Performance Evaluation of Error Rate For MIMO-SUI Channel Under M-PSK Modulation Scheme

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Abstract - The wireless communication system utilizing the space diversity has an interest in modern communication system to deliver high performance to the users. The error rate is the major challenge to fight against the increasing use of mobile devices. As the obstacles and microwaves are increasing day by day the same affecting each other, the result is interfering environment with lots of noises and distortions in the signal. In this paper we have modeled a wireless communication system utilizing the Alamouti Space Time Block Codes to transmit the signal in space with variations which is integrated with the antenna diversity with the 2 transmitter and 2 receiver antennas i.e. MIMO technology to receive more power than traditional single antenna system. Such system is analysed on the SUI environment which is a modern wireless channel model given by the scientists for modern communication technology. The outcomes of the proposed system clearly show the optimized BER than existing system.

Keyword - SUI, M-ary PSK, STBC, Antenna Diversity.

I. INTRODUCTION

Wireless communications is, by any measure, the fastest growing segment of the communications industry. As such, it has captured the attention of the media and the imagination of the public. Cellular systems have experienced exponential growth over the last decade and there are currently around two billion users worldwide. Indeed, cellular phones, or mobile phones, as they are commonly known, have become a critical business tool and a part of everyday life in most developed and developing countries.

In a basic communication system, the data are modulated onto a single carrier frequency. The available bandwidth is then totally occupied by each symbol. This kind of system can lead to inter-symbol-interference (ISI) in case of frequency selective channel. The basic idea of OFDM is to divide the available spectrum into several orthogonal subchannels so that each narrowband subchannel experiences almost flat fading. Orthogonal frequency division multiplexing (OFDM) is becoming the chosen modulation technique for wireless communications. OFDM can provide large data rates with sufficient robustness to radio channel impairments. Many research centers in the world have specialized teams working in the optimization of OFDM systems. In an OFDM scheme, a large number of orthogonal, overlapping, narrow band sub-carriers are transmitted in parallel. These carriers divide the available transmission bandwidth. The separation of the sub-carriers is such that there is a very compact spectral utilization. With OFDM, it is possible to have overlapping subchannels in the frequency domain, thus increasing the transmission rate. The attraction of OFDM is mainly because of its way of handling the multipath interference at the receiver. Multipath phenomenon generates two effects (a) Frequency selective fading and (b) Intersymbol interference (ISI).

Early radio systems transmitted analog signals. Today most radio systems transmit digital signals composed of binary bits, where the bits are obtained directly from a data signal or by digitizing an analog signal. A digital radio can transmit a continuous bit stream or it can group the bits into packets. The latter type of radio is called a packet radio and is often characterized by bursty transmissions: the radio is idle except when it transmits a packet, although it may transmit packets continuously.

The term mobile has historically been used to classify any radio terminal that could be moved during operation. Most people are familiar with a number of mobile radio communications systems used in everyday life. Television remote controllers, cordless telephones, hand-held walkie-talkies, pagers and cellular telephones are all example of mobile radio communications systems. However the cost, complexity, performance, and types of services offered by each of these mobile systems are vastly different. More recently, the term mobile is used to describe a radio terminal that is attached to a high speed mobile platform e.g. a

cellular telephone in a fast moving vehicle, whereas the term portable describes the radio terminal that can be hand-held and used by someone at a walking speed (e.g. a walkie-talkie or a cordless telephone inside a home). The term subscriber is often used to describe a mobile or portable user, and each user's communication device is called a subscriber unit. In general, the collective group of users in a wireless system is called users or mobiles.

Wireless communication has advanced ever so much in the past thirty years that after satellite communication, optical communication is the thing of for the future. Optical communication is any form of telecommunication that uses light as the transmission medium. An optical communication system consists of a transmitter, which encodes a message into an optical signal, a channel, which carries the signal to its destination, and a receiver, which reproduces the message from the received optical signal.

A block diagram of a generic communications system is given by figure 1 where a signal is first modulated then sent through the transmitted through the channel which is received by the receiver and demodulated to find the transmitted signal at the receiver.

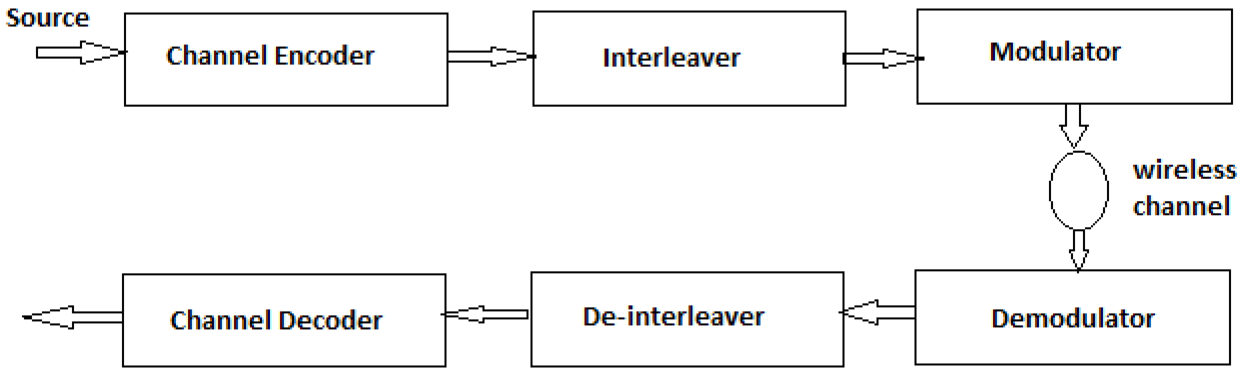

Figure 1.1 Block Diagram of a Generic Communication System.

II. SUI MODEL

In order to investigate the performances of OFDM based BWA an accurate channel model needs to be considered. Usually all the wireless channels are characterized by path loss (including shadowing), multipath delay spread, fading characteristics, Doppler spread, and co-channel and adjacent channel interference. Ricean distribution can be used for characterization of narrow band received signal fading. In this distribution the key parameter is the *K*-factor, which is defined as the ratio of the “fixed” component power and the “scatter” component power. An empirical model was derived from a 1.9 GHz experimental data set collected in a typical suburban environment for transmitter antenna heights of approximately 20 m [7]. The model presented in [7] is as follows:

$$K = F_s F_h F_b K_0 d^{\gamma} u$$

,where F_s is a seasonal factor, F_h is the receiving antenna height factor, F_b is the beam width factor, Ko and γ are regression coefficients, u is a lognormal variable which has mean at 0 dB and a standard deviation of 8.0dB. Some values of the parameters are Fs as 1.0 in summer and 2.5 in winter respectively, K_0 and γ are regression coefficients(K_0 = 10; γ = -0.5). The receiving antenna height factor F_h is defined by F_h= 0.46(h/3), where h is the receiving antenna height in meters, the beam width factor F_b is defined by F_b = (b/17)-0.62, where b is in degrees. The empirical model proposed in [7] has been confirmed by the experimental work presented in [8].

An independent set of experimental data was acquired in San Francisco Bay Area at 2.4 GHz and with similar antenna heights mentioned in [7] which has been reported in [8].It has also been shown that the experimental data presented in [8] very closely matches with the model presented in [7]. The narrow band *K*-factor distribution was found to be lognormal with the median as a simple function of season, antenna height, antenna beam width, and distance. The standard deviation was found to be about 8 dB. Using this model, it can be found that *K*-factor decreases as the distance from the antenna and the antenna beam width is increased. One of our focus is to determine *K*-factor that meets the requirement that 90% of all locations within a cell have to be served with 99.9% reliability. Calculating the *K*-Factor is quite complex as it involves path loss, delay spread, antenna correlation (if applicable), specific modem characteristics, and other parameters that influence system performance. However an approximated value can be calculated with much easier steps. First we select 90% of the users with the highest *K*-factors over the cell area. Secondly we can obtain the approximate value by selecting the minimum *K*-factor within the set.

This value of *K*-factor can be close or equal to 0. In Fig. 3 shows fading cumulative distribution functions (CDFs) for various *K* factors. For example, for K = 0 dB (i.e., linear K = 1) a 30 dB fade occurs, which is very similar to a Rayleigh fading case (i.e., linear K = 0). The significance of these fade probabilities actually depends on the system design such as whether diversity is included and the quality of service (QoS) being offered etc.

When multiple antennas are used at the transmitter and/or at the receiver, the channel can be characterized by a matrix (i.e., Multi-Input-Multi-Output or MIMO in short) system, which is a natural extension of the developments in antenna array based communication system.

III. PROPOSED METHODOLOGY

The proposed simulation model for the wireless Almouti scheme with the utilization of SUI channel model is given in the below fig. In the system we have analysed the proposed simulation model with M-ary PSK modulation to modulate the signal. Here this modulation scheme play very important role to fight against the noises and the interferences. Figure 3.1 demonstrate the flow of proposed work

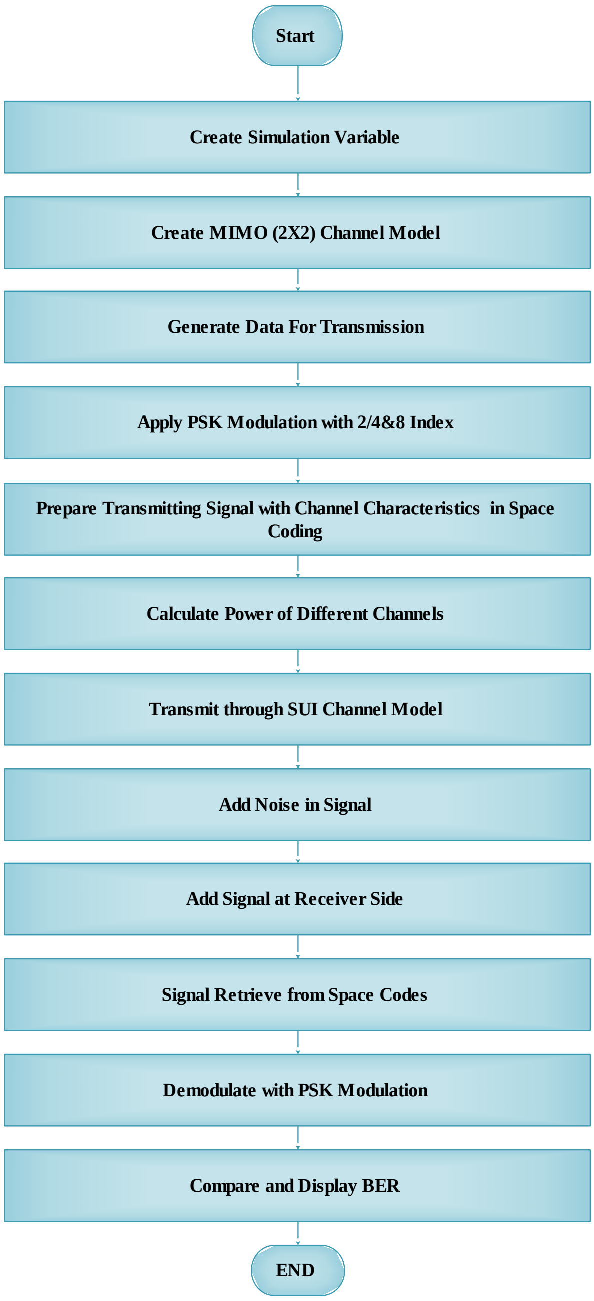

Figure 3.1 Flow of Proposed Work.

Steps of Execution of Proposed Work

Here M defines the number of constellation points in the constellation diagram and essentially the M-PSK type. For example M=4M=4 implies 4-PSK or QPSK, M=8, M=8 implies 8-PSK. The value of M depends on another parameter k – the number of bits squeeze into a single M-PSK symbol. For example to squeeze in 3 bits (k=3) in one transmit symbol, $M=2^k=2^3=8$. his gives us 8-PSK configuration. the process of simulation of proposed work has discussed below.

Steps of Execution of Proposed Work

(1) Create Simulation Variable

(2) Crate MIMO (2X2) Channel Model

(3) Generate Data For Transmission

(4) Apply PSK Modulation with 2, 4 and 8 Index

(5) Prepare Transmitting Signal with Characteristic in Space coding

(6) Calculate Power of different Channels

(7) Transmit Through SUI Channel Model

(8) Add Noise in Signal

(9) Add Signal at Receiver End

(10) Signal Retrieve Space Code

(11) Demodulate with PSK Modulation

(12) Compare and Display BER

To execute proposed work in MATLAB fist create a simulation variable, initialize signals and parameters. Create a 2X2 MIMO channel model 2X2 represents the number of transmitter and receiver antenna. Generate sinal data for transmission experimental process. Apply PSK Modulation with 2, 4, 8 Index. Prepare Transmit signal with characteristic space coding. Now calculate the power of different channels. And transmit it with through SUI channel.Calculatre Power of Different channels Transmit this signal through. Add noise for the experimental purpose and add signal at receiver Add signal at receiver end. Signal retrieve using space code model. Demodulate retrieved signal with PSK modulation Scheme. Compare received symbols with Sent symbols and calculate bit error rate (BER)s.

Figure 3.2 Demonstrated proposed system of 2X2 MIMO where two transmitter and two receiver antennas are used and c1,c2,c3,c4 are the transmitted signal by transmitter antenna 1 and 2 respectively.

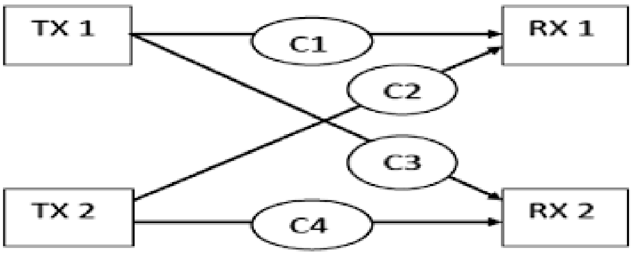

Figure 3.2 2X2 MIMO systems.

IV. SIMULATION RESULTS

The proposed methodology explained in the previous section is simulated on the MATLAB and the system analysis on the bit error rate is done. The performance of the proposed system between BER and SNR is shown in the subsequent figures.

In Fig. 4.1 performance of the proposed multiple input multiple output (MIMO) space coding with Stanford University Interim(SUI) channel model system is analysed and BER vs SNR is shown with 2 iterations. The whole system is tested for 2-PSK, 4-PSK and 8-PSK and found that the system perform well with 8-PSK Modulation and optimum value is 10^{-5}.

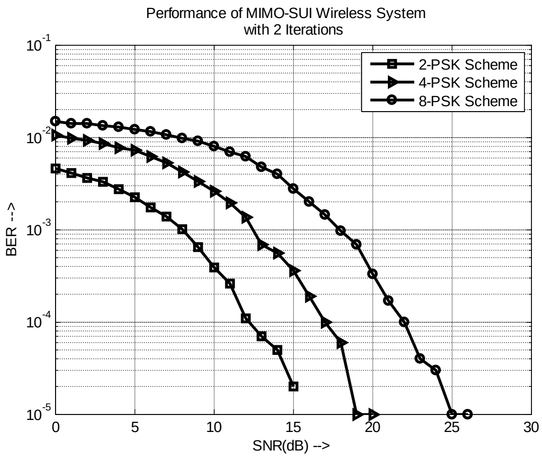

Fig. 4.1 Performance of the system with SUI model and 2 iterations

In Fig. 4.2 performance of the proposed multiple input multiple output (MIMO) space coding with Stanford University Interim (SUI) channel model system is analysed and BER vs SNR is shown with 4 iterations. The whole system is tested for 2-PSK, 4-PSK and 8-PSK and found that the system performs well with 2-PSK Modulation and optimum value is $5x10^{-6}$.

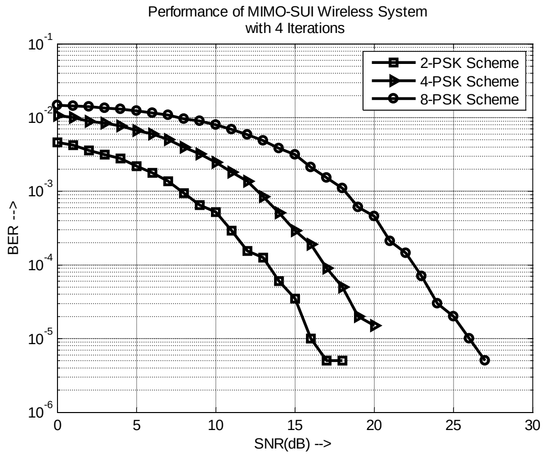

Fig. 4.2 Performance of the system with SUI model and 4 iterations

In Fig. 4.3 performance of the proposed multiple input multiple output (MIMO) space coding with Stanford University Interim(SUI) channel model system is analysed and BER vs SNR is shown with 8 iterations. The whole system is tested for 2-PSK, 4-PSK and 8-PSK and found that the system perform well with 2-PSK Modulation and optimum value is $2.5x10^{-6}$.

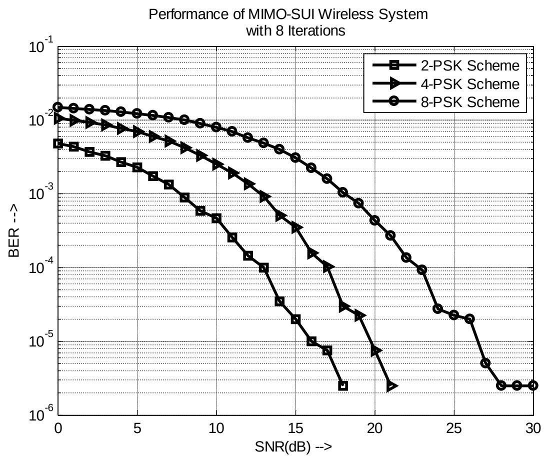

Fig. 4.3 Performance of the system with SUI model and 8 iterations

V. CONCLUSION AND FUTURE SCOPE

From the above proposed system and result analysis it can be conclude that the wireless system with MIMO technology and the utilization space coding under the SUI channel environment perform well with the 2-PSK modulation and the optimum value of BER is $2.5x10^{-6}$. The noise and effect of fading is reduced with the Space Time coding of the signal which separates the signal into multiple parts which has an inherent security for the signal. Further noises are reduced with the Digital Mean Filter which takes averages of the multiple samples and smoothen the glitches presents in the signal. In this paper the proposed system can be further improved in terms of noise immunity as well as better error rate with the integration of more complex and accurate modulation techniques and digital filtering solutions. Such system can targeted for variety of wireless applications such as mobile communications and other mobile information sharing systems.

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