Novel Approach of Channel Estimation by Wavelet with FPA Approaches

Bhawna Sharma[1], Ankur Gupta[2]
[1,2]*Dept. of ECE, Kurukshetra University, Kurukshetra, Haryana, India*

Abstract— In MIMO-LTE-A Networks, optimize receiver structure can suppress more than a single interfering layer if there are only two antennas in terminal receiver. In this paper reduce the inference of channel by predicting the distribution. In this paper proposed approach optimize the mapping in carrier mapping because it is optimize then reduce the sparsely and complexity of channel for noise reduction. For optimization use Flower pollination algorithm which global optimization the mapping and reduce BER. In simulation results flower pollination optimization reduce Bit error rate (BER) in all cases like sparsely, Rayleigh channel. IN third case reduce the power compare to existing method.

Keywords— *LTE, FPA, Optimization, BER*

I. INTRODUCTION

Multiple input, multiple output-orthogonal frequency division multiplexing (MIMO-OFDM) is the dominant air interface for 4G and 5G broadband wireless communications. It combines multiple input, multiple output (MIMO) technology, which multiplies capacity by transmitting different signals over multiple antennas, and orthogonal frequency-division multiplexing (OFDM), which divides a radio channel into a large number of closely spaced sub channels to provide more reliable communications at high speeds. Research conducted during the mid-1990s showed that while MIMO can be used with other popular air interfaces such as Time Division Multiple Access (TDMA) and code division multiple access (CDMA), the combination of MIMO and OFDM is most practical at higher data rates.

MIMO-OFDM is the foundation for most advanced wireless local area network (wireless LAN) and mobile broadband network standards because it achieves the greatest spectral efficiency and, therefore, delivers the highest capacity and data throughput. Greg Raleigh invented MIMO in 1996 when he showed that different data streams could be transmitted at the same time on the same frequency by taking advantage of the fact that signals transmitted through space bounce off objects (such as the ground) and take multiple paths to the receiver.

data, different data streams could be sent over different paths. Raleigh suggested and later proved that the processing required by MIMO at higher speeds would be most manageable using OFDM

modulation, because OFDM converts a high-speed data channel into a number of parallel, lower-speed channels [1]. The fig. 1 shows the basic structure of the MIMO OFDM system.

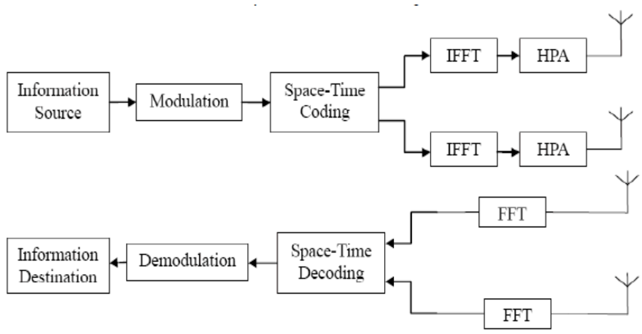


Figure 1. Basic Structure of MIMO OFDM System

A. Channel Estimation

Complex channel estimation (i.e., estimation of channel gain, which includes phase and amplitude) performed for each individual RAKE fingers is required for coherent detection (Maximal Ratio Combining). Complex channel estimation is performed with the assistance of known transmitted pilot symbols. The accuracy of the channel estimation is crucial for RAKE receiver performance, and it depends on the pilot channel energy, the channel estimation algorithms, and the environment conditions. In particular, mobile speed is required for a variety of channel estimation algorithms [2].

B. Types of Channel Estimation

Block-Type Pilot Channel Estimation: Under the assumption that the interferences are completely eliminated. As a result, the fading channel of the OFDM system can be viewed as a 2D lattice in a time-frequency plane, which is sampled at pilot positions and the channel characteristics between pilots are estimated by interpolation. The art in designing channel estimators is to solve this problem with a good trade-off between complexity and performance. The first one, block-type pilot channel estimation is shown in figure 2, is developed under the assumption of slow fading channel, and it is performed by inserting pilot tones into all subcarriers of OFDM symbols within a specific period. The second one, comb-type pilot channel estimation, is introduced to satisfy the need for equalizing when the channel changes even from one OFDM block to the subsequent one. It is thus performed by inserting pilot tones into certain subcarriers of each OFDM symbol, where the interpolation is needed to estimate the conditions of data subcarriers [3].

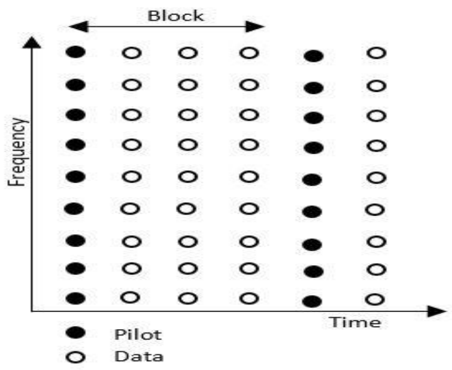


Figure 2. Block-type pilot channel estimation [6]

Comb-Type Pilot Channel Estimation:
Comb type pilot-based channel estimation is suitable for fast-fading channel where the channel condition changes between adjacent OFDM symbols. The comb type pilot arrangement is shown in Fig. 2 in which the pilot signals are uniformly distributed within each OFDM block. In comb type channel estimation, after extracting the pilot signals from the received signal, the channel transfer function is estimated from the received pilot signals and the known pilot signals. The channel responses of data subcarriers can be estimated with the interpolation of the neighboring pilot channel responses. Comb type pilot-based channel estimation can be based on least square (LS), minimum mean square error (MMSE) or least mean square (LMS) method. Here only MMSE channel estimator is employed for the estimation of channel at pilot subcarriers because of its superior performance as compared to LS estimator. Pilot signal estimation and channel interpolation algorithms are discussed in the following subsections [4].

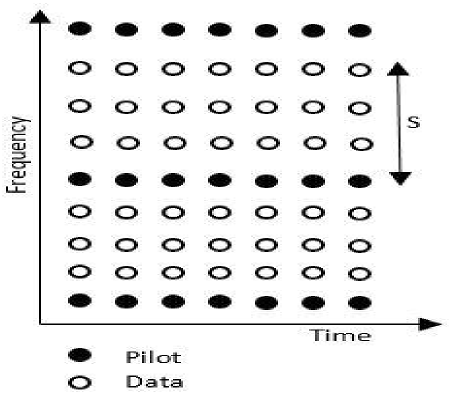


Figure 3.Comb-Type Pilot Channel Estimation [7]

Multiple Input Multiple Outputs (MIMO)-OFDM is widely recognized as a key technology for future wireless communications due to its high spectral efficiency and superior robustness to multipath fading channels. For MIMO-OFDM systems, accurate channel estimation is essential to guarantee the system performance. Generally, there are two categories of channel estimation scheme for MIMO-OFDM systems. The first one is nonparametric scheme, which adopts orthogonal frequency-domain pilots or orthogonal time-domain training sequences to convert the channel estimation in MIMO systems to that in single antenna systems. However, such scheme suffers from high pilot overhead when the number of transmit antennas increases. The second category is parametric channel estimation scheme, which exploits the sparsity of wireless channels to reduce the pilot overhead [8].

II. LITERATURE REVIEW

Zhen GAO et.al. [8]: This paper gives a MIMO-OFDM on the basis of finite rate innovation to obtain Super-resolution estimates of path delays with arbitrary values. To improve the accuracy of the channel estimation both spatial and temporal correlations of wireless MIMO channels are exploited. Performances of proposed scheme are increases by simultaneous exploitation of MIMO channels.

Feng Wan et.al. [10]: To estimate MIMO-OFDM there is a presentation of semi-blind algorithm in this paper. There is an analysis of signal of second order which is received from sparse MIMO channels, result shows the correlation matrices of the received signal can expressed as MSTs (most significant taps) of sparse channel. Then after analyses is done which shows that new semi blind solution is not subject to the signal perturbation error when the sparse channel is a decimated version of a full finite impulse response channel.

Eric Pierre Simon et.al. [11]: For MIMO-OFDM system operating in a fast time varying environment novel pilot-aided algorithm is developed in this paper. Given algorithm can work with L-path channel model and the equivalent discrete-time channel model to estimate the path of CA and CFO. The algorithm performs estimation using extended Kalman filtering. The channel matrix can easily computed, and the data symbol is estimated without inter carrier interference (ICI) when the channel matrix is QR decomposed.

P. Sridhar et.al. [12] In this paper design of Channel Quality Estimation with Parallel Inter Carrier Interference (ICI) cancellation technique for MIMO-LTE-A networks. Initially (MLD-IS) scheme is applied to suppress the interfering links. Then in ICI cancellation process, a parallel interference cancellation (PIC) method and decision statistical combining (DSC) are utilized to cancel the ICI and improve data symbol detection. The channel state is estimated by means of (LMMSE) method.

Chenhao Qi et.al.[13]In this paper subspace orthogonal matching pursuit (SOMP) is proposed. SOMP first identifies the channel sparsity and then iteratively refines the sparse recovery result, which essentially combines the advantages of orthogonal matching pursuit (OMP) and subspace pursuit (SP). With frequency orthogonal random pilot placement, the technique is also extending to MIMO OFDM systems.

Bor-Sen Chen et.al. [14] In this paper by using a Takagi-Sugeno (T-S) fuzzy-based Kalman filter under the time varying velocity of the mobile station in a MIMO-OFDM system. The parameters of the AR process and the channel gain are simultaneously estimated by the proposed method and used for the decision-directed channel-tracking design, particularly in the fast-fading channel.

Po-Lin Chiu et.al.[15] This paper presents a modified interpolation-based QR decomposition algorithm for the grouped-ordering MIMO orthogonal frequency division multiplexing (OFDM) systems. This study proposes a modified algorithm that possesses a scalable property to save the power consumption for interpolation-based QR decomposition in the variable-rank MIMO scheme. It develops the general equations and a timing scheduling method for the hardware design of the proposed QR decomposition processor for the higher-dimension MIMO system. The processor supports 2 2, 2 4 and 4 4 QR-based MIMO detection for the 3GPP-LTE MIMO-OFDM system and achieves the throughput of 35.16 MQRD/s at its maximum clock rate 140.65 MHz.

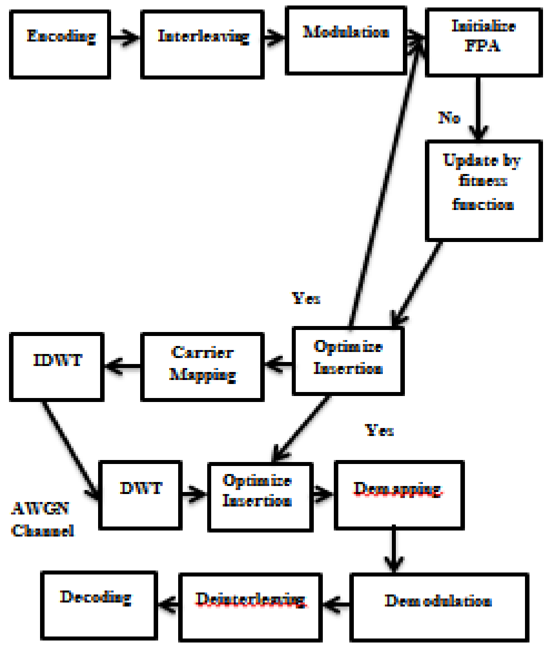
Wenbo Ding et.al. [16]: There is a introduction of time-frequency joint sparse channel estimation for (MIMO-OFDM) systems under the framework of structured compressive sensing (CS). The proposed scheme relies on a pseudo random preamble which is identical for all transmit antennas to acquire the partial common support by utilizing the sparse common support property of the MIMO channels. Simulated results show that the proposed scheme demonstrates better performance and higher spectral efficiency than the conventional MIMO-OFDM schemes.

Jin-Goog Kim et.al.[17]: This paper gives a method of obtaining the autocorrelation matrix to improve the performance of the subspace-based channel estimation method. There should be reduction in the number of received blocks from the exploitation of circulant properties of received signals which satisfy the persistency of excitation (POE) criterion for the input and decreases the residual error which affects the accuracy of the noise subspace. In simulation results, we demonstrate the efficiency of the proposed method.

Nina Wang et. al. [18]: In this paper, a novel sparse channel estimation method is proposed using sparse cognitive matching pursuit (SCMP) algorithm. Compared to other compressive algorithms in the state of art, the major innovation of the SCMP sparse channel estimation method (SCMP-SCE) is the ability of obtaining the accurate CSI without prior information of sparsity.

III. METHODOLOGY

In this methodology optimize the mapping in carrier mapping because it is optimize then reduce the sparsely and complexity of channel for noise reduction. For optimization use Flower pollination algorithm which global optimization the mapping and reduce BER.



Source of Procuring the Existing Data

The Software to be used, would include, the MATLAB R2016a and later versions possessing functions for fuzzy processing. MATLAB is a modern programming language environment: it has sophisticated data structures, contains built-in editing and debugging tools, and supports object-oriented programming. These factors make MATLAB an excellent tool for teaching and research. MATLAB has many advantages compared to conventional computer languages (e.g., C, FORTRAN) for solving technical problems. MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. The software package has been commercially available since 1984 and is now considered as a standard tool at most universities and industries worldwide. It has powerful built-in routines that enable a very wide variety of computations. It also has easy to use graphics commands that make the visualization of results immediately available. Specific applications are collected in packages referred to as toolbox. There are toolboxes for signal processing and we communication tool box.

IV. METHODOLOGY

Parameter used-

1. **SNR:** It stands for Signal to noise ratio.
2. **TTP:** It stands for total training power
3. **BER:** It stands for Bit-error-rate
4. **Channel sparsity**
5. **Normalised MSE(mean square error)**

Figure 1 shows the relation between TTP and average normalised MSE whereas Figure4 and 6 shows the relation between TTP and normalised MSE.

Figure 2 and 3 shows the relation between SNR and BER Figure5 shows the relation between the channel sparsity and MSE.

Figure 4.1 Result based on Monte-Carlo Simulations:

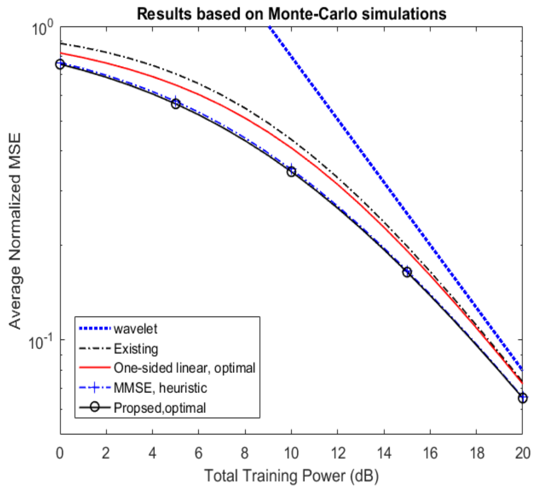


Figure 4.2 Rayleigh 100:

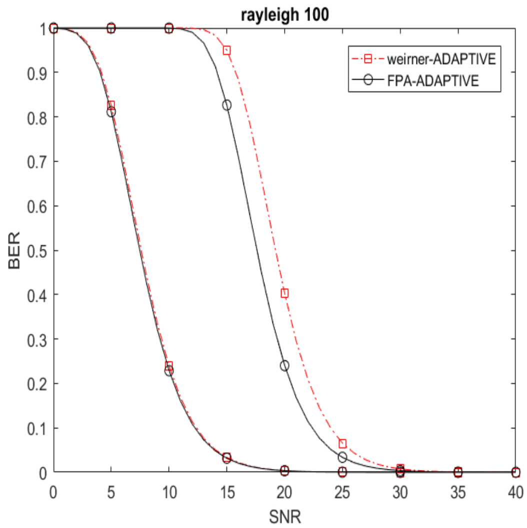


Figure 4.3 Rayleigh 1000:

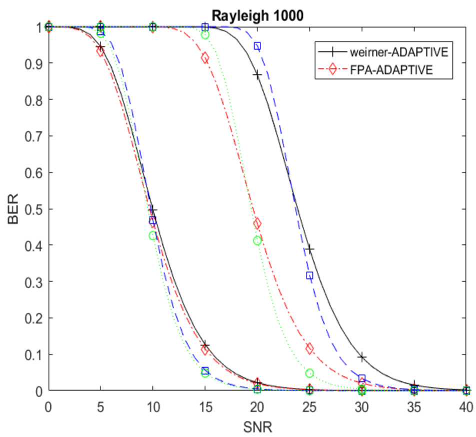


Figure 4.4 Results based on theoretical formulas:

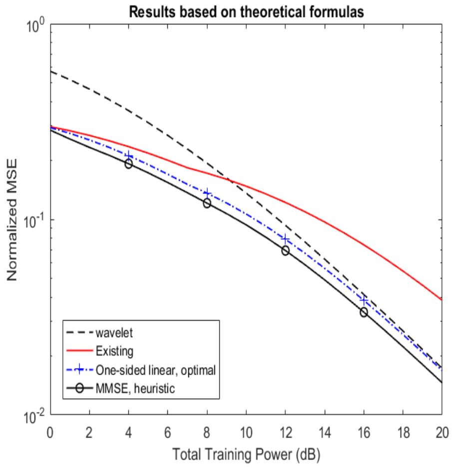


Figure 4.5Channel Sparsity:

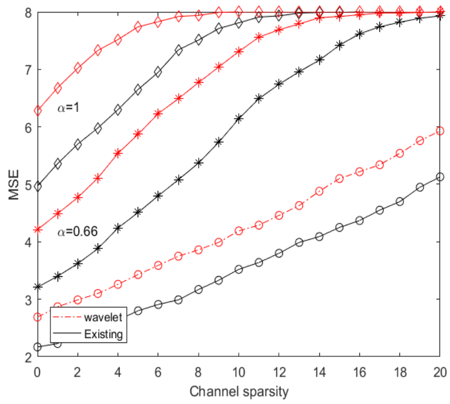
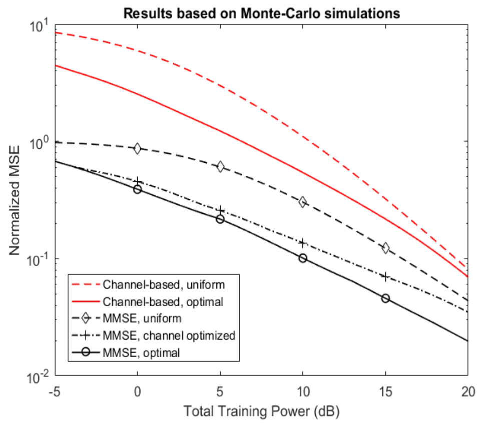


Figure 4.6 Results based on Monte-Carlo Simulations:



V. RESULT ANALYSIS

In above figures comes after simulation of LTE n sparsely. IN figure 4.1 depict the mean squared error which increase in normal heuristic method but reduce in optimization because optimization refine the wavelet transformation and reduce the inference between parallel channels. In figure 4.3 &4.3 communication on Rayleigh channel in noise in ratio 100 and 1000 but BER reduce in FPA wavelet optimization. In figure 4.4, 4.5 & 4.6 in these graph increase the sparsely but FPA show effective BER compare to wavelet method.

VI. REFERENCES

[1] https://en.wikipedia.org/wiki/MIMO-OFDM.

[2] http://140.117.160.140/CommEduImp/pdfdownload/9222/BBIC-6-ChannelEstimation.pdf.

[3] https://pdfs.semanticscholar.org/f3fa/327521f2dcbeb87d81a17b8bcc216d108cbb.pdf

[4] http://wireilla.com/papers/ijcsa/V3N6/3613ijcsa05.pdf

[5] https://www.google.co.in/search?q=basic+structure+mimo+ofdm+system&rlz=1C1DFOC_enIN625IN627&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiJ78Kt0dPSAhUBPo8KHcK9B_IQ_AUIBigB&biw=1366&bih=613#imgrc=D-hfAxOL2GqaCM:

[6] https://www.google.co.in/search?q=Blocktype+pilot+channel+estimation&rlz=1C1DFOC_enIN625IN627&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjJlPvJ0NPSAhUmSY8KHXIHDgcQ_AUIBigB&biw=1366&bih=613#imgrc=hVILHpiCthOh3M:

[7] https://www.google.co.in/search?q=CombType+Pilot+Channel+Estimation&rlz=1C1DFOC_enIN625IN627&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiZ7uzzz9PSAhXDQo8KHe4_Dg8Q_AUICCgB&biw=1366&bih=613#imgrc=63k04fSsC3YhQM:

[8] Gao, Zhen, et al. "Super-resolution sparse MIMO-OFDM channel estimation based on spatial and temporal correlations." *IEEE communications letters* 18.7 (2014): 1266-1269.

[9] http://www.scholarpedia.org/article/Metaheuristic_Optimization

[10] Wan, Feng, Wei-Ping Zhu, and M. N. S. Swamy. "Semiblind sparse channel estimation for MIMO-OFDM systems." *IEEE Transactions on Vehicular Technology* 60.6 (2011): 2569-2582.

[11] Simon, Eric Pierre, et al. "Joint carrier frequency offset and fast time-varying channel estimation for MIMO-OFDM systems." *IEEE Transactions on Vehicular Technology* 60.3 (2011): 955-965.

[12] Sridhar, P., and M. R. Sumalatha. "Interference cancellation and channel estimation for MIMO-LTE-A Networks." *Wireless Communications, Signal Processing and Networking (WiSPNET), International Conference on*. IEEE, 2016.

[13] Qi, Chenhao, and Lenan Wu. "A hybrid compressed sensing algorithm for sparse channel estimation in MIMO OFDM systems." *Acoustics, Speech and Signal Processing (ICASSP), 2011 IEEE International Conference on*.IEEE, 2011.

[14] Chen, Bor-Sen, Chang-Yi Yang, and Wei-Ji Liao. "Robust fast time-varying multipath fading channel estimation and equalization for MIMO-OFDM systems via a fuzzy method." *IEEE Transactions on vehicular technology* 61.4 (2012): 1599-1609.

[15] Chiu, Po-Lin, et al. "Interpolation-based QR decomposition and channel estimation processor for MIMO-OFDM system." *IEEE Transactions on Circuits and Systems I: Regular Papers* 58.5 (2011): 1129-1141.

[16] Ding, Wenbo, et al. "Time–frequency joint sparse channel estimation for MIMO-OFDM systems." *IEEE Communications Letters* 19.1 (2015): 58-61.

[17] Kim, Jin-Goog, Jun-Han Oh, and Jong-Tae Lim. "Subspace-based channel estimation for MIMO-OFDM systems with few received blocks." *IEEE Signal Processing Letters* 19.7 (2012): 435-438.

[18] Wang, Nina, et al. "A novel sparse channel estimation method for multipath MIMO-OFDM systems." *Vehicular Technology Conference (VTC Fall), 2011 IEEE*.IEEE, 2011.

[19] G. Eason, B. Noble, and I.N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

[20] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.

[21] I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.

[22] K. Elissa, "Title of paper if known," unpublished.

[23] R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[24] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[25] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.