PERFORMANCE ANALYSIS OF MIMO-OFDM SYSTEM IN 4G TECHNOLOGIES: A REVIEW

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Abstract: In Wireless communication, it is essential to build up an efficient technique to diminish the effect of fading and Intersymbol interference occurs due to multipath propagation. By combining the multiple-input multiple-output (MIMO) with space time coded orthogonal frequency division multiplexing (OFDM), which provides large system capacity without additional power or bandwidth utilization and helps to improve the fading and ISI for high speed wireless communication systems. So, MIMO OFDM is a technology which is broadly used in High-performance 4th generation (4G) broadband wireless communication system. This paper represents MIMO-OFDM technology used in 4G wireless system based on neuro-fuzzy approach and machine learning approach which can enhance the performance of MIMO OFDM system as compare to the general approach.

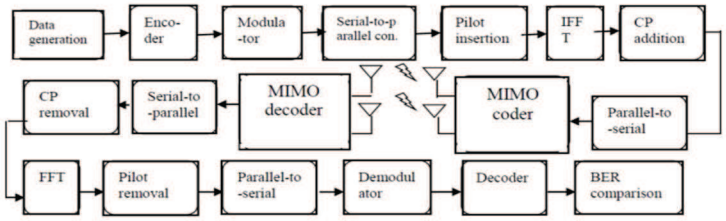
Keywords: MIMO-OFDM System, 4G Technology, Fuzzy Logic Approach.

Introduction: The next Fourth generation (4G) mobile communication systems are likely to solve remaining problems of third generation(3G) systems .4G wireless system was originally developed by the Defense Advanced Research Projects Agency (DARPA). 4G is a technology in which user will be in control [3].They will be able to decide the system even the right terminal for each application and for each mobility and coverage. This paper presents MIMO-OFDM technology in 4G wireless system.

MIMO System: The demand of forthcoming wireless communication systems is to provide high data rate wireless access at high quality of service. But these propagation conditions are unfavorable due to fading caused by destructive addition of multi-path components and interference from other users, so there is a need to increase spectral efficiency and to improve link reliability of the system. Multiple-input multiple-output (MIMO) wireless technology provides higher spectral efficiency via spatial multiplexing gain and better link reliability due to antenna diversity gain. In addition, the MIMO system contains multiple antennas both the sides of transmitter and receiver and provides high capacity in wireless communication system. MIMO technology provides remarkable increases in throughputand link range without use of additional bandwidth or transmit power. This is achieved by increasing the spectral efficiency and link reliability or diversity. Because of all these properties, MIMO is an important part of recentwireless communication standards such as Wi-Fi, WiMAX, 3GPPLTE, 3GPP HSPA+, and 4G systems.

OFDM System: OFDM is based on the frequency division multiplexing (FDM), but is utilized as digital modulation scheme through DFT. Transmitted data stream is split into several parallel streams. So it divide the wideband frequency channel into a number of parallel narrowband sub channels, and each low-rate data streams is transmitted over one sub channel. The major use of advantage of OFDM is its ability to deal with harsh channel conditions such as, multipath fading and narrowband interference, without use of complicated equalization filters.

MIMO-OFDM system: MIMO can also be used with OFDM, and it is part of the IEEE 802.16 standard and IEEE 802.11.MIMO-OFDM systems provide more choice in space, time, and frequency. MIMO system using OFDM technique has become a promising method for high data-rate wireless communication system in which the channel is dispersive in both frequency and time domains. [12]



MIMO-OFDM System

Background: Eduardo et al. [1] has examined the improvements in the performance of a broadband OFDM- system using MIMO technology. OFDM with an additional cyclic prefix(CP) is a multicarrier

technique which is capable of diminishes ISI and improves the spectral efficiency of wireless systems. So, MIMO systems assure the increase of the capacity with adequate bit error rate (BER). The combination of MIMO OFDM technology provides high spectral efficiency and high data rate which seems to be a good choice for future wireless systems.

Sheng et al. [2] has investigated a new method of adaptive modulation and power management which improve communication performance in MIMO-OFDM system. It adopts the realization of a Signal-to-Interference-Noise-Ratio (SINR) threshold and MQAM-MPSK hybrid modulation configuration for every parallel sub channel. It saves more power and gets better BER (Bit Error Rate) in comparison to adaptive modulations techniques, for example 16QAM and QPSK. It provides higher processing gain and saves more power by maintaining the same BER.

Nirmalendu et al. [4] has proposed a systems, a multidimensional diversity (time, frequency, space and modulation diversities)can be used for better bit error performance in AWGN channel for with and withoutpadding and convolution coding. The performance of the proposed OFDM-MIMO(STC/MRC)system for different antenna structures and propagation conditions was analyzed which results higher spectral efficiency because no orthogonal transmitted and received co-channel signals are separated by decorrelation due to multipath propagation. The result shows that proposed system fare capable of enhancing the bit rate and maximizing the throughput efficiency without increasing transmit power or required bandwidth with STC/MRC processing at the receiver. As by increasing the number of subcarrier using FFT approach which provides better accuracy due to higher number of points. So, data rate will also increase. Now by changing receiver elements and keeping the transmitter elements constant, for the case of with and without padding for BPSK and QPSK modulation technique, as SNR increases BER and PER improves. So data rate increases, which is mainly due to its receiver diversity technique. For with coding OFDM-MIMO (STC/MRC) system overall performance of all modulation techniques is much better than without coding. But the performance of QPSK is better than BPSK for higher values of SNR. The overall performance of BPSK for OFDM-MIMO (STC/MRC) system can improve for higher values of FFT points but the performance of QPSK almost remains constant.

P. Sunil et al. [5] has analyzed the Bit Error Rate (BER) of Rayleigh Fading Channels in MIMO-OFDM systems using BPSK and QPSK Modulation techniques which result that the number of errors in the BPSK is less when compared to the number of errors in the QPSK modulation technique. Hence the performance study of Rayleigh Fading Channels in a general communication system under BPSK modulation scheme is found to be more efficient.

Kavita Devi1 and Dr. Rajneesh Talwar [6] have described MIMO OFDMA technique to improve the capacity and diversity in cellular system.One of the characteristic that make OFDM the primary choice for 4Gis its compatibility with MIMO, because MIMO has a very high capacity, data rate, and coverage aspects. MIMO is better than SISO in terms of diversity gain and MIMO in combination with OFDM used in 4G communication to increase data capacity.

Parvathi et al. [7] has proposed that Fading occurs in wireless system is equivalent to burst error in wired system. So the forward error correcting codes developed for wired channel which can be used for wireless fading channel. This work described by considering various coding and symbol mapping schemes under flat fading condition, significant enhancement in bit error performance and coding gain can be achieved by MIMO-STBC technique and in the case of frequency-selective fading, MIMO-STBC-OFDM technique with various coding and symbol mapping schemes, offers improvement in error performance by eliminating the effects of ISI.

V.R.Balaji et al. [8] has proposed design of four Transmitter antenna based on STFC-OFDM system. In mobile communication system, the wireless channel is time varying due to the mobility of the wireless system and multipath propagation. To improve the performance of MIMO OFDM in the double selective fading channel, the design of four transmitter antenna based space-time-frequency coded OFDM scheme is introduced in this work for enhancing the performance.

WEI ZHANG et al. [9] provide a general idea of space-time coding (STC), space-frequency coding (SFC), and space-time-frequency coding (STFC) for MIMO-OFDM wireless systems. It was shown that orthogonal ST-coded OFDM has a simple implementation which provides a minimum decoding complexity, but do not provide multipath diversity and high data rate. The SF-coded OFDM with signal space diversity technique can provide the maximum diversity and full rate over multipath fading channels, at the cost of a high decoding complexity. For block-fading channels, STF-coded OFDM can provide full rate along with full diversity in space, time, and frequency.

Md. Mejbaul et al. [10] they proposed performance valuation of Alamouti's space-time block coded (ASTBC) MIMO-OFDM systems covering channel capacity, coding scheme, channel model and diversity gain. This model of capacity is derived for random, deterministic and correlated Rayleigh fading

channels. The channel capacity increases with the number of antenna added to the system due to the more diversity gain of Alamouti's code. At the higher SNR value, independent and identically distributed channel capacity outperforms the correlated channel capacity. But at low SNR value, correlated channel capacity outperforms the independent and identically distributed channel capacity.

M. N. Seyman and N. Taspinar [11] haveproposed channel estimation inspace-time block coded MIMO-OFDM systems based on the adaptive neuro-fuzzy inference system (ANFIS), by using learning capability of ANFIS the network is trained by correct channel state information, then this trained network used as a channel estimator. This estimator performs better than the LS and LMS algorithms. The LMS performs not as good as than ANFIS. According to the simulation results channel estimator based on ANFIS performs better than classical algorithms.

G. Joselin Retna Kumar and K.S. Shaji [12]have proposed an Enhanced Channel Estimation Technique for MIMO-OFDM Based Communications Using NeuroFuzzy Approach. The channel model has been described by a nonlinearstate-space dynamic equation. The states of the nonlinear channel parameter system include the time-varying channel gains and the dynamics of the channel. By using learning capability of ANFIS the network is trained by correct channel state information, then this trained network used as a channel estimator. This estimator performs better than the LS and LMS algorithms.

Proposed Work: The performance of MIMO OFDM system can be enhanced by using neuro-fuzzy approach and machine learning approach such as Bayes Net, Naive Byes and Decision trees for practical implementation. By using these techniques we can improve the quality of service(QoS), data rate, Signal to Noise Ratio (SNR), Bit Error Rate (BER), error detection, fading and fuzzy based MMSE equalizer better than the conventional MMSE equalizer which improves the LS and LMS algorithms, which further reduces the complexity of the system and increases the capacity of the MIMO OFDM system.

Conclusion: From the above work it is shown that MIMO OFDM is a technology which is broadly used in High-performance 4th generation (4G) broadband wireless communication system. In general MIMO OFDM system provides the high spectral efficiency, high data rate, maximizes diversity of the system and increases the link reliability but further by using neuro-fuzzy approach and machine learning approach, the quality of service (QoS), data rate, Signal to Noise Ratio (SNR), error detection, Bit Error Rate (BER), Inter Symbol Interference (ISI), fading and capacity of the MIMO OFDM system can be improved.

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