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A Literature Survey on Modified Iterative Channel Estimation with Coded OFDM System

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ABSTRACT

In this paper, we introduce a new method on channel estimation with coded-OFDM systems. 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 communication system over AWGN channel. In OFDM systems with channel estimation play a key role in overcoming distortions caused by phenomena like fading, delay spread and multipath effects. 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 different methods to solve the purpose. So from the study of various papers we can easily conclude that there is not any universal method. Hence in this work we introduce one of the promising channel estimation technique which will improve the performance of MSE and BER in OFDM system.

Keywords:- OFDM, IDD, Convolution coding, AWGN channel, channel estimation, modulation scheme.

I. INTRODUCTION

OFDM is an efficient multicarrier modulation scheme which is resilient to the effect of multipath fading channels. Although all the OFDM subcarriers are modulated by waveforms that are limited in the time-domain, in practice, there is unavoidable power leakage in the frequency-domain and because of this, the guard band has to be placed so as to minimize adjacent channel interference to other coexisting wireless systems [1].

Focusing on OFDM systems, Channel Estimation (CE) can be performed both in the frequency or in the time domain. Frequency Domain (FD) CE is usually simpler, since it can be applied even independently subcarrier by subcarrier: this is the case of Zero Forcing (ZF),that delivers a noisy CE. More refined estimators exploit some additional information about the channel, to reject noise. Depending on the way this information is given, it could be convenient to perform CE either in the FD or in the Time Domain (TD). E.g., if the channel Power Delay Profile (PDP) is known, one can derive the channel covariance matrix in the FD and perform LMMSE estimation to reject more noise, or can even embed the PDP into a TD LMMSE estimator, focusing on the most relevant channel taps. To reduce complexity, one can also apply estimation to small groups of subcarriers, or just exploit the largest eigenvalues of the channel covariance matrix. Reduced order models can also be applied in the TD: the most popular is ML estimation with knowledge of the channel length. A problem with TD CE is to determine the proper channel length. The easiest solution is to set the estimated channel length equal to the maximum value (say L) that produces no Intra Carrier and Inter Symbol Interference, i.e. the OFDM cyclic prefix length plus one. This assumption simplifies the problem, but can lead to performance degradation, in case of short channel impulse responses. To avoid this degradation some CLE must be implemented. Also CLE can be performed in the frequency or time domain. Frequency domain estimators look for some specific behavior of the channel estimates, such as the zero-level crossing rate. They are simple, but do not exploit all the available information and typically require several OFDM symbols to become reliable. Time domain CLE usually starts from the maximal length and then ignores taps with amplitudes below some threshold [2].

II. LITERATURE REVIEW

SU HU et.al: This paper is focused on training sequence design for efficient channel estimation in multiple input multiple-output filter bank multicarrier (MIMO-FBMC) communications using offset quadrature amplitude modulation (OQAM). MIMO-FBMC is a promising technique to achieve high spectrum efficiency as well as strong robustness against dispersive channels due to its feature of time-frequency localization. In this paper, authors proposes a new class of training sequences, which are formed by concatenation of two identical

zero-correlation zone sequences whose auto-correlation and cross correlation are zero within a time-shift window around the in-phase position [1].

Peng Xu et.al: The system model considers imperfect channel estimation, pilot contamination (PC), and multicarrier and multipath channels. Analytical expressions are first presented on the mean square error (MSE) of two classical channel estimation algorithms [i.e., least squares (LS) and minimum mean square error (MMSE)] in the presence of PC. Then, a simple H-infinity (H-inf) channel estimation approach is proposed to have good suppression to PC [2].

Yu Zhu et.al: In this paper, author considers a robust SC-FDE design with imperfect channel knowledge at a receiver due to the channel estimation error. Based on a statistical model for channel estimation, the optimal equalization coefficients are derived under the criterion of minimizing the mean square error conditioned on a given channel estimate. The bit error rate is further analyzed and a tight performance approximation is proposed. Two robust FDE schemes in coded systems were also proposed, where feedback from the channel decoder is utilized to improve the equalization and/or channel estimation performance [3].

Charles U. Ndujiuba et.al: Authors 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. Authors 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 [4].

Alessandro Tomasoni et.al: In this paper 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 switching parameter. The results show an improved throughput performance with considerable BER performance [5].

Hardeep Kaur et.al: Authors proposed a COFDM based Wi-Max here, which promises to cater these high speed and high quality applications. Worldwide Interoperability for Microwave Access (Wi-Max) 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 Wi-Max 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 [6].

Sanjana T et.al: In this paper 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 [7].

Sunho Park et.al: Authors 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 [8].

Petros S. Bithas et.al: Authors proposed a new threshold-based channel selection strategy, which decreases the system complexity, without considerably affecting the system performance. Assuming independent but non identically 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 [9].

Dimitrios Katselis et.al : Authors proposed preamble-based least squares (LS) channel estimation in 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 [10].

Yuan Ouyang et.al: Author presents the performance analysis of the multiband orthogonal frequency division multiplexing (MB-OFDM) ultra wideband (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 [11].

B. Siva Kumar Reddy et.al: Author presents The mobile-Wi-MAX 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 [12].

Han Wang et.al: An Adaptive Regularized Compressive Sampling Matching Pursuit (ARCoSaMP) algorithm is proposed here. 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 result shows 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 most advanced greedy compressive sampling matching pursuit (CoSaMP) algorithm without a prior sparse knowledge of the channel [13].

Shilpi Gupta et.al: This paper investigates a new ICI self-cancellation technique to mitigate the effect of ICI in FFT-OFDM and compares it to DCT based OFDM system 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 purposes 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 compares the proposed algorithm with other algorithm. Finally concludes that RLS-LMS equalizer with QAM modulator gives better bit error rate than RLS & LMS equalize [15].

Guan Gui et.al: Author proposes 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 Authors 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, 4-QAM), QPSK and BPSK, results shows that this equalizer is quite compatible with different digital modulator [18].

Shadma Pragi et.al: Author proposes the Long Term Evolution (LTE) is an area of research interest for next generation of wireless communication. OFDM is selected as the basis of LTE physical layer. Author 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 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, author investigates 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: Authors presents the OFDM technique is predominantly used during the implementation of Wi-MAX 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 Wi-MAX. 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 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].

Irfan Y. Khan et.al: Authors investigated the OFDM system performance of uncoded adaptive modulation using quadrature amplitude modulation (QAM) and phase shift keying (PSK). To further enhance the system, authors employed 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 result shows 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 [23].

Hamza Khan et.al: Authors proposed 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 [24].

III. PROBLEM FORMULATION

The goal of proposed method in order to achieve good trade-off between MSE and overall BER. After studying different approaches we observe that some of the algorithms provide low BER, 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) and low BER as compared to the other conventional algorithms.

IV. CONCLUSION

In this paper, we present a survey on channel Estimation for coded OFDM communication system concentrating on different techniques and emphasize on the problems, we also suggest an efficient solution to solve the above problem. Concatenation of the convolutional codes (CC) in OFDM system and proposes a new modified iterative LMMSE channel estimation algorithm. The main objective is to transmit the data with low bit error rate & low MSE in the noisy environment. Convolution coding will be employed to minimize the bit error rate (BER) of the received signal.

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