A Review on Modified Leaky Least Mean Square Algorithm for Channel Estimation in Noisy Environment Using MIMO-OFDM System

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Abstract: **Orthogonal Frequency Division Multiplexing (OFDM) is sure to be implemented in future broadcasting instead Wireless Local Area Network (WLAN) systems robustness in transmitting a high data rate. The performance is calculated in terms of Bit Error Rate (BER) and the Signal to Noise Ratio (i.e.SNR). Differential m-array phase shift keying modulation technique such as differential quadrature phase shift keying in additive white Gaussian noise channel and multilevel technique in quadrature amplitude modulation in flat Rayleigh channel have been implemented in the proposed MIMO-OFDMsystem.MIMO with OFDM can provide truly efficient and ISI rectified communication. A simple adaptive least mean square (LMS) type channel estimation is experienced through some modification of FIR Wiener filtering. A condition which guarantees the convergence of the algorithm and the mean square error (MSE) values are derived. The performance of these channel estimation a technique in real time validates the analysis when compared to that of simulated channel estimation techniques. The objective of this paper is to reduce the BER and improve the SNR, BPSK and QPSK modulations are used for analysis purposes.**

Keywords:MIMO-OFDM system, channel estimation, modified leaky least mean square, Channel Estimation, BPSK and QPSK modulations.

I. INTRODUCTION

OFDM is a technique of multi carrier transmission in which data is transmitted on a set of orthogonally free sub carriers. (OFDM) has the by potential to achieve huge increase in the capacity and link reliability. High spectrum efficiency is provided because of the fact that in this full spectrum is shared all the OFDM sub carriers that are orthogonal to each other.

The bold objective of this paper is to present an results for channel estimation & BER estimation against different challenges of wireless communication system. A differentiation is made between the existint estimation technique that will show the advantages and disadvantages of each one. The capacity of the MIMO system can be improved by a factor which is approximately equal to minimum number of antennas employed at the transmitter and receiver. It is necessary to notice that the spectrum efficiency benifits of OFDM are mainly achieved at an operation point of relative high SNR. OFDM is a technique of Multi Carrier Transmission system where a single data stream is transmitted over a various number of subcarriers. OFDM is simply defined as a type of multi-carrier modulation where the carrier spacing is carefully selected so that every sub carrier is orthogonal to the another sub carriers.

II. WORKING

A. Multiple Input Multiple Output (MIMO)

MIMO system for wireless communication, a number of transmitting and receiving antennas are spatially arranged in such a way that the maximumSystem capacity is achieved. The bandwidth is efficiently utilized resulting in an increased channel capacity in a MIMO system. In the case of MIMO system capacity increase and BERreduces. Channel capacity is defined as the maximum rate at which data can be transmitted with small error probability [5]. FFT and IFFT operations are used inOFDM due to which the oscillators are not required at the transmitter and receiver side. The capacity of the MIMOsystem can be improved by a factor equal to minimumNumber of antennas employed at the transmitterand receiver. The system offer diversity gains based on the degree at which the multiple data replicas are to be faded independently which represents the variation in SNR at the output of diversity combiner as evaluated to single branch diversity by the face of certain probability level. The MIMO OFDM system model based on pilot based channel estimation is depicted in Fig. 1

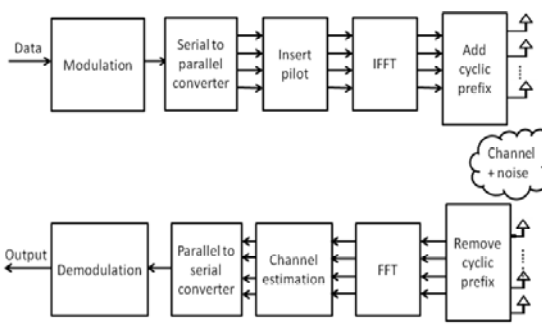

Fig. 1. MIMO-OFDM system model

Basically the MIMO-OFDM transmitter has Nt parallel transmission paths which are very similar to the single antenna OFDM system Then pilot signals are inserted uniformly between the information sequences at known positions for the purpose of channel estimation at the receiver side The wireless AWGN channel is used. After CP is removed after receiving the channel then the pilots are also removed from main signal received. After this the signal that is in time domain can be again converted to frequency domain by taking FFT of the received signal. The sequence on each of the OFDM block is then provided to channel estimation block where the received pilots altered by channel are compared with the original sent pilots. Channel estimation block consists of the algorithms that are applied to estimate the channel.

B. Orthogonal Frequency Division Multiplexing (OFDM)

In OFDM system the whole spectrum is divided into several subcarriers, and before each OFDM block the cyclic prefix (CP) is inserted is a method of encoding digital data on multiple carrier frequencies A large number of closely spaced orthogonal sub-carrier signals are used to carry data on several parallel data streams or channels. OFDM may be viewed as using many slowly modulated narrowband signals rather than one rapidly modulated wideband signal In OFDM the CP is used as guard symbols that have a variety of compensation to remove ISI and ICI caused by multipath fading OFDM therefore is considered as an efficient modulation technique for broadband access in a very dispersive environment. OFDM has developed into a popular scheme for wideband digital communication, whether wireless or over copper wires, used in applications such as digital television and audio broadcasting, DSL Internet access, wireless networks, power-line networks, and 4G mobile communications.

C. Channel Estimation:

As the wireless channel is rapidly varying with time, a channel estimation algorithm that can automatically adapt according to time is required for effective channel estimation. In MIMO-OFDM systems, a pilot channel is usually employed for synchronization and channel estimation. After dispreading a pilot channel in a finger of a MIMO-OFDM receiver, the received

Signal can be expressed as,

$u(k) = h(k) + n(k)$ ------------(a)

h(k) is a wide-sense stationary channelparameter, n(k) is zero-mean additive white noise,and k is a discrete time index. Estimating h(k)from {u(k)} is easy, because the variables are unknown are vary depending upon the velocity of mobile carrier. CE (channel estimation) methods are divided into two types. One is training based and the other one is blindsidewithout training sequences. Beamformingcan be used at both the transmitting and receiving ends in order to achieve spatial selectivity [2].

III. Reviewsof Significant Researches onChannel Estimation in MIMO-OFDM

A reviewed works that is employed for channel estimation in MIMO-OFDM using different methodologies such as pilot based, blind channel, RLS & LMS, LS & MMSE and other channel estimation methods.

A. Pilot Based Channel Estimation Methods

The minimum complexity and efficient bandwidth method of pilot symbol-assisted (PSA) channel estimator was proposed by King F. Lee et al. from the periodically transmitted pilot symbols a set of estimates a obtained for finding the time varying channel responses. Estimation of OFDM wireless channels in the presence of synchronous noise using PSA was given by aleksandarjeremicetal. A technique of robust semi-blind for jointly estimating the CFOs and channels of an uplink multiuser MIMO-OFDM SYSTEM WAS GIVEN BY YonghongZengetal.PSA MMSE channel estimation for broadband OFDM system was proposed by carlosRibeiroetal. Comb type based pilot arrangement by using channel estimation method at pilot frequencies and then the CFR at date frequencies have been estimated by the mean of interpolation was given by Hala M. Mahmoud et al. A pilot –aided and semi-blind joint data detection and frequency offset/channel estimation schemes for the uplink MIMO-OFDM system was proposed by Kyeong Jin Kim et al. A pilot-aided algorithm for the estimation of fast time-barying channels in OFDM transmission was proposed by Tareq Y.

B. Blind Channel Estimation Methods

For the multiuser MIMO channel estimation by using two semiblind methods were proposed by ShahramShahabazpanahi et al. A Subspace-based blind channel estimation method for MIMO OFDM systems using the second order statistical analysis was developed by FeifeiGaoetal. A subspace technique for blind channel in OFDM systems over time-dispersive channel was developed by Xiaodongyue et al and the this algorithm its lower complexity algorithm based on cyclostationarity properties induced by the cyclic prefix in OFDM system was proposed by Wensheng Zhu et al.

C. MMSE and LS Channel Estimation Methods

A channel estimation algorithm based on a time frequency polynomial model of the fading multipath channels was proposed by Xiaowen Wang et al. [4]. An iterative receiver algorithm for MIMO systems in frequency-selective fading channels was proposed by MajaLoncar et al. [2]. An alternative technique for minimizing the computational time for MIMO-OFDM channel estimation algorithms was proposed by Reza Abdolee et al. [3] LS channel estimation scheme in time domain for pilot tones based MIMO-OFDM a system was proposed by Han Wang et al. [2]. The performance of OFDM/TDM using MMSEFDE with practical channel estimation in a fast fading channel was evaluated by HarisGacaninetal. [7]. The design and implementation of an end to endMIMO system was discussed by Sudhakar Reddy et al. [2] A Single carrier Ultra-wideband (SC-UWB)transmission scheme with MSE channel estimation was proposed by LI Yuhong et al. [1]. [3] MIMO-OFDM channel estimation technique based on a Decision Directed Recursive Least Squares (RLS) algorithm in which pilot symbols need not to be included in the data after a short initial preamble was presented by PatricBeinscob et al. [2] A complexity structure of receiver and that the LS technique and linear interpolation have been employed for initial channel estimation was proposed by ManwinderSngh et al. [4]. versions, to minimize the complexity for LTEAdvanced which is based on MIMO-OFDM technology was discussed by SaqibSaleem et al[7].

D. Other Channel Estimation Methods

The optimum training-sequence design and Simplified channel estimation for enhancing the performance as well as for reducing the complexity of channel parameter estimation was proposed by Ye (Geoffrey) Li [5]. Reduced complexity channel estimation for an OFDM system with space–time coding in time varying, dispersive multipath fading channels was proposed by HlaingMinn et al. [6]. An iterative receiver for a joint data-detection and channel-estimation scheme in OFDM system, which includes iterative decoding in the receiver, was presented Seung Young Park et al. [4] A delay spread estimation algorithms for OFDM systems was proposed by TevfikYucek et al. [5]. The channel characteristics of OFDM communication system by using the worst case H∞ approach was estimated by Naganjaneyulu et al. [1]. A joint channel-estimation technique for thedesired and interfering channels for cell edge users in reuse-1 cellular OFDM systems was developed by Raghavendra et al. [7]. Two schemes for efficient channel estimation in OFDM-based systems operating in the presence of narrowband interference were proposed by Michele Morellietal. [1] A 2D low-pass interpolation based channel estimation of fast varying OFDM channels was proposed by MahmutYalcin et al. [2]. The performance of OFDM- BPSK & QPSK based system with and without channel estimation in Nakagami-m fading channels was analyzed by NeetuSood et al. [3] Various physical layer research challenges in MIMO-OFDM system design as well as channel modeling, space time block code techniques, channel estimation and signal processing algorithms, used for performing time and frequency synchronization in MIMO-OFDM system was investigated by Chitra et al. [1].

E. MLLMS Channel Estimation Methods

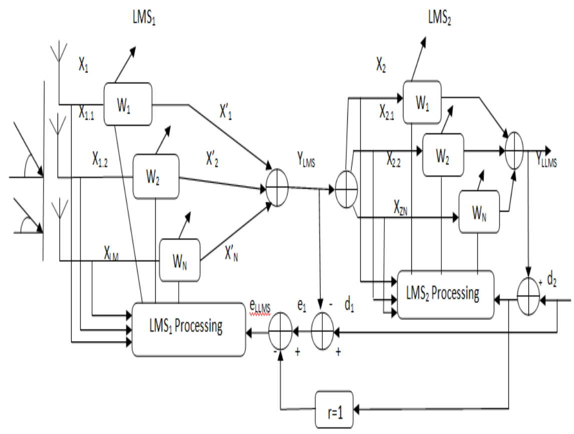

Fig. 2. Block diagram of LLMS algorithm

The above system model has been tested for QPSK modulations with an AWGN or Rayleigh fading channels. In the simulation, there are two transmitter antennas and the as many number of the receiving antennas is also two and this is LLMS algorithm.[8] But after modification we can say that, Modified Leaky Least Mean Square algorithm by only modifying parameter, if that parameter consider as zero then this algorithm act as Leaky LMS algorithm. Modification works one excess term is added that is Although this recursion does not require any training sequence, only it does required the knowledge about α (n) in the proposed algorithm α o is also updated at each recursion. [8]

F. The Performance Review

The VBER vs SNR obtained for different channel estimation methods in recent literature works are discussed below.

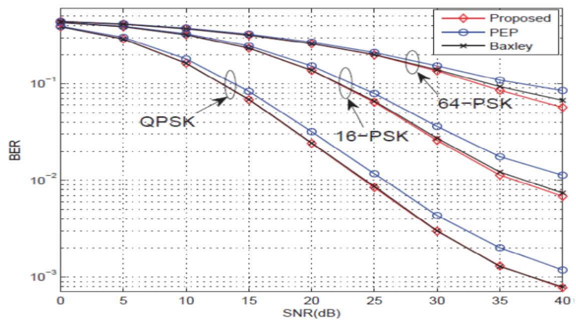

Fig. 3. Comparison of the BER vs SNR performance graph for N p =16

ii. Channel estimation in OFDM using RLS and LMS method [2].

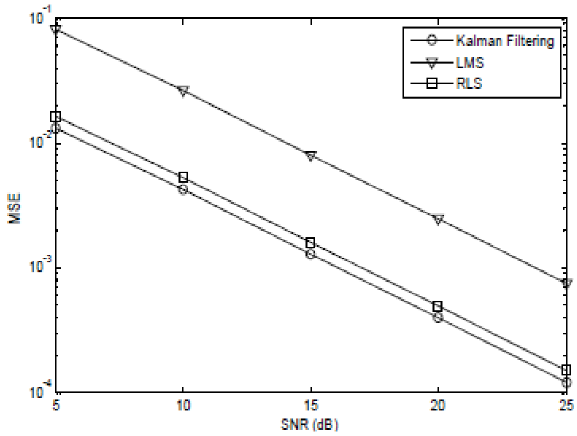

Fig. 4. BER vs SNR graph for LMS, RLS and kalman.

iii. Channel estimation in OFDM using blind channel method [2].

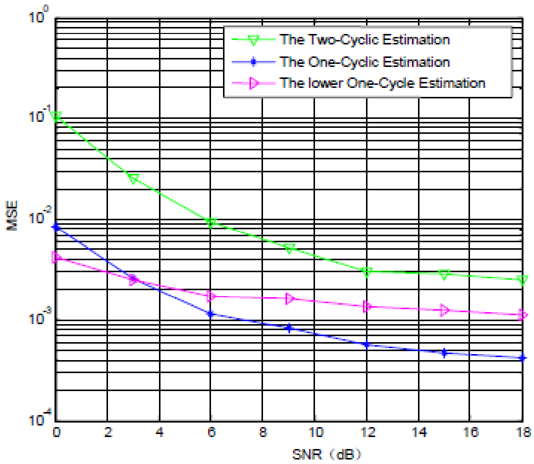

Fig. 5. BER vs SNR graph for M=2, L=4, 1000M data.

iv. Channel estimation in OFDM using LSE and LMMSE [7].

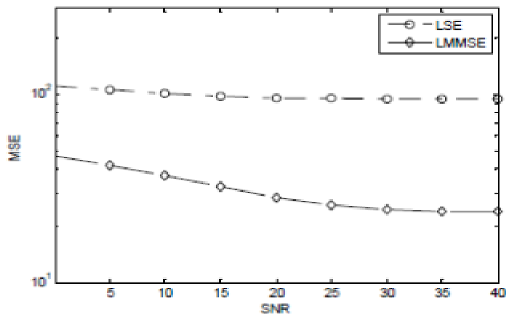

Fig. 6. BER vs SNR graph LSE and LMMSE estimator for 2x 2 systems

vi. Channel estimation in OFDM using MMLD[1].

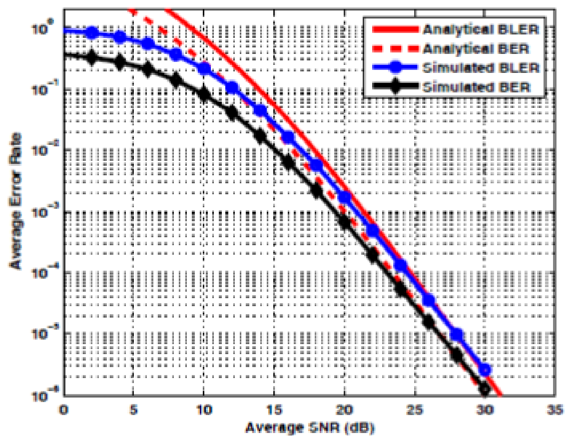

Fig. 7. Analytical and Simulated BLER and BER for a GLRD with P = 2 and P= 0

IV. ROPOSED WORKS

The previous section provides the information about the channel estimation through the different technique. The limitation of previous work is that it uses the BPSK-QPSK-PSK MIMO-OFDM System for channel estimation by used Leaky Least Mean Square (LLMS) Algorithm pilot based, LS, MMSE, LMS, RLS methods and other methods for channel estimation. LLMS and MMSE methods are more effectively used among these methods which have relatively lesser error value. So future work would be more enhancing in presenting LLMS andMMSE channel estimation method for the better results in channel estimations.

V. CONCLUSIONS

Modulation techniques using MIMO-OFDM System and Different algorithm, which has been increasing the capacity of channel that mean reduced bit error rate (BER) and improve signal to noise ratio (SNR) by varying step size or time varying step size.This paper aims to reduce bit error rate which is done by QPSK modulation scheme and resultant desire gain. It is clear that, the error value was low in LS and MMSE channel estimation methods.

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