the performance of the system they proposed a kind of improved LMMSE algorithm with a low complexity and better performance .based on the Jacobi iterative algorithm they solved linear equations the improved LMMSE algorithm optimizes the traditional LMMSE algorithm .It shows that the improved LMMSE algorithm has the best performance whereas the performance of the LS is not good .here in this paper it is complexity of these algorithm has also studied according to this the number of pilots is taken as N and the complexity of multiplication and addition in the improved LMMSE is N^2 and the complexity of the traditional LMMSE algorithm is N^3 so from this it is shown that the complexity of improved LMMSE is lower than the traditional LMMSE algorithm. The storage space is reduced in hardware implementation and the performance is greatly reduced.

In this reported it has studied the performance of LS and LMMSE estimator it is designed by Sweta. M. Patil and prof A.N. Jadhav and the paper titled “Channel Estimation using LS and MMSE Estimator”. Now here according to this paper it focuses on the comparison of the performance of the channel estimation algorithm in terms of bit error rate ,symbol error rate and mean square error. Here in this they used the BPSK modulation technique. When the performance of LS and MMSE is both done with respect to BER that is bit error rate .it is shown that for low SNR values noise effect is higher than the approximate effect .now here it is concluded that as the value of SNR increases the difference between BER by LS and MMSE methods also increases. And the second comparison of SER performance for these two algorithms were also done the MMSE estimator assumes a prior knowledge of noise variance and channel variance .from this it is assumed that the performance of MMSE estimator is better than LS estimator .Its complexity is more for LS estimator. Its complexity is large to the LS estimator .and for high SNR LS estimate is simple and adequate. so basically this paper highlights the channel estimation technique based on pilot aided block type training symbols using LS and MMSE algorithms .

In this paper which is designed by Shraddha Patel ,Vijay K. Patel ,Dr D J Shah .this paper focuses on the channel estimation technique in OFDM system. the performance of LS and LMMSE channel estimation technique under the channel length effect was studied .when the CP is longer than the channel length .the LMMSE gives better performance than LS but at its cost of complexity. in other case where CP is shorter than the channel length. LMMSE gives better performance than the LS .A proposed hybrid LS and LMMSE channel estimation technique and it is robust to the channel length effect .In this hybrid when CP is equal to or longer than the channel length .the hybrid LS -LMMSE algorithm will apply directly to the LMMSE channel estimation technique. On the other hand when CP is shorter than the channel length ,the hybrid algorithm will depend upon the received SNR value. When the SNR value which is received is low ,this algorithm will apply LMMSE channel estimation technique and when SNR value is high then the hybrid algorithm is switched to LS estimation . they studied the two cases in the first case when the cyclic prefix is longer than the channel length. Here in this the hybrid LS and LMMSE estimation will be applied directly. here in this the simulator shows that the LMMSE gives better result than LS but at the cost of complexity. in the second case when cyclic prefix is shorter than the channel length .simulation results shows that the hybrid LS and LMMSE performs better than LMMSE estimator specially for high SNR values . In this paper they compare the simulation results for both the hybrid and non hybrid system. In this paper the hybrid technique applies LMMSE estimator for low SNR values. whereas for the high SNR values the proposed technique applies for LS estimator. In the paper [8]which is designed by Mei Li and Xiang Wang .now here in this paper it has been

studied the channel estimation algorithm of LS is studied. They use the QR decomposition in LS, that is the QRD-LS .now here in this there is a direct computation of LS involves a matrix inversion which is highly complex .they use a QR decomposition avoid explicit inversion and it is more robust. QR decomposition is an orthogonal matrix triangularization technique that reduces full rank matrix into a simpler form. QRD-LS algorithm is robust than LS algorithm .these two algorithms are having the similar performance and their results were also coming same .and there is no matrix inversion in QRD –LS algorithm so that it can simplify the compositionality.

PROPOSED WORK

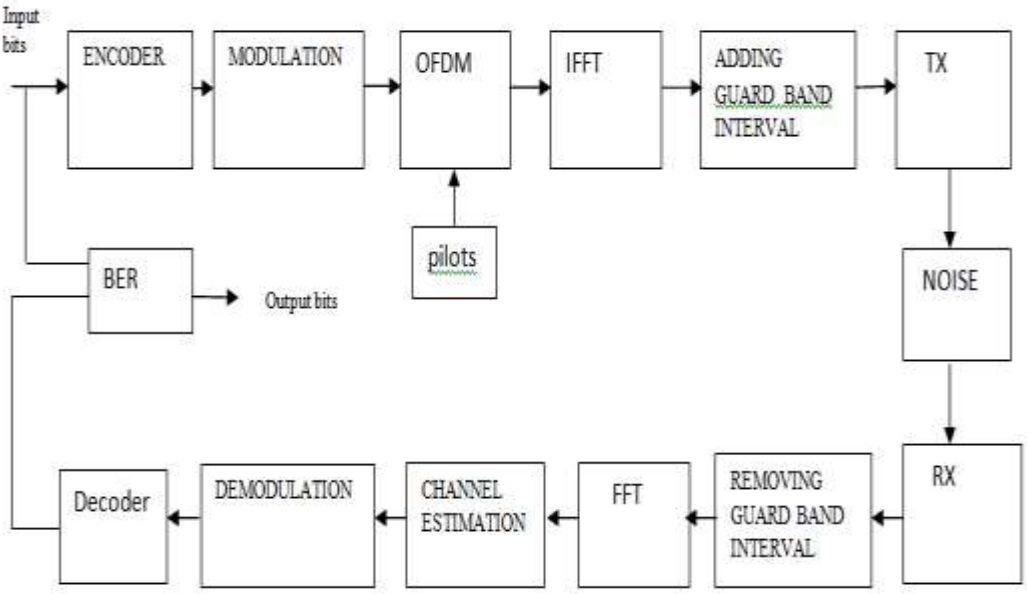

Fig1. Proposed block diagram

In this method first we are going to initialize the parameters as the proposed model is for MIMO OFDM system . at the transmitter side input bits are sent to encoder , it is used for setting code rate and also used for the security purpose for the data which we have sent

After this the data is sent to the modulation block which is used sending the information bits where information message are sent to the blocks from this the data is sent to the OFDM bock The basic principle of OFDM is to split high rate data stream into number of lower rate streams that are transmitted simultaneously over a number of subcarriers here in this the pilot is inserted basically this pilots are the unwanted symbols which are used for separating the data which we have sent and this is observed at the receiver side what effect has taken place due to noise on these symbols.

Now the data which we have sent is send to the next block which is IFFT block that is inverse of fourier transform which is used for transforming its domain from frequency to the time domain after tgis the data is transferred to the next block that is to the adding guard band interval .

Guard band interval are used to ensure that the distinct transmission do not interfere with one another in other means which is aused for avoiding the interference between the two data the purpose of the guard band interval is to introduce immunity to propogation delay, echoes and reflection to which digitally data is normally sensitive. Afterwards from the transmitter antenna the data is sent to the receiver antenna which will receive the data which we have sent in between this the noise is added which is additive Gaussian noise here ends the transmitter side and the receiver section starts from here.

Now the at the receiver side the reverse process of transmitter happens. Receiver antenna receives the data from the transmitter antenna and now the removal of guard band interval will be done now comes the FFT block now it converts a signal from its original domain (tome or space) in frequency domain. FFT is widely used for many applications in engineering, science, mathematics. after transforming our data to the original domain now the transformed data is sent to the channel estimator which is used for estimating the channel where we are using LS , LMMSE and LS modified. now the data is demodulated that is basically the inverse of modulation from this the data

is sent to the decoder where data is decoded which we have sent and after this the data which we get from the decoder is sent to the BER bock where both the data that is the input data which we have sent is compared with the data which we are receiving from the decoder side and the data is compared with respect to SNR and we get the desired output.

CONCLUSION

In this paper we have studied the LS and LMMSE channel estimation algorithm in MIMO-OFDM has studied and we concluded that the MIMO OFDM has the capability of transmitting information at high data rate without increasing the transmitting power. The performance of any system can be improved by estimating the channel parameters effectively.

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