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Research Article on PN Sequence and their effects on quality of signal

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ABSTRACT

The objective of writing the whole paper is to compare the PN-Sequence, Gold sequence in terms of correlation and BER performance of both the CDMA system in effect of AWGN channel and QAM, BPSK scheme. Simulated results shows that Gold sequence has better autocorrelation and less BER than PN-sequence with QAM, and with BPSK the performance of both the sequence are nearly same. Orthogonality is the term which makes CDMA successful which is checked by their cross- correlation and auto-correlation. As the number of user doesn't affect the allotted bandwidth used by a person so this way of communication is faster and reliable. BIT ERROR RATE is another parameter which makes us able to judge the performance of the system with changing the sequences. As in general this sequence can be used in communication system as well assecured data transmission and digital authentication, these sequences can be used.

INTRODUCTION

Code Division Multiple Access (CDMA) is a multiple access technique that can be used in telecommunications radio system and can transport multimedia traffic at high data rates. Many communications researchers have studied CDMA and are also further developing it. It has come out that because of the various reasons which contributed to evolution in wireless technology.

They include:

- Need for highly reliable telecom network and most important and security against eavesdropping and cryptanalysts.
- Implementation of inexpensive data network.
- End users need new services, like new telephony and internet services.
- Explosive growth of data leading to market growth.
- Introduction of new services imposed by technology changes.

Direct-sequence code-division multiple access (DS-CDMA) is developed as a promising multiple access capability for third as well as for the fourth generations mobile communication systems. Code-division multiple access (CDMA) is a technique in which many users simultaneously accesses a communication channel. The users of the system are identified at the base station by their unique spreading code. Signal transmitted by any user consists of the user's data that modulates its spreading code, which in turn modulates a carrier. An example of such a modulation scheme is Quadrature phase shift keying (QPSK).

In the DS-CDMA system, the narrowband message signal is multiplied by a large bandwidth pseudo noise signal, which is called the spreading of a signal. The spreading signal is generated by convolving an M-sequence & GOLD sequence code with a chip waveform whose duration is much smaller than the symbol duration. All users in the system use the same carrier frequency and can transmit simultaneously. At the receiving end receiver performs a correlation operation to detect

the message addressed to a given user and the signals from other users appear as noise due to de-correlation. The synchronous DS-CDMA system is presented for eliminating the effects of multiple access interference (MAI) which limits the capacity and degrades the BER performance of the system. MAI refers to the interference between different direct sequences users.

Direct Sequence Spread Spectrum

A direct sequence spread spectrum signal is one in which the amplitude of an already modulated signal is amplitude modulated by a high rate NRZ binary stream of digits. Thus, if the original signal is s(t), where

$$s(t) = sqrt(2 * Ps)d(t)cos\omega_0 t \qquad (1.1)$$

(a binary PSK signal), the DS spread spectrum signal is

$$v(t) = g(t).s(t) \qquad (1.2)$$

where g(t) is a pseudo-random noise (PN) binary sequence having the values +1 or -1.

In a direct sequence system uses a locally generated pseudo noise code is used to encode digital data to be transmitted. This local code runs at much higher rate than the data rate. The data is logically modulo-2 added with pseudo noise code signal. As the data signal is narrowband compared to the spreading signal, but the resulting product signal will have the bandwidth approximated to that one of the spreading signal.

At the receiver end, direct sequence which uses a locally generated replica pseudo noise code and a correlator to separate the desired coded information from all possible signals. At the receiver end correlator responds only to signals that are encoded with a pseudo noise code and matches its own code. [5]

RESEARCH METHODOLOGY

The bit error rate calculation of different sequence generator is the check of the orthogonality, efficiency of the sequence generated with different scheme. Here I am trying to generate the different sequence of high frequency and then modulate the data with it. The modulated data is passed through the AWGN channel and resulted signal is retrieved back. The number of bit error depends upon both the length of the sequence (which is related to degree of polynomial), order f modulation and shift keying technique used to modulate the high frequency polar binary signal. Here I aimed to make a tradeoff between modulation order and technique of modulation, as well as performance of different sequence generator that can be used for digital modulation. All these sequence have some advantage like correlation between sequence and relation to noise and some disadvantage like power management is a main concern of CDMA system. Computer simulations and code has been generated for all cases are carried out using Mat lab software and experimental results are presented that illustrate the usefulness of Simulation & Performance Analysis of sequence generators.

The methodology which will be adopted for carrying my research work is as follows:

1. Literature Review & Study

It defined the different sequence like PN, Gold, Ksami for spreading the data over the spectrum and their correlation properties and its various application with performance analysis tools.

2. Identification of specific issue related to topic.

Different sequences are used for the CDMA system. Specific issue is to find out the best generator that gives good orthogonality and minimum BER.

3. Design & Implementation.

For design and implementation we use simulation using MAT LAB software.

Simulation Models

The simulation modeling used for the results generated in this paper. We first discuss the general mathematical model of the channel equalization process. After that, we look at the various algorithms used in this paper, and their implementation.

Tool used:

MATLAB simulink tool used for the simulation purpose. The name MATLAB stands for Matrix Laboratory is a high performance programming language. MATLAB is software package for high-performance numerical computation and visualization. This software is used for a wide variety of scientific and engineering calculations, especially for automatic control and signal, image processing, it has extensive graphical capabilities, and algorithm development. Matlab allows easy matrix manipulation, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs in other languages. Matlab is built around the Matlab language, sometimes called M-code or simply M.

BER Tool Introduction

BER Tool is a bit error rate analysis application for analyzing communication systems' bit error rate (BER) performance. Using BERTool we can:

- Generate BER data for a communication system using
    1. Closed-form expressions for theoretical BER performance of selected types of communication systems.
    2. The semianalytic technique.
    3. Simulations contained in MATLAB simulation functions or Simulink models. After you create a function or model that simulates the system, BER Tool iterates over your choice of Eb/N0 values and collects the results.
- Plot one or more BER data sets on a single set of axes. For example, you can graphically compare simulation data with theoretical results or simulation data from a series of similar models of a communication system.
- Fit a curve to a set of simulation data.
- Send BER data to the MATLAB workspace or to a file for any further processing you might want to perform.

Components of BER TOOL

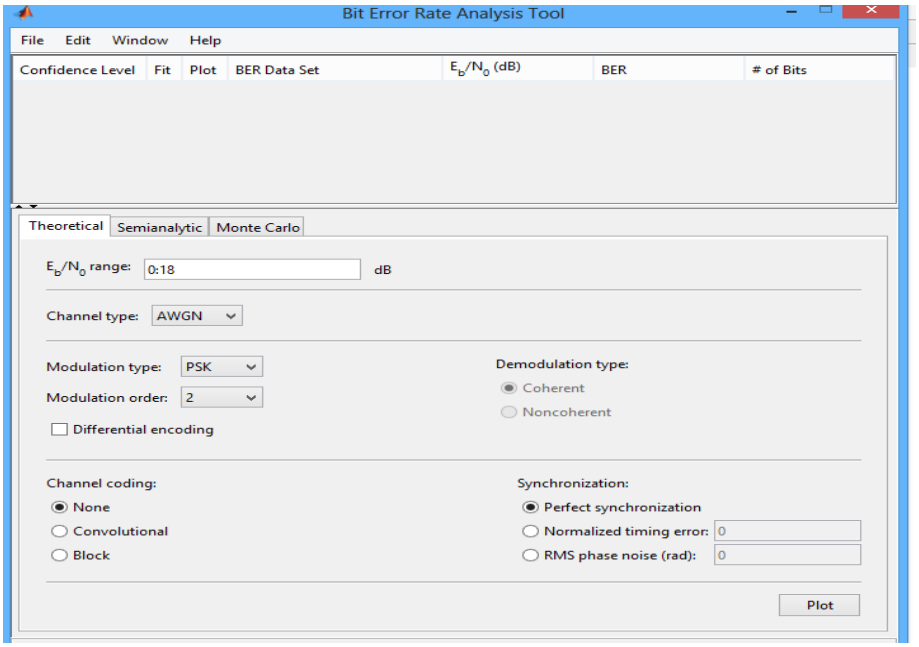

Fig.1: BER tool view and content for theoretical analysis

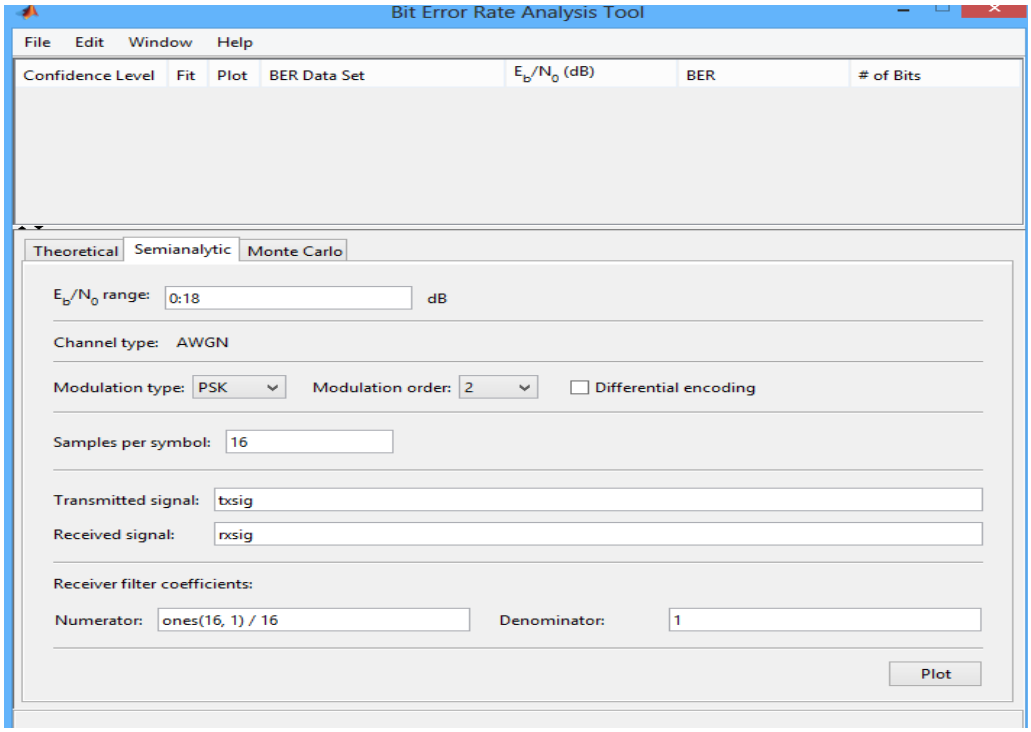

Fig. 2: BER tool view and content for semantic analysis

Algorithm of Program Used

- For selecting the generator polynomial degree of polynomial is entered manually as a length parameter.
- With the help of primpoly() two preferred primitive polynomial has been entered and if the length found divisible by 4 then re-entered the length parameter.
- Now enter the initial state for shift registers to be used for generation of PN Sequence.
- Now with the help of generator polynomial find the tap connection for generation
- of PN sequence.
- Update the shift register's which carry the data for generation of next PN sequence bit.
- Run the loop up to (2^length-1) for generation of at least one complete cycle.
- Logically xor the two PN sequence and generate the GOLD sequence
- GOLD SEQUENCE=PN SEQUENCE 1 XOR PN SEQUENCE 2
- Now generate a random data signal of low frequency.
- Modulate the low frequency signal with first pn sequence and then gold sequence.
- Apply shift keying technique to digitally modulated signals.
- Pass the signal through the AWGN channel and get the received signal.
- Now using BER TOOL link the transmitted and received signal and get the BER
- for different Modulation Order.
- End the process.

RESULTS AND DISCUSSIONS

In the present work, simulation of the block diagram shown in chapter 3 has been simulated on MATLAB and different results regard the BER and correlation has been obtained for the PN sequence and GOLD sequence. The different results obtained regarding BER and Correlation for GOLD and PN sequence has been explained below:

Generation of Gold Sequence and Their Auto- Correlation

PN sequence and gold sequence for particular generator polynomials [5 2 0] and [5 4 3 2 0] has been generated and their corresponding auto correlation also has been plotted. From the above simulated plot it has been observed that GOLD sequence has better orthogonality then PN sequence and energy is centralised towards mean position and less toward edges.

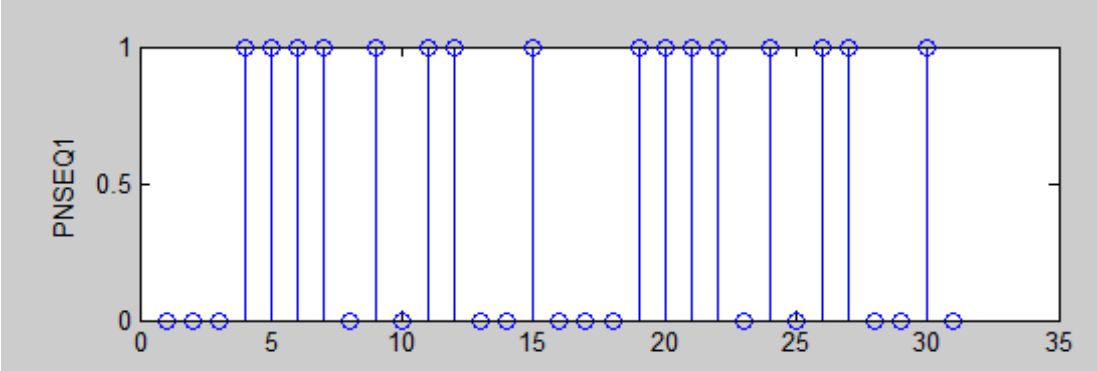

Fig. 3: PN SEQUENCE1 [5,2,0]

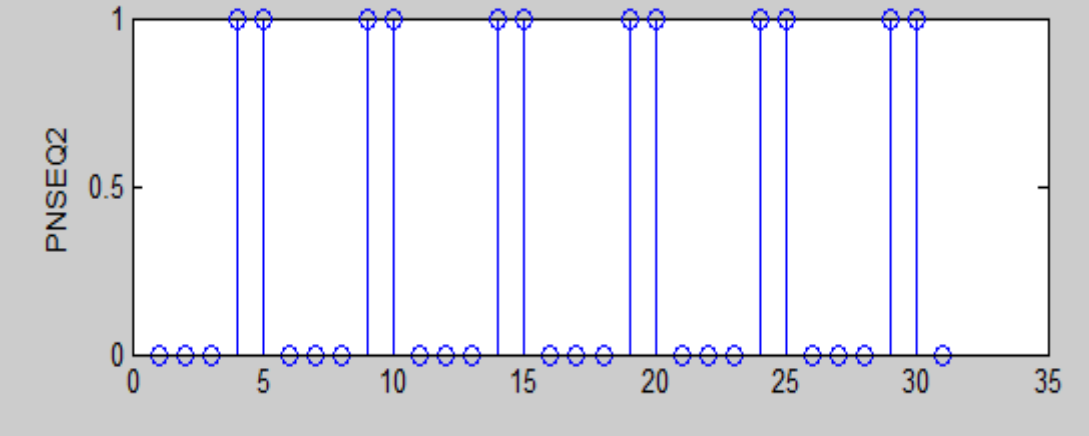

Fig. 4: PN SEQUENCE2 [5, 4, 3, 2, 0]

CONCLUSIONS

This work presents a study and analysis of PN Sequence and Gold sequence in terms of correlation and bit error rate performance of CDMA system. To evaluate the performance of the system with changing the sequence and modulation process matlab coding has been written and a model presented in chapter 3 is simulated in matlab environment. For the process of script writing the mathematical derivation which is presented in chapter 1, 3 was coded in the matlab and then the results has been analyzed. The resulted figure from the process of correlation and modulation derive some interesting facts regards codes and analysis process.

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