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Performance Improvement Based on MIMO-OFDM Using Space Time Block Coding with Pilot Pattern in the Hetnet System

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ABSTRACT:

The combination of multiple-input multiple-output (MIMO) signal processing with orthogonal frequency division multiplexing (OFDM) is regarded as a promising solution for enhancing the data rates of next-generation wireless communication systems operating in frequency-selective fading environments. It can optimize the better performance using various combination of transmitter antenna and receiver antenna with different modulation scheme. The main objective of research work is to optimized good value of SNR, BER and throughput by using proposed space time block coding with pilot pattern in het-net system.Modulation/Demodulation schemes are the distinct building blocks in digital communication system. Digital data is represented by exhaustible number of digital signals and it has finite number of periods and each periods are encodes in equal number of digital bits. QAM techniques can be extending to implement the modulation and demodulation schemes. The low power QAM modulator and demodulator are expound by consider the data values inside the memory as per the design data.Wireless communication framework is taken into thought for the reenactment and change inside the execution of the present framework. The current remote correspondence framework is receiving MIMO with M-QAM. Alamouti STBC is applied to make a framework higher order style. However amid this work the arranged framework is embracing numerous information different yield (MIMO) framework that is best for solid conveyance of information from supply to goal, to broaden the insurance and rate procedure receive M-QAM (Upto 1024-PSK) and to accomplish higher piece mistake likelihood the Alamouti STBC is coordinate with the specified framework.

Keywords: MIMO,OFDM,QAM & STBC.

Introduction:

Wireless correspondence, or some of the time just remote, is the exchange of data or power between at least two focuses that are not associated by an electrical conveyor. The most widely recognized remote advancements utilize radio waves. It envelops different kinds of settled, versatile, and compact applications, including two-way radios, cell phones, individual computerized aides (PDAs), and remote systems administration. Orthogonal frequency division multiplexing (OFDM) is a procedure, strategy or plan for advanced multi-transporter regulation utilizing numerous firmly divided subcarriers - a formerly tweaked flag balanced into another flag of higher frequency and transfer speed. multi-reception apparatus MIMO (or Single client MIMO) innovation has been created and executed in a few norms, e.g., 802.11n items.

Orthogonal frequency division multiplexing (OFDM) is a strategy for encoding advanced information on various bearer frequencies. OFDM has formed into a well-known plan for wideband advanced correspondence, utilized as a part of uses, for example, computerized TV and sound telecom, DSL web get to, remote systems, control line systems, and 4G portable interchanges.

The raising solicitations for quick and strong remote trades have nudged change of multi-input– multi output (MIMO) systems with different radio wires at each transmitter and recipient sides. To viably gather the capacity and collection increments practical by MIMO channels, different space-time continuum process procedures have been created, for instance, Ringer Labs layered space-time continuum models and orthogonal space- time continuum piece codes, to give a few cases.

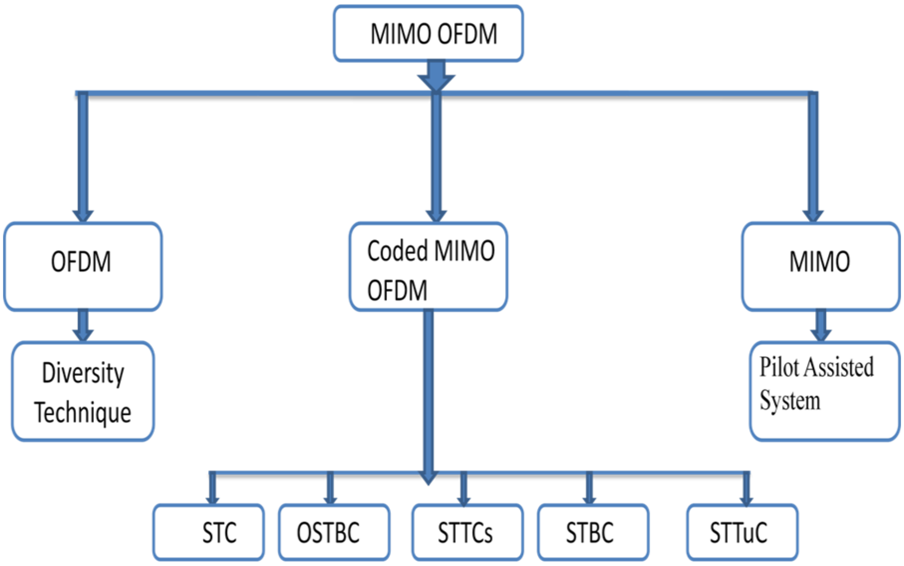

Fig1.1 classification of MIMO-OFDM

OBJECTIVE OF PAPER

The combination of multiple-input multiple-output (MIMO) signal processing with orthogonal frequency division multiplexing (OFDM) is regarded as a promising solution for enhancing the data rates of next-generation wireless communication systems operating in frequency-selective fading environments. It can optimize the better performance using various combination of transmitter antenna and receiver antenna with different modulation scheme. The main objective of research work is to optimized good value of SNR, BER and throughput by using proposed space time block coding with pilot pattern in het-net system.

Consider an OFDM communication system using M_T transmit antennas (Tx) and M_R receive antennas (Rx) for a downlink communication. Such a system could be implemented for the M_T transmit antennas using a space-time (ST) encoder which takes Q data complex symbols and transforms them to a (M_T,T) output matrix according to the ST block coding (STBC) scheme. The ST STBC coding rate is then defined by $L=Q/T$. Figure 3.1 depicts the transmitter modules. Information bits b_k are first channel encoded with a convolutional encoder of coding rate R, randomly interleaved, and fed directly to a quadrature amplitude modulation (QAM) module which assigns B bits for each of the complex constellation points. Therefore, each group $\mathbf{s}=[s_1,\ldots,s_Q]$ of Q complex symbols s_q becomes the input of the STBC encoder. Let $\mathbf{X}=[x_{i,t}]$ where $x_{i,t}$ $(i=1,\ldots,M_T;\ t=1,\ldots,T)$ be the output of STBC encoder. This output is then fed to M_T OFDM modulators, each using N subcarriers.

Since It assume a frequency domain transmission, the signal received on the subcarrier n by the antenna j is a superposition of the transmitted signal by the different antennas multiplied by the channel coefficients to which white Gaussian noise (WGN) is added. It is given by:

$$y_j[n,t] = \alpha_j \sum_{m=1}^{M_T} h_{i,j}[n] x_i[n,t] + w_j[n,t] \qquad (3.1)$$

where $y_j[n,t]$ is the signal received on the n^{th} subcarrier by the j^{th} receiving antenna during the t^{th} OFDM symbol duration. $h_{i,j}[n]$ is the frequency channel coefficient assumed to be constant during T symbol durations, $x_i[n,t]$ is the signal transmitted by the i^{th} antenna and $w_j[n,t]$ is the additive WGN with zero mean and variance $N_0/2$. α_j is the power attenuation factor of the j^{th} receiving antenna. By introducing an equivalent receive matrix $\mathbf{Y}[n] \in C^{M_R \times T}$ whose elements are the complex received symbols expressed in (3.1)) It can write the received signal on the n^{th} subcarrier on all receiving antennas as:

$$\mathbf{y}[n] \square \mathbf{AH}[n]\mathbf{X}[n] \square \mathbf{W}[n] \qquad (3.2)$$

Methodology:

Modulation/Demodulation schemes are the distinct building blocks in digital communication system. Digital data is represented by exhaustible number of digital signals and it has finite number of periods and each periods are encodes in equal number of digital bits. QAM techniques can be extending to implement the modulation and demodulation schemes. The low power QAM modulator and demodulator are expound by consider the data values inside the memory as per the design data.

An assortment of types of QAM are accessible and a portion of the more typical structures incorporate 16 QAM, 32 QAM, 64 QAM, 128 QAM, and 256 QAM. Here the figures allude to the quantity of focuses on the heavenly body.

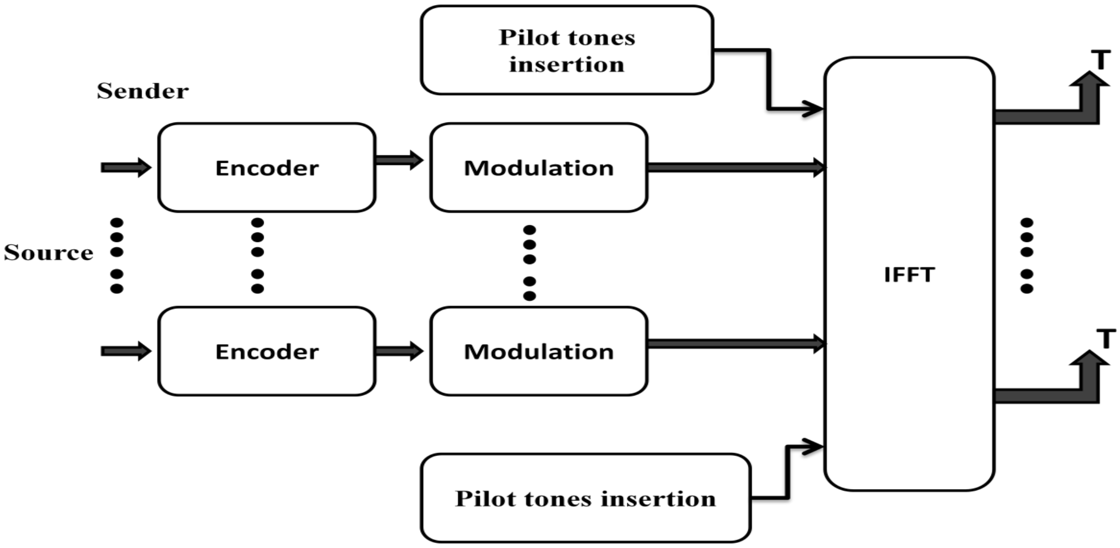

Figure 4.1: Transmitter stage

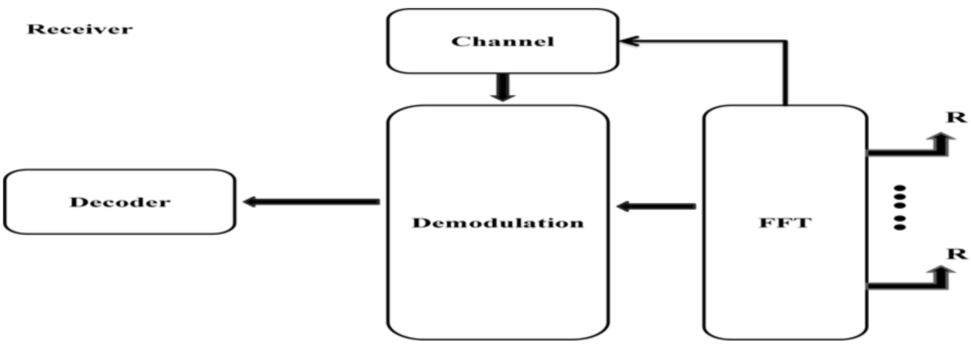

Figure 4.2: Receiver stage

Results & Discussion

Firstly, defined all parameters then make function of STBC OFDM with 2 level montecarlo. Now run this file with different M-PSK order. Result graph is showing considerable improvement in bit error rate and signal to noise ratio.

Parameter	**Value**
Number of transmit antennas	4
Number of receive antennas	4, 8, 16, 32
Number of subcarriers	64 and 128
Guard interval percentage	¼
M-QAM Modulation	8-128
Subcarrier space between two pilots	1
Signal to noise ratio	25 Db

Table 5.1: Simulation Parameters

Tx-Rx Antenna	BER	MSE	Max SNR (dB)
4Tx-4Rx	10-0.7	10-2.0	15
4Tx-8Rx	10-0.8	10-2.0	15
4Tx-16Rx	10-0.9	10-2.0	15
4Tx-32Rx	10-1.0	10-2.0	15

Table 5.6: Simulation Result for 128 QAM

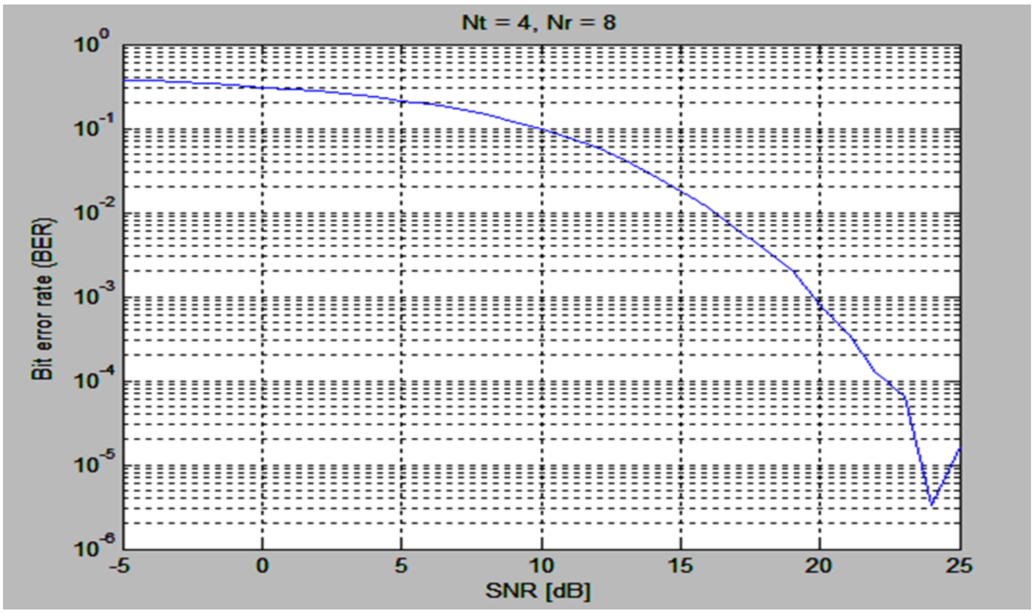

Figure 5.13: BER vs SNR Curve for Tx=4 and Rx=8 with 128-QAM

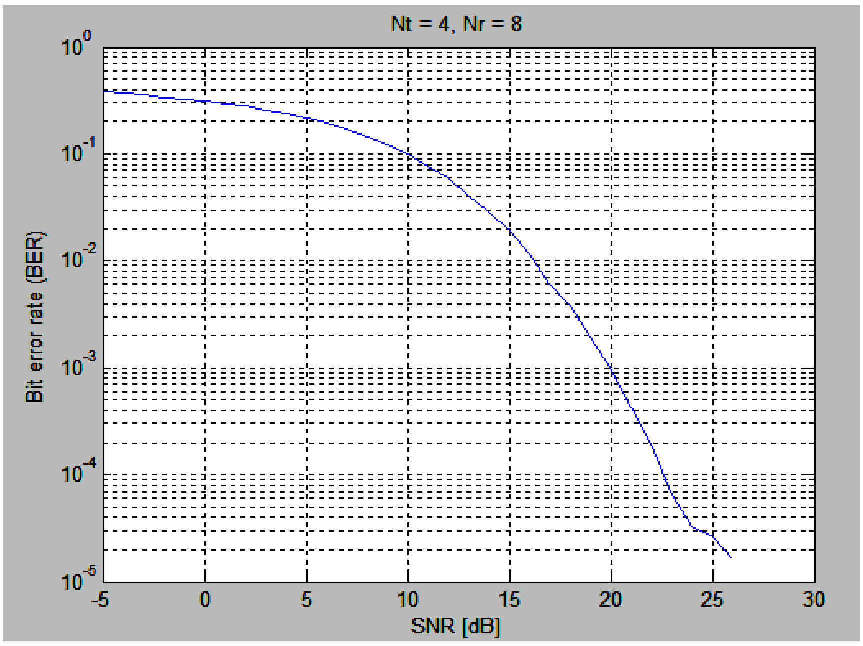

Figure 5.14: BER vs SNR Curve for Tx=4 and Rx=8 with 128-QAM with improved SNR

Figure 5.14 is showing output graph between bit error ratio and signal to noise ratio. Here modulation scheme is 128-QAM, after analyzing both graphs, it is clear that antenna combination of 4Tx8Rx gives better SNR (27dB) than previous approach. BER achieved $10^{-4.8}$, which is also improved.

Table 5.7: Simulation Result for 128 QAM with improvement

Tx-Rx Antenna	BER	MSE	Max SNR (dB)
4Tx-8Rx	10-4.8	10-2.0	27

From table 5.7, it is can say that for significant performance of SNR as well as BER MIMO dimension 4Tx-8Rx is considerable and BER value is less than previous.

After simulation of 4Tx and M-Rx antenna configuration (where M=4,8,16,32,64,128). Table 5.8 shows that simulation result of proposed work and previous work and proposed work is better than previous work in terms of number of transmitter number of receiver antenna and BER, MSE and SNR.

Table 5.8: Comparison chart of proposed work with previous work

Parameters	**Base Work work**	**Proposed Work**	**Improvement in %**
Method	Spatial Phase Coding With CoMP	Alamouti-STBC	NA
Modulation	Q-QAM	M-QAM (M=8 To 128)	NA
BER	-4.5 10	-5.5 10	22%
MSE	-	-2.0 10	NA
SNR	-5 to 25 dB	-5 to 27 dB	8%
Number of subcarriers	256	64	Reduce 4 times
Throughput	1 bps	1.6 kbps	60%
Tx Antenna	2	4	Increase 2 times
Rx Antenna	2	8	Increase 4 times

Therefore proposed work result is better than previous work[1][6] so STBC-OFDM approach is considerable and significant result is achieved.

Conclusion

Alamouti-STBC based Execution Estimation of Multi Transmitter Radio wire and Getting Reception apparatus over MIMO-OFDM investigate. The investigation of the framework with BER reveal to us that the arranged approach is best with the lessened blunder likelihood with the MIMO configuration used in the system. Space-time square codes with bring down regulation request always gave low bit-error-rate in comparison with space-time block codes that use higher order modulation ways.

The results of the planned model when simulation is displayed within the previous section and also the analysis of the system with BER tell us that the planned approach is best with the reduced error probability with the MIMO design utilized in the technique. 4xM configuration giving more BER for higher signal power varies keeping number of receivers (M) lower or adequate to variety of transmitters. however once number of receivers is increased than the transmitters BER for all the signal powers perform higher than the present work that was pilot assisted STBC MISO system. Therefore STBC with BPSK is a lot of power efficient and want less bandwidth; except for close to Base station STBC with higher modulation has higher bandwidth and a lot of power. So space time Block Code with digital modulation will be used in multi antenna system to extend the reliability and output. This can be the essential model for MIMO analysis.

In this work, essential idea of OFDM and MIMO are clarified. Different channel estimation methods MIMO-OFDM downlink framework are examined and after that analyzed. For that distinctive past procedures and calculations are checked on. From every one of these audits it can be reasoned that MMSE technique is superior to LS strategy, however at the cost of computational many-sided quality. Delicate handover systems guarantee to be better treatment of the administration irregularity related with the hard handover. A large portion of the exploration works make utilization of keeping up different associations one with every controller. This has the preferred standpoint yet at the cost of the portable station transmission control. The pilot supported channel estimation method by utilizing brush sort pilot course of action with contrast introduction system for STBC based OFDM plot is explored over multipath blurring channel. The orthogonal properties of pilot game plan have been depicted in a substantial detail. Couse to the orthogonal pilot game plan in the two transmitting radio wires, the channel estimation system is basic and low calculation cost on the grounds that no grid reversal is vital. The reenactment comes about demonstrate the brush sort pilot with spline and low- pass interjection procedure of STBC-OFDM plot performs superior to the typical OFDM framework. From the recreation result, clear that the low-pass insertion beat than spline sort interjection process. it is can see that SER diminish as number of accepting radio wire increments. The created channel estimation has a disappointment of 2dB to 2.5dB SNR when contrasted with the model situation where it is expected that the ideal channel learning is known at the less than desirable end. So that from the recreation results and hypothesis, it is demonstrated that created channel estimation method is best appropriate for the channel estimation reason for multipath blurring channel.

References:

Research Papers:

M. Paek, W. Kim, M. Kim and H. Song, "Spatial Phase Coding With CoMP for Performance Enhancement Based on MIMO-OFDM in HetNet System," in *IEEE Access*, vol. 7, pp. 62240-62250, 2019.

[2].S. Jacobsson, G. Durisi, M. Coldrey and C. Studer, "Linear Precoding With Low- Resolution DACs for Massive MU-MIMO-OFDM Downlink," in *IEEE Transactions on Wireless Communications*, vol. 18, no. 3, pp. 1595-1609, March 2019.

[3].C. Sacchi, T. F. Rahman, I. A. Hemadeh and M. El-Hajjar, "Millimeter-Wave Transmission for Small-Cell Backhaul in Dense Urban Environment: a Solution Based on MIMO-OFDM and Space-Time Shift Keying (STSK)," in *IEEE Access*, vol. 5, pp. 4000-4017, 2017.

[4].J. Lebrun, M. A. Hisojo and L. Deneire, "Spatial Diversity, Low PAPR and Fast Decoding for OFDM using L2-Orthogonal CPM ST-Codes," in *IEEE Latin America Transactions*, vol. 13, no. 11, pp. 3585-3591, Nov. 2015.

[5].P. Tsai, P. Lo, F. Shih, W. Jau, M. Huang and Z. Huang, "A 4$\times$4 MIMO- OFDM Baseband Receiver With 160 MHz Bandwidth for Indoor Gigabit Wireless Communications," in *IEEE Transactions on Circuits and Systems I: Regular Works*, vol. 62, no. 12, pp. 2929-2939, Dec. 2015.

[6].E. V. Zorita and M. Stojanovic, "Space–Frequency Block Coding for Underwater Acoustic Communications," in *IEEE Journal of Oceanic Engineering*, vol. 40, no. 2, pp. 303-314, April 2015.

[7].C. K. Sung, H. Suzuki and I. B. Collings, "Channel Quantization Using Constellation Based Codebooks for Multiuser MIMO-OFDM," in *IEEE Transactions on Communications*, vol. 62, no. 2, pp. 578-589, February 2014.

[8].Z. Iqbal, S. Nooshabadi and H. Lee, "Analysis and design of coding and interleaving in a MIMO-OFDM communication system," in *IEEE Transactions on Consumer Electronics*, vol. 58, no. 3, pp. 758-766, August 2012.

[9].T. Chang, W. Ma, C. Huang and C. Chi, "Noncoherent OSTBC-OFDM for MIMO and Cooperative Communications: Perfect Channel Identifiability and Achievable Diversity Order," in *IEEE Transactions on Signal Processing*, vol. 60, no. 9, pp. 4849-4863, Sept. 2012., W. Ma, C. Huang and C. Chi, "Noncoherent

[10]. K. Pelekanakis and A. B. Baggeroer, "Exploiting Space–Time–Frequency Diversity With MIMO–OFDM for Underwater Acoustic Communications," in *IEEE Journal of Oceanic Engineering*, vol. 36, no. 4, pp. 502-513, Oct. 2011.