International Journal of Advanced Technology and Engineering Exploration
ISSN (Print): 2394-5443 ISSN (Online): 2394-7454
Volume-2 Issue-7 June-2015

Efficient BER performance analysis in AWGN and Rayleigh Fading Channel with range modulation

Shraddha Rawat[1*] and Bhagwat Kakde[2]
M.Tech research scholar, RKDF IST Bhopal,India[1]
Assistant Professor, Electronics and Communication Engineering, RKDF IST Bhopal, India[2]

Abstract

In this paper we have proposed an efficient multiple Additive white Gaussian noise (AWGN) and Rayleigh Fading Channel which will be able to model irrespective of transmission mode like orthogonal frequency division multiplexing (OFDM) and multiple inputs and multiple output (MIMO) system. So that the bit error rates (BER) can be reduced. We have considered timing error with respect to the timing jitters which is being considered as mismatch of sampling time between the transmitters and receiver may degrades the performance of the system as timing destroys orthogonally among sub-carriers. At the initial stage, we have configured the modulation format to be different for the high spectral efficiency and define the upper and lower limits of the BER threshold. So that different range of Quadrature amplitude modulation (QAM) with quadrature components can be considered. So that the variation is wide for checking the performance.

Keywords

AWGN, Rayleigh Channel, OFDM, MIMO, BER, QAM.

1. Introduction

OFDM is a successful method to relieve the medium correspondence. OFDM is a recurrence division multiplexing(FDM) scheme used as an advanced multi-bearer tweak method[1][2] as it were OFDM is recurrence division multiplexing of multi-bearers which are orthogonal to one another i.e. they are put precisely at the nulls in the regulation spectra of one another. This makes OFDM frightfully more effective [3]. In OFDM information is separated into a few parallel information streams or sub-channels, one for every sub bearer which are orthogonal to one another despite the fact that they cover frightfully

*Author for correspondence

Each sub-transporter is regulated with an ordinary regulation scheme (such as QAM or PSK) at a low image rate keeping up aggregate information rates like traditional single-transporter tweak plots in the same transmission capacity.

In today's situation MIMO is extremely helpful with the blend of OFDM framework. Misusing the adaptability of MIMO frameworks keeping in mind the end goal to have high information rates is a particularly alluring exploration theme for future booking plan plans and their applications. Different information various yield (MIMO) frameworks offer much bigger channel limit over customary single-information single-yield framework.

As of numerous transmit Algorithms have been produced to adventure the high limit in the MIMO frameworks [4][5].Furthermore, in MIMO frameworks, subsequent to selecting the gathering of clients with the at present greatest attainable rates dictated by a parcel scheduler in every time-opening, we have to appoint them to the transmitter's radio wires in such a route, to the point that we can accomplish the greatest throughput in the framework. Assorted qualities procedures, for example, space-time coding have gotten a lot of consideration because of their capacity to give higher unearthly productivity than routine single-information single-yield systems [6][7][8][9]. When applying these procedures in a recurrence particular channel, a space-time equalizer is needed at the beneficiary to make up for the impedance [10].

This multipath spread reasons discretionary time scattering, constriction, and stage movement, known as blurring, in the got signal [11][12]. Blurring is brought about by obstruction between two or more forms of the transmitted sign which touched base at the collector at somewhat distinctive times [13]. DS-CDMA procedure has the upsides of expanding the channel limit alongside the resistance against sticking [14][15][16]. In multi-client CDMA frameworks, multiple access interface (MAI) is viewed as one of the principle wellsprings of execution corruption. Versatile separating methods have been effectively used to level the channel and in this manner diminish the MAI in the DS-CDMA framework [17][18]. This procedure can be extended also in [19] and [20].

2. Proposed Work

The receiver side BER in any channel and irrespective of the mode transmission may be influenced by deformation, imparting channel noise, intercession, attenuation, bit synchronization problem, wireless multipath fading etc. So AWGN and Rayleigh fading channel have been presented with different simulation parameter for calculating the BER effects.

The Gaussian random variable of circularly symmetric is of the form,

$H=H_{re} + JH_{im}$

where re and im parts are zero mean autonomous and indistinguishably dispersed Gaussian irregular variables with mean 0 and change $б^2$.

The magnitude |h| which has a probability density,

$P(h)=h/ б^{2x}\ x==h^2/2\ б^2 \quad z>=0$

is known as a Rayleigh arbitrary variable. This model, called Rayleigh blurring channel model, is sensible for a domain where there are vast quantities of reflectors.

Rayleigh fading channel received signal can be represent by the below equation,
Y=hx + n
Where y represents received symbol, h is scaling factor which belongs to Rayleigh multipath channel. x represents the transmitted symbol which can take +-1 and n is noise or is the Additive White Gaussian Noise (AWGN).

The flowing assumptions have been taken in this approach.

The multipath channel has flat fading tap. As it reduces simple multiplication in the convolution operation. It can be a fading or frequency selective fading. The transmission mode and the channel is varying according to the time randomly meaning the every transmitted symbol have been goes under the condition of multiplication of randomly varying complex number h. Since h is displaying a Rayleigh channel, the genuine and nonexistent parts are Gaussian circulated having mean 0 and difference 1/2. The noise let n has the Gaussian probability density function as shown below:

$$P(n) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-(n-\mu)^2}{2\pi\sigma^2}}$$

Where μ=0 and $\sigma^2 = \frac{N_0}{2}$

The channel h is known at the beneficiary. Adjustment is performed at the beneficiary channel by isolating the got image y by previous signal known h i.e.

$$\tilde{Y} = \frac{y}{h} = \frac{hx+n}{h} = x + \tilde{n}$$

Where $\tilde{n}\ is\ \frac{n}{h}$ which is the noise adjunct under and scaled by the channel coefficient.

In case of the performance computation based on BER for AWGN, then the error probability for the transmission of either +1 or -1 is calculated by Gaussian probability integration which is based on density function for a specified bit to noise ratio E_b/N_0. It can be represented by:

$$P_b = \frac{1}{2}\mathrm{erfc}(\sqrt{\frac{E_b}{N_0}})$$

However in the vicinity of channel h, the compelling bit vitality to commotion proportion is $|h|^2E_b/N0$. So the bit error probability for a given value of h is,

$$P_{b|h} = \frac{1}{2}\mathrm{erfc}(\sqrt{\frac{|h^2|E_b}{N_0}}) = \frac{1}{2}\mathrm{erfc}(\sqrt{\gamma})$$

Where $\gamma = \frac{|h^2|E_b}{N_0}$

There is also another method for finding the bit error rate which can be calculated based on the probability density function of $\tilde{Y}$.

The transmission and reception in Rayleigh channel can be as follows:

a) It can be selected from random binary sequence which is +-1.

b) The channel is then multiply by the symbol and then white Gaussian noise has been added.
c) Divide the receiver transmission or equalize it it should be with the known channel.
d) Count the bit errors with decoding the decision symbols.
e) The multiple values then repeated with Eb/N0 and plot for the simulation and standard theoretical results.

The process of our methodology is shown below:

Step 1: generating 0,1 with equal probability
Step 2: s = 2*ip-1; % BPSK modulation 0 -> -1; 1 -> 0
Step 3: Eb_N0_dB = [-3:35]; % multiple Eb/N0 values
Step 4: for i = 1:length(Eb_N0_dB)
Step 5: white gaussian noise, 0dB variance
Step 6: h = 1/sqrt(2)*[randn(1,N) + j*randn(1,N)]
Step 7: Channel and noise Noise addition
y = h.*s + 10^(-Eb_N0_dB(ii)/20)*n;
Step 8: equalization
yHat = y./h;
Step 9: receiver - hard decision decoding
ipHat = real(yHat)>0;
Step 10: counting the errors
Step 11: nErr(ii) = size(find([ip- ipHat]),2)
Step 12:bit_count = 10000;
Step 13: Eb_No = -3: 1: 30;
Step 14: SNR = Eb_No + 10*log10(2);
Step 15: for aa = 1: 1: length(SNR)
Step 16: qpsk_sig = ((B1==0).*(B2==0)*(exp(i*pi/4))+(B1==0).*(B2==1)...*(exp(3*i*pi/4))+(B1==1).*(B2==1)*(exp(5*i*pi/4))...+(B1==1).*(B2==0)*(exp(7*i*pi/4)));
Step17:ray = sqrt(0.5*((randn(1,length(qpsk_sig))).^2+(randn(1,length(qpsk_sig))).^2)); Step 18: rx = qpsk_sig.*ray;
Step 19: N0 = 1/10^(SNR(aa)/10);
Step 20: rx = rx + sqrt(N0/2)*(randn(1,length(qpsk_sig))+i*randn(1,length(qpsk_sig)));
rx = rx./ray;

We have proposed this methodology in order to assign the modulation format of the proposed transmitter. Keeping in mind the end goal to either ensure the sign quality at the recipient side or augment the otherworldly proficiency, it is important to consequently allot a fitting balance group and/or a transmission rate of the optical flag as per the join's condition. For this purpose, first, we continuously check the signal's quality by monitoring BER of the signal. When BER is degraded below the pre-defined BER threshold, we select a lower-order QAM format than the current modulation format to improve the OSNR margin. For example, if BER of the 16QAM signal becomes worse than the upper limit of the BER threshold in the restoration path, 32QAM, 64 QAM or QPSK is then chosen. Then again, if BER turns out to be superior to the lower furthest reaches of the BER limit, a higher-request QAM configuration is chosen to give the high phantom effectiveness. Figure 1 shows the flow chart of this method regarding how to assign the modulation format of the. At the initial stage, we set the modulation format to be different for the high spectral efficiency and define the upper and lower limits of the BER threshold.

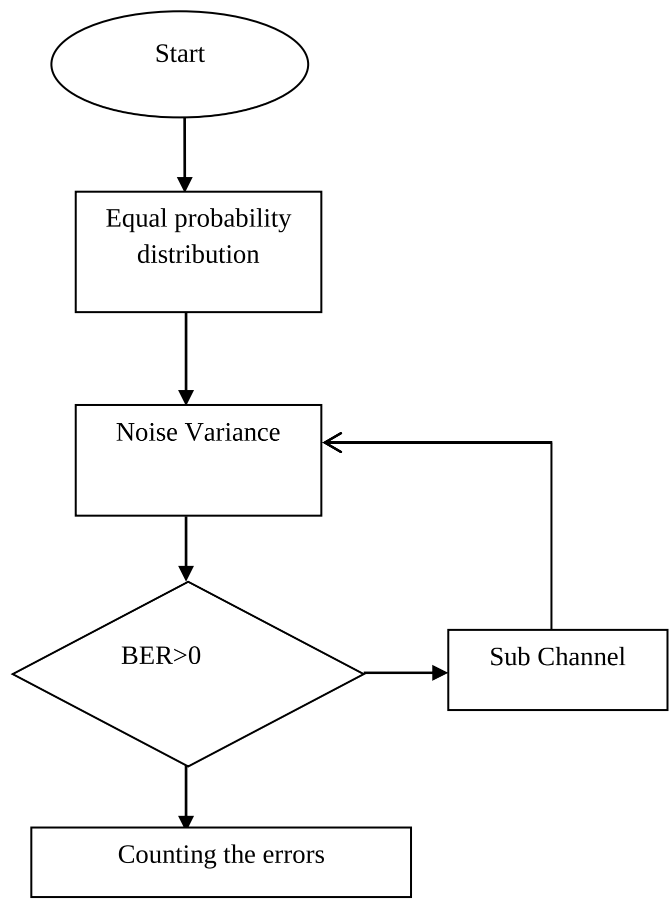

Figure 1: Flowchart

3. Results

The multiple access systems are more sensitive to errors in time. Multi-Carrier Code Division Multiple Access (MC-CDMA) is a different access plan utilized as a part of OFDM-based telecom frameworks, permitting the framework to bolster numerous clients in the meantime over same recurrence band. In this case timing error is being considered as mismatch of sampling time between the transmitters and receiver may degrades the performance of the system as timing destroys orthogonally among sub-carriers.

Terminology should be known to us for understanding the effect of BER

- 'N' denotes the number of sub-carriers;
- 'L' is the length of spreading code;
- 'a' corresponds to the level of correlation of the timing jitters, for instance, 'a=0' corresponds uncorrelated timing jitter and 'a=1' means fully correlated timing jitter.

BER performances are shown in this section. The effects of white with the correlated Rayleigh and AWGN zero timing jitters are presented. The circle with dash shows the white timing jitter affected BER performance. The star with dash shows the correlated timing jitter affected BER. The plus with dash shows the effect of zero timing jitter affected BER performance and the x-mark with the dash shows the ideal BER performance without interference. The first simulation parameter is shown in table 1. The analysis parameter shown in table 2. The second simulation parameter is shown in table 3. The analysis parameter for table 3 is shown in table 4. The BER results shows the improve in comparison to the traditional technique.

Table 1: Simulation Parameter

Parameter	
Channel Model	Rayleigh/ AWGN
Channel Bandwidth	5MHZ
Cyclic Prefix	[0 I 2 3]
HARQ combining	Incremental redundancy
Frame structure	TDD
modulation	16QAM
separation distance	4 λ
antennas Transmitting Power	equality

Table 2: Analysis parameter based on table 1

S. No	N	L	a	Channel
1	16	4	0.4	AWGN
2	16	4	0.4	Rayleigh Fading
3	16	4	0.5	AWGN
4	16	4	0.5	Rayleigh Fading

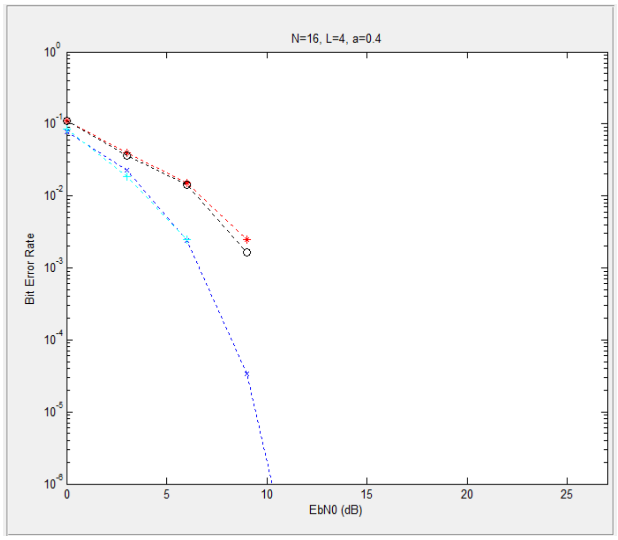

Figure 2: BER Performance under AWGN Channel (parameters N=16, L=4, a=0.4)

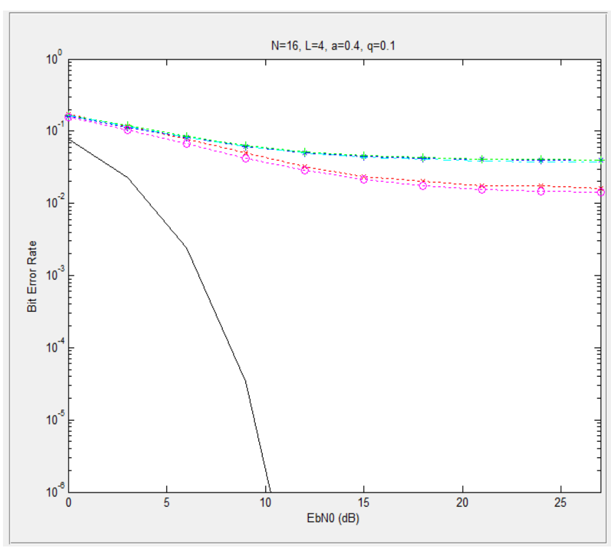

Figure 3: BER Performance under Rayleigh Fading Channel (parameters N=16, L=4, a=0.4)

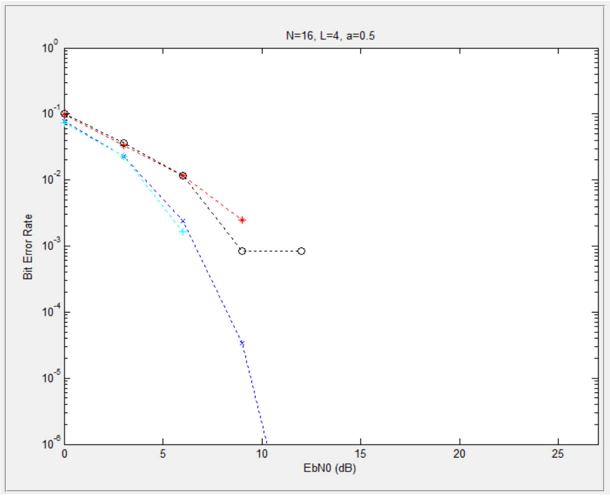

Figure 4: BER Performance under AWGN Channel (parameters N=16, L=4, a=0.5)

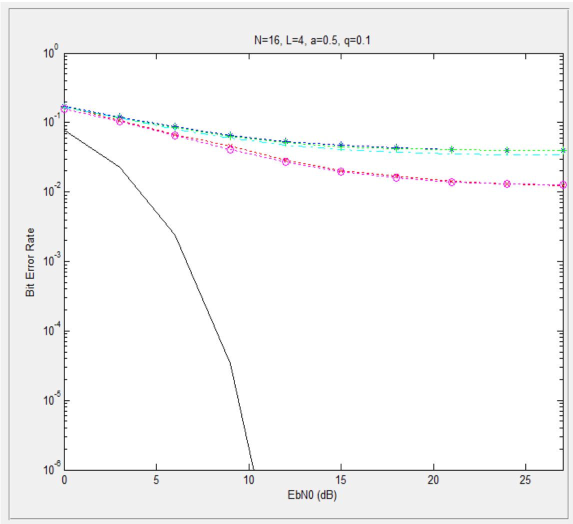

Figure 5: BER Performance under Rayleigh Fading Channel (parameters N=16, L=4, a=0.5)

Table 3: Simulation Parameter

Parameter	
Channel Model	Rayleigh/ AWGN
Channel Bandwidth	5MHZ
Cyclic Prefix	[0 I 2 3]
HARQ combining	Incremental redundancy
Frame structure	TDD
modulation	64QAM
separation distance	4 λ
antennas Transmitting Power	equality

Table 4: Result analysis

S. No	N	L	a	Channel
1	64	4	0.4	AWGN
2	64	4	0.1	Rayleigh Fading
3	64	4	0.5	AWGN
4	64	4	0.5	Rayleigh Fading

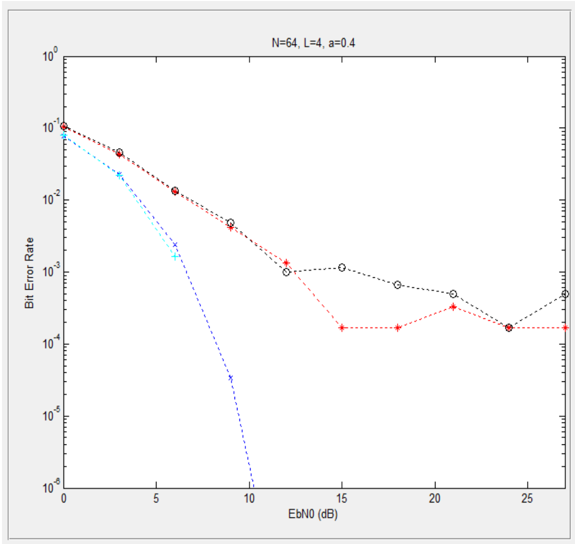

Figure 6: BER Performance under AWGN Channel (parameters N=64, L=4, a=0.4)

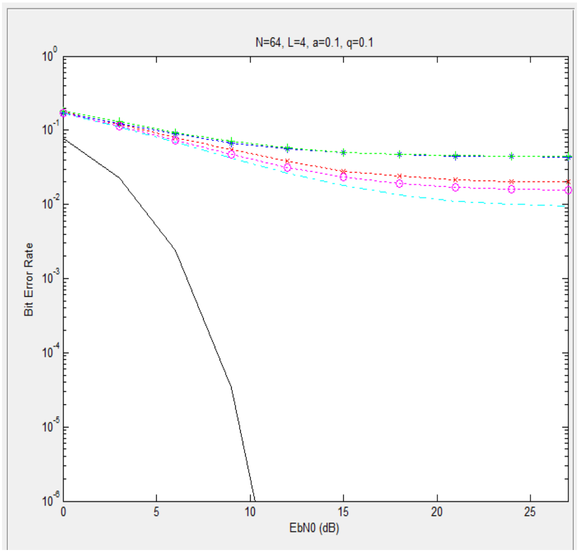

Figure 7: BER Performance under Rayleigh Fading Channel (parameters N=64, L=4, a=0.1)

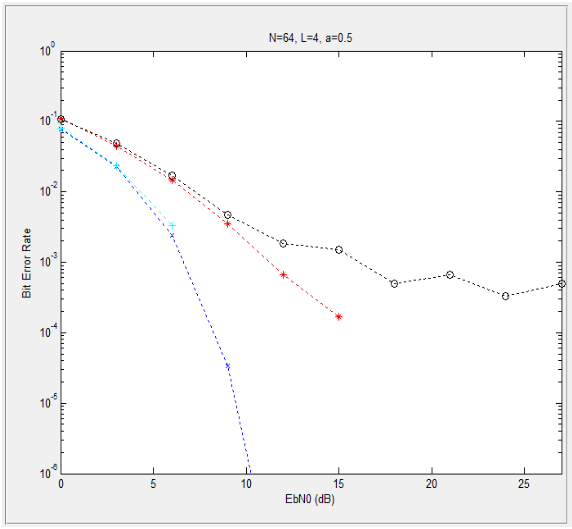

Figure 8: BER Performance under AWGN Channel (parameters N=64, L=4, a=0.5)

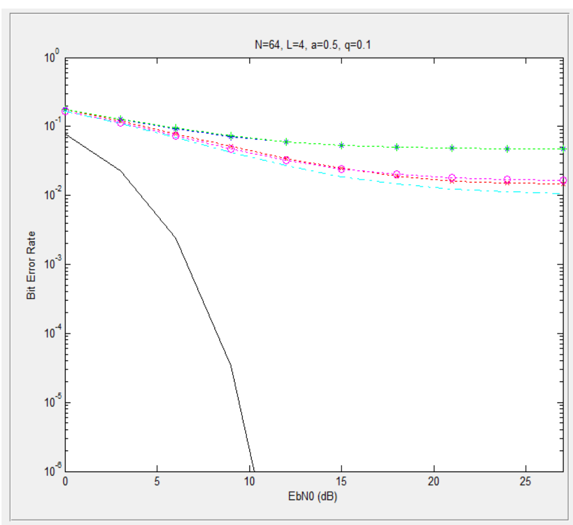

Figure 9: BER Performance under Rayleigh Fading Channel (parameters N=64, L=4, a=0.5)

4. Conclusion

Our proposed framework is based on AWGN and Rayleigh channel with STBC can be efficient in reducing BER rates. As this framework will be able to cope the modulation variations from 16, 32, 64 and 128 QAM. It also provide length variations with timing jitters which will be able to get better results in different timing jitters with different correlation coefficients.

References

[1] Tse, David, and Pramod Viswanath. Fundamentals of wireless communication. Cambridge university press, 2005.
[2] Bingham, John AC. "Multicarrier modulation for data transmission: An idea whose time has come." Communications Magazine, IEEE 28, no. 5 (1990): 5-14.
[3] Zhengdao Wang,"OFDM or single carrier block transmission," IEEE Trans.on Comm., vol.12, no.3, pp.380-394, Mar 2004.
[4] Shruti Trivedi, Mohd. Sarwar Raeen, Shalendra Singh pawar, "BER Analysis of MIMO-OFDM System using BPSK Modulation Scheme", International Journal of Advanced Computer Research (IJACR), Volume-2, Issue-5, September-2012, pp.219-226.
[5] Xia, Pengfei, and Georgios B. Giannakis. "Design and analysis of transmit-beamforming based on limited-rate feedback." Signal Processing, IEEE Transactions on 54, no. 5 (2006): 1853-1863.
[6] Saswati Paramita, Sruti Suvadarsini Singh, Jyotiprava Mohanta, "Time and Frequency Synchronization in OFDM System", International Journal of Advanced Computer Research (IJACR), Volume-4, Issue-16, September-2014, pp.856-865.
[7] Vikas Gupta, Ruby Tiwari, "Performance Analysis and Simulation Result of MC-CDMA for AWGN Channel and Rayleigh Based on SNR/BER", International Journal of Advanced Computer Research (IJACR), Volume-1, Issue-1, September-2011 ,pp.13-17.
[8] Manisha Rathore, Puspraj Tanwar, "Reduction of Co-Channel Interference in transmit/Receive diversity (TRD) in MIMO System", International Journal of Advanced Computer Research (IJACR), Volume-2, Issue-5, September-2012, pp.13-17.
[9] Pragya Gupta , Uday Pratap Singh, Vineet Richhariya, " Analysis and comparison of the 4-PSK and 8-PSK STTC over Rayleigh fading Channels for determining Performance", International Journal of Advanced Computer Research (IJACR), Volume-2, Issue-5, September-2012 ,pp.142-149.
[10] Zhou, Shengli, Zhengdao Wang, and Georgios B. Giannakis. "Quantifying the power loss when transmit beamforming relies on finite-rate feedback." Wireless Communications, IEEE Transactions on 4, no. 4 (2005): 1948-1957.
[11] Tarokh, Vahid, Nambi Seshadri, and A. Robert Calderbank. "Space-time codes for high data rate wireless communication: Performance criterion and code construction." Information Theory, IEEE Transactions on 44, no. 2 (1998): 744-765.

[12] G. J. Foschini, "Layered space-time architecture for wireless communications in a fading environment", Bell Labs Tech. J., vol. 1,no. 2.pp.41-59, 1996.
[13] K. Anitha, Umesharaddy, B.K.Sujatha, " FPGA Implementation of High Throughput Digital QPSK Modulator using Verilog HDL", International Journal of Advanced Computer Research (IJACR), Volume-4, Issue-14, March-2014 ,pp.217-222.
[14] G. J.Foschini and M.J.Gans,"On the limit of wireless communications in a fading environment when using multiple antennas," Wireless Personal Commun. vol.6, no. 3, pp. 311-335, 1998.
[15] E.Telatar,"Capacity of multi-antenna Gaussian channels, "European Trans. Telecomm., vol. 10, no.6, pp.585-595, 1999.
[16] Jitendra Kumar Daksh, Ravi Mohan, Sumit Sharma, " Performance Analysis with Space-time coding in MIMO-OFDM Systems with Multiple Antennas " , International Journal of Advanced Computer Research (IJACR), Volume-3, Issue-10, June-2013 ,pp.126-129.
[17] Rishi Choubey, Ravi Mohan, Sumit Sharma, "A survey of BER Performance of Generalized MC DS-CDMA System", International Journal of Advanced Computer Research (IJACR), Volume-3, Issue-10, June-2013, pp.130-133.
[18] Jitendra Kumar Daksh, Ravi Mohan, Sumit Sharma, " A survey of Performance Analysis in MIMO-OFDM Systems " , International Journal of Advanced Computer Research (IJACR), Volume-3, Issue-10, June-2013 ,pp.91-94.
[19] Ashutosh K. Dubey, Yogeshver Khandagre, Ganesh Raj Kushwaha,Khushboo Hemnani, Ruby Tiwari, and Nishant Shrivastava," PAPR Reduction in OFDM by Using Modernize SLM Technique", WiMo/CoNeCo, CCIS 2011.
[20] George A. Ropokis, Athanasios A. Rontogiannis, and Kostas Berberidis, "BER Performance Analysis of Cooperative DaF Relay Networks and a New Optimal DaF Strategy", IEEE Transactions on Wireless Communications, VOL. 10, NO. 4, April 2011.

Ms. Shraddha Rawat hails from Bhopal and was born on 27-July-1988. She did her schooling from Bhopal Public Higher Secondary School, Bhopal and completed her graduation in stream of Electronics and Communication Engineering from RKDF Institute of Science and Technology, Bhopal with 71.8%. She is pursuing M.Tech in Electronics and Communication Engineering from RKDF Institute of Science and Technology, Bhopal ,under Rajiv Gandhi Proudhyogiki Vishwavidhyalaya , Bhopal, Madhya Pradesh.