The Research of Sequence Partial Ensembles Application in MC-CDMA System

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Abstract – **The research of Walsh sequence partial ensembles application in MC-CDMA system given in this paper. The analysis of bit error rate performance during data transmission also conducted.**

Keywords – **Walsh sequence ensembles, Simulation model, OFDM, MC-CDMA, BER.**

I. Introduction

For past decade, DS-CDMA has been considered to be the best technology for mobile radio communication. This technology is used in cdmaOne, cdma2000 mobile systems based on IS-95 standard, ZigBee networks, etc.

The main advantage of orthogonal frequency division multiplexing scheme is that allows data transmission in case of fading channel, where the use of conventional modulation types doesn't give positive results. The OFDM scheme splitting serial data stream into K parallel substreams of lower rate, increasing initial symbol duration. Thus application of OFDM scheme allow to consider radio channel during one symbol duration as time-invariant and fading for all subchannels became flat. The MC-CDMA technology intended to use advantages of DS-CDMA and OFDM and increase overall performance of mobile communication system.

II. System Model

The MC-CDMA signal generation for one user (k) can be completed by two stages: data symbol b_k multiplication with the specific user spreading code $pn^{(k)}$:

$$d^{(k)} = b_k \cdot pn^{(k)}, \qquad (1)$$

and OFDM modulation:

$$x^{(k)} = \frac{1}{N_c} \cdot \sum_{n=0}^{N_c-1} b_k \cdot pn^{(k)} \cdot e^{j\cdot\omega_n\cdot t} = \frac{1}{N_c} \cdot \sum_{n=0}^{N_c-1} d^{(k)} \cdot e^{j\cdot\omega_n\cdot t}. \qquad (2)$$

where N_c is the number of carrier signals.

Complete MC-CDMA signal is obtained by superposition of K active user signals [1]:

$$x(t) = \sum_{k=1}^{K} x^{(k)} \qquad (3)$$

The received signal is affected by Raleigh flat fading and AWGN noise n(t):

$$y(t) = x(t) * h(t) + n(t) = \int_{-\infty}^{\infty} x(t-\tau) \cdot h(t) \cdot d\tau + n(t) \qquad (4)$$

Fading channel modeled as a tapped delay line, the equivalent impulse response is given by:

$$h(t) = \sum_{k=1}^{p} A_k(t) \cdot \delta(\tau - \tau_k) \qquad (5)$$

where A_k is path amplitude, τ_k - propagation delay.

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After OFDM demodulation equalization and detection is applied.

III. System Performance

There are exists various types of spreading sequences. Walsh and Gold sequences are proposed for MC-CDMA systems. They met Welch boundary and provide sufficient number of sequences in ensembles. These types of sequence have different properties. Walsh sequences are orthogonal while Gold sequences have good crosscorrelation properties.

As shown in paper [2] sequence can be selected from initial ensemble based on total average interference parameter proposed by Pursley M.B. and Sarwate D.V. [3]. This selection allows us to use sequences with best crosscorrelation properties in MC-CDMA system, reducing multiple access interference, Fig. 1. The MC-CDMA system performance can be increased by the cost of reducing available data transmission channels.

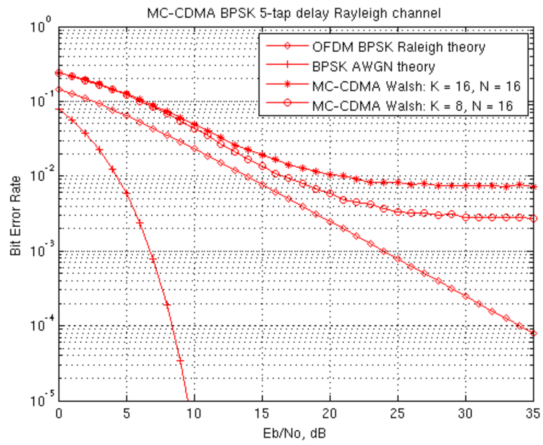

Fig.1 Modeling results

IV. Conclusion

In this paper the results of Walsh sequence partial ensembles application in MC-CDMA system given.

References

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