2581-4575

International Journal For Recent Developments in Science & Technology

Crossref

A Peer Reviewed Research Journal

BER ANALYSIS IN MIMO-OFDM SYSTEM

[1]Y. Bhanu Priya,[2]B. Divya,[3]A. Bhagya Sri, [4]U. Madhuri, [5]D. Halima Beebi,
[1] Assistant Professor [2,3,4,5]M. Tech**,**
[1,2,3,4,5] Department of Electronics and Communications Engineering
[1,2,3,4,5]G. Pullaiah College of Engineering and Technology, Nandikotkur Rd, near Venkayapalle, Pasupula Village, Kurnool, Andhra Pradesh 518002, India.

Abstract:

Higher data rates and reliability have been problem in wirelesscommunication systems from the outset. We can achieve reliability and high data rates through MIMO-OFDM with Space time block codes and spatial multiplexing techniques. This project explores to analyze different fading channels (Rayleigh and Nagakami) under AWGN environment on spatial multiplexing (SM) based MIMO-OFDM systems. The combination of MIMOOFDM technique can achieve large throughput, spectral efficiency and diversity gains in 4G wireless communications. Due to faded signal undergoing multipath effects, BER performance is degraded. The benefits of spatial multiplexing are the fact that it is able to provide additional data capacity. MIMO spatial multiplexing achieves this by utilizing the multiple paths and effectively using them as additional channels to carry data. MIMO-OFDM technology is a great source to achieve high spectral efficiency by transmitting multiple data streams.

Key words: Diversity, Spatial multiplexing, MIMO-OFDM, Wi-Max, Equalization,Fading Channels, Successive interferenceCancellation, STBC, Modulation Techniques.

1. Introduction

Higher data rates and reliability have been problems in the wirelesscommunication systems from the outset. It is essential and necessary even by deal with multiple antennas at both ends; simultaneously fading occurs to each link can be considered due to multipath propagation this leads to increase BER performance at the receiver. We can achieve reliability and high data rates through MIMO-OFDM with STBC and spatial multiplexing techniques are used respectively. This paper explores to analyze different fading channels (Rayleigh and Nakagami) under AWGN environment on spatial multiplexing (SM) based MIMO systems, zero forcing with Successive interference Cancellation (ZF-SIC), MMSE-SIC and ML equalization techniques are used to channel equalization. And of transmit diversity, STBC based MIMO-OFDM systems, Maximum Ratio Combining (MRC) technique is used. Simulation results showed with various modulation techniques (BPSK/QPSK/64QAM/32PSK) both Systems. Furthermore, BER performance of coded MIMO-Wi-Max systems also describes to transmit diversity.

2. Literature survey

K. Blocskei, E. Zurich, IEEE Members proposed an article that provides an overview of the basics of MIMO-OFDM technology and focuses on spacefrequency signaling, receiver design, multiuser systems, and hardware implementation aspects. The goal of this article is to provide a high-level review of the basics of MIMO-OFDM wireless systems with a focus on transceiver design, multiuser systems, and hardware implementation aspects. This contains a brief introduction into MIMO wireless and OFDM followed by discussion on Space Frequency signaling and corresponding.

Brijesh Kumar Yadav, Rabinder Kumar Singh and Sovan Mohanty, Senior Members, IEEE, authored, a paper that presents the performance of VBLAST and STBC on MIMO-OFDM.V-BLAST is superior in terms of spectral efficiency and bit error rate. The performance analysis of V-BLAST based multiple input multiple output orthogonal frequency division multiplexing (MIMO-OFDM) system also analyzed with respect to bit error rate per signal to noise ratio (BER/SNR) for various detection techniques i.e., zero forcing (ZF), minimum mean square error (MMSE) and maximum likelihood (ML).

Idris, K. Dimyati, Sharifah K. Syed Yusof, Senior Member, IEEE put forward which highlights the space time frequency block codes (STFBC) that exploit spatial, time and frequency diversity can be designed using orthogonal frequency division multiplexing (OFDM). However, OFDM suffers from ICI. Hence, a new OFDM-MIMO using STFBC method combining ICI-SC scheme is investigated to reduce ICI and error correction effectively. The technique of reducing ICI using Space Time Frequency diversity is recognized to be an ultimate means to achieve the objective of this work and providing diversity at the same time. The system developed is analyzed with CFO and compared in terms of BER performance.

Alexander, A Kalachikov, Nikolai S, Shelkunov, Senior members of IEEE put forward[6] the experimental numerical simulation of the detection algorithms for MIMO spatial multiplexing based on experimental analytical MIMO channel modeling. The suboptimal ZF and MMSE detection algorithms for MIMO spatial multiplexing are described. The effect of spatial correlation between MIMO channel coefficients results in channel capacity degradation and affects on bit error rate performance. The channel correlation matrices calculated from the measured channel coefficients are used as parameters for analytical MIMO channel models. Numerical simulation demonstrated that spatial correlation has a significant effect on BER performance of the ZF and MMSE detection algorithms. CDF of minimum and maximum eigenvalues of equivalent channel matrix are presented which have the close connection with the performance of the ZF and MMSE detection algorithms.

C. Poongodi, P. Ramya, A. Shanmugam, Jr and Senior Members, IEEE put forward [7] which studies the estimation of channel at high frequencies with conventional Least Square (LS) and Minimum Mean Square (MMSE) estimation algorithms which is carried out through MATLABsimulation. The biterror rate (BER) of multilevel quadrature amplitude modulation (M-QAM) in flat Rayleigh fading channel is also analyzed. The performance of MIMO OFDM is evaluated on the basis of Bit Error Rate (BER) and Mean Square Error (MSE) level.

Keerti Tiwari, Anjana Jain and S.V. Charhate, Department of Electronics and Communication Engineering put forward[8] which says that Analytical estimations of Bit Error Rate can be obtained with Space Time Transmit Diversity(STTD). The desired user's BER performance proves as a fading is becoming more relevant in the performances analysis and other studies related to mobile Radio Communication. In this paper, BER is determined for identifying distributed Nakagami fading channels with different modulation techniques. These results can be used for efficient wireless system design for next generation mobile services.

3. Proposed Methodology:

Block Diagram:

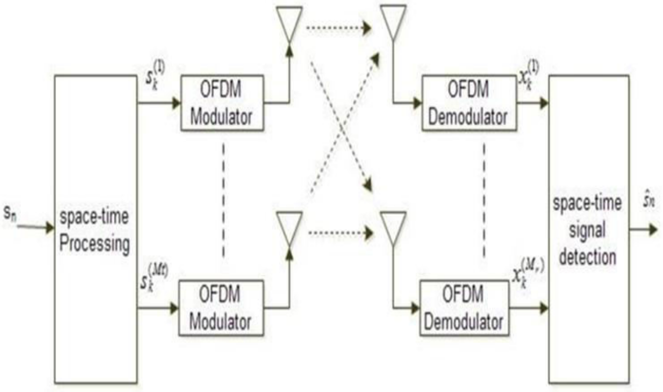

Fig 1: Block Diagram

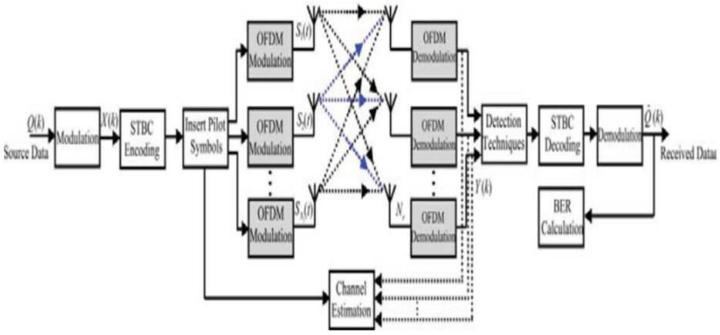

Fig 2: Block Diagram

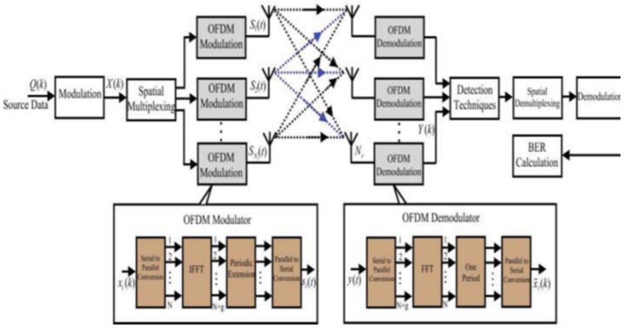

Fig 3: Block Diagram

Algorithm:

$$\begin{bmatrix} S11 & \cdots & S1n \\ \vdots & \ddots & \vdots \\ Sm1 & \cdots & Smn \end{bmatrix}$$

- At the receiver, the received vector ***Y*** can be represented by the following equation:

$$Y = \begin{bmatrix} y_1^1 \\ y_2^1 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} n_1^1 \\ n_2^1 \end{bmatrix}$$

- This is for the first time period. For the second time period, the equation is as follows:

$$Y = \begin{bmatrix} y_1^2 \\ y_2^2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} -x_2^* \\ x_1^* \end{bmatrix} + \begin{bmatrix} n_1^2 \\ n_2^2 \end{bmatrix}$$

- Both equations can easily be combined and arranged to produce the following result:

$$Y = \begin{bmatrix} y_1^1 \\ y_2^1 \\ y_1^{2*} \\ y_2^{2*} \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \\ h_{12}^* & -h_{11}^* \\ h_{22}^* & -h_{21}^* \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} n_1^1 \\ n_2^1 \\ n_1^{2*} \\ n_2^{2*} \end{bmatrix}$$

- We can isolate x_1 and x_2 by simply multiplying the matrix ***Y*** by the inverse of ***H***

$$H^+ = \left(H^H H\right)^{-1} H^H$$

- Using this inverse matrix expression, the noisy estimated transmitted symbols can be found using the following expression:

$$\begin{bmatrix} \widehat{x_1} \\ x_2 \end{bmatrix} = \left(H^H H\right)^{-1} H^H \begin{bmatrix} y_1^1 \\ y_2^1 \\ y_1^{2*} \\ y_2^{2*} \end{bmatrix}$$

Table 1: Simulation Parameters

PARAMETER	SPECIFICATION
TYPE Of Fading Channel	Rayleigh, Nakagami
Noise	AWGN
No. of Pilot Symbols	8
Band Width	10 MHz
Type of Modulation	BPSK,QPSK,64QAM
Transmit Antennas	2and 4
Receive Antennas	1,2 and 4

4. Results and Discussions:

The Fig 4 explains the BER Analysis of Alamouti coded 2*2 System. Thefigure displays BER performance of MIMO Alamouti coded estimation with 8 pilot symbols/frame with fading channel have 0.01085 at 6 db.

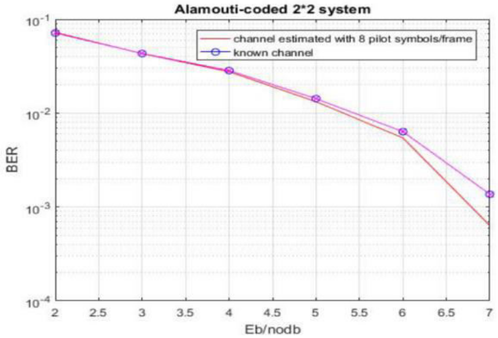

Fig 4: BER Analysis of Alamouti-coded 2*2 system

The Fig 5 represents the BER performance for Spatial Multiplexing overRayleigh Fading Channel. This depicts BER performance of SM-OFDM method achieved by Rayleigh fading channel with different equalization methods gives best results i.e., 0.01082 on various modulation techniques. Here we have performed BER Analysis comparing different equalization techniques combined with different modulation methods. Here we observed that BER Performance of the system using 32-PSK with ML technique (Maximum Likelihood), QPSK with ZF-SIC(Zero Forcing Successive Interference Cancellation) are relatively better than BPSK with MMSE(Minimum Mean Square Error)technique.

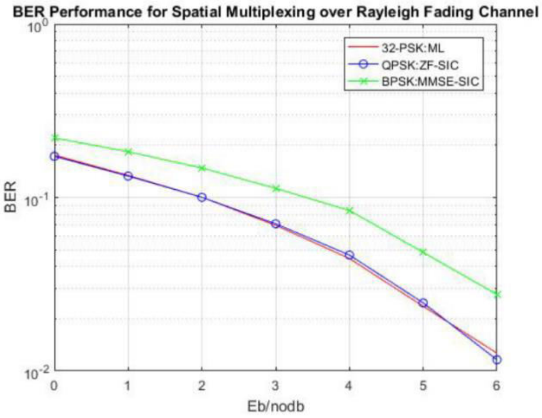

Fig 5: BER Analysis of Spatial Multiplexing over Rayleigh Fading Channel

The Fig 3 represents the BER Performance for STBC (Space Time BlockCode) over Rayleigh Fading Channel. From Fig 5 at 6dB SNR, minimum error rate of 0.02411 is attained using BPSK through Rayleigh fading channel with MRC by 1Tx and 2Rx antennas for transmit and receive diversity i.e., STBC-OFDM 0.00818 is the lesser amount of BER is accomplished as associated similar modulation technique with 2Tx-1Rx/2Tx-2Rx antennas. In addition, for QPSK and 64-QAM, the STBCOFDM Alamouti system BER performance is as compared others.

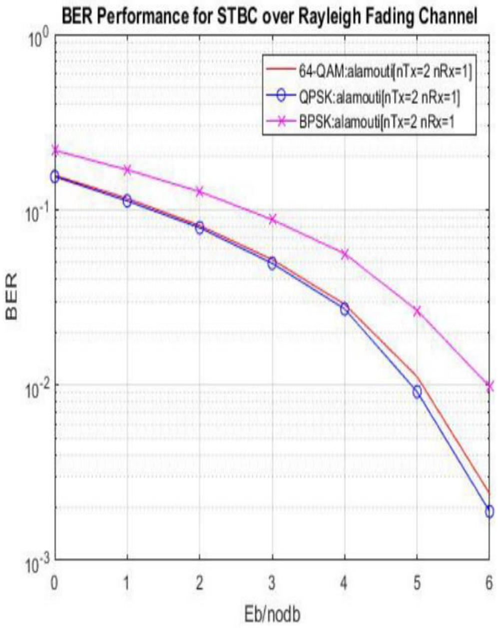

Fig 6: BER Analysis of STBC over Rayleigh Fading Channel

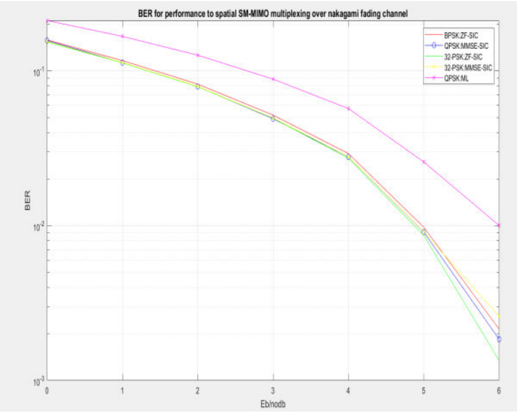

Fig 7: BER Analysis of spatial SM-MIMO multiplexing over Nakagami fading channel

The Fig 7 represents the BER Performance for Spatial Multiplexing MIMIOover Nakagami Fading Channel. The figure 6 depicts BER performance of SMOFDM method achieved by Nakagami fading channel with different equalization methods, as comparing other techniques the ML equalization gives best results i.e., 0.000010.0013 and 0.06324 of BPSK, QPSK and 32-PSK respectively.

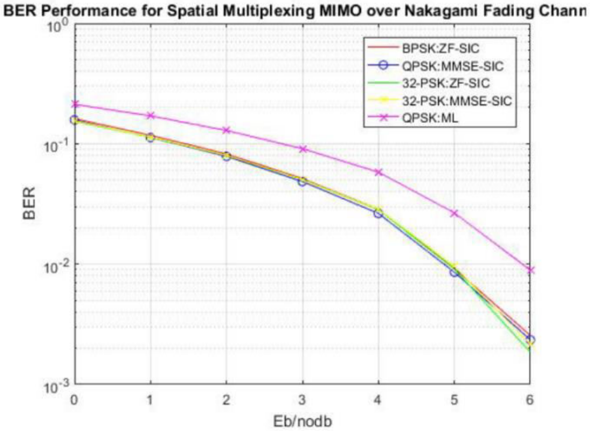

Fig 8: BER Analysis of Spatial Multiplexing over Nakagami Fading Channel

The Fig 8 represents the BER Performance for STBC over Nakagami FadingChannel. From figure 7, For Nakagami-m channel, with fading parameter value m=5, the lowest error rate is 0.1225 is attained via Nakagami fading channel of BPSK over MRC with 1Tx and 2Rx antennas on STBC-OFDM 0.06538 less bit error rate is reached as compared to similar modulation technique with 2Tx-1Rx/ 2Tx-2Rx antennas. In addition, for QPSK and 64-QAM of the STBC-OFDM Alamouti system BER performance is best as compared others.

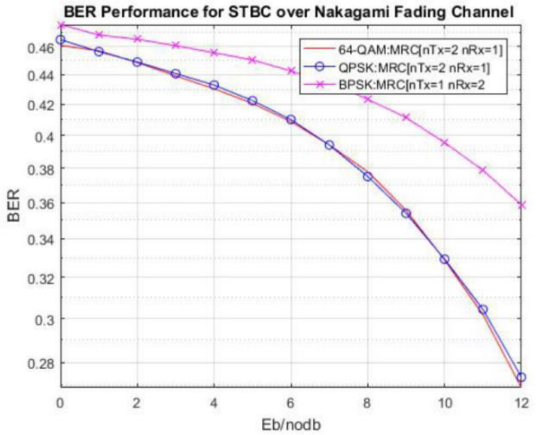

Fig 9: BER Analysis of STBC over Nakagami Fading Channel

5. Conclusion:

In this paper, we presented BER analysis of both STBC and SM efficientmultiple antenna transmission schemes with OFDM system are proposed. By applying STBC and SM MIMO-OFDM scheme is thoroughly examined over Rayleigh and Nakagami channels and the relationship made it different equalization techniques like ZF-SIC, MMSE-SIC and ML respectively. The STBC MIMO-OFDM and SM MIMOOFDM is liable to employing lower modulation techniques to obtain the lowest bit error rate, while comparing higher order modulation techniques like 64QAM, 32-PSK is shown even though higher SNR than QPSK and BPSK seems identical BER. As compared BER performance to MRC or ML through the Nakagami-m channel in accordance with gamma distribution consequence looks greatest in SM MIMO-OFDM of BPSK than other modulation techniques.

In addition, bit error rate performance of STBC G4-coded System and othercomparisons are calculated with different modulation techniques of increased multiple antennas. And also, BER performance of STBC MIMO-OFDM channel estimation with 8 pilot symbols/frames with fading channels. Result seems that BER performance is enriched have to do with receive diversity. Thus, enhancement of reliability, spectral efficiency and throughput over STBC and SM MIMO-OFDM systems interfere over multiple antenna arrangements through the equalization or diversity techniques are most desirable.

References:

[1]H. Bolcskei, E. Zurich, "MIMO-OFDM Wireless System: BASICS, Perspectives and Challenges," IEEE Wireless Communications, vol. 13, no. 4, pp. 31-37, Aug.2006.

[2]Xiaodong Li and Leonard J.Cimini, "Effects of Clipping and Filtering on the performance of OFDM", International Conference on Wireless Commun..

[3] Brijesh Kumar Yadav, Rabinder Kumar Singh and Sovan Mohanty, "Performance Analysis of Efficient and Low Complexity MIMO-OFDM using STBC and V-Blast", International Conference on Emerging trends in electrical, electronics and sustainable energy systems (ICETEESES-16)

[4] Xudong Wang, Yu Gong, Bin Lin, "SER Performance of Orthogonal SpaceTime Block Coding Over Fading Channels with Impulsive Noise", IEEE International Conference on Wireless Communications, Networking and Mobile Computing, 2007

[5] A. Idris, K. Dimyati, "Space Time Frequency Block Codes for MIMO-OFDM system using intercarrier interference self-

cancellation schemes", International Conference on Communications

[6]Alexander A.Kalachaikov, Nikoli S.Shelkunov, "Performance Evaluation of the Detection Algorithm for MIMO Spatial Multiplexing Based on Analytical Wireless MIMO Channel Model", XIV International Scientific-Technical Conference on Actual Problems of Electronics Instrument Engineering[APEIE], 2018

[7]C. Poongodi, P. Ramya, A.Shanmugam, "BER Analysis of MIMO-OFDM system using M-QAM over Rayleigh Fading Channel", IEEE International Conference on Commun.. and computational intelligence- 2010.

[8]Keerti Tiwari, Anjana Jain, S.V. Charhate, "BER Analysis of Nakagami-m Channels with Different Modulation Techniques and Transmit Diversity", Proceeding of International Conference on Methods and Models in Computer Science[ICM2CS], 2009.

[9]V. Tarokh, H. Jafarkhani, and A. R. Chalderbank, "Space-time block coding for wireless communications: performance results", IEEE Trans. Sel.AreasCommun., vol. 17, no. 3, pp. 45 1-460, March1999.

[10] M. Nakagami, "The m-distribution-A general formula of intensity distribution of rapid fading", in Statistical Methods of Radio Wave Propagation, W. C. Hoffman, Ed. Oxford, U.K.: Pergamon, 1960, pp. 3–36.

[11] Q. T. Zhang, "A decomposition technique for efficient generation of correlated Nakagami fading channels," IEEE J. Sel. Areas Commun., vol. 18, no. 11, pp. 2385–2392, Nov.2000.

[12] Guo Rui; Liu Ji-Lin; Jiang Yang "Performance analysis of BPSK forMIMO-OFDM in Nakagami-m fading channels" IEEE Intelligent SignalProcessing and Communication Systems, 2005. ISPACS 2005.Proceedings of 2005 International Symposium at Hong Kong, China,China, 21 February 2006.

[13] Md. Mejbaul Haque et al. "Performance Analysis of MIMO- OFDM for4G Wireless Systems under Rayleigh Fading Channel". International Journal of Multimedia and Ubiquitous Engineering Vol. 8, No. January, 2013.

[14] S. R. Sabuj ; K. J. A. Chisty ; M. D. A. Satter "BER performance ofMIMO-OFDM system over Nakagami fading channel" at Dhaka, Bangladesh, 09March 2012.

[15] Y. S. Gill and R. Khanna "Analysis of data transmission techniques inRayleigh Rician and Nakagami fading model under various modulation schemes " International Journal of VLSI and Signal Processing. Applications vol. 1 iss. 2 May 2011

[16] Bolcskei H., Gesbert D. and Paulraj A. J. 2002 On the Capacity ofOFDM Based Spatial Multiplexing Systems IEEE Trans. Commun. 50225-34 Feb.