ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume4, Issue 7, July 2015

Comparison and Analysis of Channel Estimation Algorithms in MIMO-OFDM System: A Review

Dhariti Sharma

***Abstract*— The main objective of this paper is to preview the work that has already been done related to channel estimation techniques in MIMO-OFDM system. Channel estimation algorithm i.e. Block type, Comb type, etc, are discussed. In communication systems MINO-OFDM, channel estimation plays a major role. Channel estimation is the estimation of transmitted signal bits using received signal bits. In this paper a review on different channel estimation methods like Least Square and Minimum Mean Square Error, Least mean Square methods are discussed.**

***Index Terms*— Channel estimation, MIMO, OFDM, ISI, CIR, LS, MMSE, RLMS, LLMS.**

I. INTRODUCTION

In mobile communication systems bits of information is transmitted by making changes in amplitude or phase of radio waves. On the receiving side, amplitude or phase vary dramatically. The performance of receiver is highly dependent on the accuracy of the estimated instantaneous channel so as a result system quality is degraded. Due to this reason channel estimation technique is introduced so that the accuracy of the received signal is improved. The radio channels are usually multipath fading channels which causes Inter Symbol Interference (ISI) in the received signal. Many a kind of detection algorithms are used at the receiving side to remove ISI from the signal. A separate channel estimator provides knowledge on channel impulse response. The channel estimator is based on the known sequence if bits which are unique for certain transmitter. Thus channel estimator estimates CIR separately for each burst from the transmitted bits which are known.

OFDM (Orthogonal frequency division multiplexing) is a multicarrier modulation technique used to transmit high rate data stream through wireless medium. A high rated data stream is divided into parallel lower rate data streams which are transmitted simultaneously over a number of separate subcarriers. This technique also eliminates Inter Symbol Interference. In OFDM implementation is performed by making use of Fast Fourier Transform (FFT)/Inverse Fast Fourier Transform (IFFT) algorithms. It improves the frequency spectral efficiency and minimizes the complexity of the receiver by converting the frequency selective channel into collection of parallel frequency flat sub channels.

MIMO (Multiple Input Multiple Output) uses multiple antennas in the transmitter and receiver sides at the same time, increasing the transmission rate. The use of multiple antennas at both sides of the wireless link provides a most promising solution to enhance the bandwidth efficiency and reliability of system without any need of extra bandwidth or transmitting more power to the channel. MIMO technology also maximizes the signal to noise ratio for wireless technologies.

Advantages:

1) It has the ability to turn the multipath propagation which is a drawback of wireless transmission, into an advantage.
2) Multiple streams can be coded and decoded simultaneously.

II. INTRODUCTION OF MIMO-ODM SYSTEMS

Traditional wireless communication systems provided constant bandwidth, no possibility of increasing the sending rate of information. Bandwidth, information sending rate and software-hardware complexities are the important parameters to design a communication system. Methods such as MIMO, OFDM and integrating them as MIMO-OFDM are suggested to expand the new generation of communication system.

OFDM's high resistance against the ISI event and its function against fading, besides the high rate of information sending of MIMO create an efficient complex in accession towards the fourth generation of wireless communication's demand. The increase in number of unknowns makes estimating the channel in these systems more complex than estimating channel in one antenna systems. Block diagram of one kind of MIMO-OFDM is shown in the figure.

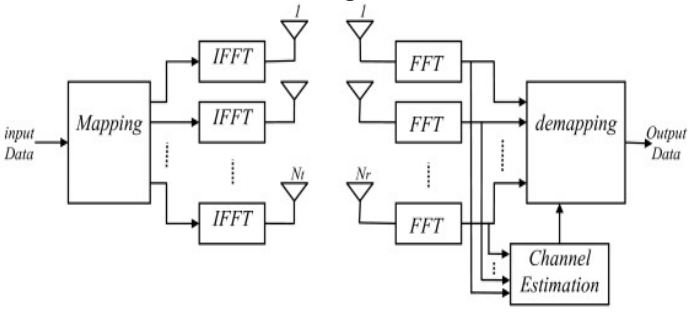

Fig. MIMO communication system with Nt transmitting antennas and Nr receiving antennas

According to the figure the information in each antenna goes under IDFT action and cyclic prefix is added and then sent. Each receiver antenna receives sum of noises and signals sent by the transmitter antenna. In each receiver antenna revealing is done only after removal of CP and DFT action.

Manuscript received July, 2015.
***Dhariti Sharma**, Department of Electronics and Communication, Bahra University Shimla-Hills, H.P, Shimla, India.*

III. Channel Estimation

Channel estimation is a very important task in coherent communication systems. As well as it is a major issue for coherent OFDM systems [7]. Channel estimation is more difficult because of the increased number of channels to be estimated as compared to SISO systems. Channel estimation method is developed based on the signals correlation and MAI suppression. The quality of the channel estimation method has an intense impact on the overall bit error rate (BER) performance of the receiver.

There are two major types of channel estimation schemes, (1) Pilot assisted schemes, in which a portion of the bandwidth is assigned to training symbols and, (2) Blind approach, which can be implemented by using statistical properties. At receiver side, channel estimation can be done by adding pilot signals into the transmitted signals. Pilot tones, along with OFDM symbol are used to estimate the channel. Block type and comb type pilot arrangements are the two types of pilot channel insertions.

IV. Literature Survey

A. Channel Estimation using Adaptive filters in MIMO-OFDM systems [4]

Yongming Liang, Hanwen Luo, Chongguang Yan, Jianguo Huang, IEEE .2006. In this paper channel estimation method is done by using adaptive filters in MIMO-OFDM systems. The method exploits pilots and adaptive filters to estimate channel. The simulation results show that this method has moderate computational complexity than the LS one.

B. Pilot aided LS channel estimation in MIMO-OFDM system [7]

In this paper theoretical and simulation results of LS channel estimation in MIMO-OFDM system are presented. These results are based on block type pilot and comb type pilot structures. The simulation results verify that the theoretical analysis and suggest that the comb type pilot structure is more suitable for time variant channel.

C. Channel estimation analysis in MIMO-OFDM wireless systems [9]

In this paper researchers have analyzed channel estimation on MIMO-OFDM system for Rayleigh fading channel. The two different algorithms such as LS and MMSE channel estimation algorithms are applied and simulation is performed. Simulation results show that MMSE has less MSE and less BER than LS and also channel estimation using comb type carrier has lower BER than block type pilot carrier.

D. A new derivation of LS fitting principle for OFDM channel estimation [8]

Mian–Xian Chang, IEEE. 2006. Channel estimation and data detection algorithms of OFDM system has presented in this paper. Proposed algorithm is based on LMMSE estimation. The results show that non statistical LSF principle can be derived alternatively from statistical LMMSE principle by Eigen-vector approximation. It also gives characteristics and discussion of LSF principle.

E. Detection of OFDM signals in fast varying channels with low-density pilot symbols [3]

Ming-Xian Chang, IEEE. 2007. In this paper a pseudo pilot algorithm for data detection in fast varying channel without increasing pilot density is proposed. This algorithm is based on regression model based LS fitting approach. The result of this paper shows that the proposed algorithm performance could approach a bit error probability lower bound which is obtained by letting the receiver know the true values of the pseudo pilots.

F. Efficient MIMO channel estimation with optimal training sequences [6]

In this paper efficient MIMO channel estimation with optimal training sequences are presented. The minimum mean square error of the channel estimate is achieved with optimal training sequences. Optimal training sequences of minimum length are determined on the basis of the required accuracy of the estimate.

G. Enhanced Adaptive channel estimation technique for MIMO-OFDM wireless systems [5]

An enhanced technique for channel state information estimation in MIMO-OFDM system has been presented. It is concluded that RLMS algorithm outperforms LLMS but RLMS has a disadvantage that it is more complex than LLMS. The results show that BER performance is better of proposed algorithm. BPSK outperforms than QPSK modulation but at the same time it is a fact that the capacity of QPSK is higher than BPSK. With the increase in SNR value, BER performance becomes better in both cases. Do RLMS algorithm is better than LLMS algorithm.

H. Channel estimation techniques based on pilot arrangement in OFDM system [1]

The researchers in this paper have given a full review of block type and comb type pilot based channel estimation. Also channel estimation based on comb type pilot arrangement is presented by giving channel estimation methods at the pilot data frequencies. The results show that comb type pilot based channel estimation with low pass interpolation performs the best among all channel estimation algorithms. For Doppler frequencies, the performance of decision feedback estimation is observed to be slightly worse than the best estimation.

V. Conclusion

In this paper, the various channel estimation techniques for MIMO-OFDM are studied**.** Channel estimation algorithms have been compared and results show that least square algorithm is the simplest amongst all but has low performance. It is also found that comb type pilot system performs better than block type system.

Acknowledgment

The author is grateful to Mr. Pavan K Sarma for his help.

REFERENCES

[1] S. Coleri, M. Ergen, A. Puri, and A. Bahai, "Channel estimation techniques based on pilot arrangement in OFDM systems," IEEE Trans. Broadcast., vol. 48, no. 3, pp. 223–229, Sep. 2002.

[2] Helmi Chaouech,Ridha Bouallegue, "Channel Estimation and multiuser detection in asynchronous satellite communications", International Journal of Wireless & Mobile Networks (IJWMN) Vol.2, No.4, November 2010.

[3] M. X. Chang and T. D. Hsieh, "Detection of OFDM signals in fast-varying channels with low-density pilot symbols," IEEE Trans. Veh. Technol., vol. 57, no. 2, pp. 859–872, Mar. 2008.

[4] Yongming liang, hanwen luo, chongguang yan, jianguo huang, "channel estimation using adaptive filters in mimo-ofdm systems".

[5] Hardeep Singh, Ishan Khurana, "Enhanced Adaptive Channel Estimation Technique for MIMO-OFDM Wireless Systems", International Journal of Computer Applications (0975 – 8887) Volume 94 – No.20, May 2014.

[6] Oomke Weikert ,Udo Z¨olzer, "Efficient MIMO Channel Estimation With Optimal Training Sequences" Department of Signal Processing and Communications, Helmut Schmidt University - University of the Federal Armed Forces Hamburg Holstenhofweg 85, 22043 Hamburg, Germany.

[7] Changchuan Yin, Jingyu Li, Xiaolin Hou, Guangxin Yue, "Pilot Aided LS Channel Estimation in MIMO-OFDM Systems" ICSP2006 Proceedings.

[8] M.-X. Chang,"A new derivation of least-squares-fitting principle for OFDM channel estimation," IEEE Trans. Wireless Commun., vol. 5, no. 4, pp. 726–731, Apr. 2006.

[9] R.S.Ganesh, Dr J.Jayakumari, Akhila I.P , "Channel Estimation Analysis in MIMO-OFDM Wireless Systems" icsccn 2011 proceedings.

Dhariti Sharma has obtained her B.Tech. (Electronics and Communication Engineering) degree from Eternal University,Sirmaur, 2013 and presently she is doing M.Tech. (Electronics and Communication Engineering) from Bahra University, Waknaghat. At present, she is working on her M. Tech. (Electronics and Communication Engineering) thesis. Her area of interest is Wireless Communication.