# A LITERATURE SURVEY ON CHALLENGES FOR EFFICIENT HIGH SPEED COMMUNICATION SYSTEM

**Pramod Patel[1], Amit Mishra[2]**
1. Dept of ECE, MTECH student, VITS, JABALPUR, M.P., INDIA.
2. Dept of ECE, H.O.D., VITS, JABALPUR, M.P., INDIA.

**Abstract:** The demands for high bandwidth & high speed application are growing at a faster rate and with the minimum tolerance of error. To enhance available bandwidth and improve the quality of transmission convolution codes are used on the OFDM (Orthogonal frequency division multiplexing) communication system over AWGN channel. In OFDM (Orthogonal frequency division multiplexing) systems with channel equalization play a key role in overcoming distortions caused by phenomena like fading, delay spread and multipath effects. A new framework for designing robust adaptive filters is introduced. A series of review papers were already available to provide a history of the development of the field until the end of the last decade. During survey of work we have found that different authors have developed separate methods to solve the purpose. So from the study of various papers we can easily conclude that there is not any unique method. Hence in this work we come across to develop new adaptive channel equalization – OFDM algorithm to solve the purpose using MATLAB.

**Key Words:** LMS, NLMS, OFDM, CONVOLUTIONAL CODING, ISI, Channel estimation.

## 1. INTRODUCTION:

These days communication requires a very high rate with high reliability. Two major difficulties that hinder reliable communication via high rate wireless communication systems are bandwidth limitation of communication channels and multipath fading [1].

Orthogonal Frequency Division Multiplexing (OFDM) based communication a system has been identified as one of key transmission techniques for next generation wireless communication systems. The main attractions of OFDM are handling the multi-path interference, and mitigate inter-symbol interference (ISI) causing bit error rates in frequency selective fading environments. Wireless mobile communication systems of the 21st century have to confirm a wide range of multimedia services such as speech, image, and data transmission with different and variable bit rates up to 2 Mbit/s. It is all recognized that there is a great impact of channel coding on the performances of OFDM based wireless communication system to provide high data rates over severe multipath channels [2].

We focus on Channel Estimation (CE) and Channel Length Estimation (CLE) for Orthogonal Frequency Division Multiplexing (OFDM) systems. CE plays a fundamental role in modern communication systems, especially for wireless devices. For a coherent communication, the channel must be estimated at the transmitter and/or receiver side. Knowledge of the Channel State Information (CSI) at the transmitter side is usually the most favorable condition, since the transmitter can apply smart techniques in advance, to adapt the communication to the environment conditions [3].

In recent years, orthogonal frequency-division multiplexing (OFDM) has emerged as the standard of choice in a number of important high-data-rate applications. In OFDM, instead of using a single wide-band carrier to transmit information, a large number of parallel narrow-band sub-carriers are used. In OFDM serial-to-parallel transmitter converts the incoming high-rate data stream into low-rate streams, and then transmits each low-rate data stream over a unique orthogonal carrier. The data rate of each transmitted stream is effectively reduced by a factor of N from the original data rate. Utilizing this strategy, OFDM drastically reduces inter symbol interference (ISI) by avoiding multipath in frequency-selective channels [4].

## 2. LITERATURE REVIEW:

**Charles U. Ndujiuba et.al :** Author's proposed a Joint estimation of the channel length and of the impulse response for OFDM systems, exploiting information criteria to find the best trade-off, in terms of Kullback-Leibler divergence, between noise rejection and channel description accuracy. So far, information criteria have not been used for practical channel length estimation methods, due to their prohibitive complexity. Author's show how to make them affordable, performing channel estimation in a recursive way that allows establishing the optimal channel length with a moderate incremental cost & achieved performance and robustness are very good [1].

**Alessandro Tomasoni, *Member et.al :*** Author's proposed the performances of adaptive transmission scheme for OFDM have been investigated. The advantage of employing adaptive transmission scheme is described by comparing their performance with fixed transmission system. A better adaptation algorithm is used to improve the throughput performance. This algorithm utilizes the average value of the instantaneous SNR of the subcarriers in the nswitching parameter. The results show an improved throughput performance with considerable BER performance [3].

**Hardeep Kaur et.al:** Authors proposed a COFDM based WiMax is the outcome in this direction which promises to cater these high speed and high quality applications. Worldwide Interoperability for Microwave Access (WiMax) is an IEEE 802.16 standard-based broadband wireless access (BWA) technology which employs Coded orthogonal frequency division multiplexing access (COFDM). This paper analyses Bit Error Rate for WiMax based COFDM system with QPSK modulation scheme under various channel conditions like AWGN, Rayleigh, Rician and Nakagami-m. It has been observed that performance of Nakagami fading channel is better than other fading channels [4].

**Sanjana T et.al :** In this paper author's used channel estimation and equalization techniques are analyzed to improve the performance of OFDM system. The channel estimation techniques considered here are estimation using wiener filter and frequency domain approach. Prior Channel estimation leads to simple equalization. The channel equalization techniques employed here are based on LMS algorithm and one tap frequency domain equalization, under different channels; AWGN, Rayleigh and Rician channels. Eye patterns for different channels are compared in simulation. It is observed from simulation that wiener filter provides better estimation and OFDM performance is better under AWGN channel than fading channels. SER curves shows 6dB improvement in AWGN performance than fading channels to achieve 0.1 SER. In addition, MSE performance shows fast convergence for AWGN channel [5].

**Sunho Park et.al:** Author's proposed a new decision-directed channel estimation technique dealing with pilot shortage in the MIMO-OFDM systems. The proposed channel estimator uses soft symbol decisions obtained by iterative detection and decoding (IDD) scheme to enhance the quality of channel estimate. Using the soft information from the decoders, the proposed channel estimator selects reliable data tones, subtracts interferences, and performs re-estimation of the channels. Authors analyze the optimal data tone selection criterion, which accounts for the reliability of symbol decisions and correlation of channels between the data tones and pilot tones. From numerical simulations, we show that the proposed channel estimator achieves considerable improvement in system performance over the conventional channel estimators in realistic MIMO-OFDM scenarios [6].

**Petros S. Bithas et.al :** Author's proposed a new threshold-based channel selection strategy is proposed, which decreases the system complexity, without considerably affecting the system performance. Assuming independent but nonidentically distributed channel conditions, a generic analytical framework is first presented, based on the Markov chain theory. Then, the proposed selection scheme is applied to three specific communication scenarios, namely multichannel reception, transmit antenna selection with diversity reception, and cooperative relay selection. In all three cases, closed-form results are obtained and used to analyze the performance of the systems under consideration. It is shown that based on the proposed scheme, computational complexity is reduced and thus important energy savings can be achieved, without a significant loss in performance [7].

**Dimitrios Katselis et.al :** Author's proposed preamble-based least squares (LS) channel estimation in orthogonal frequency division multiplexing (OFDM) systems of the QAM and offset QAM (OQAM) types is considered. The construction of optimal (in the mean squared error (MSE) sense) preambles is investigated, for sparse (a subset of pilot tones, surrounded by nulls) preambles. The two OFDM systems are compared for the same transmit power, which, for cyclic prefix (CP) based OFDM/QAM, also includes the power spent for CP transmission. OFDM/OQAM, with a sparse preamble consisting of equipowered and equispaced pilots embedded in zeros, turns out to perform at least as well as CP-OFDM. Simulations results are presented that verify the analysis [8].

**Yuan Ouyang et.al :** Author's presents the performance analysis of the multiband orthogonal frequency division multiplexing (MB-OFDM) ultrawideband (UWB) systems for multipath fading and multiuser interference channels. A closed form approximation of the BER performance of the MB-OFDM UWB system with multiple interferences is proposed. Based on the derived approximation, the effects on the BER performance for the choice of the codeword constraint lengths of the convolutional encoder, the length of the cyclic prefix, and the multiuser environments of two or more interferers are thoroughly discussed. The simulated results provide us with useful information to appropriately choose the parameters of the MB-OFDM UWB system for the sake of achieving the BER performance that conforms to requirement of the FCC standards [9].

**Leonardo Rey Vega et.al :** Author's present a robust variable step-size NLMS algorithm which optimizes the square of the *a posteriori* error. We also showthe link between the proposed algorithm and another one derived using a robust statistics approach. In addition, a theoretical model for predicting the transient and

steady-state behavior and a proof of almost sure filter convergence are provided. The algorithm is then tested in different environments for system identification and acoustic echo cancelation applications [10].

**B. Siva Kumar Reddy et.al :** Author's presents The mobile-WiMAX offers a special feature that has adopted an adaptive modulation and coding (AMC) in OFDM to provide higher data rates and error free transmission. AMC technique employs the channel state information (CSI) to efficiently utilize the channel and maximize the throughput with better spectral efficiency. In this paper, LSE, MMSE, LMMSE, Low rank (Lr)-LMMSE channel estimators are integrated with the physical layer. The performance of estimation algorithms is analyzed in terms of BER, SNR, MSE and throughput. Simulation results proved that increment in modulation scheme size causes to improvement in throughput along with BER value [11].

**Han Wang et.al:** Author's proposed an Adaptive Regularized Compressive Sampling Matching Pursuit (ARCoSaMP) algorithm is proposed. Unlike anterior greedy algorithms, the new algorithm\ can achieve the accuracy of reconstruction by choosing the support set adaptively, and exploiting the regularization process, which realizes the second selecting of atoms in the support set although the sparsity of the channel is unknown. Simulation results show that CS-based methods obtain significant channel estimation performance improvement compared to that of conventional preamble-based methods. The proposed ARCoSaMP algorithm outperforms the conventional sparse adaptive matching pursuit (SAMP) algorithm. ARCoSaMP provides even more interesting results than the mostadvanced greedy compressive sampling matching pursuit (CoSaMP) algorithm without a prior sparse knowledge of the channel [12].

**Jalal Abdulsayed Srar et.al :** Author's proposed a new adaptive algorithm, called least mean squareleast mean square (LLMS) algorithm, which employs an array image factor, , sandwiched in between two least mean square (LMS) algorithm sections, is proposed for different applications of array beamforming. It can operate with either prescribed or adaptive. The convergence of LLMS algorithm is analyzed for two different operation modes; namely with external reference or self-referencing. The range of step size values for stable operation has been established. Computer simulation results show that LLMS algorithm is superior in convergence performance over earlier LMS based algorithms, and is quite insensitive to variations in input signal-to-noise ratio and actual step size values used. Furthermore, LLMS algorithm remains stable even when its reference signal is corrupted by additive white Gaussian noise (AWGN) [13].

**Shilpi Gupta et.al:** Author's presents the paper investigates new ICI self-cancellation technique to mitigate the effect of ICI in FFT-OFDM and compares it to DCT based OFDMsystem in terms of bit error rate (BER) and carrier to interference ratio (CIR). The proposed method for group size three results in a significant 20 dB improved CIR in FFT-OFDM. In terms of BER, proposed ICI self-cancellation technique outperforms the other self-cancellation techniques in FFT-OFDM. Also, this paper investigates outperforming BER and CIR improvement by using DCT-OFDM without applying self-cancellation techniques, due to its energy compaction property [14].

**Archana Jatav et.al :** Author's purpose the adaptive equalizer is to operate on the channel output such that the cascade connection of the channel & the equalizer provides an appropriate to an ideal transmission medium. This paper presents the performance of channel equalization based RLS & LMS Adaptive equalizer. Author's compare the proposed algorithm with other algorithm . Finally conclude that RLS-LMS equalizer with QAM modulator gives better bit error rate than RLS & LMS equalize [15].

**Guan Gui et.al** : author's propose two stable *sparse variable step-size* NLMS (VSSNLMS) algorithms to improve the accuracy of MIMO channel estimators. First, ASCE is formulated in MIMO-OFDM systems. Second, different sparse penalties are introduced to VSS-NLMS algorithm for ASCE. In addition, difference between sparse ISS NLMS algorithms and sparse VSS-NLMS ones is explained and their lower bounds are also derived. At last, to verify the effectiveness of the proposed algorithms for ASCE, several selected simulation results are shown to prove that the proposed sparse VSS-NLMS algorithms can achieve better estimation performance than the conventional methods via mean square error (MSE) and bit error rate (BER) metrics [16].

**Thamer M. Jamel et.al :** "Author's proposes new two smart antennas algorithms based on a combined method for performance enhancement of mobile communications systems. The first proposal combination method includes merging pure Conjugate Gradient Method (CGM) with pure Normalized Least Mean Square (NLMS) algorithms, so that the new algorithm is called as CGM-NLMS. While the second proposed algorithm will merge pure CGM with Modified NLMS algorithm so that this algorithm is called as CGMMNLMS algorithm. The MNLMS algorithm is regarded as variable regularization parameter that is fixed in the conventional NLMS algorithm. the two new proposed algorithms provides fast convergence time, higher interference suppression capability and low level of Mean Square coefficients Deviation (MSD) and minimum Mean Square Error (MSE) at the steady state compared with the pure CGM and pure NLMS algorithms [17].

**Bharti Kaushal et.al :** In this paper Author's presented a channel Equalizer based on Adaptive Kalman Filter. The performance indexes used for measurement are mean square error (MSE), Rate of convergence and signal to noise ratio (SNR). This analysis is compared with some other Adaptive Equalizer like recursive least square (RLS) and experimental results shows that this approach gives a less mean square error which is better

than other equalizer with fast rate of convergence. Also experimented for different communication system like QAM (64 QAM, 16 QAM, 4QAM), QPSK and BPSK, results shows that this Equalizer is quite compatible with different digital modulator [18].

**Shadma Pragi et.al :** Author's propose the Long Term Evolution (LTE) is an area of research interest for next generation of wireless communication. Orthogonal Frequency Division Multiplexing (OFDM) is selected as the basis of LTE physical layer. Author's presents the performance of OFDM UMTS based LTE system where minimum BER is measured for different modulators. The proposed model is compared with OFDMIDMA system in terms of BER. This paper concludes that it is quiet efficient and is applicable for next generation wireless communication system [19].

**Farhana Enam et.al :** Author's proposes a specific approach to channel equalization for Orthogonal Frequency Division Multiplex (OFDM) systems. Inserting an equalizer realized as an adaptive system before the FFT processing, the influence of variable delay and multi path could be mitigated in order to remove or reduce considerably the guard interval and to gain some spectral efficiency. The adaptive algorithm is based on adaptive filtering with averaging (AFA) for parameter update. Based on the development of a model of the OFDM system, through extensive computer simulations, we investigate the performance of the channel equalized system. The results show much higher convergence and adaptation rate compared to one of the most frequently used algorithms - Least Mean Squares (LMS)[20].

**B. Siva Kumar Reddy et.al :** Author's presents the OFDM technique is predominantly used during the implementation of WiMAX Physical layer. This paper focuses on the PHY-layer design aspects, namely, modulation and coding techniques associated. OFDMA, an extension of OFDM, makes use of Adaptive Modulation and Coding techniques to improve efficiency, fairness, and throughput in WiMAX. To achieve higher data rates and smaller BER's channel coding can be carried out in OFDM, called COFDM. The channel state information is fed back to the transmitter by the channel estimator. The simulation analysis presented includes comparison of BER vs. SNR for different modulation schemes. Here, LMS channel estimator is used [21].

**Marwa Abdelfatah Abdeltwab et.al:** Author's discusses the performance improvement of OFDM communication system using different channel coding techniques through AWGN channel model. These coding techniques include Reed Solomon coding, Convolutional coding, Concatenated coding (by combining Reed Solomon with Convolutional), and Interleaved concatenated coding techniques. Besides, a new algorithm produced to choose a good convolutional encoder design for a certain rate and memory registers [22].

**JAYPRAKASH UPADHYAY et.al:** "The main objective of author is to transmit the data with low bit error rate in the noisy environment. Convolution coding based OFDM systems with channel equalization (CC-OFDM-CE) is used to reduce bit error rate & to overcome the distortions caused by phenomena like fading, delay spread and multipath effect. This work investigated the OFDM system performance for uncoded channel equalization using quadrature amplitude modulation (QAM) and BPSK. To further enhance the system, convolutional coding employed to OFDM system with channel equalization [23].

**Irfan Y. Khan et.al:** Author's investigated the OFDM system performance of uncoded adaptive modulation using quadrature amplitude modulation (QAM) and phase shift keying (PSK). To further enhance the system, we employ convolutional coding to OFDM system. In OFDM system, the Signal to noise ratio is estimated at receiver and then transmitted to the transmitter through feedback channel, the transmitter according to the estimated SNR select appropriate modulation scheme and coding rate which maintain constant bit error rate lower than the requested BER. The obtained results show that a significant improvements in terms of bit error rate (BER) and throughput can be achieved demonstrating the Superiority of the adaptive modulation schemes compared to fixed transmission schemes [24].

**Hamza Khan et.al :** Author's propose a dynamic interference control method using the additive signal side lobe reduction technique and genetic algorithm(GA) in CR-OFDM systems. Additive signal side lobe reduction technique is based on adding a complex array to modulated data symbols in the constellation plane for side lobe reduction in OFDM system. In the proposed method, GA generates optimum additive signal which can effectively reduce the OOB signal interference to the primary system. The results show that the side lobes of the OFDM-based secondary user signal can be reduced by up to 38 dB and the PU interference tolerable limit can be satisfied at the cost of a minor addition in bit error rate (BER). The results further show that the proposed method delivers better performance as compared to non-GA additive signal method in terms of side lobe reduction as well as BER [25].

## 3. PROBLEM FORMULATION:

After studying different approaches we observe that some of the algorithms provide low BER, fast convergence time, higher interference suppression capability and minimum Mean Square Error (MSE), but still there is need of an approach which may provide better result i.e. reduces the mean square error (MSE), low BER and shows faster convergence rate as compared to the conventional algorithm.

## 4. PROPOSED WORK:

After analyzing several techniques we proposed a new Adaptive channel equalization algorithm technique to reduce the mean square error (MSE), BER & higher interference suppression capability and also shows faster convergence rate for communication system.

## 5. CONCLUSION:

In this paper we present a survey on channel Estimation with equalization for communication system concentrating on different Adaptive techniques and emphasize on the problems, we also suggest an efficient solution to solve the above problem.

LMS algorithm is the most popular adaptive algorithm because of its low computational complexity. However, it suffers from slow convergence behavior. NLMS is a variant of LMS that requires additional computation but offers superior performance. For high speed wireless communication system new adaptive channel equalization method is developed. The main objective is to transmit the data with low bit error rate with high convergence speed & low error rate in the noisy environment. Convolution coding will be employed to minimize the bit error rate (BER) of the received signal.

## REFERENCES:


1. Charles U. Ndujiuba et.al : "Dynamic Differential Modulation of Sub-Carriers in OFDM" Journal of Wireless Networking and Communications 6(1): 21-28., 2016.
2. Pallavi Suryawanshi et.al : "Underwater communication by using OFDM system" International Journal of Scientific and Research Publications, Volume 3, Issue 12, December 2013.
3. Alessandro Tomasoni, Member et.al: "Efficient OFDM Channel Estimation via an Information Criterion" IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, VOL. 12, NO. 3, MARCH 2013.
4. Hardeep Kaur et.al : " Analyzing the Performance of Coded OFDM based WiMax System with different Fading Conditions" International Journal of Advanced Science and Technology Vol.68 (2014), pp.01-10.
5. Sanjana T et.al : "COMPARISON OF CHANNEL ESTIMATION AND EQUALIZATION TECHNIQUES FOR OFDM SYSTEMS" Circuits and Systems: An International Journal (CSIJ), Vol. 1, No. 1, January 2014.
6. Sunho Park : ""Iterative Channel Estimation Using Virtual Pilot Signals for MIMO-OFDM Systems" IEEE TRANSACTIONS ON SIGNAL PROCESSING, VOL. 63, NO. 12, JUNE 15, 2015.
7. Petros S. Bithas et.al : "An Improved Threshold-Based Channel Selection Scheme for Wireless Communication Systems" IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, VOL. 15, NO. 2, FEBRUARY 2016.
8. Dimitrios Katselis et.al: "Preamble-Based Channel Estimation for CP-OFDM and OFDM/OQAM Systems: A Comparative Study" IEEE TRANSACTIONS ON SIGNAL PROCESSING, VOL. 58, NO. 5, MAY 2010.
9. Yuan Ouyang et.al : "Performance Analysis of the Multiband Orthogonal Frequency Division Multiplexing Ultra-Wideband Systems for Multipath Fading and Multiuser Interference Channels" Hindawi Publishing Corporation Mathematical Problems in Engineering Volume 2015, Article ID 190809, 9 pages.
10. Leonardo Rey Vega et.al: "A New Robust Variable Step-Size NLMS Algorithm" IEEE TRANSACTIONS ON SIGNAL PROCESSING, VOL. 56, NO. 5, MAY 2008.
11. B. Siva Kumar Reddy et.al: "Adaptive Modulation and Coding with Channel State Information in OFDM for WiMAX" I.J. Image, Graphics and Signal Processing, 2015, 1, 61-69.
12. Han Wang et.al: "A New Sparse Adaptive Channel Estimation Method Based on Compressive Sensing for FBMC/OQAM Transmission Network" MDPI, sensors 2016 page no. 2-12.
13. Jalal Abdulsayed Srar et.al: "Adaptive Array Beamforming Using a Combined LMS-LMS Algorithm" IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 58, NO. 11, NOVEMBER 2010.
14. Shilpi Gupta et.al: "Performance on ICI Self-Cancellation in FFT-OFDM and DCT-OFDM System" Hindawi Publishing Corporation Journal of Function Spaces Volume 2015, Article ID 854753, 7 pages.
15. Archana Jatav, Agya Mishra: "channel equalization & BER analysis based on combination of RLS & LMS adaptive filter for communication SYSYEM" : GJCAT, Vol 2 (4), 2012.
16. Guan Gui et.al: "Variable Is Better Than Invariable: Sparse VSS-NLMS Algorithms with Application to Adaptive MIMO Channel Estimation" :Hindawi Publishing Corporation, Scientific World Journal Volume 2014, Article ID 274897, 10 pages.
17. Thamer M. Jamel: " Performance Enhancement of Smart Antennas Algorithms for Mobile Communications System" :INTERNATIONAL JOURNAL OF CIRCUITS, SYSTEMS AND SIGNAL PROCESSING Volume 8, 2014.

18. Bharti Kaushal et.al : " Adaptive Kalman Filter based Channel Equalizer" (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 3 (5) , 2012,page no. 5195 – 5199.
19. Shadma Pragi et.al : "OFDM UMTS Based LTE System" International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 7, July 2013.
20. Farhana Enam et.al : "Performance Evaluation of Orthogonal Frequency Division Multiplexing (OFDM) based Wireless Communication System with implementation of Least Mean Square Equalization technique" (IJCSIS) International Journal of Computer Science and Information Security, Vol. 10, No. 11, November 2012.
21. B. Siva Kumar Reddy et.al : "Adaptive Modulation and Coding in COFDM for WiMAX Using LMS Channel Estimator" Conference on Advances in Communication and Control Systems 2013. (CAC2S 2013).
22. Marwa Abdelfatah Abdeltwab et.al : " Performance Improvement of Coded OFDM Communication System in AWGN Channel" International Journal of Computer Applications (0975 – 8887) Volume 110 – No. 11, January 2015.
23. JAYPRAKASH UPADHYAY et.al: "BER PERFORMANCE OF CC-OFDM SYSTEM WITH NNLMS EQUALIZATION TECHNIQUE" IEEE International Conference on Computer, Communication and Control, MGI Indore, INDIA. September 10 -12, 2015.
24. Irfan Y. Khan et.al : "To Improve Performance of OFDM System Using Optimize Adaptive Coding Technique with Convolutional and BCH Coding" International Journal of Application or Innovation in Engineering & Management (IJAIEM) Volume 3, Issue 5, May 2014.
25. Hamza Khan et.al : "Dynamic Interference Control in OFDM-Based Cognitive Radio Network Using Genetic Algorithm" Hindawi Publishing Corporation International Journal of Distributed Sensor Networks Volume 2015, Article ID 870607, 10 pages.