Channel Prediction with Kalman filter Optimization by Bacterial Foraging Approach

Richa Arora[1], Er. Nitin Kumar[2], Er. Harmeet Singh[3]
[1]Student, ECE Deptt Universal Group of Institution, Lalru, Punjab
[2]Assistant professor, ECE Deptt Universal Group of Institution, Lalru, Punjab
[3]HOD, ECE Deptt Universal Group of Institution, Lalru, Punjab

Abstract- The basic idea underlying channel systems is the division of the available frequency spectrum into several subcarriers. To obtain a high spectral efficiency, the frequency responses of the subcarriers are overlapping and orthogonal, hence the name channel. This orthogonally can be completely maintained with a small price in a loss in SNR, even though the signal passes through a time dispersive fading channel, by introducing a cyclic prefix (CP). In channel prediction or estimation There are two main problems in designing channel estimators for wireless OFDM systems. The first problem is the arrangement of pilot information, where pilot means the reference signal used by both transmitters and receivers. The second problem is the design of an estimator with both low complexity and good channel tracking ability. The two problems are interconnected. In general, the fading channel systems). The optimal channel estimator in terms of mean-square error is based on 2D kalman filter interpolation. Unfortunately, such a 2D estimator structure is too complex for practical implementation. The combination of high data rates and low bit error rates in channel systems necessitates the use of estimators that have both low complexity and high accuracy, In this research propose the bacterial foraging optimization method for channel estimation , which iterative predict BER according to SNR and reduce BER by optimization threshold.

Keywords— *OFDM,* Cyclic prefix, BER, SNR

I. Introduction

Multiple-input, multiple-output orthogonal frequency-division multiplexing (MIMO-OFDM) is the prevailing air interface for 4G and 5G broadband remote correspondences. It consolidates multiple-input, multiple-output (MIMO) innovation, which increases limit by transmitting distinctive flags over multiple reception apparatuses, and orthogonal frequency-division multiplexing (OFDM), which separates a radio channel into countless dispersed sub channels to give more solid correspondences at high speeds. Research led amid the mid-1990s demonstrated that while MIMO can be utilized with other mainstream air interfaces, for example, time-division multiple access (TDMA) and code-division multiple access (CDMA), the mix of MIMO and OFDM is most useful at higher data rates [1]. The measure of data transported over correspondence systems develops quickly. The record sizes increment, as well as expansive data transfer capacity required applications, for example, video on request and video conferencing requires expanding information rates to move the data in a sensible measure of time or to build up constant associations. To help this sort of administrations, broadband correspondence systems are required. Large-scale penetration of wireless systems into our day by day lives will require critical diminishments in cost and increments in bit rate or potentially framework limit. Later data hypothetical examinations have uncovered that the multipath wireless channel is fit for colossal limits, gave that multipath diffusing is adequately rich and is legitimately misused through the utilization of the spatial measurement . Suitable answers for abusing the multipath appropriately, could be founded on new procedures that as of late showed up in writing, which depend on Multiple Input Multiple Output (MIMO) innovation. Fundamentally, these procedures transmit distinctive information streams on various transmit reception apparatuses at the same time. By planning a suitable handling design to handle these parallel surges of information, the information rate or potentially the Signal-to-Noise Ratio (SNR) execution can be expanded. Multiple Input Multiple Output (MIMO) systems are frequently consolidated with a frightfully productive transmission strategy called Orthogonal Frequency Division Multiplexing (OFDM) to stay away from Inter Symbol Interference (ISI). Channel estimation is a significant and testing issue in reasonable demodulation. Its exactness has huge effect on the general execution of the MIMOOFDM framework. The computerized source is ordinarily ensured by channel coding and interleaved against blurring marvel, after which the twofold signal is adjusted and transmitted over multipath blurring channel. Additive noise is included and the aggregate signal is gotten. Due to the multipath channel there is some intersymbol interference (ISI) in the got signal. In this way a signal detector has to know channel drive reaction (CIR) qualities to guarantee fruitful evacuation of ISI. The channel estimation in MIMO-OFDM framework is more confused in examination with SISO framework because of synchronous transmission of signal from distinctive radio wires that reason co-channel interference. Calculation with high exactness is a fundamental prerequisite to accomplish maximum capacity execution of the MIMO-OFDM framework. An extensive number of channel estimation techniques have as of now been examined by various specialists for MIMO systems [2].

Block-type based channel estimation: In block-type pilot based channel estimation, OFDM channel estimation images are transmitted occasionally, in which all sub-transporters are utilized as pilots. On the off chance that the channel is steady amid the block, there will be no channel estimation mistake since the pilots are sent at all transporters. Fast fading channel, where the channel changes between adjoining OFDM images, the pilots are transmitted constantly however with a notwithstanding separating on the subcarriers, speaking to a comb type pilot channel estimation.

$$S_t \leq 1/f_{Doppler}$$

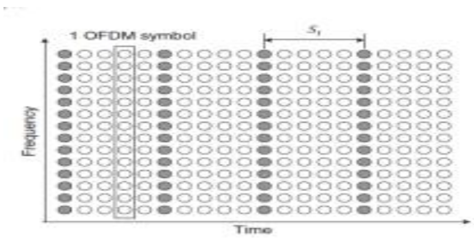


Fig.1: Block-type based channel estimation

Comb Type based channel estimation: Comb-type pilot game plan is delineated in Fig.2. In this type, each OFDM symbol has pilot tones at the periodically-found subcarriers, which are utilized for a frequency-domain interpolation to gauge the channel along the frequency pivot. As the intelligence data transfer capacity is controlled by an opposite of the most extreme defer spread S_{max}, the pilot symbol period must fulfil the accompanying disparity:

$$S_f = 1/\sigma_{max} \text{ [3]}$$

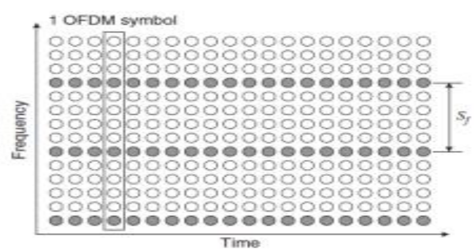


Fig.2: Comb Type Based channel estimation

II. LITERATURE REVIEW

S. R. Aryal et.al. [4] MIMO-OFDM satisfies the high information rate prerequisite through spatial multiplexing gain and enhanced connection unwavering quality because of antenna diversity gain. With this procedure, both impedance decrease and greatest diversity gain are accomplished by expanding number of antennae on either side. Gotten motion in MIMO-OFDM framework is generally mutilated by multipath blurring. In request to recuperate the transmitted flag accurately, channel impact must be evaluated and repaired at beneficiary. In this paper the execution assessing parameter mean square error and image error rate of least square error, least mean square error and DFT based channel estimation strategies are evaluated and suitable arrangement is suggested. Moreover, correlation among their qualities is reproduced in MATLAB and valuable conclusion is depicted.

Erik G. Larsson et.al. [5] In this paper they have highlighted the huge capability of enormous MIMO systems as a key empowering innovation for future past 4G cellular systems. The innovation offers colossal preferences as far as energy efficiency, spectral efficiency, robustness and reliability. It allows for the utilization of low-cost hardware both at the base station and also at the portable unit side. At the base station the utilization of costly and capable, yet control wasteful, hardware is supplanted by enormous utilization of parallel low-cost, low-control units that work reasonably together. There are still difficulties ahead to understand the maximum capacity of the innovation, e.g., with regards to computational complexity, acknowledgment of distributed processing algorithms, and synchronization of the recieving wire units.

Zhen Gao et.al. [6] This letter proposes a parametric sparse multiple input multiple output (MIMO)- OFDM channel estimation conspire in view of the finite rate of innovation (FRI) hypothesis, whereby super-determination assessments of path delays with self-assertive qualities can be accomplished. Then, both the spatial and fleeting connections of wireless MIMO channels are abused to enhance the exactness of the channel estimation. For open air correspondence situations, where wireless channels are sparse in nature, path delays of various transmit-get reception apparatus sets share a typical sparse example because of the spatial connection of MIMO channels. In the meantime, the channel sparse example is almost unaltered amid a few adjoining OFDM images due to the worldly connection of MIMO channels. By at the same time abusing those MIMO channel qualities, the proposed conspire performs superior to anything existing cutting edge plans. Moreover, by joint preparing of signs related with diverse antennas, the pilot overhead can be decreased under the structure of the FRI hypothesis.

Haifan Yin et.al. [7] This paper tends to the issue of channel estimation in multi-cell interference-limited cellular networks. They consider frameworks utilizing multiple antennas and are intrigued in both the limited and large-scale antenna number administrations (so-called "enormous MIMO"). Such frameworks manage the multi-cell interference by method for per-cell beamforming connected at each base station. Channel estimation in such networks, which is known to be hampered by the pilot contamination impact, constitute a noteworthy bottleneck for general execution. They exhibit a novel approach which handles this issue by empowering a low-rate coordination between cells amid the channel estimation stage itself. The coordination makes utilization of the extra second-arrange factual data about the client channels, which are appeared to offer intense method for separating crosswise over meddling clients with even unequivocally associated pilot groupings.

EleftheriosKofidi et.al. [8] A specific sort of FBMC, the supposed FBMC/OQAM or OFDM/OQAM framework, comprising of heartbeat molded OFDM conveying balance QAM (OQAM) symbols, has gotten expanding consideration due to, among different components, its higher spectral efficiency and implementation effortlessness. It endures, notwithstanding, from an imaginary inter-carrier/inter-symbol interference that muddles flag preparing undertakings, for example, channel estimation. This paper concentrates on channel estimation for OFDM/OQAM frameworks in light of a known preamble. An audit of the current preamble structures and related estimation strategies is given, for both single-(SISO) and multichannel le-antenna (MIMO) frameworks. The different preambles are looked at by means of re-enactments in both gently and very frequency selective channels.

Song Noh et.al. [9] In this paper, the issue of pilot beam pattern outline for direct estimation in huge multiple-input multiple output frameworks with a substantial number of transmit radio wires at the base station is considered, and another calculation for pilot beam pattern plan for optimal channel estimation is proposed under the suspicion that the channel is a stationary GaussMarkov random process. The proposed calculation outlines the pilot beam pattern sequentially by abusing the properties of Kalman filtering and the related forecast blunder covariance matrices and furthermore the channel insights, for example, spatial and transient channel relationship. The subsequent outline produces a sequentially-optimal grouping of pilot beam patterns with low unpredictability for a given arrangement of framework parameters.

Er. AbhinandanBharti et.al. [10] The present work investigates the adjustment strategies, the OFDM what's more, MIMO strategies and presents the channel estimation idea alongside tossing light on the adaptive filters. The current framework fused the utilization of Leaky LMS channel estimation strategy. This introduces work proposed the utilization of LMS and RMS in channel estimation. The proposed approach has been actualized in MATLAB. The outcomes are thought about to the current framework and it has been watched that the proposed approach is indicating better execution in the methods for BER.

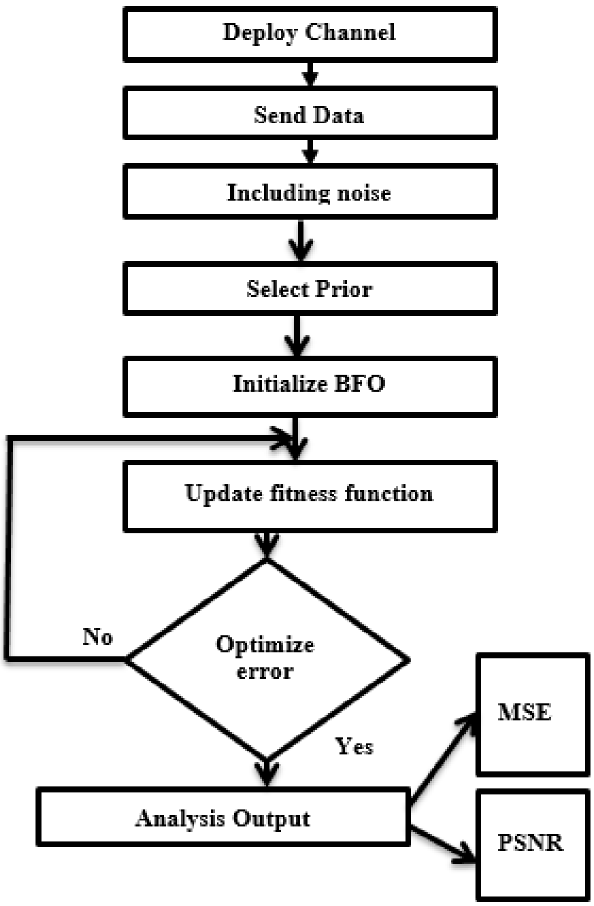
Yinsheng Liu et.al. [11] In this paper, they will show overview on channel estimation for OFDM. This study will initially audit conventional channel estimation approaches in view of channel frequency response (CFR). Parametric model (PM)- based channel estimation, which is especially appropriate for meager channels, will be additionally explored in this overview. Following the achievement of turbo codes and low-density parity check (LDPC) codes, iterative handling has been broadly embraced in the plan of collectors; what's more, iterative channel estimation has gotten a ton of consideration since that time. Iterative channel estimation will be underlined in this review as the rising iterative beneficiary enhances framework execution fundamentally.

Jung-Lang Yu et.al. [12] In this paper, the blind subspace channel estimation utilizing the block matrix scheme is proposed for multiple-input multiple-output (MIMO) orthogonal frequency division multiplexing (OFDM) frameworks. In view of the Toeplitz structure, the block matrix scheme gathers a gathering of the got OFDM images into a vector and after that allotments it into a set of proportionate images. The quantity of equal images is about N times of OFDM images, where N is the span of FFT operation. With those equal images, the proposed blind subspace channel estimation can focalize inside a little measure of OFDM images. The identifiability of the proposed channel estimation is inspected that the channel matrix is resolved up to an ambiguity matrix. In addition, the semi-blind channel estimation is additionally researched by consolidating few pilot groupings with the subspace strategy.

MuhammetNuriSeyman et.al. [13] In this study, they propose feed-forward multilayered perceptron (MLP) neural network trained with the Levenberg–Marquardt algorithm to estimate channel parameters in MIMO–OFDM systems. Bit error rate (BER) and mean square error (MSE) performances of least square (LS) and least mean square error (LMS) algorithms are also compared to their proposed neural network to evaluate the performances. Neural network channel estimator has got much better performance than LS and LMS algorithms. Furthermore it doesn't need channel statistics and sending pilot tones, contrary to classical algorithms.

Guan Gui et.al. [14] In this paper, proposed an ASCE strategy utilizing inadequate NLMS and meager NLMF calculations for time-variant MISO-OFDM frameworks. As a matter of first importance, framework display was figured to guarantee every MISO channel vector can be assessed. Furthermore, cost elements of the two proposed techniques were built utilizing meager punishments. Afterward, MISO channel vector was assessed utilizing ASCE strategy. Reenactment comes about show that the proposed ASCE-NLMS technique accomplishes a superior execution than the standard ACE-NLMS technique without much increment in computational complexity.

III. PROPOSED METHODOLOGY



Step1: Deploy the channel.
Step2: Send the data to the channel.
Step3: Noise is included in the data.
Step4: Prior is selected.
Step5: Bacterial Foraging Optimization is initialized.
Step6: When BFO is initialized then fitness functions are updated.
Step7: After updated the fitness function one condition is applied if error is optimized then analysis the output in which MSE and PSNR is calculated, if error is not optimized then go to the step6.

IV. RESULTS

Fig3. Graph between Probability of detection and Probability of false alarm.

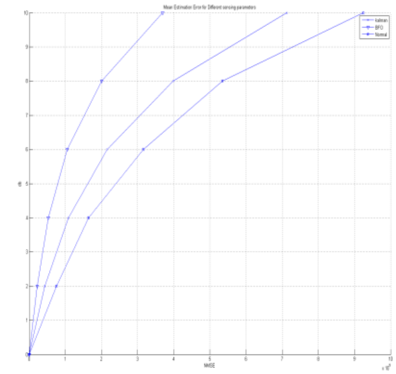


Fig4. Graph between Probability of false alarm and throughput

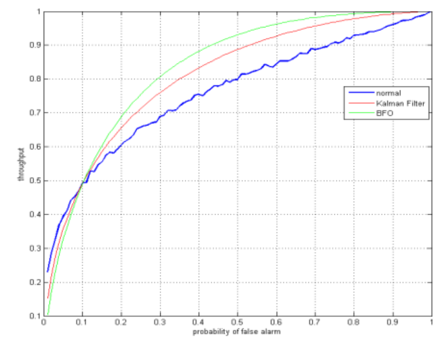


Fig5. Graph between Total Error rate and Threshold of Kalman filter.

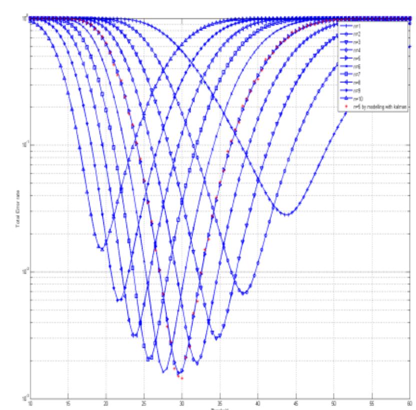
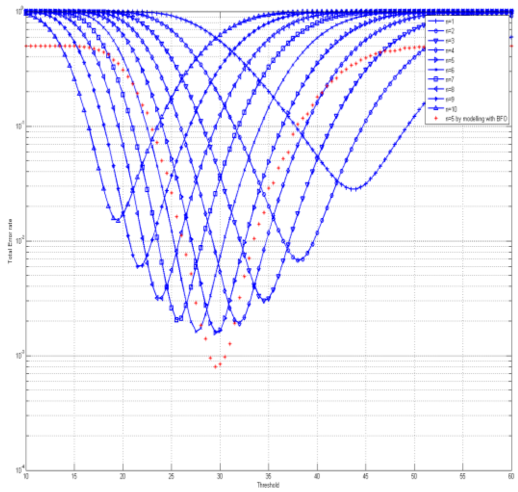


Fig6. Graph between Total Error rate and Threshold of BFO



V. REFERNCES

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

[2]. Bhoyar, D. B., and Vaishali B. Niranjane. "Channel estimation for MIMO-OFDM systems." *International Journal of Engineering Research and Applications (IJERA)* 2.1 (2013): 044-050.

[3]. https://www.ijarcce.com/upload/2015/may-15/IJARCCE%20135.pdf

[4]. Aryal, S. R., and H. Dhungana. "Channel Estimation in MIMO-OFDM System." *Nepal Journal of Science and Technology* 14.2 (2014): 97-102.

[5]. Larsson, Erik G., et al. "Massive MIMO for next generation wireless systems." *IEEE Communications Magazine* 52.2 (2014): 186-195.

[6]. 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.

[7]. Yin, Haifan, et al. "A coordinated approach to channel estimation in large-scale multiple-antenna systems." *IEEE Journal on Selected Areas in Communications* 31.2 (2013): 264-273.

[8]. Kofidis, Eleftherios, et al. "Preamble-based channel estimation in OFDM/OQAM systems: A review." *Signal Processing* 93.7 (2013): 2038-2054.

[9]. Noh, Song, et al. "Pilot beam pattern design for channel estimation in massive MIMO systems." *IEEE Journal of Selected Topics in Signal Processing* 8.5 (2014): 787-801.

[10]. Bhoyar, Dinesh B., et al. "Leaky least mean square (LLMS) algorithm for channel estimation in BPSK-QPSK-PSK MIMO-OFDM system." *Automation, Computing, Communication, Control and Compressed Sensing (iMac4s), 2013 International Multi-Conference on*.IEEE, 2013.

[11]. Liu, Yinsheng, et al. "Channel estimation for OFDM." *IEEE Communications Surveys & Tutorials* 16.4 (2014): 1891-1908.

[12]. Yu, Jung-Lang, Biling Zhang, and Po-Ting Chen. "Blind and semi-blind channel estimation with fast convergence for MIMO-OFDM systems." *Signal Processing* 95 (2014): 1-9.

[13]. Seyman, MuhammetNuri, and NecmiTaşPıNar. "Channel estimation based on neural network in space time block coded MIMO–OFDM system." *Digital Signal Processing* 23.1 (2013): 275-280.

[14]. Gui, Guan, and Fumiyuki Adachi. "Adaptive sparse channel estimation for time-variant MIMO-OFDM systems." *Wireless Communications and Mobile Computing Conference (IWCMC), 2013 9th International*.IEEE, 2013.