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Research Paper

Analysis of Cdma Chaotic Sequences

Engineering

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Jatin Dua

Student M.Tech ECE Ganga College of Engg. Jhajjar Haryana Add 20/4 Model Town B.Garh-124507 Haryana

ABSTRACT

Direct sequence-code division multiple access (DS-CDMA) technique is used in cellular systems where users in the cell are separated from each other with their unique spreading codes. In recent times DS-CDMA has been used extensively. These systems suffers from multiple access interference (MAI) due to other users transmitting in the cell, channel inter symbol interference (ISI) due to multipath nature of channels in presence of additive white Gaussian noise(AWGN). Spreading codes play an important role in multiple access capacity of DS-CDMA system. M-sequences, gold sequences etc., has been traditionally used as spreading codes in DS-CDMA. These sequences are generated by shift registers and periodic in nature. So these sequences are less in number and also limits the security.

This paper presents an investigation on use of new type of sequences called chaotic sequences for DS-CDMA system. These sequences are generated by chaotic maps. First of all, chaotic sequences are easy to generate and store. Only a few parameters and functions are needed even for very long sequences. In addition, an enormous number of different sequences can be generated simply by changing its initial condition. . Chaotic sequences are deterministic, reproducible, uncorrelated and random-like, which can be very helpful in enhancing the security of transmission in communication. This paper investigates the performance of chaotic sequences in DS-CDMA communication systems using various receiver techniques.

INTRODUCTION

CDMA stands for "Code Division Multiple Access". It is the technique which provides multiple access to multiple users at the same time. But this technique is very efficient than any other available multiple access technique. As this technique utilizes the whole bandwidth of the channel irrespective of the bandwidth of the message signal and provides multiple access to the multiple users at the same time by coding the users. The user's data is encoded over the channel with other user's data by using PN code i.e Pseudorandom Noise Codes

A chaotic sequence is non-converging and non-periodic sequence that exhibits noise-like behavior through its sensitive dependence on its initial condition. Chaotic systems have sensitive dependence on their initial conditions. 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. Chaotic sequences are real valued sequences. Moreover, since chaotic dynamical system is a deterministic system, disguising modulation as noise would be easily made upon its random-like behavior

- **CASE STUDY :** P. G. Flikkema, "Spread Specrtum Techniques for Wireless Communications," IEEE Signal Processing Magazine, May 1997 states that The most significant feature of the chaotic system is its sensitively dependence on its initial condition. It is properly illustrated by the finding of Professor P. G. Flikkema, teaching Meteorology at MIT. In 1997, P. G. Flikkema attempted to solve a much-simplified model and finally he did succeed in simulating real weather patterns for weather predictions. However, something drew his attention: when he slightly changed the initial conditions in the model, the resulting weather patterns changed completely after a very short period. He discovered the fact that very simple differential equations could possess sensitive dependence on initial conditions. Through the sensitive dependence of chaotic systems on their initial conditions, a large number of uncorrelated, random-like, yet deterministic and reproducible signals can be generated. Moreover, since chaotic dynamical system is a deterministic system, disguising modulation as noise would be easily made upon its random-like behavior.[1]

- Hussain, J.J. Soraghan, T.S. Durrani, "A new adaptive functional-link neural-network based DFE for overcoming co-channel interference," IEEE Trans. Commun., November 1997 states that The use of chaotic sequences for spectral spreading in a direct-sequence spread spectrum system (DS/SS) has been shown to provide several advantages over conventional binary sequences, particularly pseudo noise sequences which are frequently used in digital communication. The most important characteristics of the periodic sequence are: the autocorrelation and the cross-correlation. The autocorrelation is important in the synchronization between the periodic pseudo-sequence generated at the transmitter and at the receiver.[12]

- Laxmi Bhat and Dr.K.L.Sudha "Performance analysis of chaotic DS-CDMa with CSK Modulation" International Journal of Mobile Network Communications & Telematics (IJMNCT) Vol.2, No.2, April 2012 states that The diverse applications of chaos to various areas are growing.The professor describes the various ways of implementation of chaotic sequences for the DS-CDMA downlink receiver. He investigates BER performance of different linear and nonlinear receivers for DS-CDMA system using chaotic sequences and comparison with gold sequences.[7]

- S. Mandal and S. Banerjee, "A chaos-based spread spectrum communication system," Nat. Conf. Nonlinear Sys. Dynamics, Indian Institute of Technology, Kharagpur, Dec 28-30, 2003 states that The cross-correlation of the periodic pseudo-sequences must be zero to obtain communication between different users at the same band of frequency and at the same time. The author intends to test the chaotic sequence based DS-CDMA system for different receiver techjniques.. These sequences are generated by chaotic maps. First of all, chaotic sequences are easy to generate and store. Only a few parameters and functions are needed even for very long sequences. In addition, an enormous number of different sequences can be generated simply by changing its initial condition. . Chaotic sequences are deterministic, reproducible, uncorrelated and random-like, which can be very helpful in enhancing the security of transmission in communication. The professor describes the possibility of using chaotic sequence for better utilization of CDMA technique.[8]

Research Objective The main objective of this work is to present a evaluation of different DS-CDMA receiver using Chaotic Sequences. Various analysis and investigations are needed in support of the above statement which includes the generation of spreading sequences based on Chaotic Sequences with different spreading factors and with different cross-correlation threshold. Also the analysis of the generated sequence in a general DS-CDMA system in comparison with other existing codes and under different channel environment and for different loading scenarios. The evaluation of DS-CDMA receiver's performance while using Chaotic Sequences & analyzing efficiency achieved by using Chaotic Sequences.

CONCLUSION : It is seen that chaotic sequence based DS-CDMA performs inferior to gold sequences. The results also showed that MMSE receiver performs better than Matched fil-

ter receiver for chaotic sequence based DS-CDMA. Following these BER performances of various nonlinear receivers using chaotic sequences has been analyzed and compared with linear receivers. It is seen that chaotic sequence based DS-CDMA performs inferior to gold sequences. The results also showed that Volterra receiver performs better than FLANN receiver for chaotic sequence based DS-CDMA. It is seen that Volterra receiver performs better than all other receivers .MMSE receiver performs better than MF receiver. FLANN receiver outperforms both MMSE and MF receiver. It is also seen that nonlinear receivers outperforms better than linear receivers. Even though chaos based DS-CDMA performance is inferior to gold sequence based DS-CDMA ,it can provide the other advantages of chaotic sequences in DS/SS are the availability of a great numbers, the ease of their generation, and their inherent improvement in the security of transmission

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