LARGE SET ORTHOGONAL KASAMI CODES FOR CDMA SYSTEM

VIJAYALAKSHMI V V

M.Tech Student Electronics and Communication Department, KMEA Engineering College
Aluva
Email: vijayaalakshmi@gmail.com

Abstract—The ever increasing demand of the users has led the present day communication System to adopt new efficient technologies to meet the specific requirements; mainly bandwidth and power. CDMA is the most popular and efficient mechanism that has been widely used in present mobile communication system. There are different types of spreading code namely PN sequence, Walsh hadamard code, Gold sequence, Kasami code etc. While assigning the codes to the CDMA users, the objective should be to serve as many users as possible. At the same time, proper care must be taken to ensure that inter-code interference between the users should be as low as possible. In this paper, the proposed Large Set Orthogonal Kasami sequence is capable of providing more number of different codes as compared to other spreading code in synchronous CDMA system. Also developed code generation algorithm and studied the Bit Error Rate (BER) Vs Signal to Noise Ratio (SNR).

Keywords—BER, CDMA, Walsh Hadamard Code, Small Set Orthogonal Kasami Code, Large Set Orthogonal Kasami Code, SNR.

I. INTRODUCTION

Code division multiple access (CDMA) is a channel access method utilized by various radio communication technologies. CDMA employs spread-spectrum technology and a special coding scheme (where each transmitter is assigned a code) to allow multiple users to be multiplexed over the same physical channel. CDMA is a form of spread-spectrum signaling, since the modulated coded signal has a much higher data bandwidth than the data being communicated ones and zeros. Walsh functions can be constructed for block length N=2^n. Walsh Hadamard matrix can be generated by using the MATLAB. From the structural method of the Walsh matrix, we can construct the Walsh matrix of size 2N x 2N as follows:

\[ W_{2N} = \begin{bmatrix} W_N & W_N \\ W_N & -W_N \end{bmatrix} \]

with \( W_N \) being the Walsh matrix of size N x N, where over score implies the binary complement of the corresponding bit(s) in the Walsh matrix. Since Walsh matrix is a square matrix, each row of the matrix has as many columns as the number of rows of the matrix. So using N-length Walsh code as a spreading sequence, we can serve at most N number of users in a CDMA communication system [1].

II. KASAMI SEQUENCE

Kasami sequence sets are one of the CDMA belongs to two basic categories:
- Synchronous(orthogonal codes)
- Asynchronous(pseudorandom codes)

In CDMA system, a number of spreading codes are used as signature codes for the users, which are one of the responsible factors to influence the system performance. Hence the selection of an appropriate spreading code for CDMA system is important. Spreading codes generally used in CDMA are PN sequence, Walsh Hadamard Code, Kasami code, Gold codes.

The transmitter identification of the DTV systems becomes crucial nowadays. Gold sequences and Kasami sequences are two excellent candidates for the transmitter ID sequences. The larger the Kasami sequence length, the larger the received signal-to-interference ratio [8]. Currently CDMA techniques are proliferating in multuser ultrasonic applications [7].

In this paper, Proposed Large set Kasami sequence generate a new family of orthogonal code sets that can be employed as a spreading sequence in CDMA communication system. MATLAB 7.0 has been used for the code generation algorithm, which is capable to produce the proposed code. The BER Vs SNR performance of the Proposed Large set Orthogonal Kasami sequence is plotted and is compared with the Walsh Hadamard Code and Small Set Orthogonal Kasami Code.

III. WALSH HADAMARD CODE

Walsh Hadamard Code are generated by

Large Set Orthogonal KASAMI Codes For CDMA System

33
important types of binary sequence sets because of their very low cross-correlation. To generate small set of Kasami code, PN sequence is the fundamental sequence to start with. Using a maximum length sequence \( m_1 \) of length \( N = 2^m - 1 \), another sequence \( m_2 \) is formed by decimating \( m_1 \) by \( 2^{m/2} + 1 \) bits. Similar to the small set of Kasami sequence, large set of Kasami sequence is also a collection of code members of period \( 2^m - 1 \) for any even number \( m \). This type of sequence is a superset of the sets consisting of Gold sequence and small set of Kasami sequence. To construct such a sequence, once again any maximum length sequence \( m_1 \) is the fundamental sequence to start with. Two other \( m \)-sequences \( m_2 \) and \( m_3 \) are formed from \( m_1 \) by decimating \( m_1 \) by \( 2^{m/2} + 1 \) and \( 2^{(m+2)/2} + 1 \) bits respectively [2].

An ideal spreading code must serve a huge number of users with less mutual interference between them. Small Set orthogonal Kasami code has been generated using small set Kasami sequence, which is very useful binary sequence for its low cross correlation value. By using Small Set orthogonal Kasami 60 numbers of unique codes of length 16,4 orthogonal code sets, each containing 15 members are obtained.

IV. SIMULATION RESULTS AND ITS ANALYSIS

The proposed large set orthogonal Kasami sequence is generated from the small set Kasami code and gold code. The objective is to find out as many codes as possible to serve a huge number of users. The proposed code will generate large number of codes compared to other codes. Then the BER Vs SNR of proposed Large set Orthogonal Kasami sequence is plotted and is compared with the Walsh Hadamard Code and Small Set Orthogonal Kasami Code.

![fig 1BER Vs SNR Performance for 8 users](image)

IV. FLOW CHART REPRESENTATION OF THE PROPOSED ALGORITHM

```plaintext
Number of Stages | Initial Stages | Number Of Users
PN Sequence Generation Algorithm
Generate Small Set Kasami code and Gold code
Combine Small Set Kasami code and Gold code
Large Set Kasami code of size \( l = m + m^2 \) Obtained.
Construct matrices of size \( N \times N \) whose first rows are the input sequences respectively. All the other rows of the matrices are obtained by rotating the previous row by one bit position.
Obtain the matrices \( M_1 \) and \( M_2 \).
Perform modulo-2 addition between the elements of each row of \( M_1 \) and the corresponding elements of \( M_2 \).
Obtain the matrix \( M_{12} \) of size \( N \times N \).
Append the matrix \( M_1 \) to \( M_{12} \) and get a new matrix \( M_{12}' \).
Take the first column of \( M_{12}' \), complement it and Store it in a buffer.
Replace all the elements of the first column of \( M_{12}' \) with '1' and get the matrix \( M_{12}^* \).
Append the buffer contents to the matrix \( M_{12}^* \) and Obtain another matrix \( M_{12}^{**} \).
Is there any repetition amongst the rows of the Matrix \( M_{12}^{**} \)?
Yes
No
Reject the repeated rows.
Get the matrix \( M \).
Select the rows of \( M \) as the members of proposed Large Set Orthogonal Kasami sequence.
```
Large Set Orthogonal KASAMI Codes For CDMA System

The BER Vs SNR of Walsh Hadamard code, Small Set Orthogonal Kasami, and the Proposed Large Set Orthogonal Kasami Codes are shown above. The Fig shows the BER Vs SNR performance for 8, 10 and 12 users, the Proposed Large Set Orthogonal Kasami Codes outperforms the other two codes. The BER performances of Walsh code closely match with those of Small Set Orthogonal Kasami, except under twelve-user scenario where the performance of Small Set Orthogonal Kasami is superior to that of Walsh code.

CONCLUSION

Present day communication uses a technology called Code Division Multiple Access (CDMA) to serve a large number of users simultaneously and to ensure that all of them utilize the entire available channel bandwidth. In this particular access system, each user is identified by a unique code.

CDMA system uses different spreading codes such as, maximal length sequence, gold sequence, Kasami sequence, Walsh hadamard code. Walsh code is widely used spreading code is due to its ease of generation, simplicity and have low multi user interference. The performance of Walsh is poor when the number of users increases. The Small Set Orthogonal Kasami sequence which is capable of providing more number of different codes as compared to popularly used orthogonal spreading code in synchronous CDMA system such as Walsh code. The Proposed Large Set Orthogonal Kasami sequence can produce large number of different codes compared to the Small Set Orthogonal Kasami sequence. Larger the number of codes data is more protected.

Studied the Bit Error Rate (BER) performances of these codes and compare there performance by plotting BER Vs SNR. The performance of Small Set Orthogonal Kasami is better than Walsh code and poor when compared to Proposed Large Set Orthogonal Kasami. The Proposed Large Set Orthogonal Kasami sequence performs better in multi-user environment than other codes.