Performance Analysis of MIMO OFDM system using BPSK & QPSK modulation techniques under Rayleigh Fading Channel

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ABSTRACT

Now a day's MIMO-OFDM system in Rayleigh Fading Channel is very popular technique for mobile communication for research. Here our main motive is to analyses the performance of MIMO-OFDM system by using ASTC encoder. In this paper, we evaluated the performance of MIMO OFDM system under different modulation techniques. The performance of system is evaluated by calculating the probability of Bit Error Rate (BER) versus the Signal Noise Ratio (SNR) and Energy per bit to Noise power spectral density ratio under the Rayleigh fading channel. The simulation results have been carried out for different number of transmitters.

Key Terms

Digital Modulation, Fading, BER (Bit Error Ratio), SNR (Signal to Noise Ratio)

[I]. INTRODUCTION

It is vital to judge the performance of wireless devices by considering the transmission characteristics, wireless channel parameters and device structure. In wireless channels, many models are planned and investigated to calculate SNR. The signal is detected and decoded by using many replicas of the received signal. So, we have a tendency to think about multilink receiver structure.

Wireless communication is one in every of the foremost active areas of technology development and has become an ever-more vital and distinguished a part of daily life. Simulation of wireless channels accurately is extremely vital for the planning and performance analysis of wireless communication systems and parts. Attenuation or loss of signals may be a vital development that associated with the Wireless Communications Field. A very important issue is in wireless application development is that the choice of attenuation models. A comparative analysis of BPSK and QPSK will also provide knowledge base which helps for application development in real-world.

a) Fading Channels

A fading Channel is understood as communications channel that should face completely different fading phenomenon's, throughout signal transmission. In world atmosphere, the radio propagation effects mix along and multipath is generated by these fading channels. As a result of multiple signal propagation methods, multiple signals are going to be received by receiver and therefore the actual received amplitude is that the vector of the all signals. These signals incident from any direction or angle of arrival. In multipath, some

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signals aid the direct path and a few others calculate.

b) **Rayleigh fading Channel:**

There are many models that describe the phenomenon of small scale fading. Out of these models, Rayleigh fading, Ricean fading and Nakagami fading models are most widely used.The Rayleigh fading is primarily caused by multipath reception. It is a statistical model for the effect of a propagation environment on a radio signal. This model is suitable for troposphere and ionospheres‟ signal propagation as well as the effect of heavily built-up urban environments on radio signals. Rayleigh fading is most applicable when there is no line of sight between the transmitter and receiver.

[II]. MODULATION

It is the process of varying one or more properties of a periodic waveform called the carrier signal, with a modulating signal that typically contains information to be transmitted.. This alteration is termed modulation, and it's the modulated signal that's transmitted. The receiver then recovers the initial signal through a method known as *demodulation.*

Modulation techniques are expected to have three positive properties:

- *Good Bit Error Rate Performance*: Modulation schemesshould achieve low bit error rate in the presence of fading, Doppler spread, interference and thermal noise.
- *Power Efficiency*: Power limitation is one of the criticaldesign challenges in portable and mobile applications. Nonlinear amplifiers are usually used to increase power efficiency. However, nonlinearity may degrade the bit error rate performance of some modulation schemes. Constant envelope modulation techniques are used to prevent the re growth of spectral side lobes during nonlinear amplification
- *Spectral Efficiency*: The modulated signals powerspectral density should have a narrow main lobe and fast roll-off of side lobes. Spectral efficiency is measured in units of bit /sec/Hz.

[I]. Binary phase-shift keying (BPSK)

Binary phase shift keying is the simplest form of phase shift keying. It uses two phases which are separated by 180°. It does not particularly matter exactly where the constellation points are positioned. This modulation is the most robust of all the phase shift keying. It is, however, only able to modulate at 1 bit/symbol.

Implementation

The simple form for BPSK follows the equation:

$$s_n(t) = \sqrt{\frac{2E_b}{T_b}}\cos\big(2\pi f_c(t) + \pi(1-\mathrm{n})\big), \mathrm{n} = 0{,}1.$$

This yields two phases, 0 and π. In the specific form, binary data is often conveyed with the following signals:

$$s_0(t) = \sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_c \mathrm{t} + \pi)$$

$$= -\sqrt{\frac{2E_b}{T_b}}\cos(2\pi \mathrm{f_c t})$$

for binary “0”

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$$s_1(t)=\sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_c t) \text{ for binary "1"}$$

Where

f_c= frequency of the carrier-wave.

The signal-space can be represented by the single function as given below:

$$\Phi(t)=\sqrt{\frac{2}{T_b}}\cos(2\pi f_c t)$$

Where

1=is represented by $\sqrt{E_b}\phi(t)$

0=is represented by - $\sqrt{E_b}\phi(t)$

[II]. Quadrature phase-shift keying (QPSK)

This is known as *quadriphase PSK or* 4-PSK.QPSK uses four points on the constellation diagram, equispaced around a circle. With four phases, QPSK can encode two bits per symbol, shown in the diagram with gray coding. QPSK transmits twice the data rate in a given bandwidth compared to BPSK - at the same BER.

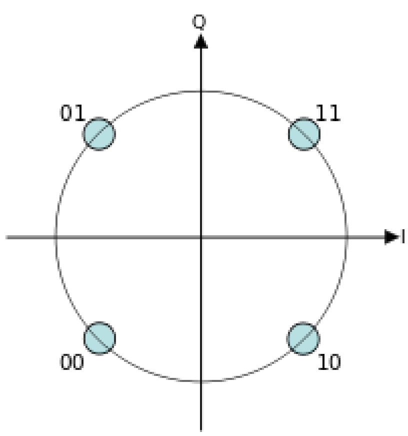

Figure 1. Constellation diagram for QPSK

Implementation

The implementation of QPSK is more general than that of BPSK as given below:

$$s_n(t) = \sqrt{\frac{2E_s}{T_s}}\cos\left(2\pi f_c t + (2n-1)\frac{\pi}{4}\right),$$

Where

n=1, 2, 3, 4.

This yields the four phase's π/4, 3π/4, 5π/4 and 7π/4 as needed.This results in a two-dimensional signal space with unit basis function. The first basis function is used as the in-phase component of the signal:

$$\phi_1(t)=\sqrt{\frac{2}{T_s}}\cos(2\pi f_c t)$$

And second basis function is used as the quadrature component of the signal.

$$\phi_2(t)=\sqrt{\frac{2}{T_s}}\sin(2\pi f_c t)$$

[III]. Bit Error Rate (BER)

The Bit error rate is calculated from the number of bits received in error divided by the number of bits transmitted.

BER= (Bits in Error) / (Total bits received). During transmission, the number of bit errors is the number of received bits of a data stream over a communication channel that has been altered due to noise, interference, distortion or bit synchronization errors. BER is a unit less performance measure, often expressed as a percentage.

Noise affects the BER performance. Quantization errors also reduce BER performance, through incorrect or ambiguous reconstruction of the digital waveform. The accuracy of the analog modulation process and the effects of the filtering on signal and noise bandwidth also effect quantization errors.

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[IV]. Signal to Noise Ratio (SNR)

SNR is the ratio of the received signal strength over the noise strength in the frequency range of the operation. Noise strength, in general, can include the noise in the environment and other unwanted signals (interference). BER is inversely related to SNR, that is high BER causes low SNR. High BER causes increases packet loss, increase in delay and decreases throughput. The exact relation between the SNR and the BER is not easy to determine in the multichannel environment. Signal to noise ratio (SNR) is an indicator commonly used to evaluate the quality of a communication link and measured in decibels

SNR = 10 $\log_{10}$ (Signal Power / Noise Power) dB.

[V]. Energy per bit to Noise Power Spectral Density Ratio

It is a normalized signal-to-noise ratio measure, also known as the "SNR per bit". It is especially useful when comparing the bit error rate performance of different digital modulation schemes without taking bandwidth into account. E_b/N_0 is equal to the SNR divided by the "gross" link spectral efficiency in (bit/s)/Hz, where the bits in this context are transmitted data bits, inclusive of error correction information and other protocol overhead.

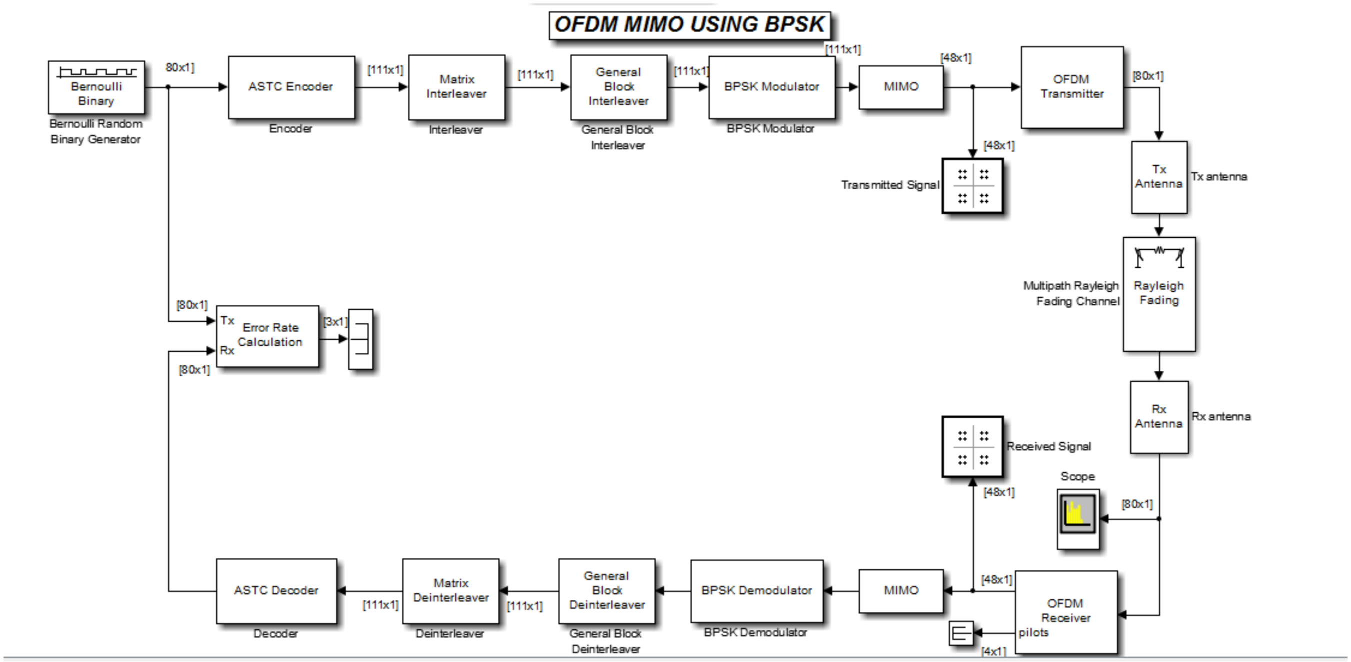

Figure 2. Proposed Model of MIMO OFDM.

[VI]. SIMULATION RESULTS

Simulink is a graphical extension to MATLAB for the modeling and simulation of systems. In Simulink, systems are drawn on screen as block diagrams. Many elements of block diagrams areavailable (such as transfer functions, summing junctions, etc.), as well as virtual input devices and output devices. Simulink is integrated with MATLAB and data can be easily transferred between the programs.in this paper I have considered the analysis of MIMO OFDM system using BPSK and QPSK modulation

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under Rayleigh fading channel.the simulation result shows the graph for frequency response of received signal,simulated bit error rate,theoretical bit error rate,simulated bit error rate for different number of transmitters in the case of BPSK as well as in the case of QPSK.Here I have considered nt=1 and nt=2 for the purpose of simulated bit error rate in both the cases as shown in the graphs.

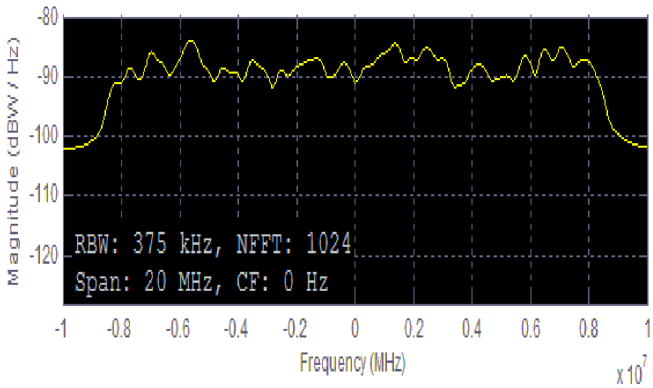

Fig. 3 BPSK signal FREQUENCY response ofMultipath Rayleigh fading channel

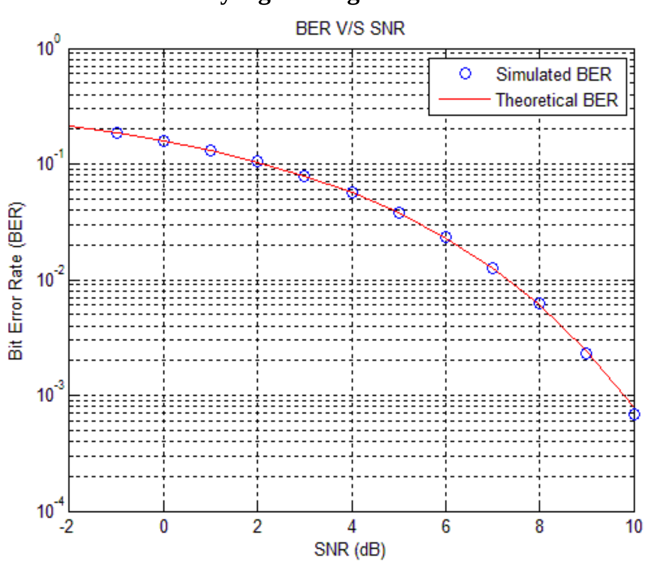

Fig. 4 BER Vs SNR FOR BPSK

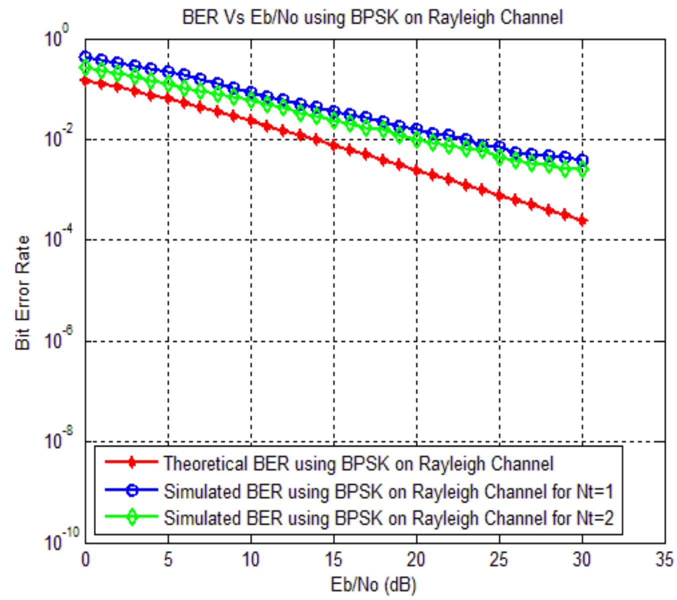

Fig. 5 BER Vs Eb/No FOR BPSK

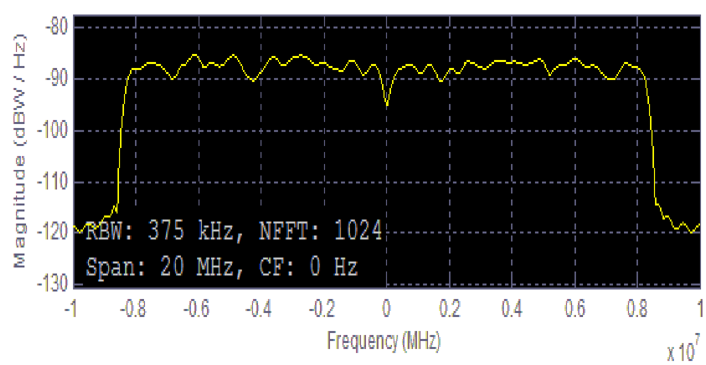

Fig. 6 QPSK signal FREQUENCY response of multipath Rayleigh fading channel

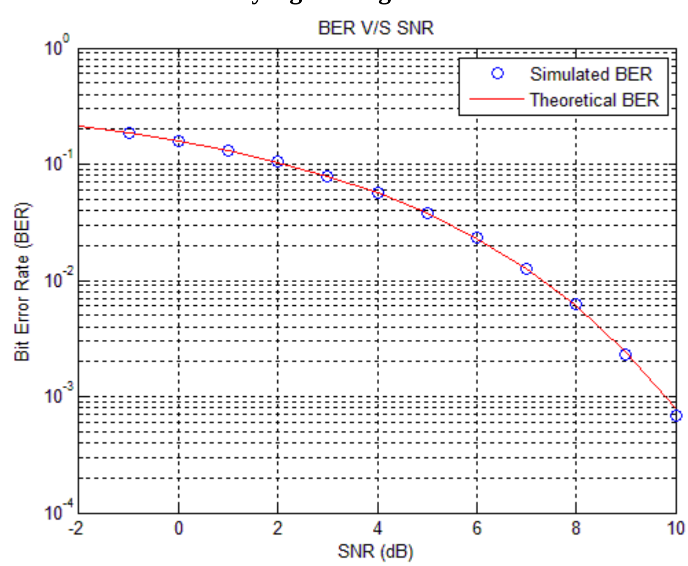

Fig. 7 BER Vs SNR FOR QPSK

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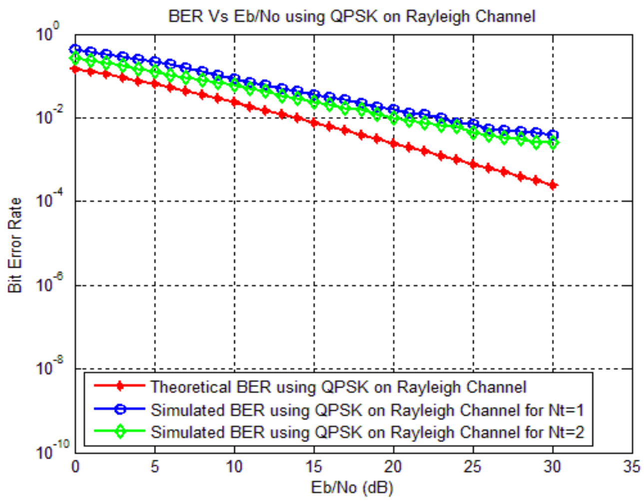

Fig. 8 BER Vs Eb/No FOR QPSK

CONCLUSION

The Bit Error Ratio of a digital communication system is an important figure of merit used to quantify the integrity of data transmitted through the system.it is clear from the graph that bit error rate is approximately same in the case of BPSK and QPSK.in the case of Energy per bit to Noise power spectral density ratio For higher values of E_b / N_0, the BER is decreasing for both the modulation schemes.

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BIBLOGRAPHY:

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