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OFDM-MIMO methods to improve BER in chaos CDSK communication system

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Abstract— chaotic signals have characteristics such as aperiodicity, broadband, sensitive initial conditions, the difficulty of predicting the signal, simple implementation. The characteristics of chaotic signals are determined from the initial conditions. Due the characteristics of the chaos signal, the chaos communication system is strong from multipath channel and jamming, it is provides security as well as privacy. The BER (bit error rate) performance of this is worse than the digital communication system. Many diversity methods have been studied to improve the BER performance in Rayleigh channel. Here in this paper we are using alamouti STBC(space time block code) to improve the BER performance, also evaluating the BER performance of a CDSK(correlation delay shift keying) communication system using alamouti STBC.by applying alamouti STBC to CDSK communication system, there is improvement in BER performance in the Rayleigh channel. Therefore if alamouti MIMO system is used to chaos CDSK communication system the BER performance will improve in the channels that are fading. Also the use of OFDM (orthogonal frequency division multiplexing) in CDSK communication system will improve the BER (bit error rate) and will avoid intersymbol interference. So the use of OFDM along with Alamouti MIMO gives better improvement in BER when compared to using MIMO alone.

Keywords- correlation delay shift keying, MIMO, alamouti STBC, BER performance,

I. INTRODUCTION

"CHAOS"this word takes several meanings which vary from common man, mathematicians and scientists. Generally a common mans says chaos is something negative with characters such as randomness ,disorder .all the chaotic systems are non linear .a better and a good way to define chaos is that it is used to describe a system which is nonlinear ,deterministic and is sensitive to initial conditions. Chaotic signals have characteristics such as aperiodicity, broadband, sensitive initial conditions, the difficulty of predicting the signal, simple implementation. Therefore chaotic signals have been widely used in the field of communication. Chaotic signals have broadband spectra, due to these characteristics they are used as carriers in spread spectrum communication [4].chaos communication system is decided by initial values of the equation that generated from chaos signal generator. It has the sensitive characteristic according to initial values. Chaos signals are changed to completely different signal according to changing initial values or parameters [2-3]. It is possible to predict in the value of the future by the value of the past. Chaos signal has a sensitive characteristic to initial values. If users of chaos communication system do not know the exact initial values, it is impossible to predict the value of the future [1][4]. Using the combination of the characteristics of chaos signal and digital communication technologies, the study makes difficult to detect other user's signal, interfere with waves, and have strong features in the jamming. It is possible to reduce the probability of eavesdropping. Chaos communication system is highly secured than other systems. Chaos communication system has the BER performance deterioration more than digital communication system, and BER performance of chaos communication system is very bad in fading channel [4].. By the deterioration of BER performance, existing chaos communication system evaluates the BER performance of several chaos maps, and user of chaos communication system uses selectively chaos map that has the best BER performance. Also, the existing study of chaos communication system evaluates the BER performance according to kind of chaos modulation system, and security [5].Study on Chaos communication system is performed in order to improve the BER performance by applying the MIMO system in fading channel. Chaos communication System that is applied MIMO system is studied in various channels [6-7].

In a mobile communication environment, multipath fading is a greatest disorder factor for realizing high-speed data Communication. If a MIMO system is applied to chaos communication system performance of system is possible to improve [8]. Therefore, BER performance that is deteriorated due to fading channel environment can be improved by applying the MIMO system. BER performance deterioration of the chaos communication system in multi-path fading

channel can be solved by applying the MIMO system. It is possible to obtain diversity gain and array gain. These gains have a good effect on the BER performance [9].

Basically a CDSK system does not use encoding scheme such as encoding with different codes such as reed Solomon codes ,etc. due to this the system will be more prone to error By the use of MIMO in CDSK system the error can be minimized because MIMO method provides spatial diversity and it provides orthogonality between the symbols and its conjugates. With the use of OFDM here the error is further minimized because it provides diversity gain , provides orthogonality between the symbols and avoids intersymbol interference.

In this paper, in CDSK (Correlation Delay Shift Keying) System, we apply the Alamouti STBC (Alamouti Space Time Block Coding) that uses two transmitters and one receiver in Order to improve the BER performance at Rayleigh channel. And, we apply the Alamouti STBC that uses two transmitters And two receivers. In order to improve the bit error rate and avoid inter symbol interference an OFDM block is added to the existing system. The use of OFDM along with MIMO system improves bit error rate when compared to MIMO alone .

II. SYSTEM OVERVIEW

A. GENERATION OF CHAOTIC SIGNAL

The output generated by the chaos master generator is a voltage signal which is seen on a CRO, this signal is seen as some form of noise on the CRO.

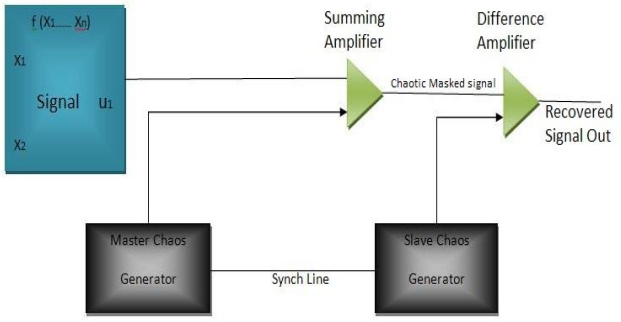

Figure 1.chaotic signal generator

The simplest way of generating a chaotic signal is to use a input signal, a chaos master generator, a summing amplifier, a chaos slave generator and a difference amplifier. This signal is then added to the original message signal; as a result it makes the message unrecognizable. To recover back the message signal the exact copy of the master generator should be available. To achieve this there must be synchronization between the master generator and the slave generator. To achieve synchronization the components used at the master and slave should be matched for them to produce identical voltage dynamics; this makes the slave to duplicate the signal which is generated by the master in real time. The signal generated by the slave is subtracted from the unrecognizable noisy signal; this is how the exact copy of signal is recovered back. Hence a chaos communication system provides secure communication.

B. *CDSK (correlation delay shift keying*)

Correlation Delay Shift keying modulation was proposed by Sushchik to continuously transmit information and to increase the efficiency of bandwidth [6]. Figure 2 shows a block diagram of the CDSK transmitter .figure 3 shows a block diagram of CDSK receiver.

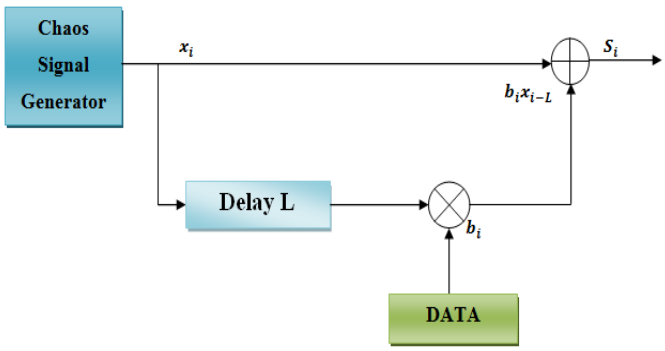

Figure 2. CDSK transmitter system.

The transmitted signal is the sum of the generated chaotic signals in the generator and delayed chaotic signals by the transmitted symbol. Thus, the transmitted signal will have the information signal and reference chaotic signal. Therefore, the transmitted signal is the same as equation (1)

$$S_i = x_i + b_i\, x_{i-L} \qquad (1)$$

In Eq. (1), x_i is the chaotic signal, L is the delayed time.

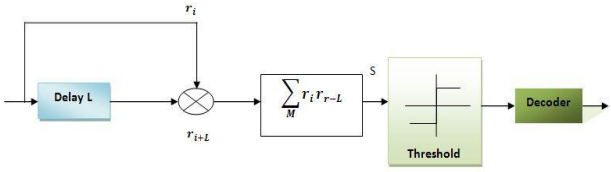

Figure 3. CDSK Receiver system.

The receiver based on the CDSK is performed to restore the symbol. Thus, the received signal, we can find the information by multiply the received signal and delayed signal such as equation (2).

$$S = \sum_{i=0}^{m} R_i R_{i-L} \qquad (2)$$

Where M is the spreading factor and R_i is the received signal through the channel.

c. Alamouti STBC (space time block coding)

MIMO system is a smart antenna technology, used to increase the capacity of the wireless communication. Using MIMO system it is possible to increase the capacity in proportion to the number of antennas by using multiple of antennas. In the fading channel, if transmitters and receivers are used, system will improve the performance by using the diversity effectively [11].

The Alamouti STBC of MIMO system is used in this paper Alamouti STBC says that it group symbols into groups of two. The first time slot send x1 and x2 from the first and second antenna. Second time slot send -x2* and x1 from the first and second antenna. It is grouping two Symbols, but it uses two time slots to send two symbols. There is no change in the data rate [5][9].

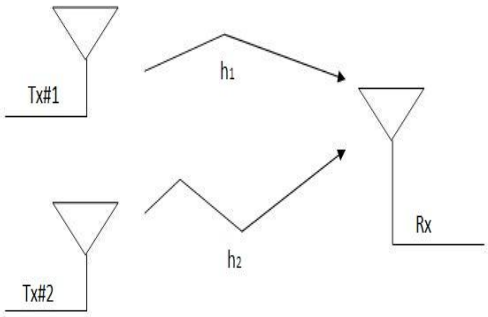

Figure 3. Basic Alamouti STBC.

The channel characteristics will be orthogonal if the symbols are transmitted as shown in the figure 4. The channel characteristics can be separated mathematically if the channel is orthogonal.

$$y_1 = h_1 x_1 + h_2 x_2 + n_1 \qquad (4)$$

$$y_2 = -h_1 x_2^* + h_2 x_1^* + n_2 \qquad (5)$$

The received signal in the first time slot is expressed in equation (4). The received signal in the second time slot is expressed in the equation (5).

y_1, y_2 Are the symbols received in the first and second timeslot. h_1 is the channel from the first transmitter to the receiver and h_2 is the channel from the second transmitter to the receiver .x_1, x_2 Are the transmitted symbols respectively and n_1, n_2 are the noise on the first and the second time slot.

D. OFDM (orthogonal frequency division multiplexing)

OFDM is one of the encoding methods used in encoding digital data on multiple carrier frequencies. OFDM provides othogonality between the symbols which it is transmitting, there by avoids intersymbol interference, this in turn improves bit error rate .OFDM also provides diversity gain.

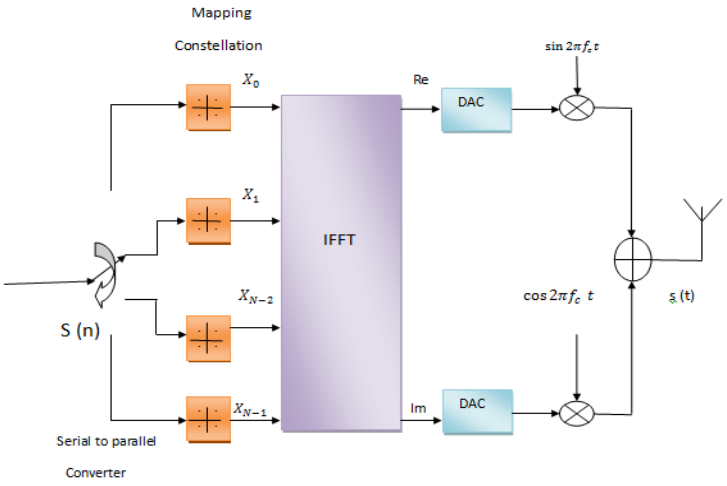

Figure 4. Basic OFDM transmitter

A number of orthogonal sub carriers are combined to form an OFDM carrier signal. Each sub carrier consists of baseband data that is modulated using any modulation techniques such as QAM or PSK. S (n) is a sequence of binary data. This binary data is demultiplexed into a stream of parallel data, where each is mapped into a symbol using one of the modulation constellations. IFFT on each set of symbol is calculated to give a set of complex time domain samples. These samples are then quadrature mixed to pass band. The real and imaginary components are converted to analog form using DAC (digital to analog converter). At the carrier frequency the analog signal modulated the sine and cosine waves. Later these signals are added up to give the transmitted signal s (t).

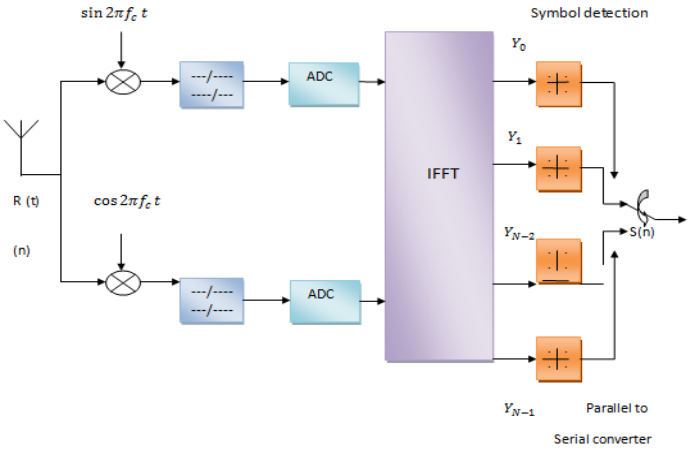

Figure 5. Basic OFDM receiver

The receiver picks the signal r (t), at the carrier frequency it is quadrature mixed down to base band using sine and cosine waves. The based band signal is sampled and digitized using ADC (analog to digital converter). A FFT is used to convert back to the frequency domain. The parallel stream of data is converted back to a sequence of digital data using symbol detector. These sequences are re combined to get the original signal.

E.proposed system

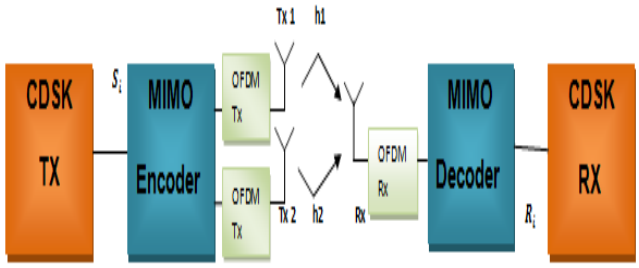

Figure 6. 4-Transmit, 1-Receive Alamouti STBC along with ODFM.

Figure 5 shows a block diagram of CDSK system applying the Alamouti STBC of MIMO system and an OFDM block. The figure shows the transmitter which has Alamouti STBC Coder and OFDM transmitter and the receiver which has Alamouti STBC Decoder and OFDM receiver . Through this process, it is possible to improve the BER performance in Rayleigh channel.

III. SIMULATION RESULTS

A multipath channel that has a single tap is used here ,so that convolution operation reduces to simple multiplication.

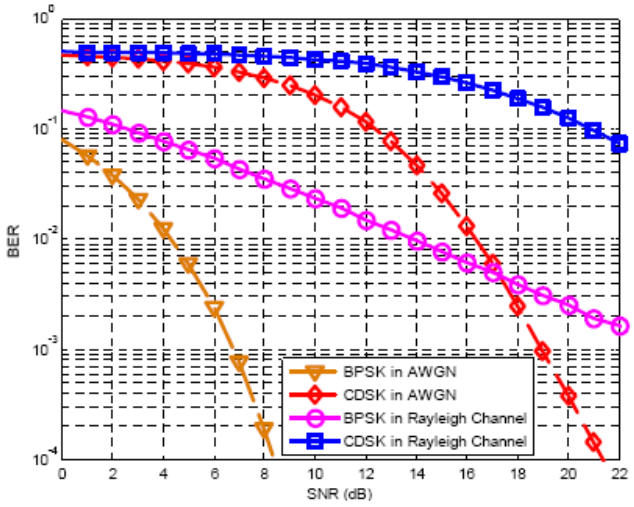

Figure 5.BER performance of BPSK and CDSK system

The figure5 shows the BER performance of BPSK in AWGN and Rayleigh channel, BER performance of CDSK in AWGN and Rayleigh channel. From the figure 6 we can see that BER performance of CDSK system in Rayleigh channel is very bad. To improve the BER performance of CDSK system in Rayleigh channel we use alamouti STBC .

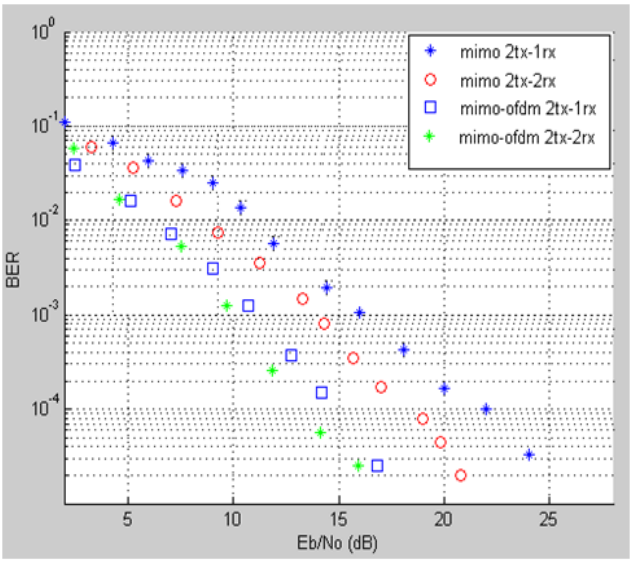

Figure 6, BER performance of CDSK system using Alamouti STBC and MIMO with OFDM (nTx:2, nRx:1)and (nTx:2, nRx:2).

The figure shows the BER performance of CDSK system using Alamouti STBC with 2 transmit and 1 receive antenna.

It also shows that BER performance of CDSK system is improved using alamouti STBC with 2 transmit and 1 receive antenna. The BER performance is better with the use of alamouti STBC with 2 transmit and 2 receive antenna. When an OFDM block is used along with alamouti STBC with 2 transmit and 1 receive antenna, the BER is further improved .when an OFDM block is used along with alamouti STBC with 2 transmit and 2 receive antenna the BER performance is further improved .

IV.CONCLUSION

In a wireless communication environment, multipath fading is a greatest disorder factor for achieving high-speed data communication. BER performance of chaos communication system is very bad in fading channel. Because the chaos system does not use encoding schemes, the system will be more prone to error. The BER performance can be improved in Rayleigh channel by applying the Alamouti STBC using the two transmitters and one receiver. .With the use of the Alamouti STBC that uses two transmitters and two receivers in CDSK system, BER performance is better than existing performance that uses only one receiver. When an OFDM system is used along with MIMO the BER will further improve. This improvement is because OFDM provides diversity gain, avoids intersymbol interference, and provides orthogonality between the symbols. The use of the Alamouti STBC that uses two transmitters and two receivers along with OFDM applied to CDSK system, BER performance is better than existing performance that uses only MIMO.

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Authors Profile

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