Journal of
Data Acquisition and Processing
ISSN: 1004-9037
https://sjcjycl.cn/
DOI: 10.5281/zenodo.7766333

PERFORMANCE OF TRANSMISSION IN CDMA SYSTEM

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ABSTRACT

Spread spectrum methods are used by users in CDMA, and the full spectrum is utilized during transmissions; this multiple access method is known as CDMA. There is a strong correlation between the signal-to-noise ratio (SNR) and the overall system performance in wireless communications. Channel impairments including noise, interference, and fading may occur in any mobile transmission method. The signal-to-noise ratio (SNR) dropped because of the distorted signal and the impaired channel. Additionally, uplink (forward channel) and downlink (reverse channel) communication have distinct characteristics (reverse channel). In addition to these dissimilarities, the two links use distinct sets of codes in order to direct their respective customers. In this study, we model the formulas for the pdfs of the SNR for both uplink and downlink transmission, assuming that the system is running with an average signal-to-noise ratio of 6dB per data bit.

KEYWORD: - CDMA, SNR, downlink, uplink, multipath fading

1. INTRODUCTION

In reality, a hospital ward or senior living facility room may have many residents who all need close supervision under normal circumstances. Then, it will be necessary to apply suitable multiple-access (MA) approaches to accommodate the simultaneous data transfer from several patients. Potential methods with minimal implementation complexity include time- and code-division multiple access (TDMA and CDMA). Several TDMA approaches, including as time-hopping, periodic-based data transmission, and priority-based data transmission, have been suggested for use in OWC-based WBANs with the aim of facilitating the monitoring of numerous patients simultaneously. These technologies, however, cannot accommodate the asynchronous data transfer required when dealing with several patients. Recently, optical camera communication has been studied for multi-patient monitoring inside a hospital ward; nevertheless, this system loses dependability without line-of-sight (LOS) connectivity. In addition to CDMA, a sparse code MA approach based on VL LOS connections was also developed, although with a higher implementation complexity. Here, we suggest using optical code division multiple access (O-CDMA) to strengthen the network and lessen the need for synchronization between several transmitters (clearly critical in the case of TDMA). Subsequently, data is sent via intensity modulation with direct detection (IM/DD). The binary pulse-position modulation (BPPM) technique is studied here. We'll explain why this decision was made in terms of how easy it is to implement later. How well O-CDMA works is contingent on the signature codes used to map user data. Well-known optical orthogonal codes (OOC) are applicable here; they were originally developed for use with optical fiber networks. O-CDMA, when employed in an asynchronous OWC setting, is susceptible to the multi-access interference (MAI) and near-far problems. The performance of the system may also be greatly diminished due to the patients' movement and the unpredictable orientations of the transmitters (Txs). It is important to note that intra-WBAN data transfer is possible over IR OWC lines as well. When used with optical filters at the Txs, various wavelengths may prevent crosstalk across intra- and extra-WBAN lines. Therefore, it seems sense that we exclude the possibility of MAI for intra-WBAN links in this research.

Recent research in wireless communication has focused on improving system performance in terms of capacity, data rate, and other metrics. The use of many antennas, either for transmission or reception, is known as "spatial diversity," and it's an intriguing strategy. In this research, we use Space-Time Shifted (STS) diversity transmission for a CDMA network. To further boost wireless systems' performance, variable rate transmission approaches have been developed. The information transfer rate adapts to the quality of the signal, as in adaptive rate transmission. Multiple modulation methods for use in a code division multiple access (CDMA) system that can handle high data rates are investigated. We also analyze and contrast several multi-processing-gain, multi-channel, multi-modulation, and multi-chip rate systems. The effects of power and rate adaptation on the CDMA system are studied. W-error CDMA's performances are studied and contrasted between multi code and variable spreading gain systems. The multicode and variable spreading factor multirate systems of MC-CDMA are analyzed in terms of their general performance. The maximum achievable bit error rate (BER) of a time division duplex (TDD) system is determined in which the number of modulation levels is changed depending on the channel. The effects of various spreading factors on adaptive rate transmissions inside a code division multiple access (CDMA) system are studied (VSF). These studies include adjusting the data rate based on the amount of multiuser interference (MUI). Using a nonlinear programming method, we construct the throughput maximization issue for CDMA uplink as an optimization problem in terms of the spreading gain and transmit power of the users.

The capacity of a cellular network may be increased by the employment of an antenna array at a cell base station by increasing signal strength through increased diversity or by increasing the signal strength of individual antennas. Antenna components need to be physically separated enough to experience uncorrelated fading and, hence, the diversity benefit in a fading environment. The minimum distance between a mobile device and a base station in an urban environment is half a wavelength at the mobile device and 10 times a wavelength at the base station. Due to the possibility of coherent combining of the sent and/or received signals and the underlying uncorrelated noise, multiple antennas may give antenna gain regardless of the fading environment and in addition to the diversity gain. Beamforming is the common name for this method, in which incoming and outgoing signals are described as planar wavefronts impinging on and propagating from an antenna array (DOD). To produce correlated fading coefficients for the components of an antenna array, which form a vector termed the spatial signature or the steering vector, the antenna elements are typically tightly spaced in the beamforming technique. In direct-sequence code-division multiple-access (DS-CDMA) systems, the spreading signature is typically used for interference suppression, whereas in other systems, the spatial signature is used instead. Here, we examine the relevance of array processing approaches for enhancing CDMA cellular downlink transmission, which is expected to play a pivotal role in the future generation of communication systems that underpin wireless Internet, video on demand, and other multimedia applications. In particular, we will analyze the effect of feedback and antenna count on the best transmission techniques for voice and data applications.

2. LITERATURE REVIEW

Chedlia Ben Naila ET.AL. (2011) In order to describe the transmission of code-division multiple-access (CDMA)-based wireless signals across a radio frequency on free-space optical (RF-FSO) system, this research provides a theoretical and practical performance analysis using an aperture averaging (AA) approach. First, we provide an analytical model that accounts for the AA method, laser diode nonlinear distortion, and multiple-access interference, and includes formulas for the CNIR and the likelihood of outages. We further demonstrate that a necessary average CNIR assuring a large scintillation fade reduction is achieved by a design trade-off between an ideal optical modulation index on the transmitter side and the receiver aperture size. As a result, we provide some preliminary criteria for improving the RF-FSO system's transmitter and receiver. Here, we use an experimental RF-FSO system to study the factors that affect the transmission of wideband code division multiple access (W-CDMA) signals over a free-space optical communication (FSO) connection with a length of 1 km. The impact of environmental factors is monitored and studied using key performance metric indicators including the CNIR and the neighboring channel leakage ratio. We verify the accuracy of the proposed mathematical model by comparing it to data collected from actual transmissions of W-CDMA signals via RF-FSO. The work provided here may serve as a benchmark for future work on designing and evaluating the efficacy of FSO systems for transmitting a variety of broadband wireless service signals.

BehnamVakili (2021) Many modern multi-core CPUs use the Code-division multiple-access (CDMA) technique for their networking architecture. Its benefit lies in the fact that all parts of the network may be linked at once. This approach also has the benefit of a continuous latency, which is an advantage. However, one disadvantage is that the number of transmitters is limited by the amount of encoding bits. More than four times the transmission capacity of the conventional mode was achieved by combining Walsh codes and their inverses with the simultaneous use of the time-division multiple access (TDMA) technique in this research. Despite the fact that the suggested design does not greatly expand the circuit size, the CDMA network's throughput is increased by a factor of four. It is feasible to get even higher capacities by using the strategy suggested in this research.

Halak, B., (2014) Code-division multiple-access (CDMA) utilizes spreading-code technology to let many independent data streams to use the same physical channel without interfering with one another during transmission. Using this strategy, we design a new kind of architecture for on-chip communication networks. With the suggested architecture, users of the network may pool their coding resources by taking advantage of the dynamic assignment of spreading codes. By organizing the encoding and decoding circuits in parallel, we may decrease the delay introduced by the data transfer. Based on the suggested design, a 14-node CDMA network is synthesized in 65nm ST technology library. The suggested method provides much reduced data packet latency compared to both traditional CDMA and packet switched network-on-chip implementations, as shown by the performance study. When compared to conventional methods, significant space and energy savings are realized.

Venkatesan, P. (2014) When designing the communication subsystem between IP Cores in a SoC, a network on chip, or NoC, is an effective method (System on Chip). This study presents a communication infrastructure concept for core-to-core communication in NoC that is based on a shared bus architecture and uses CDMA (Code division multiple access). CDMA has been offered as a replacement for traditional methods of joining IP cores in SoC designs, or as a means of connecting modules within a system built on many PCBs. This study shows how using concurrent data transfers in a multiprocessor system is preferable than using a traditional TDMA-based bus. The system is simulated using VHDL source code. Results from the system's performance tests are analyzed.

Rajesh, V. et.al. (2012) It is now feasible to create Network-on-chip (NoC) designs that include a dense cluster of IP blocks (cores) on a single silicon die. The biggest problem in recent years, however, has been the inability of IP Cores to effectively communicate with one another. In order to facilitate communication across IP cores, this article details the design of a Code Division Multiple Access (CDMA) based wrapper interconnect, which is implemented as part of a System on programmable chip (SOPC) builder. Within the framework of the proposal, CDMA coding is used only to the bus lines that transmit the aforementioned address and data signals. CDMA technology improves upon previous methods by decreasing the number of lines required in the bus design to transport data from master to slave. This is due to improvements in data integrity, channel continuity, and channel isolation.

3. RESEARCH METHODOLOGY

Both the targeted signal and the intracell interference travel down the same channel and arrive at the receiver at the same time in a downlink situation (within one ray). Uplink scenarios are different because the user signals, t_k [n], travel over their own fading channels and so reach at their destination at separate times. As a result, BPSK-modulation uplink systems have lower interference levels than downlink systems. Therefore, QPSK-modulation is assumed for both the uplink and downlink systems for a level playing field. Perfect power control in the average sense, i.e., all user signals arrive to the base station with the same average power, is a fair assumption in the analysis of an uplink CDMA system. This is nearly never the case with a downlink system. Due to their dispersed locations, mobile stations may need to request varied transmitted strengths to maintain the same level of service. However, it is illustrative to assume that the intended signal and each interfering user have the same average power also in the downlink, as this would help explain the performance difference between CDMA in the uplink and the downlink. For the same reason, synchronous transmission is expected in both the uplink and the downlink. Random variables with identical distributions and independent $q_k[n]$

sequences may take on the value ±1 with probability 1/2. Channel estimations, interleaving, and synchronization are considered to be flawless in both the uplink and downlink analyses conducted in computer simulations. The union bound is often used as an upper limit on the BER when assessing the performance of a convolutional code.

$$p_b \leq \sum_{d=d_f}^{\infty} c_d \, p_2(d) \qquad (1)$$

the information error weights d_f, the hamming distance d, and the pairwise error probability $p_2(d)$ of two sequences separated by the hamming distance d and c_d. By truncating the sum in equation (1) at a convenient value of d, we may get a rough estimate of the BER. The conventional method for calculating the error probability in a fading situation involves first finding a formula for the error probability given the instantaneous signal-to-noise ratio, and then averaging this across time with regard to the probability density function. The error probability may be represented as $p_r(e)$, and from this we can deduce

$$p_r(e) = \int_{-\infty}^{\infty} f(\gamma) p_r(e/\gamma) d\gamma \qquad (2)$$

If symbols have their conventional meanings and additive Gaussian noise is present, the error probability is provided by the instantaneous signal-to-noise ratio represented as a Q-function:

$$p_r(e \mid \gamma) = Q(\sqrt{2\gamma}) \qquad (3)$$

$$Q(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{-2} / 2dt \qquad (4)$$

the equation for the pdf of the signal-to-noise ratio of d concatenated coding bits is needed for both the uplink and the downlink in order to evaluatep_2 (d).

Uplink and Downlink

Individual channels are used to transmit uplink user signals of type t_k [n]. The average coded signal-to-noise ratio, $\overline{yc}$ is given by [4].

$$\overline{\gamma_c} = \frac{\overline{\xi}}{2(k-1) + N_o} \qquad (5)$$

While ξ stands for the average energy received per coded bit, No represents noise, and k is the restriction length. Each coded bit's corresponding instantaneous signal-to-noise ratio, y_c[m], follows an X^2 distribution with 2 degrees of freedom.

$$f_{\gamma_c}(\gamma_c) = e^{-\gamma_c/\gamma_c} \Big/ \overline{\gamma_c} \qquad (6)$$

With 2d degrees of freedom, the X^2 distribution [5] will also hold for the instantaneous signal-to-noise ratio y[m] of d concatenated coded bits.

$$f_\gamma(\gamma) = \gamma^{d-1} e^{-\lambda}_{\gamma_c} \Big/ (d-1)!\gamma_c^{-d} \qquad (7)$$

When it comes to the downlink, the equivalence ratio remains stable over time, therefore the probability density function (pdf) of the equivalence ratio of d combined samples is equal to 1.

$$f_\tau(\gamma) = f_{\tau_c}(\gamma) * f_{\tau_c}(\gamma) * .... * f_{\gamma_c}(\gamma) \qquad (8)$$

Due to the multi-user interference, the signal-to-noise ratio will be poor, meaning the code's free distance d_f must be big for satisfactory performance to be achieved. Typically, d_f is higher than 100 for the codes of interest. So, for d>= 100, you just need the pair-wise error probabilities, $p_2(d)$, to estimate the union limit. The pdf of the signal-to-noise ratio may be approximatively described by a Gaussian pdf [3] if d is sufficiently big.

$$f\tau(\gamma) = Ae^{\frac{(\gamma-\mu)}{2\sigma^2}} \Big/ \sqrt{2\pi}\sigma\,, \quad 0 < \gamma < \frac{d}{2(k-1)}$$

$$f\tau(\gamma) = 0\,, \text{ elsewhere} \qquad (9)$$

4. DATA ANALYSIS

Using QPSK-modulating and a rate 1/4, constraint length 10, maximum free distance convolutional code for spreading [7], this article devised a mathematical CAD simulation software for the CDMA system. This code has a d_f of 164, which is its free distance. The system is assumed to be functioning at a signal-to-thermal-noise ratio ξ/N_o of 6 dB/No. For both the uplink and the downlink, the probability density functions (pdf) of the signal-to-noise ratio per coded bit and the probability density function (pdf) of d_f = 164 combined coded bits are shown in figures 1,2, and 3.

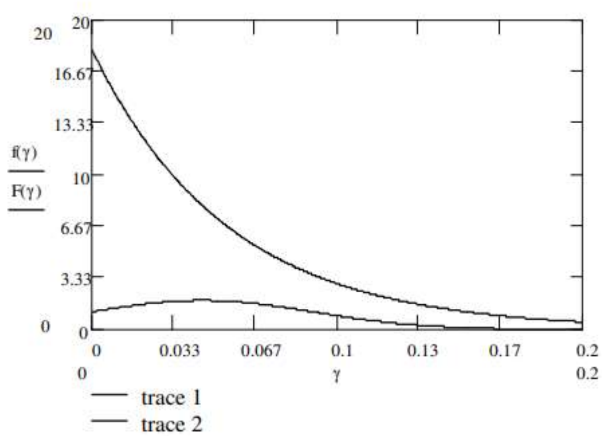

Fig. 1. pdf of signal-to-noise ratio for both uplink and downlink when k=10

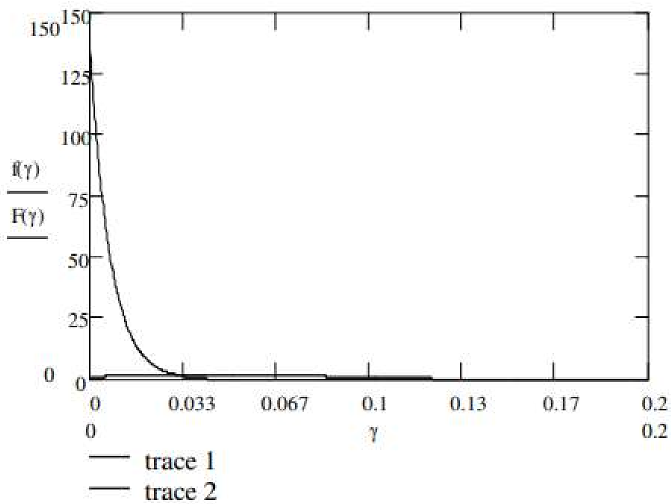

Fig.2. pdf of signal-to-noise ratio for both uplink and downlink when k=70

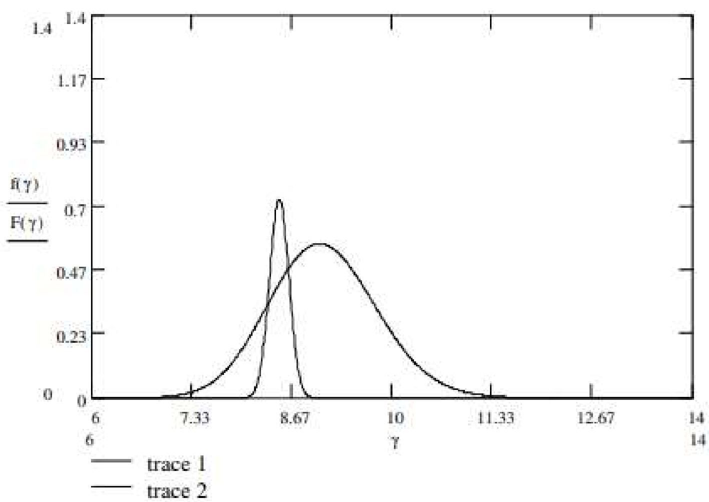

Fig. 3. pdf of signal-to-noise ratio for both uplink and downlink when k=10 and d_f =164

Figs. 1-3 show that uplink and downlink pdfs of signal-to-noise ratio are quite different.

5. CONCLUSION

We looked at the efficacy of uplink extra-WBAN signal transmission using BPPM O-CDMA for many users in the medical field. Using a realistic ORWP mobility model, we analyzed the effects of Tx orientation and the shifting locations of the users (both the intended user and the interferers) with regard to the AP, and we calculated the effectiveness of MAI on the performance of the desired user. In this article, you may find examples of excellent codes and learn what makes a code good. Two characteristics, free distance and distance spectrum, define a code's error performance. Code length and bit rate are dependent on one another. The best approximation was found to be achieved by the codes with the shortest coding rates and length. It was shown, however, that below a specific threshold, reducing the pace was the same as repeating the parent codes. As a result, a code with a relatively high rate and a simple repetition encoder may achieve almost the same level of performance as a code with a considerably lower rate. This realization is crucial for the development of effective synchronization algorithms and the construction of efficient decoders. We have observed in this study that the selection of method for CDMA cellular downlink transmission using antenna arrays in multipath fading channels is affected by the kind of traffic being sent. The Max SNR beamforming approach is optimal for circuit switched downlink CDMA networks (accommodating 12 to 42 more users than transmit diversity).

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