Comparative Study of Chaotic Colpitts Oscillator with BPSK and I-CDPK scheme

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Abstract
This project addresses a colpitts oscillator in chaotic communication based system as well as secures systems using Interleaved Chaotic Differential Peaks Keying (I-CDPK). Many subjects where learned and resolved.after studying the dynamics of chaotic system, one problem that needed addressing and was worked on during the project was generating a chaotic signal or non linear signal. Due to large circuitry and number of element generating chaotic signal, we use Colpitt oscillator that generate nonlinearity in signal. Due to their possible application for secure internet communications, a number of promising non-linear circuits, demonstrating chaotic behavior, have been presented in the last decade.comparison result discuss the better performance with I-CDPK scheme than BPSK through MACT and MACR system. The final outcome of this and the entire project are a small setup consisting of two chaotic colpitts oscillator , which is a Rossler like (master and slave)chaotic system, that secure communication using the demonstrated methods is indeed a accurate use.

1. Introduction

A multiple access technique is proposed for chaos-based communication systems in which chaotic reference signals are transmitted together with the information bearing signals. Chaotic reference signals modulated by a binary training sequence are sent periodically. The same chaotic signals are then modulated by binary data and transmitted. To achieve multiple access, different chaotic signals and training sequences are assigned to different users. At each receiver, an adaptive filter is employed to perform the demodulation based on the user's pre-assigned training sequence. The bit error rates of the proposed scheme are simulated and compared. The proposed communication system consists of four major modules: Multiple-Accessing Chaotic Transmitter (MACT), Frequency modulation (FM) transmitter, FM receiver and Multiple-Accessing Chaotic Receiver (MACR). The transmitted data of every Link are carried in a different state of the chaotic system instead of the using of chaotic sequences spreader or binary codes spreader, and only a scalar state variable is sent to the MACR's chaotic circuit through both FM transmitter and FM receiver. For synchronizing the chaotic circuits of the MACT and MACR, an observer based chaotic synchronization scheme is used in this work. Besides, the Bit Detector in MACR is applied to recover the transmitted input digital bits corresponding to each individual Link [1]. The final outcome of this and the entire project are a small setup consisting of two chaotic colpitts oscillator , which is a rossler like (master and slave)chaotic system, that secure communication using the demonstrated methods is indeed a accurate use. In this study chaotic behavior and synchronization of colpitts oscillator is simulated by using MATLAB and Tools.[2][3]

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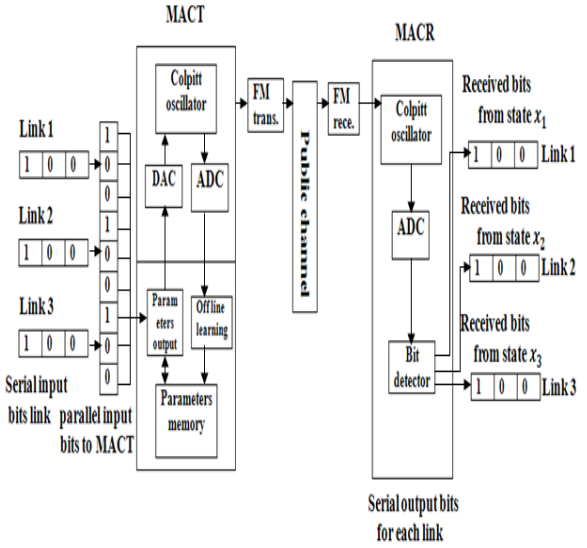

Figure 1.The Proposed MACT and MACR Systems by colpitts oscillator.

2. System model for MACT and MACR communication

In figure1 Shows, communication between MACT and MACR . There are three individual Links in the proposed system. In order to perform transmission at the same time among these Links, the encoding/decoding rule used I-CDPK scheme. The transmitted data bits are coded by extracting the consecutive peak values from all the system states of transmitter's chaotic circuit and decoded by all the recovered system state of receiver's chaotic circuit. For achieving Multiple Access, every Link is represented by a specified system state pair in the chaotic circuits of transmitter and receiverIn this system, there are total three Links, which are Link 1, Link 2 and Link 3. Every three serial input bits from each Link will be combined to nine parallel bits as the input bits to the MACT. As mentioned above, every Link is assigned to a system state of the transmitter's chaotic circuit. Then, the output of the MACT is fed into FM transmitter. From the public channel, FM receiver extracts the transmitted chaotic signal as the input of the MACR. Finally, the every three bits transmitted from each Link in a transmission, will be received by demodulating the corresponding recovered system state of the chaotic circuit in the MACR. The MACT must carry out a self-learning process to find out the chaotic parameters corresponding to every bit binary code and store these digitalized found chaotic parameters into MACT's memory. After that, these three Links are ready to transmit data bits[2][3][4].

3. BPSK Modulation through colpitts oscillator

In BPSK, individual data bits are used to control the phase of the carrier. During each bit interval, the modulator shifts the carrier to one of two possible phases, which are 180 degrees or π radians apart. This can be accomplished very simply by using a bipolar baseband signal to modulate the carrier's amplitude, as shown in Figure 2. The output of such a modulator can be represented mathematically as:

$$x(t) = R(t)\cos(\omega ct + \theta)$$

where R(t) is the bipolar baseband signal, ωc is the carrier frequency, and θ is the phase of the unmodulated carrier.

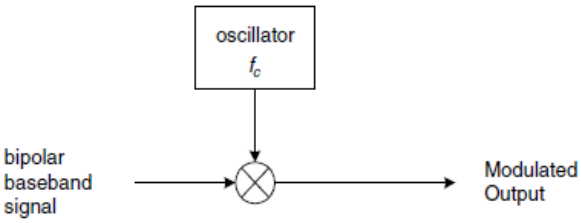

Figure 2 BPSK modulator

3.1 BER Perfomance

Bit error rate performance of colpitt oscillator using BPSK modulation.the BER for our simulation result goes to about 0.08 through this formula:

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$$BER_{BPSK} = \frac{1}{2}\operatorname{erfc}\sqrt{\frac{E_b}{N_0}}$$

Where $\frac{E_b}{N_0}$ is signal to noise ratio

In this quantization error will occur due to A/D and D/A converter .Time delay is also problem on this communication. So this study discussed about i-cdpk method.

4. I-CDPK Technique

bit error rate performance of colpitt oscillator using BPSK modulation.the BER for this simulation result goes to about 0.012 through this formula:

$$BER_{I-CDPK} = \frac{1}{2}\operatorname{erfc}\sqrt{\frac{E_b}{2N_0}}$$

$$\text{BER}_{\text{I-CDPK}} = \widetilde{P_E}$$

$$= Q\left(\sqrt{\frac{E_b}{N_0}}\right)$$

$$= \frac{1}{2}\operatorname{erfc}\left(\sqrt{\frac{E_b}{2N_0}}\right) \quad (: Q(Z) = \frac{1}{2}\operatorname{erfc}\left[\frac{z}{\sqrt{2}}\right])$$

I-CDPK uses the difference between the current and next peak values of chaotic signal to decide bit “1” or “0”, the channel noise will cause that these received peak values deviate from those of the transmitted signal during the transmitting.the bit errors will occur when the received differential peaks cross the threshold Vth at the decision instant. erfc shows the error function.

In order to compare the BER performance between I-CDPK and BPSK, the BER of coherent BPSK is not gives better performance than I-CDPK sheme.[5][6]

5. Chaotic Colpitts Oscillator

A Chaos colpitt Oscillator (CCO) has been proposed capable of producing anti-phase signals. The presented circuit design has numerous advantages such as insensitivity to parasitic capacitances and improved of the start-up condition due to the enhance loop gain obtained by the negative resistance of the tail cross-coupled pair. The Colpitts oscillator is a combination of a transistor amplifier consisting of a single bipolar junction transistor (BJT), and an LC circuit used to feedback the output signal to simulated in this work simulated result shown in figure 3 . [2][7][8].

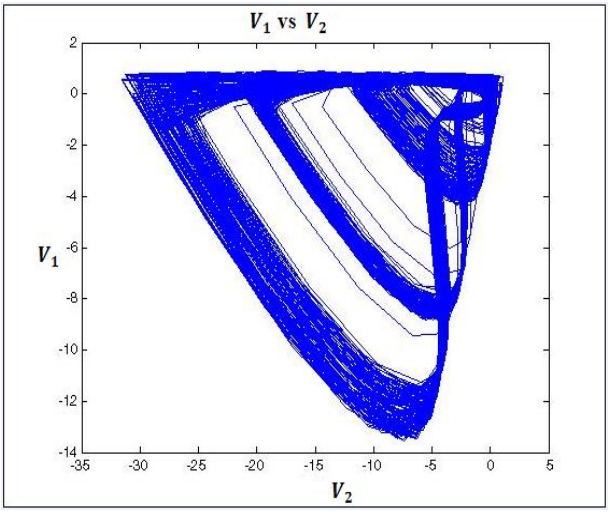

Figure 3 response of chaotic oscillator

Response of chaotic colpitts oscillator is generated by this circuit and equation (1).

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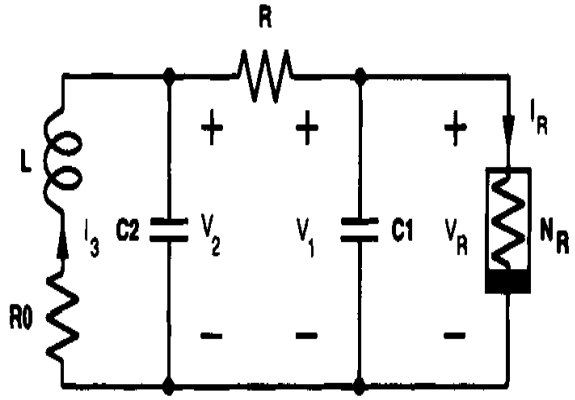

Figure 4 chua's oscillator consist of a linear inductor L with series resistance R0 ,a linear resistance R,two linear capacitor C1 and C2 , and a nonlinear resistor NR.

In figure 4. shows that the response of chaotic oscillator across voltage V1 and V2. That is nonlinear response generated by this circuit[5].

when voltage applied in chaotic circuit, then i3 current passed through R0 and L, and then capacitor C2 charged, and generate voltage V2 at initial condition .when inductor behaves as open circuit then capacitor C2 dischage. Some current will pass through resister R , and it charge C1 capacitor,and generate voltage V1.voltage V1 , V2 and nonlinear resistance NR are parallel, so it produce across the resistance NR .when V1 discharge, then V2 charged, when V1 charged then V2 discharged. Oscillation produce across this circuit is nonlinear. Voltage shown by these equations: $\frac{dV_1}{dt} = \frac{I_L}{C_1}$

$$\frac{dV_2}{dt} = -\frac{1}{RC_2}V - \frac{I_L}{C_1} - \frac{V_1}{R_0\ C_2} \quad \text{.... (1)}$$

6. Simulation results and bit error rate performance

Simulated result gives both performance of I-CDPK and BPSK, here we see that BER analysis with these scheme. Bit shifting property used by i-cdpk scheme is also simulated,shown in figure 5. Because of it resist the overlapping of peaks .by which we can easily detect the peaks at receiver end. DCSK shows the better SNR and lower BER than other pulse modulation technique like BPSK,QPSK etc.I-CDPK and CDPK is type of DCSK, I-CDPK is better than BPSK because it resist the overlapping of peaks and it reduces BER. So receiver easily detecte the bits. And colpitts reduces our system cost.BER performance shown in figure 6. And 7.

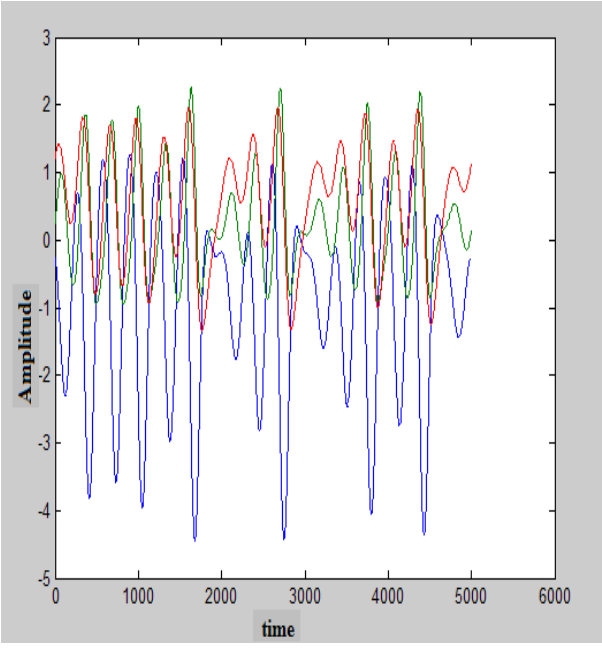

Figure 5. Bit shifting of input signal

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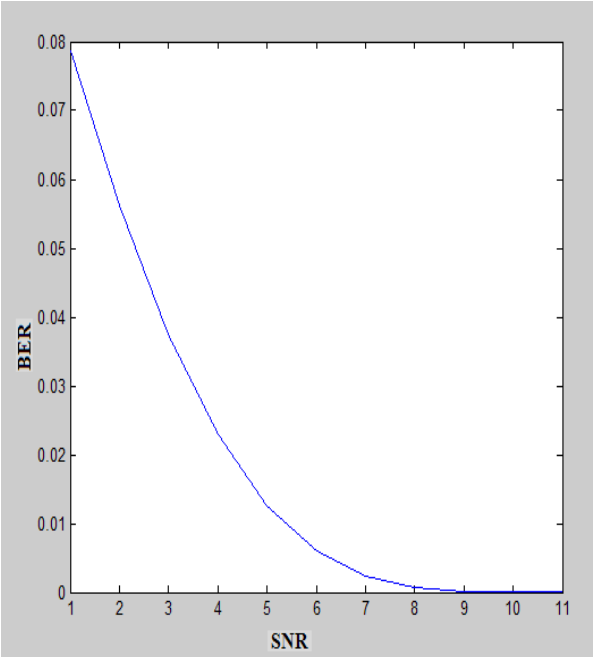

Figure 6. Colpitts oscillator BER of proposed BPSK

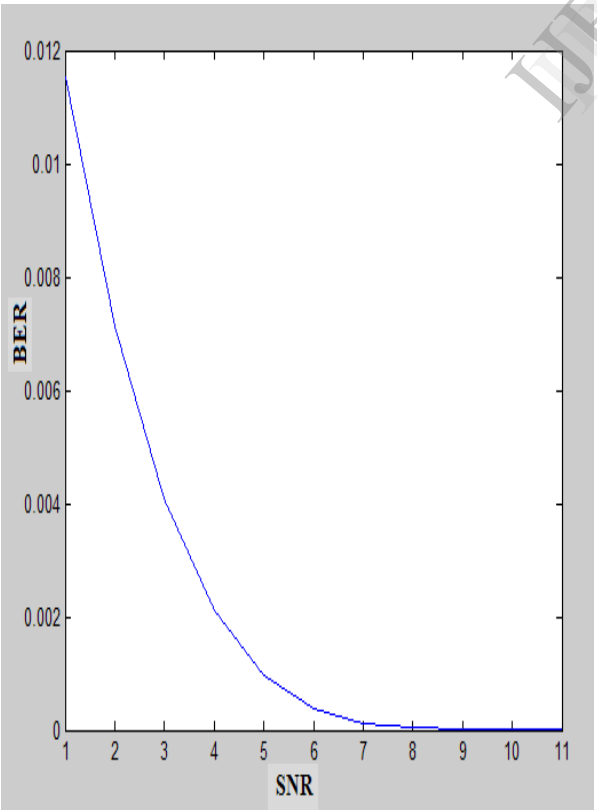

Figure 7. Colpitts oscillator BER of proposed I-CDPK scheme

7.Conclusion

The present study has proposed the colpitts oscillator communication link using I-CDPK based system employing the peak shift keying of bits using Matlab Simulink .The I-CDPK modulation scheme plays a crucial role in transmitting bits from MACT. The BER performance of proposed method is better than pervious theoretical result. A computer flowchart has been prepared and a program is written in MATLAB 7.5 version.In this multiple accessing scheme, the transmission between all the three links can be achieved on the same frequency band without interference. It reduces the quantization error through A/D and D/A converter by using colpitt oscillator instead of chaotic circuit. Our proposed model shows better BER response than BPSK.

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