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PERFORMANCE ANALYSIS OF 16 PSK OVER AWGN, RICIAN, RAYLEIGH CHANNEL FOR MIMO-OFDM WIRELESS SYSTEM

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Abstract- In this paper we have focus on the performance of 16 PSK modulation and impact of different channels on the signals for MIMO OFDM .It is compared by taking readings with and without beam forming and showing graph between SNR and BER for various channels. Higher-order modulations (M large) are more spectrally efficient but less power efficient (i.e. BER higher). This Paper shows a performance analysis on the basis of different fading channels. The results show that the BER performance is improved dramatically in low SNR than in high SNR.

Keywords:- OFDM, MIMO, 16PSK, Rayleigh, AWGN, Rician channel

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INTRODUCTION

Digital modulation techniques contribute to the evolution of our mobile wireless communications by increasing the speed, capacity, performance as well as the quality of the wireless network. This paper focuses on 16PSK modulation technique. Digital modulation schemes have greater capacity to convey large amounts of information than analog modulation schemes Multiple Phase Shift Keying (M-PSK) is much more spectrally efficient, the greater the number of smaller phase shifts, the more difficult the signal is to demodulate in the presence of noise. The benefit of M-PSK is that the constant carrier amplitude means that more efficient nonlinear power amplification can be used. 16-PSK uses 22.5° shifts of constant amplitude carrier signals. This arrangement results in a transmission of 4 bits per symbol.MPSK signal is represented as below.

$$\begin{aligned} s_i(t) &= \Re\{Ag(t)e^{j2\pi(i-1)/M}e^{j2\pi f_c t}\}, \quad 0 \le t \le T_s \\ &= Ag(t)\cos\left[2\pi f_c t + \frac{2\pi(i-1)}{M}\right] \\ &= Ag(t)\cos\left[\frac{2\pi(i-1)}{M}\right]\cos 2\pi f_c t - Ag(t)\sin\left[\frac{2\pi(i-1)}{M}\right]\sin 2\pi f_c t. \end{aligned}$$

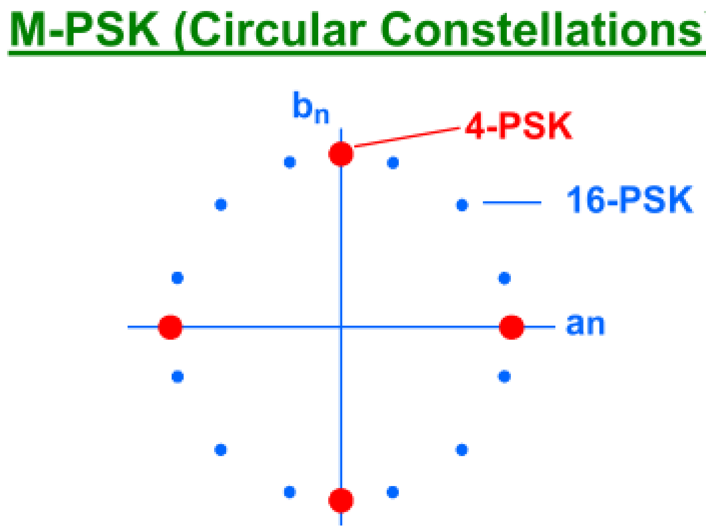


FIG.1.MPSK Cirular Constellations(16 PSK)

In this paper system used is MIMO-OFDM which is widely used in today's wireless communication world. Results are shown with and without using the Adaptive Beamforming technique.

2) MIMO-OFDM:

Multiple-input multiple-output (MIMO) in combination with orthogonal frequency division multiplexing (OFDM) is the promising technique to achieve the high data rates and large system capacity for wireless communication systems in frequency selective fading environments. The most likely application of MIMO is the next generation wireless local area network (WLAN). The current standards of WLAN i.e. IEEE 802.11a and IEEE 802.11g are basically relying on OFDM but to achieve higher data rates they are based on MIMO. The quality of wireless link is basically depended on three factors the transmission rate, the transmission range and the transmission reliability. With the emergence of MIMO assisted OFDM system, the above factors can be improved concurrently. The main advantage of wireless LAN is the deployment in indoor environments. All individual functions of OFDM like IFFT, FFT and CP when applied to every single transmit and receive antenna (MIMO) makes it MIMO-OFDM.

3 MIMO channel model are:

3.1 AWGN Channel

For an AWGN (Additive White Gaussian Noise) channel, θ'is a constant and is equivalent to the AoA of the LoS propagation path. In this case, we use the so-called narrowband data model to model the received signal at the antenna arrays. The narrowband data model assumes that the envelope of the signal wave front propagating across the antenna array essentially remains constant[2]. This model is valid when the signals or the antennas have a bandwidth that is much smaller than the carrier frequency fc. Under the above assumptions, the vector from of the baseband complex equivalent received signal can be written as,

$$Y(n) = V(\theta)\, S(n) + G(N)$$

Where, V (θ) is the array manifold vector ,S(n) is the signal and G (n) is AWGN with zero mean and two-sided power spectral density given by No/2. This is simply a plane-wave model.

3.2 Rayleigh Fading Channel

In wireless telecommunications, multipath is the propagation phenomenon that results in radio signals reaching the receiving antenna by two or more paths. Causes of multipath include atmospheric ducting, ionosphere reflection and refraction, and reflection from water bodies and terrestrial objects such as mountains and buildings. The effects of multipath include constructive and destructive interference, and phase shifting of the signal. This causes Rayleigh fading. The standard statistical model of this gives a distribution known as the Rayleigh distribution. Rayleigh fading is a term used when there is no direct component, and all signals reaching the receiver are reflected. Mathematically, the multipath Rayleigh fading wireless channels modeled by the channel impulse response (CIR)

$$h(t) = \sum_{l=0}^{L-1} \sigma_1 \partial(t - \tau_l)$$

Where, L is the number of channel paths, α_l and τ_l are the complex value and delay of path l, respectively.

The paths are assumed to be statistically independent, with normalized average power. The channel is time variant due to the motion of the mobile terminal, but we will assume that the CIR is constant during one OFDM symbol.

3.3 Rician MIMO Channel

A Rician model is obtained in a system with LOS propagation and scattering. The model is characterized by the Rician factor, denoted by K and defined as the ratio of the line of sight and the scatter power components. The pdf for a Rician random variable x is given by

$$p(x)=2x(1+k)e^{-k(1+k)x^2}\, I_o\, (2x\sqrt{k(k+1)}\quad x\geq 0 \ldots\ldots\ldots\ldots\ldots(1)$$

Where $k= D^2/2\,\sigma_r^2$……………………………….(2)

D^2 and $2\,\sigma_r^2$ are the powers of the LoS and scattered components, respectively. The powers are normalized such that

$$D^2 + 2\,\sigma_r^2 = 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The channel matrix for a Rician MIMO model can be decomposed as,

$$H=DH_{LOS}+\sqrt{2}\,\sigma_r\, H_{Rayl} \ldots\ldots\ldots (4)$$

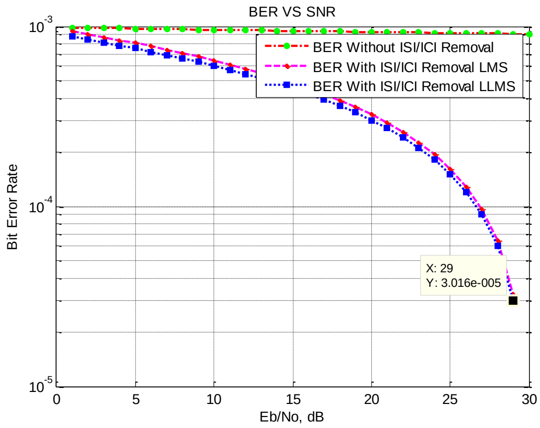
Where, H_{LOS} is the channel matrix for the LoS propagation with no scattering and H_{Rayl} is the channel matrix for the case with scattering only.

4. SIMULATION PARAMETERS

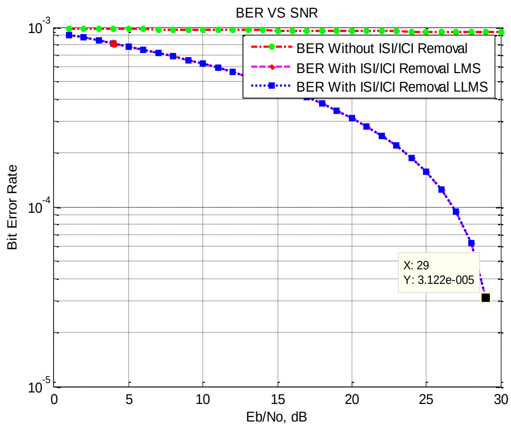
In this paper we have taken simulation parameters by using different channels and different transmitting angle.

Table 1 Parameters taken for simulation

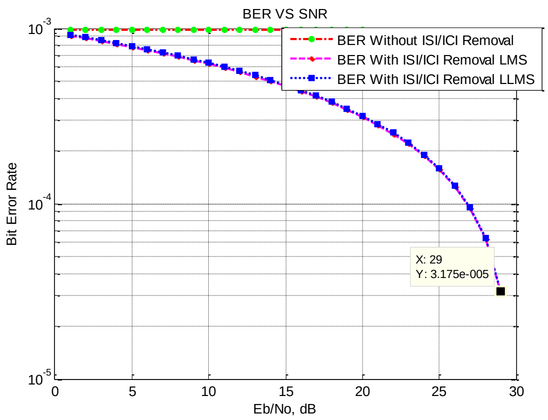
Parameter	Value/Type
Input size	1000 bits
No. of Carriers	64
IFFT/FFT size	64
SNR range	1-30
Carrier modulation used	16PSK
Channel used	AWGN,Rayleigh,Rician
Coding Technique	Convolution based Forward error correction with rate 1/3
No of transmitting Antenna	2
No of Receiving Antenna	2
Interfering Angle	10^o
Transmitting Angle	TX_1 -10^o & TX_2 - 90^o



1)SNR&BER FOR AWGN Channel



2) SNR & BER for Rician Channel



3) SNR & BER for Rayleigh channel

Table 2: SNR(Signal to Noise Ratio) & BER(Bit Error Rate) FOR 16 PSK

	AWGN Channel		Rician Channel		Rayleigh Channel	
	10^{o} & 90^{o}		10^{o} & 90^{o}		10^{o} & 90^{o}	
SNR	Without Beam Forming BER	With Beam Forming BER	Without Beam Forming BER	With Beam Forming BER	Without Beam Forming BER	With Beam Forming BER
4	0.0009735	0.0007841	0.0009778	0.0008116	0.000982	0.0008254
8	0.000963	0.0006635	0.0009714	0.0006868	0.0009799	0.0006984
12	0.0009524	0.0005429	0.0009651	0.0005619	0.0009778	0.0005714
16	0.0009418	0.0004222	0.0009587	0.000437	0.0009757	0.0004444
20	0.0009312	0.0003016	0.0009524	0.0003122	0.0009735	0.0003175
24	0.000929	0.000181	0.000945	0.0001873	0.0009714	0.0001905
28	0.000913	0.00006032	0.000937	0.00006243	0.0009693	0.00006349
29	0.000905	0.00003016	0.000921	0.00003122	0.0009688	0.00003175

5. CONCLUSION

In this paper, performance comparison 16 PSK over AWGN, Rician and Rayleigh channel for MIMO-OFDM wireless system is given with and without using adaptive beamforming. Receive (Adaptive) beamforming can more effectively mitigate interference and enhances the system performance. As the beamforming is done at the receiving side by considering the parameters of multipath propogation characteristic of the channel like Scattering, reflection, diffraction, attenuation, fading and noise, the performance of the system increases in terms of SNR thereby decreasing the BER. The proposed scheme has been verified in AWGN channel, Rayleigh Fading channel and Rician Fading channel. It has been observed that BER performance of the system is improved with adaptive beamforming over AWGN channel for the 16 PSK modulations. Channels perform in the following order in terms of best (less SNR requirement) to worst (more SNR requirement) to maintain the required BER: AWGN, Rician, Rayleigh.

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