International Journal for Research in Applied Science & Engineering Technology(IJRASET)

Chaos CDSK Communication System

Arathi. C
M.Tech Student, Department of ECE,
SRKR Engineering College,
Bhimavaram, India

Abstract: **In recent years chaotic communication systems have emerged as an alternative solution to conventional spread spectrum systems. The chaotic carrier used in this kind of modulation-demodulation schemes, have unique properties that make them suited for secure, and multi-user communications. The security of chaos communication system is superior to other digital communication system, because it has characteristics such as non-periodic, wide-band, non - predictability, easy implementation and sensitive initial condition. In this paper, a new approach for communication using chaotic signals is presented.**

Keywords **— Chaos Communication System, CDSK**

I. INTRODUCTION

Previous digital communication technology continually used a linear system. However, as this technology reached basic limit, people started to improve performance of nonlinear communication systems applying chaos communication systems to nonlinear systems [1]. Chaos communication systems have the characteristics such as non - periodic, wide-band, non-predictability and easy implementation. Also, chaos communication system is decided by initial conditions of equation, and it has sensitive characteristic according to initial condition, because chaos signal is changed to different signal when initial condition is changed [2]. Chaos signal is expressed as randomly and non-linearly generated signal. If initial conditions of chaos signal is not exact, users of chaos system are impossible to predict the value of chaos signal because of its sensitive dependence on initial conditions [1][3]. As these characteristics, the security of chaos communication system is superior to other digital communication system.

Due to security and other advantages, chaos communication systems are being studied continuously. Look at existing research, in order to solve disadvantage that bit error rate (BER) performance of this system is bad, chaos communication system is evaluated the BER performance according to chaos maps, and find a chaos map that has the best BER performance [4]. In addition, chaos users evaluate the BER performance according to chaos modulation system [5][6], and propose a new chaos map that has the best BER performance.

In this paper, in AWGN and Rayleigh fading channel, BER performances of chaotic CDSK system is evaluated. At existing study, we proposed a novel chaos map in order to improve the BER performance [7], and we named a novel chaos map "Boss map".

II. CHAOTIC SYSTEM

A chaotic dynamical system is an unpredictable, deterministic and uncorrelated system that exhibits noise-like behavior through its sensitive dependence on its initial conditions, which generates sequences similar to PN sequence. The chaotic dynamics have been successfully employed to various engineering applications such as automatic control, signals processing and watermarking. Since the signals generated from chaotic dynamic systems are noise-like, super sensitive to initial conditions and have spread and flat spectrum in the frequency domain, it is advantageous to carry messages with this kind of signal that is wide band and has high communication security. Numerous engineering applications of secure communication with chaos have been developed [8].

III. CHAOTIC SIGNALS

A chaotic sequence is non-converging and non-periodic sequence that exhibits noise-like behavior through its sensitive dependence on its initial condition [1]. A large number of uncorrelated, random-like, yet deterministic and reproducible signals can be generated by changing initial value. These sequences so generated by chaotic systems are called chaotic sequences [8].

Chaotic sequences have been proven easy to generate and store. Merely a chaotic map and an initial condition are needed for their generation, which means that there is no need for storage of long sequences. Moreover, a large number of different sequences can be generated by simply changing the initial condition. More importantly, chaotic sequences can be the basis for very secure communication. The secrecy of the

transmission is important in many applications. The chaotic sequences help achieve security from unwanted reception in several ways. First of all, the chaotic sequences make the transmitted signal look like noise; therefore, it does not attract the attention of an unfriendly receiver. That is, an ear-dropper would have a much larger set of possibilities to search through in order to obtain the code sequences [4][8].

Chaotic sequences are created using discrete, chaotic maps. The sequences so generated even though are completely deterministic and initial sensitive, have characteristics similar to those of random noise. Surprisingly, the maps can generate large numbers of these noise-like sequences having low cross-correlations. The noise-like feature of the chaotic spreading code is very desirable in a communication system. This feature greatly enhances the LPI (low probability of intercept) performance of the system [4].

These chaotic maps are utilized to generate infinite sequences with different initial parameters to carry different user paths, as meaning that the different user paths will spread spectrum based on different initial condition [8].

IV. SYSTEM OVERVIEW

A. Correlation delay shift keying system

CDSK system has an adder in transmitter. Existing modulation system than CDSK system consists switch in transmitter, and problem of power waste and eavesdropping occurs by twice transmission. Technique that has been proposed for overcoming these problems is CDSK system. And, transmitted signal does not repeat by replacing an adder with a switch in the transmitter [9].

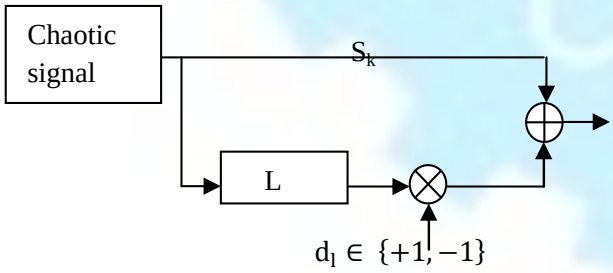
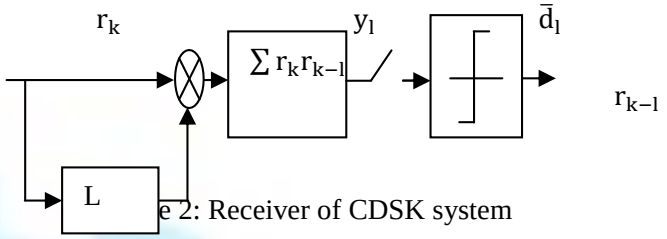


Figure 1: Transmitter of CDSK system

CDSK transmitter is composed of sum in which delayed chaos signal multiplied with information bit is added to generated chaos signal from chaos signal generator. Here, information bit that is spread as much as spreading factor is multiplied by delay chaos signal.

$$s_k = x_k + d_l x_{k-l} \qquad (1)$$

Above equation (1) indicates transmitted signal from transmitter.



e 2: Receiver of CDSK system

CDSK receiver is correlator based receiver, and it is performed in order to recover the symbol. Received signal and delay received signal are multiplied, and this signal is as much added as spreading factor. Afterward the signal pass through the threshold, and information signal recover through decoding.

Information bits are possible to recover when delay time and spreading factor have to use exact value that is used in transmitted signal.

B. Chaos maps

In this paper, types of chaos map used are Tent map and Boss map. At existing study, Boss map means a novel chaos that we proposed for BER performance improvement [8].

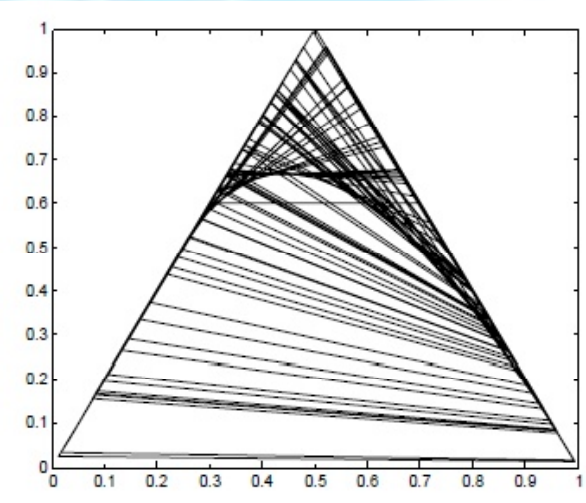


Figure 3: Trajectory of tent map

Figure (3) shows trajectory of Tent map. The x-axis and the y-axis of figure (3) mean x_n and x_n+1, and Tent map has trajectory of triangular shape.

$$x_{n+1} = \alpha - b|x_n - c| \equiv F(x_n) \qquad (2)$$

Equation (2) of tent map is expressed as above. Equation (2) of Tent map uses existing output value as current

input value, and it is indicated as figure when initial value is 0.1 and parameter alpha is 1.9999.

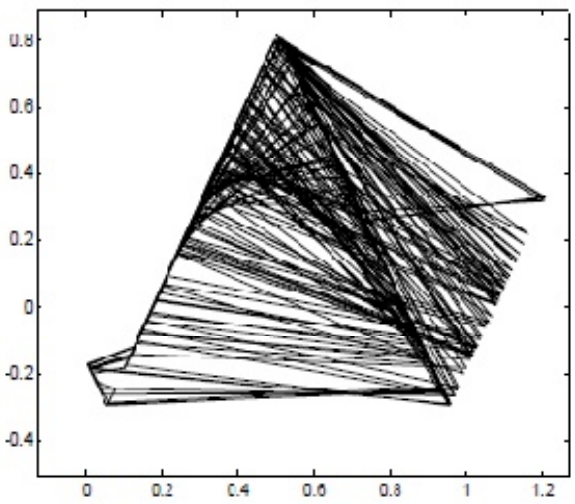


Figure 4: Trajectory of boss map

Figure (4) shows trajectory of Boss map, a novel map that is proposed in order to improve the BER performance. The x-axis and the y-axis of Boss map mean x_n and y_n unlike the Tent map, it draws trajectory like pyramid shape.

$$x_{n+1} = \alpha \left|0.45|0.503 - x_n|\right|$$
$$y_{n+1} = x_n - 0.3 \qquad (3)$$

Equation (3) of Boss map is expressed as above. Equation (3) form of Boss map is similar to Tent map because Boss map was proposed by transforming from Tent map. And, trajectory of Boss map is indicated as figure (4) when initial value is 0.1 and parameter alpha is 2.5.

V. PERFORMANCE EVALUATION

In this paper, the BER performance of chaotic CDSK system in AWGN (adaptive white Gaussian noise) channel and Rayleigh fading channel is evaluated for Tent map and Boss map.

In AWGN channel, figure (5) shows BER performance of chaotic CDSK system is evaluated. Looking at the figure (5), the BER performance of chaotic CDSK system with tent map and boss map is observed. Here, we observe that the BER performance of Boss map is better than Tent map at each stage i.e. at different values of SNR we observe that the Boss map shows better performance than Tent map. We also observe that at initial values the BER is same for both maps but as SNR increases the BER for Boss map is less than Tent map.

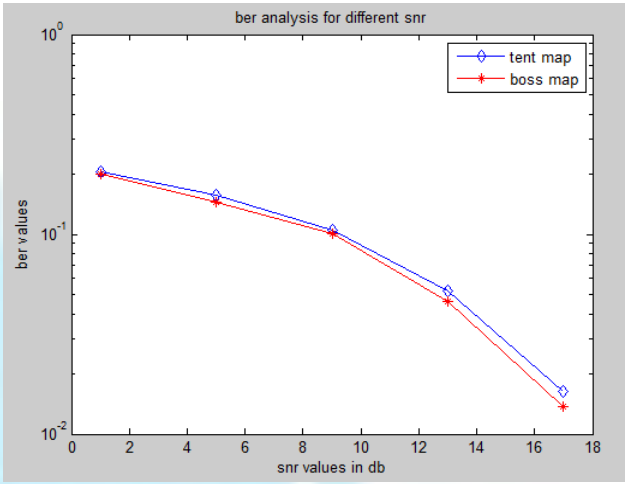


Figure 5: BER analysis in AWGN channel

In Rayleigh fading channel, figure (6) shows the BER performance of chaotic CDSK system. Here, the performance is evaluated for both Tent map and Boss map. We observe that at initial values of SNR the BER performance is the same for both maps. But as SNR value increases the BER performance of Boss map is better than Tent map.

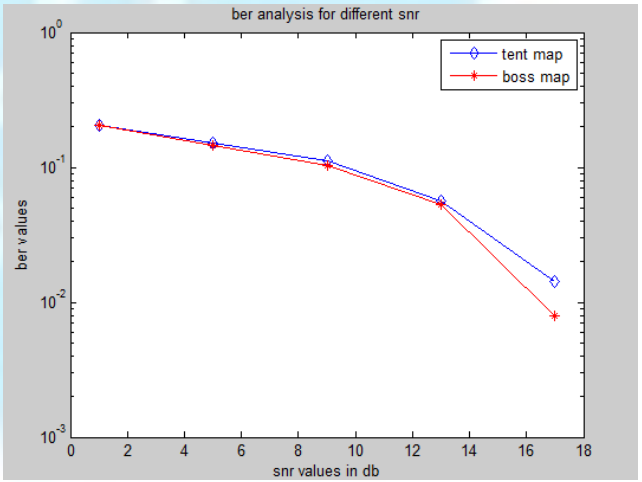


Figure 6: BER performance in Rayleigh fading channel

VI. CONCLUSION

In this paper, a new type of communication system using chaos is proposed. Chaos sequences are non – periodic sequences which are sensitive to their initial conditions. Chaos sequences are generated using chaos map. CDSK system using

chaos has many advantages over other systems. But the BER performance of chaos communication system is bad. In order to improve this, we proposed a new chaos map that has better BER performance than existing map. In AWGN and Rayleigh fading channel the chaotic CDSK system is evaluated and we observed that the BER performance of chaos system with Boss map has better than with Tent map which improves BER of CDSK communication system.

VII. FUTURE SCOPE

Chaos communication system increases the number of transmitted symbols by spreading and transmitting information bits according to characteristic of chaos maps. So the research that improves data transmission speed is necessary for chaos communication system. If many antennas are applied to chaos communication system, the capacity of data is proportional to the number of antenna. So it is good way applying multiple-input and multiple-output (MIMO) to the chaos communication system.

REFERENCES

[1] M. Sushchik, L.S. Tsimring and A.R. Volkovskii, "Performance analysis of correlation- based communication schemes utilizing chaos," *Circuits and Systems I: Fundamental Theory and Applications, IEEE Transactions on*, vol. 47, no. 12, pp. 1684-1691, Dec. 2000.

[2] Q. Ding and J. N. Wang, "Design of frequency-modulated correlation delay shift keying chaotic communication system," *Communications, IET*, vol. 5, no. 7, pp. 901-905, May 2011.

[3] Chen Yi Ping, Shi Ying and Zhang Dianlun, "Performance of differential chaos-shift-keying digital communication systems over several common channels," *Future Computer and Communication (ICFCC), 2010 2nd International Conference on*, vol. 2, pp. 755- 759, May 2010.

[4] Suwa Kim, Junyeong Bok and Heung-Gyoon Ryu, "Performance evaluation of DCSK system with chaotic maps," *Information Networking (ICOIN), 2013 International Conference on*, pp. 556-559, Jan. 2013.

[5] S. Arai and Y. Nishio, "Noncoherent correlation-based communication systems choosing different chaotic maps," *Proc. IEEE Int. Symp. On Circuits and Systems, New Orleans, USA*, pp. 1433-1436, June 2007.

[6] Jun-Hyun Lee and Heung-Gyoon Ryu, "New Chaos Map for CDSK Based Chaotic Communication System," *The 28th International Technical Conference on Circuit/System, Computers and Communication (ITC-CSCC 2013), Yeosu, Korea*, pp. 775-778, July2013.

[7] M.A. Ben Farah, A. Kachouri and M. Samet, "Design of secure digital communication systems using DCSK chaotic modulation," *Design and Test of Integrated Systems in Nano-scale Technology, 2006. DTIS 2006.International Conference on*, pp. 200-204, Sept. 2006.

[8] Ned J. Corron, and Daniel W. Hahs "A new approach to communication using chaotic signals", IEEE transactions on circuits and systems—I: fundamental theory and applications, VOL. 44, NO. 5, MAY 1997.

[9] Wai M. Tam, Francis C. M. Lau, and Chi K. Tse, "Generalized Correlation-Delay-Shift-Keying Scheme for Non - coherent Chaos-Based Communication Systems" IEEE transactions on circuits and systems—I: regular papers, VOL. 53, NO. 3, MARCH 2006.