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|  | **Experiment No.2: CDMA**  **PART A**  **(PART A: TO BE REFFERED BY STUDENTS)**   * 1. **Aim: To implement a basic function of Code Division Multiple Access (CDMA) to test the orthogonality and autocorrelation of a code to be used for CDMA operation. Write an application based on the above concept.**   2. **Prerequisite:** Knowledge of multiplexing schemes   3. **Objectives:** To understand the importance of security in wirelesss communication by means of spread spectrum technologies.   4. **Outcomes:** Student will be able to articulate the knowledge of GSM, CDMA & Bluetooth technologies and demonstrate it.(LO-2)   5. **Tools Used/programming language: Java**   6. **Theory:**      + **Code-division multiple access (CDMA)** is [a channel access method](https://en.wikipedia.org/wiki/Channel_access_method) [**u**](https://en.wikipedia.org/wiki/Channel_access_method)**sed by various** [**radio**](https://en.wikipedia.org/wiki/Radio) **communication technologies**. CDMA is an example of multiple accesse[s,](https://en.wikipedia.org/wiki/Channel_access_method) where several transmitters can send information simultaneously over a single communication channel. This allows several users to share a band of frequencies (see [bandwidth).](https://en.wikipedia.org/wiki/Bandwidth_(signal_processing)) To permit this without undue interference between the users, CDMA employs spread spectru[m](https://en.wikipedia.org/wiki/Spread_spectrum) technology and a special codling’s scheme (where each transmitter is assigned a code). | |
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|  | CDMA issued as the access method in many [mobile phone standards](https://en.wikipedia.org/wiki/Mobile_phone_standards)[. IS-95,](https://en.wikipedia.org/wiki/CdmaOne)also called" cdma One", and its [3G e](https://en.wikipedia.org/wiki/3G)volution [CDMA2000,](https://en.wikipedia.org/wiki/CDMA2000) are often simply referred to as "CDMA", but [UMTS,](https://en.wikipedia.org/wiki/UMTS) the 3G standard used by [GSM c](https://en.wikipedia.org/wiki/GSM)arriers, also uses "wideband CDMA", or W-CDMA, as well as TDCDMA and TD- SCDMA, as its radio technologies.   * **CDMA Orthogonality**:   Techniques generally used are direct sequence spread spectrum modulation (DS-CDMA), frequency hopping or mixed CDMA detection (JDCDMA). Here, a signal is generated which extends over a wide bandwidth. A code called spreading code is used to perform this action. Using a group of codes, which are orthogonal to each other, it is possible to select a signal with a given code in the presence of many other signals with different orthogonal codes.   * **CDMA Autocorrelation:**   Autocorrelation of the sequence, it determines the ability to synchronize and lock the spreading code for the received signal.  **A.7 Procedure:**   * The station encodes its data bit as follows.   + If bit = 1 then +1 o   If bit = 0 then -1   * + no signal(interpreted as 0) if station is idle * Each station is allocated a different orthogonal sequence (code) which is N bit long for N stations | |
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|  | * Each station does a scalar multiplication of its encoded data bit and code sequence. * The resulting sequence is then stored on the channel. * Since the channel is common, amplitudes add up and hence resultant channel sequence is the sum of sequences from all channels. * If station 1 wants to listen to station 2, it multiplies (inner product) the channel sequence with code of station S2 * The inner product is then divided by N to get data bit transmitted from station 2. * **Working** * CDMA uses orthogonal codes to transmit different signal over the same channel * CDMA is use in 3’rd generation wireless communication like CDMA 2000, w-CDMA,HSDPA (high speed downlink packet access), HSUPA(high speed uplink packet access)    CDMA stands for Code Division Multiple Access.   * It is a digital cellular standard that utilizes spread-Spectrum Technology. * It spreads the signal over a fully available spectrum or over multiple channels through division. * It is a more secure and private line. * It has good voice and data communication capabilities. * The information is sent simultaneously through several transmitters over a single communication channel. * **Consider there is single channel having four users, user1,user2,user3,user4** | |
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|  | * Assume there are four orthogonal codes        * If two diff orthogonal codes are multiplied it will always give 0; this is the property of orthogonal code. * User send data 1,0 (stream of data)or use may be silent that is no data to transmit. | |
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|  | * Users are having following data      * Data in channel is;      * If data 2 want to receive then R2= C(x)\*C2   And hence we are getting –a after dividing by 4 and data send by user 2 is -a | |
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|  | **Sample Output:** | |
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|  | **PART B**  **(PART B: TO BE COMPLETED BY STUDENTS)**  ***(Students must submit the soft copy as per following segments within two hours of the practical. The soft copy must be uploaded on the ERP or emailed to the concerned lab in charge faculties at the end of the practical in case the there is no ERP access available)*** | | | | |  |
|  | | Roll No. B30 | Name: Pranjal Bhatt | |  | |
|  | | Class : TE-B COMPS | Batch : B2 | |
|  | | Date of Experiment: | Date of Submission | |
| **B.1** | | Grade : |  | |
| **Question of Curiosity:** | | | |  |
|  | | Q.1: Source Code (students need to implement CDMA using any programming language like Java, Python , etc) | | | |
| i | | mport numpy as np | | | |
| c1 | | = [1, 1, 1, 1] | | | |
| c2 | | = [1, -1, 1, -1] | | | |
| c3 | | = [1, 1, -1, -1] | | | |
| c4 | | = [1, -1, -1, 1] | | | |
| r | | c = [] | | | |
| pr | | int("Enter the data bits:") | | | |
| d1 | | = int(input("Enter D1: ")) | | | |
| d2 | | = int(input("Enter D2: ")) | | | |
| d3 | | = int(input("Enter D3: ")) | | | |
| d4 | | = int(input("Enter D4: ")) | | | |
| r1 | | = np.multiply(c1, d1) | | | |
| r2 | | = np.multiply(c2, d2) | | | |
| r3 | | = np.multiply(c3, d3) | | | |
| r4 | | = np.multiply(c4, d4) | | | |
| r | | esultant\_channel = r1 + r2 + r3 + r4 | | | |
| pr | | int("Resultant Channel:", resultant\_channel) | | | |
| C | | hannel = int(input("Enter the station to listen for (C1=1, C2=2, C3=3, C4=4): ")) | | | |
| i | | f Channel == 1: | | | |
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|  | rc = c1  elif Channel == 2: rc = c2  elif Channel == 3: rc = c3  elif Channel == 4: rc = c4  inner\_product = np.multiply(resultant\_channel, rc) print("Inner Product:", inner\_product)  res1 = sum(inner\_product)  data = res1 / len(inner\_product) print("Data bit that was sent:", data)  Q.2: Output of CDMA | |
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|  | Q.3: Explain CDMA with one suitable example.  **What is CDMA?**  CDMA (**Code Division Multiple Access**) is a multiple-access technique used in wireless communication where multiple users share the same frequency **simultaneously**. Each user is assigned a unique **code** to distinguish their signal from others.  **How CDMA Works?**   * Instead of dividing frequency or time, CDMA allows multiple users to transmit over the **entire bandwidth** at the same time. * Each user's signal is multiplied by a unique **spread spectrum code** (PN sequence). * The receiver, using the same code, **extracts** the intended signal while ignoring others as noise.   **Example:**  Consider a **large hall** where multiple people are speaking **different languages**.   * Even though everyone is talking at the same time (same frequency), a listener can understand only the person speaking **their language (code)**, while other conversations seem like background noise. * This is similar to how CDMA works, allowing multiple signals to coexist without interference.   ⬛ **CDMA is used in 3G mobile networks and GPS systems.**  Q.4: What is spread spectrum? List types of spread spectrum technologies.  **Definition:**  **Spread Spectrum** is a technique used in wireless communication to spread a signal over a **wider bandwidth** than required.   * It improves **resistance to interference, jamming, and eavesdropping**. * Signals appear as noise to unauthorized receivers.   **Types of Spread Spectrum Technologies:**   1. **Frequency Hopping Spread Spectrum (FHSS)**    * Rapidly switches (hops) between multiple frequencies.    * Example: **Bluetooth, military communication.** 2. **Direct Sequence Spread Spectrum (DSSS)**    * Spreads the signal by multiplying it with a **pseudo-random code**.    * Example: **CDMA, GPS.** | |
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|  | Q.5: Differentiate between FDM and FHSS**.**  **B.2 Conclusion:**  In this experiment I implemented a basic function of Code Division Multiple Access (CDMA) to test the orthogonality and autocorrelation of a code to be used for CDMA operation. I understood the importance of security in wireless communication by means of spread spectrum technologies through this experiment. Through this exp I gained knowledge regarding GSM, CDMA & Bluetooth technologies and will be easily able to demonstrate it in future wherever needed | |
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