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To Compare the Pulse Performance value on Multi User DS-CDMA System

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Abstract

In this proposed work we analyze the performance of different type of pulse shaping filters on the performance of DS-CDMA System using spreading sequences. We evaluate and compare the BER performance value of different type of pulses on multiuser detection. Our work will justify the best pulse shape on reducing the error in DS-CDMA system with the simulation results..

Keywords: Ds-CDMA.

Introduction

Code-division multiple access (CDMA) system support multimedia services in mobile communications due to its ability to cope with the asynchronous nature of multimedia data traffic. The propagation of maximum number of users through the wireless channel results in multi-user interference from non-orthogonal users. This exhibits a user capacity limit on the CDMA systems.

Different multi-user detection methods are proposed in the recent years to eliminate the adverse effects of multi-user interference. The Common methods used to suppress the multiple path interference in CDMA systems are Linear CDMA detectors viz., Matched filter, Decorrelator, and MMSE adaptive filter. G.L.Turin [1] in 1980 has used the simplest scheme of conventional matched filter detector to demodulate CDMA signal. This detector though optimal in additive white Gaussian noise (AWGN) is sub-optimal because the MAI does not necessarily resembles white Gaussian noise. The optimal multiuser detector for CDMA systems based on maximum likelihood (ML) detection technique using Viterbi's algorithm is proposed by Verdu in the mid of 1980's in [2]. Most work examined the performance of DS-CDMA systems only considers the use of rectangular chip waveforms science no oversampling is needed in this case, and the transmitted signal can be formed, and chip matched filter can be implemented readily. This simplifies the simulation models, and considerably reduces the simulation complexity. However more

Spectrally efficient waveforms are employed in practical systems in order to satisfy the bandwidth limitations imposed by the channels and to limit the out of band power. Chip waveform design was studied in many papers as like [III] optimum pulse shapes are designed to minimize multiple access interference (MAI) given a restriction on out of band power, and chip pulses are limited to the chip duration T_c . In [IV] chip waveform such as Blackman and Kaiser Pulses. Are examined and their performance in a micro-cellular packet mobile radio system is compared. The paper is organized as follows. In Section [2], the system model is briefly described. Synchronous and Asynchronous Model is presented in section [3]. Section [4] describes Probability of Error. Simulation results are presented in section [5] and the paper is completed by some concluding remarks.

System Model

We will consider BPSK transmission through a common Additive White Gaussian Noise (AWGN) channel shared by K simultaneous users employing a DS-CDMA system. As mentioned earlier, each user is assigned a unique signature waveform $s_k(t)$ of duration T , where T is the symbol duration. A signature waveform can be expressed as

we shall assume that the data rate $1/T$ is identical for all users.

$$s_k(t) = \sum_{n=0}^{N-1} a_k(n)h(t - nT_c), 0 \leq t \leq T \dots\dots\dots(1.1)$$

where $[a_k(n) \in \{+1, -1\}, 0 \leq n \leq N-1]$ is a pseudo-noise (PN) code sequence of the k th user consisting of N chips, $h(t)$ is the spreading chip whose duration is $T_c = T/N$. The signature waveforms are assumed to be zero outside the interval $[0, T]$, and, therefore, there is no inter symbol interference (ISI).

In general, one can assume without loss of generality that all K signature waveforms are normalized so as to have unit energy, i.e.

$$\int_0^T \|s_k(t)\|^2 dt = 1 \dots\dots\dots(1.2)$$

The corresponding base-band transmitted signal of each user can be expressed as

$$g_k(t) = A_k \sum_{i=1}^M b_k(i) s_k(t - iT) \dots\dots\dots(1.3)$$

where A_k is the received amplitude of the k th user's signal user such that A_k^2 is referred to as the energy of the k th user. Figure 1.1 illustrates the received waveform, $y(t)$, comprising the sum of K transmitted waveforms in AWGN which can be expressed as

$$y(t) = \sum_{k=1}^K A_k \sum_{i=1}^m b_k(i) s_k(t - iT - \tau_k) + \sigma n(t) \dots\dots\dots(1.4)$$

Where τ_k is the transmission delay and $n(t)$ is white Gaussian noise with unit power spectral density. Note that the noise power in a frequency band with bandwidth B is $2\sigma^2 B$ (the noise one-sided spectral density level $2\sigma^2$ is often denoted by N_0).

Without loss of generality, we can assume that the delays τ_k are smaller than the bit period time T ($0 \leq \tau_k \leq T$ for $1 \leq k \leq K$) and $0 \leq \tau_1 \leq \tau_2 \leq \dots \leq \tau_k < T$. Additionally,

Synchronous and Asynchronous Model

Multiuser detectors basically have a front-end whose objective is to convert the received continuous-time waveform, $y(t)$, into a discrete-time process. The matched filter output is then given by:-

$$y_k = \int_0^T y(t) s_k(t) dt \dots\dots\dots(1.5)$$

In the synchronous case, it is sufficient to restrict our attention to a one-shot model. Therefore, one can express the output of the k th matched filter as:

$$y_k = A_k + \sum_{j \neq k} A_j b_j \rho_{kj} + n_k \dots\dots\dots(1.6)$$

$$y_k = (y, S_k) = \text{Desired Information} + \text{MAI} + \text{Noise}$$

Probability of Error

As derived before for the synchronous case, the k -th user matched filter output is

$$y_k = A_k b_k + \sum_{j \neq k} A_j b_j \int_0^T s_j(t) s_k(t) dt + n_k$$

The probability of errors can be expressed as follows, with change of integration variable and symmetry:

$$\begin{aligned} P &= \frac{1}{2} \int_0^{\infty} f_{Y/1}(v) dv + \frac{1}{2} \int_{-\infty}^0 f_{Y/1}(v) dv \\ &= Q\left(\frac{A < s, h >}{\sigma |h|}\right) \\ &= Q\left(\frac{A}{\sigma}\right) \end{aligned}$$

The analysis in the asynchronous case can be done in a similar fashion. The major difference is that each bit is affected by $2K-2$ interfering bits instead of $K-1$ bits as in the synchronous case. Probability of error for the k -th user is

$$P_k^e(\sigma) = \frac{1}{2^{2K-2}} \sum_1 \dots \sum_{j \neq k} \dots \sum_k Q\left(\frac{A_k}{\sigma} + \sum_{j \neq k} \frac{A_j}{\sigma} (e_j \rho_{jk} + d_j \rho_{kj})\right)$$

Where e_j and $d_j \in \{-1, +1\}$ the asynchronous cross correlations in the above equation depend on the offsets between the users' symbol periods. As a result, those parameters are random variable that may actually be time varying.

Simulation Results

In Fig 1.1 We find the Performance of increasing user value in chip length of 128.

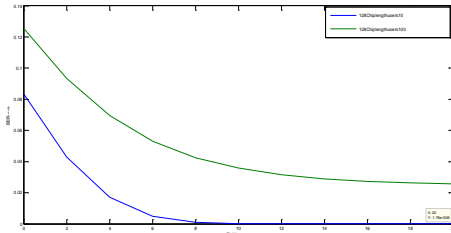


Figure 1.1:- BER performance of 10 and 100 user value in chip length 128.

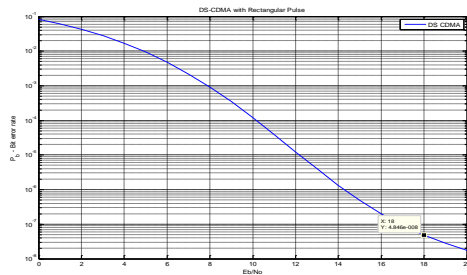


Figure 1.2:- BER performance of Rectangular pulse in DS-CDMA System chip length 128.

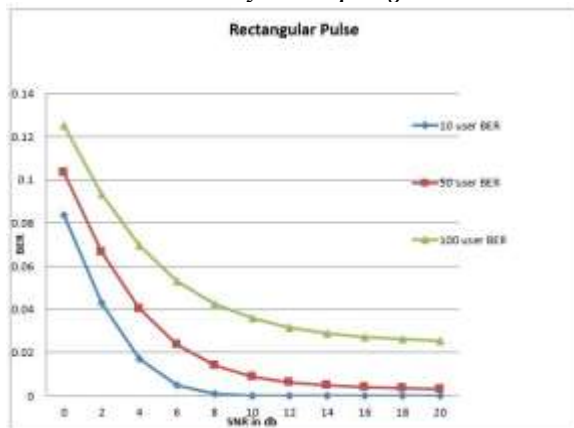


Figure 1.3:- BER performance of Rectangular pulse in Multi user DS-CDMA System chip length 128.

In Fig.1.2 and 1.3 we have value of Multiuser performance in DS-CDMA system using Rectangular Pulse on 128 chip length.

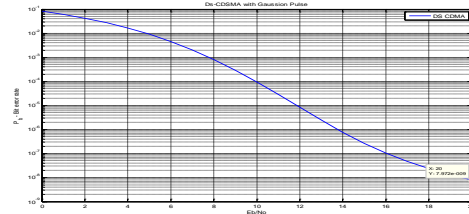


Figure 1.4:- BER performance of Gaussian pulse in DS-CDMA System chip length 128.

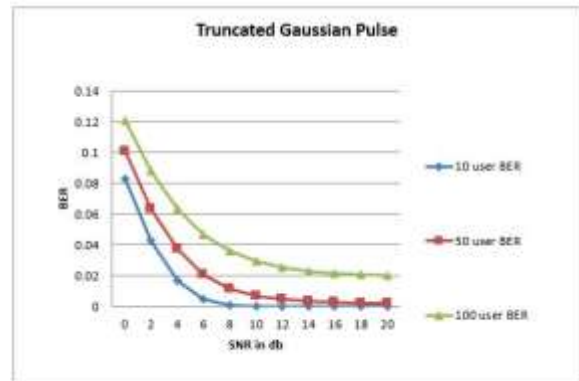


Figure 1.5:- BER performance of Gaussian pulse in Multi user DS-CDMA System chip length 128.

In Fig.1.4 and 1.5 we have value of Multiuser performance in DS-CDMA system using Gaussian Pulse on 128 chip length.

Conclusion

DS-CDMA is the most commonly proposed CDMA system for the third generation of mobile systems. It has many advantages as explained earlier. However, its performance is mainly degraded by the near-far problem and the multiple access interference. One way to circumvent these difficulties is to utilize a multiuser detector. We can reduce this multi user interference problem by using the different type of pulse shape too in this paper we can calculate the value of Multi user BER performance value in Rectangular Pulse and Gaussian Pulse and we find the Gaussian Pulse provide better performance as compare to Rectangular Pulse on 128 chip length value.

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