CODE TRACING IN A DISTINCT PERIOD OF UNSPECIFIED ENVIRONMENTSUSING ADAPTIVE DS-CDMA RECEIVER

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ABSTRACT

In this paper, I propose and analyze a new non coherent receiver with PN code tracking for direct sequence code division multiple access (DS-CDMA) communication systems in multipath channels. I employ the decision-feedback differential detection method to detect MDPSK signals. An “error signal" is used to update the tap weights and the estimated code delay. Increasing the number of feedback symbols can improve the performance of the proposed non coherent receiver. For an infinite number of feedback symbols, the optimum weight can be derived analytically, and the performance of the proposed non coherent receiver approaches to that of the conventional coherent receiver. Simulations show good agreement with the theoretical derivation.

Keywords: Privacy Protection, DS-CDMA, PSK, MDPSK, Non-Coherent Receiver

I.INTRODUCTION

The telecommunications industry faces the problem of providing telephone services to rural areas, where the customer base is small, but the cost of installing a wired phone network is very high. One method of reducing the high infrastructure cost of a wired system is to use a fixed wireless radio network. The problem with this is that for rural and urban areas, large cell sizes are required to get sufficient coverage. This presents extra problems as there are long delay times in multi path signal propagation. Currently Global System for Mobile telecommunications (GSM) technology is being applied to fixed wireless phone systems in rural areas or Australia. However, GSM uses time division multiple access (TDMA), which has a high symbol rate leading to problems with multi path causing inter-symbol interference. Several techniques are under consideration for the next generation of digital phone systems, with the aim of improving cell capacity, multi path immunity, and flexibility. These include CDMA and OFDM. Both these techniques could be applied to providing a fixed wireless system for rural areas. However, each technique as different properties, making it more suited for specific applications.OFDM is currently being used in several new radio broadcast systems including the proposal for high definition digital television (HDTV) and digital audio broadcasting (DAB). However, little research has been done into the use of OFDM as a transmission method for mobile telecommunications systems. In CDMA, all users transmit in the same broad frequency band using specialized codes as a basis of channelization. Both the base station and the mobile station know these codes, which are used to modulate the data sent.

In today's world cell phone have become the single greatest tool in day today life. It has become a necessity that business associates should be able to communicate on the go. That's why it has become so important to make choices in choosing which handheld device one should go for. A handheld device is selected according to its features and benefits, like does it provide access to internet and email or does it look slick and more. An important question when designing and standardizing cellular systems is the selection of the multiple access schemes.

There are three basic principles in multiple access, FDMA (Frequency Division Multiple Access), TDMA (Time Division Multiple Access), and CDMA (Code Division Multiple Access). All three principles allow multiple users to share the same physical channel. But the two competing technologies differ in the way user sharing the common resource. TDMA allows the users to share the same frequency channel by dividing the signal into different time slots. Each user takes turn in a round robin fashion for transmitting and receiving over the channel. CDMA uses a spread spectrum technology that is it spreads the information contained in a particular signal of interest over a much greater bandwidth than the original signal. In TDMA users can only transmit in their respective time slot. Unlike TDMA, in CDMA several users can transmit over the channel at the same time.

Spread-spectrum communication needs to synchronize the spreading waveforms in transmitting and receiving ends. If the two waveforms are out of synchronization by a little chip time, insufficient signal energy will reach the receiver, the performance of data demodulation is thus degraded. Synchronizing the DS-SS system includes a two step procedure, code acquisition and code tracking. Although code acquisition is an important problem, the development of some techniques for accurate code tracking plays an equally important role in supporting the acquisition process once the code has been acquired. In , some adaptive code tracking techniques were proposed.

In this paper we proposed the scheme that performed both acquisition and tracking with the same circuitry, therefore a significant simplification in the overall DS-SS receiver structure is gained. In an FIR adaptive filter that mitigates the effect of multipath on delay estimation was utilized. The tap weight vector of this adaptive filter can be used to provide accurate estimation of the multipath delays. Hosemann*et al.*presented a new tracking scheme for handling multiple access interference (MAI) effect without the requirement of a pilot channel or training symbols.

In a coherent timing error detector embedded in a code tracking loop for Rake reception was presented. Its filter coefficients are computed online in order to minimize an interference cost function. However, in these references, multipath and MAI effects are not considered simultaneously. This paper deals with tracking issue and assumes successful initial acquisition before tracking process. Therefore, the received signal has only a small timing offset (•}1/2 chip duration) from the correct timing. In this paper, we refer to the adaptive Pseudo-Noise (PN) code tracking scheme proposed in with well-known coherent detection as conventional coherent (closed-loop time-delay estimation) receiver. The conventional coherent receiver deals with data detection and PN code timing recovery jointly is described in Fig. 1.

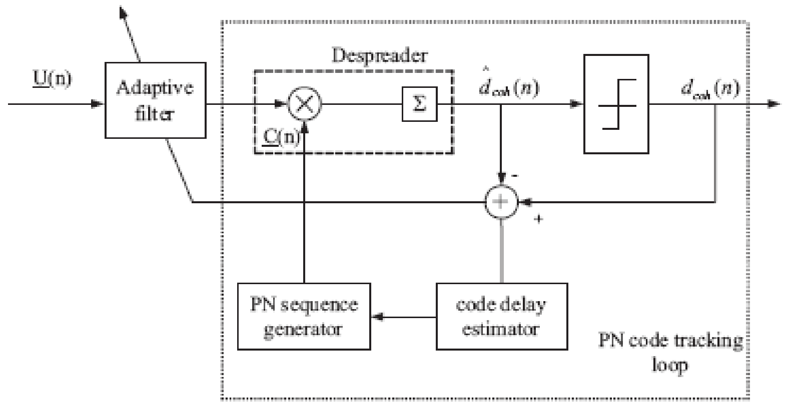


Fig.1. The conventional coherent receiver - joint detection and PN code tracking.

PN code tracking can be categorized into coherent and noncoherent loops. When the demodulation is coherent, a coherent carrier reference must be generated prior to demodulation. The generation of coherent reference at low signal-to-noise ratio is difficult. This difficulty is from the fact that any communication system must convey information from transmitter to the receiver. This implies that the carrier is in some way modulated with this information. In contrast to coherent case, the noncoherent detection is less complex and more robust against carrier phase variations. Sehier*et al.* proposed to combine a linear equalizer with conventional differential detection, whereas Masoomzadeh-Fard*et al.* considered decision-feedback equalizer with conventional differential detection. All of those schemes suffer from a significant loss in power efficiency compared to coherent case. Schober*et al.*proposed the noncoherent minimum mean-square error (MMSE) receiver for DS-CDMA in a nondispersive channel. The receiver is related to the noncoherent linear MMSE equalizer reported in , i.e., the first stage of the receiver is a linear filter for interference suppression and the second stage is a decision-feedback differential detector. The receiver uses a certain observation window to generate a noncoherent decision variable. Varying the size of this observation window can provide gain in the power efficiency. For this reason, we apply the decision-feedback differential detection method in our proposed non-coherent receiver that is described in Fig. 2.

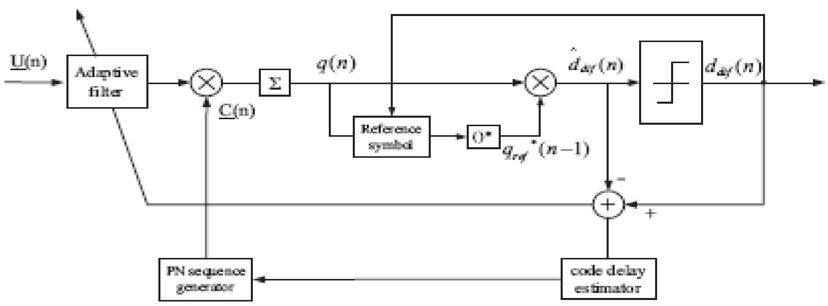


Fig.2. The proposed non-coherent differential detection receiver with PN code tracking

This noncoherent detection requires the differential encoding in the transmitter and the reference symbol is needed for decoding in the receiver. In and chip-level differential encoding/detection techniques for DS-SS signal to cope with frequency-nonselective fast fading channels were proposed. Also, the decision feedback differential detection for DS-CDMA with multi-chip differential encoding was proposed to enable a large performance gain. Because the computational loading for chip-level differential detection is heavy in both encoding and decoding, we select the symbollevel differential encoding as in , the taps of the adaptive filter act as a despreader for code adjustment without considering a multipath channel, so the length of the adaptive filter is the same as code length. For our structure, the filter taps are used to estimate a set of chip signals at one symbol time. In other words, is the symbol-level signal estimation algorithm, while our proposed scheme is the chip-level signal estimation algorithm. In our proposed receiver, the adaptive filter is used to estimate the desired signal and suppress the multipath and MAI effects based on the received signals simultaneously, we use the LMS algorithm to estimate the code delay through the same error signal. In addition to above process, the noncoherent receiver employs the decisionfeedback differential detection to recover the MDPSK signal.

II. MULTIPLE ACCESS TECHNIQUES

Multiplexing is done at the earth stations then after modulating the signals at the earth stations it is transmitted to the satellite. At the satellite the signals will share the satellite transponder by different multiple access techniques. There are basically three multiple access techniques. They are:

1. Frequency division multiple access (FDMA)
2. Time division multiple access (TDMA)
3. Code division multiple access (CDMA)

The reason of using such techniques is to allow all users of a cellular system to be able to Share the available bandwidth in a cellular system simultaneously.

III. FREQUENCY DIVISION MULTIPLE ACCESS (FDMA)

Frequency division multiple access is a technique in which all the earth stations share the satellite transponder bandwidth at the same time but each earth station is allocated a unique frequency slot. Each station transmits its signals within that piece of frequency spectrum.FDMA was the first multiple-access technique deployed for cellular systems, the AMPS Cellular systems. In Figure below, it can be seen that each user is assigned a unique channel (frequency band). In other words, no other user can share the same frequency channel during the period of the Call using FDD (Frequency Division Duplexing).

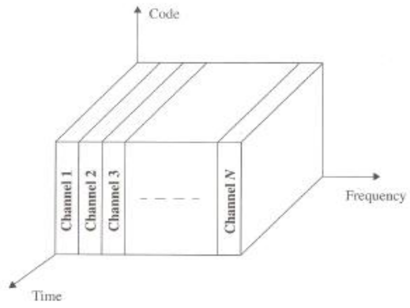


Fig: 3 FDMA channels

IV. TIME DIVISION MULTIPLE ACCESS (TDMA)

Time division multiple access is a technique in which each earth station is allocated a unique time slot at the satellite so that signals pass through the transponder sequentially. TDMA causes delay in the transmission.TDMA is a digital multiple-access technique, which divides the radio spectrum in to time slots (channels), and only one user is allowed to either transmit or receive in each slot. In Figure below, it can be seen that each user occupies a particular time slot with in every frame, where a frame comprises of N times slots.

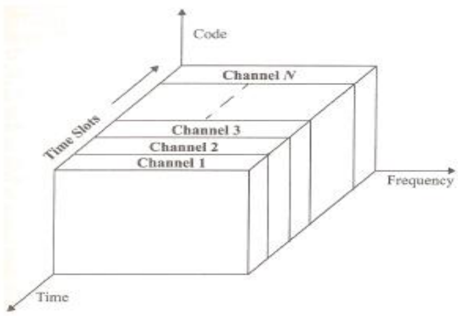


Fig: 4 TDMA channels

V. CODE DIVISION MULTIPLE ACCESS (CDMA)

Code division multiple access is a technique in which all the earth stations transmit signals to the satellite on the same frequency and at the same time. The earth station transmits the coded spectrum which is then separated or decoded at the receiving earth station. Due to the daily demand of higher user capacity, FDMA and TDMA systems were unable to with stand high system over load and system problems. In particular, in FDMA systems, non-linear effects were observed when the power amplifiers or the power combiners operate at or near saturation for maximum power efficiency and adjacent-channel interference occurs. Developed by Qualcomm Incin1995, CDMA is a recently developed digital multiple access technique. CDMA or Code Division Multiple Access was standardized by the Telecommunications Industry Association (TIA) as an Interim Standard (IS-95). Compared to TDMA and FDMA, CDMA is superior in terms of user capacity, signal quality, security, power consumption and reliability. It enables allocation of data in increments of 8 kilo bits per second with in the1.25MHz CDMA channel bandwidth. As a bench mark, CDMA is able to offer up to 6 times the capacity of TDMA, and about7-10 Times the capacity of analog technologies such as AMPS and FDMA, and now holds over 600 million subscribers worldwide. In CDMA systems, all user so that the system are allowed to use the same carrier frequency band May transmit simultaneously as depicted inFigure2.4,through the use of Direct-Sequence Spread Spectrum. Therefore, CDMA is also known as DSMA – Direct Spread Multiple Access.

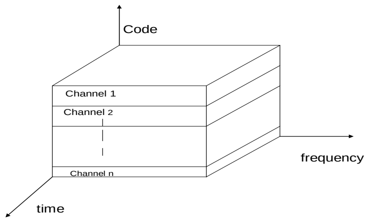


Fig: 5 CDMA Channels

A CDMA system is a multi-user spread spectrum system that eliminates the frequency reuse problem in cellular systems. Unlike TDMA and FDMA systems, where user signals never overlap in either the time or the frequency domains, respectively, a CDMA system allows transmissions at the same time while using the same frequency. For example, in the first widespread commercial CDMA system, The mechanism separating the users in a CDMA system consists of assigning a unique code that modulates the signal from each user; the number of unique codes in a CDMA link is equal to the number of active users. The code modulating the user's signal is also called a spreading code, spreading sequence, or chip sequence.

VI. TRANSMITTER

The transmitter interoperations comprise of convolution encoding and repetition, block interleaving, long PN sequence, data scrambling, Walsh coding and quadrature modulation. The Convolution encoder performs error-control coding by encoding the incoming bit stream information. This allows error correction at the receiver, and hence improves communication reliability.

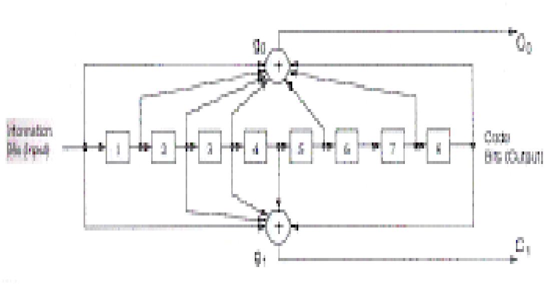


Fig:6 Rate1/2 ConvolutionalEncoderforRateset2

VII. RECEIVER

The CDMA standard describes the processing performed in the terminal receiver as being complementary to those of the base station modulation processes on the Forward CDMA Channel".

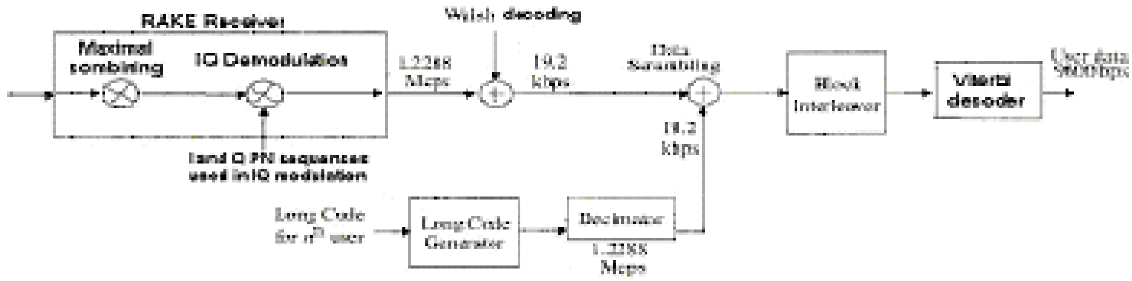


Fig: 7 CDMA receiver demodulation process.

VII. SIMULATION RESULTS

From the above discussion, I know that the selection of the chip waveform and the sample number *D* are the factors to control the performance of the system. The effect of the gradient of chip waveform about the code delay as in[9] on the performance of the system can be large. However, as the dependence of the system performance on the chip waveform is usually very complicated, it is generally difficult to evaluate this effect. Therefore, we use simulation to compare the effectiveness of different chip waveforms. In this section, the following time-limited chip waveforms are considered:

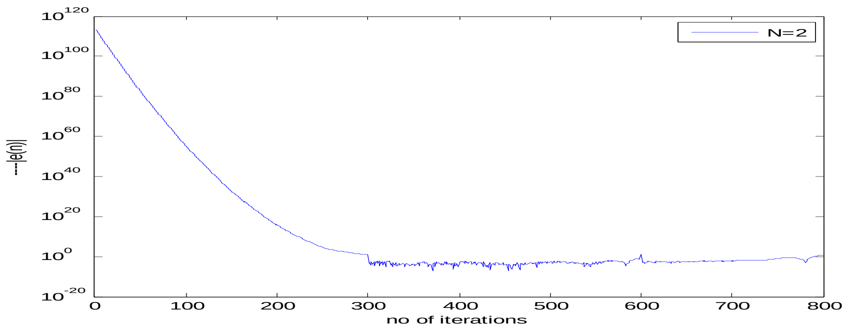
1) Raised-Cosine (rct) :

$$\Psi(t) = \sqrt{\frac{2}{3}}\left[1 - \cos(2\pi t/T_c)\right]\zeta_c(t)$$

2) Blackman (bm) :

$$\Psi(t) = \epsilon\left[\varepsilon_1 - \varepsilon_2\cos(2\pi t/T_c) + \varepsilon_3\cos(4\pi t/T_c)\right]\zeta_c(t)$$

where $\epsilon^2 = (\varepsilon_1^2 + \varepsilon_2^2/2 + \varepsilon_3^2/2)^{-1}$ and $\varepsilon_1 = 0.42$, $\varepsilon_2 = 0.5$, and $\varepsilon_3 = 0.08$



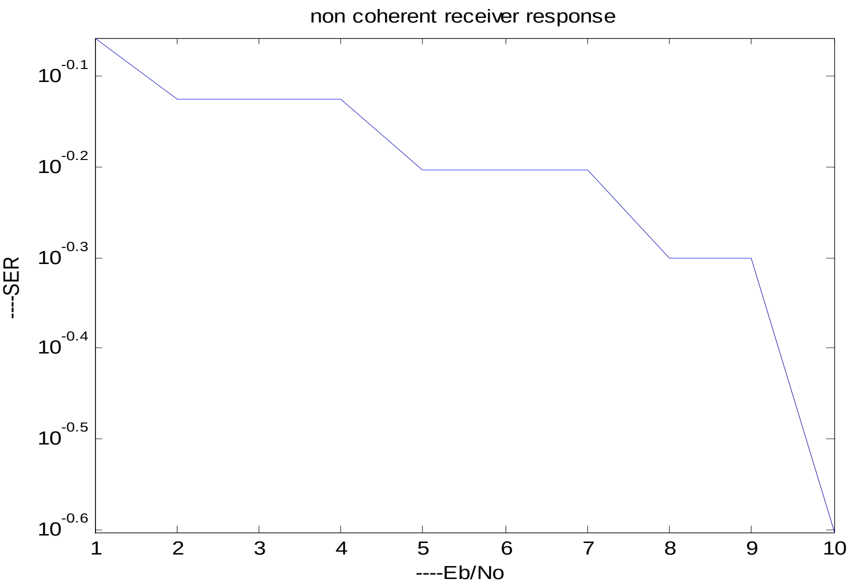


Fig:8 Non-Coherent Receiver Response

VIII. CONCLUSION

A novel non coherent receiver for joint timing recovery and data detection in DS-CDMA systems is proposed in this work. It estimates the desired signal and code delay by LMS algorithm at the same time. The MMSE solution of the proposed receiver is analyzed theoretically and by computer simulations. Three different chip waveforms are simulated in two different multipath channels with different numbers of active users. It is shown that the timing offset can be rapidly tracked even if the mismatch is up to half chip time interval. The loss of noncoherent detection compared with conventional coherent detection is limited and can be adjusted via the generation of the reference symbol for the decision-feedback differential detection. The performance of the noncoherent receiver can approach the performance of the conventional coherent receiver if an infinite number of feedback symbols is used, as has been shown analytically. Furthermore, simulations show that the proposed receiver in an asynchronous situation approaches the performance as that of the receivers with perfect synchronization.

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