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Performance of IDMA with Prime Interleaver By Using Semi-Blind Detection Technique In Wireless Communication System

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Abstract

This paper provides basic information on the IDMA (Interleave Division Multiple Access) technology in wireless communication system based on interleaver. IDMA is a multi- user scheme in which chip interleavers are the only means of user separation. The receiver involves iterative multi-user detection method. The IDMA performance in terms of bit error rate, bandwidth efficiency and complexity reduction is discussed. In proposed scheme an IDMA system with semi-blind detection technique that simulate in AWGN channel by using Prime Interleaver. Thus, it promises a good performance compared with the IDMA when a priori information is perfectly estimated. However, we observe that during iterative process, the IDMA output performs well with ISI Cancellation when numbers of users increases. Indeed, the increase in the number of users requires the independent processing of MAI and ISI that is carried out in IDMA.

Keywords: encoded, prime inter leaver, semi-blind detection technique, spreaded

Abbreviations: AWGN, additive white Gaussian noise; **GF**, Galois Field; **IDMA**, interleave division multiple access; **ISI**, intersymbol interference; **MAI**, multiple access interference

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INTRODUCTION

Numerous entrance strategy is one of the key methods in the remote correspondence framework, particularly in cell versatile correspondence framework. In later recent years; the solicitation for data transfer capacity has begun to surpass the accessibility in remote systems. Diverse strategies have been mulled over to enhance the data transfer capacity proficiency and expand the quantity of clients that can oblige inside of every cell. Existing different access methods utilized as a part of 1G/2G/3G frameworks, (for example, FDMA/TDMA/CDMA individually) are suitable for voice correspondence just yet it is not suitable for high information rate transmission and burst information movement which would be the predominant segment of activity burden in 4G framework. Information rates up to 100 Mbps for high versatility and up to 1 Gbps for low portability or neighborhood remote are anticipated. Be that as it may, 3G frameworks give information rate of around 3.6-7.2 Mbps. Typically if the frameworks satisfy every one of these prerequisites then it can be considered as fourth era (4G) frameworks.[1-5]

There are different types of multi-access techniques which are proposed for 4G systems such as CDMA, MC-CDMA, OFDMA and IDMA. In CDMA, each user assigned a unique code sequence and it is

used to encode the information bearing signal. The receiver knows the sequence of the user code. After reception, it decodes the received signal and recovers the original data. Since the bandwidth of the coded signal is chosen to be larger than the information bearing signal.

In MC-CDMA, it is a multiple access technique used in OFDM based telecommunication system. It allows the system to support multi-users at same time. MC-CDMA system is highly complex in receiver and extreme requirement for changing the spreading code at high data rates in transmitter which make the system inefficient.[6–11]

OFDM is the one of the multi-carrier modulation technique that transmits signal through multiple carriers. These carriers (sub carriers) have different frequencies and they are orthogonal to each other. On the other hand, OFDM is more sensitive to carrier frequency offset and phase noise than single carrier system[3] because the loss of orthogonality among OFDM subcarriers result in the appearance of common phase error (CPE) and inter-carrier interference (ICI). To maintain the condition of orthogonality, remove the risk of collision between the inter leavers[8] in the channel. In OFDM, the cyclic prefix needs to be larger than the maximum excess delay of the channel.

Along these lines, this procedure likewise obliged some change, for example, timing and recurrence synchronization, productive computerized sign preparing execution of OFDMA and so on for proficient handling of fourth era (4G). IDMA is a multi-user scheme in which chip interleavers are only means of user separation. The basic principle of IDMA is that two users are separated by an interleaver. The receiver involves a chip-by-chip iterative multi-user detection.[1] In this way, IDMA can perform better for extensive number of clients. It supports asynchronous transmission. The orthogonal MA technologies, such as TDMA, FDMA, and orthogonal-FDMA (OFDMA), require frame synchronization to maintain orthogonality.

IDMA MECHANISM

Different multiple access method have been proposed for broadband wireless networks to support multiple-service transmissions over the shared wireless link. Interleave Division Multiple Access (IDMA) is a recently proposed multi-access scheme, in which the users are differentiate by various interleaving patterns.[2] By the selection of interleaver along with design methodology for IDMA system leads to bandwidth efficiency. An interleaver is used as a component for channel encoder to enhance the coding gain, or as a channel interleaver to combine the time/frequency coherent fading by scrambling burst errors however, cell-specific interleaving can also be used to randomize the inter-cell interference.

The above Figure 1 shows the block diagram of IDMA.The upper part of above Figure 1 shows the transmitter structure of the IDMA method receiver. The scramble block can be either same or different for different users.In the lower part of the Figure 1, shows the receiver section of the IDMA system, iterative multi-user detection which tries to overcome the multiple access problems (MAI). The estimation technique used in this technology is semi-blind channel estimation method in which the information about the known training sequence as well as inherent information in unknown received signal is used for efficient communication.

In IDMA, the data streams are separated at the receiver by using iterative and a low complexity method. Hence it is very accurate for multi-user detection. The receiver structure that is shown in above Figure 1 consists of the decoders (DECs),

,despreading and demodulation, the data is iterated for preset number of time before finally taking information bit in final iteration. & will be end when any stopping criterion is fulfilled. Hence this scheme is used for high spectral efficiency, improved performance and low receiver complexity. Simulation results show the advantages of IDMA in many terms.

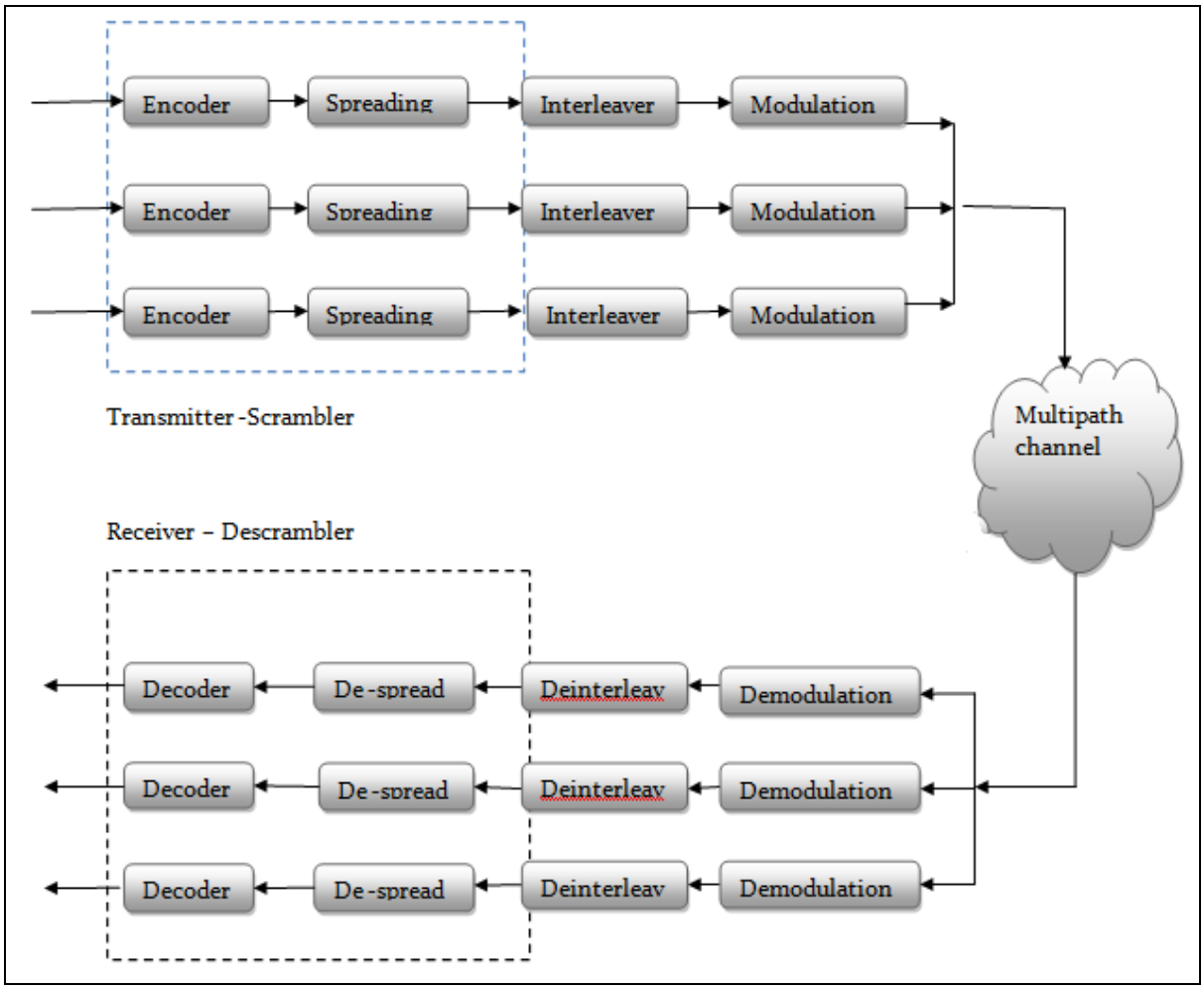

Fig. 1. *Block diagram of IDMA.*

TYPES OF INTERLEAVERS

Random Interleaver

Irregular entomb leavers scramble the date of diverse clients with distinctive example. It modifies the components of its data vector utilizing an arbitrary stage. on the off chance that the arbitrary entomb leavers are utilized with the end goal of client detachment, then part of memory space will be needed for capacity reason at the transmitter and collector furthermore impressive measure of data transfer capacity will be needed for transmission of all these between leavers and in addition intricacy will be expanded at beneficiary closures.

Master Random Interleaver

Master random interleaver. It require less memory compared to random interleaver. Bandwidth requirement is less compared to random interleaver but complexity is very high compared to random interleaver and specific user cross-correlation is low.

Tree Based Interleaver

Fundamentally tree based entomb leaver is planned to minimize the computational

many-sided quality and memory necessity that happened in expert arbitrary interleaver and irregular between leave.

Prime Interleaver Mechanism

Beforehand, irregular interleaver and different interleavers proposed by the analysts is as yet abandoning some space for further research that prompts optimality of Interleavers. In this work , we propose a novel interleaver in light of prime numbers for the era of client particular interleavers to uproot the issue of high utilization of transfer speed presupposed amid transmission and it has comparative execution like arbitrary interleaver as far as BER.

In IDMA, the computational unpredictability and memory prerequisite ought to be little for the era of interleavers and distinctive clients are alloted diverse interleavers. Fundamentally, the prime between leaver is planned to minimize the transfer speed and memory prerequisite that happened in other accessible interleavers withthe execution of bit mistake rate (BER) that is contrasted and the arbitrary interleaver.

Here, client particular seeds are doled out to distinctive clients. For comprehension the component of prime interleaver, let us consider an instance of interleaving n bits with seed p.

In the first place, we consider a Galois Field GF (n). Presently, the bits are interleaved {1,2,3,4,5,6,7,8… n} are back to back bits to be interleaved with seed p then area of bits in the wake of interleaving will be as per the following.

1⇒ 1
2⇒ (1+p) mod n
3⇒ (1+2p) mod n
4⇒ (1+3p) mod n
…
n⇒ (1+(n-1)p) mod n

For instance : in the event that we need to interleave 8 bits, for example, [1,2,3,4,5,6,7,8] and on the off chance that we are attempting to interleave these bits with seed 3 then the new area of these bits will be as per the following.

1⇒ 1
2⇒ (1+1*3)mod 3⇒ 4
3⇒ (1+2*3) mod 3⇒ 7
4⇒ (1+3*3) mod 3⇒ 2
5⇒ (1+4*3) mod 3⇒ 5
6⇒ (1+5*3) mod 3⇒ 8
7⇒ (1+6*3) mod 3⇒ 3
8⇒ (1+7*3) mod 3⇒ 6

Now the order of the bits will be [1, 4, 7, 2, 5, 8, 3, and 6]. The obliged data transmission by the prime interleaver (PI) is littler than the other accessible interleavers as now just seed is to be transmitted. Notwithstanding this little measure of memory needed at the transmitter and beneficiary side.

In expert irregular interleaving plan the computational multifaceted nature and transmitter and collector end . It is very high because of estimation of client particular interleaving veils. The prime interleaving scheme reduce the complexity that occurs in master random interleaver; however it is little bit high compared to that of tree based interleaver due to computation involved for the calculation of user specific interleavers.

DIFFERENT ESTIMATION TECHNIQUES

There are basically many channel estimation techniques such as:

1. Pilot layer aided channel estimation.
2. Blind channel estimation.
3. Semi -blind channel estimation.

In this paper, among these, Semi-blind Channel Estimation technique is preferred for this work.

Pilot Layer Aided Channel Estimation Technique

It is likewise called as preparing based channel location strategy; it is a traditional method for getting channel estimation for correspondence frameworks. The significant downside of pilot-helped direct estimation system is in effective use of accessible data transmission. In visually impaired estimation strategy, utilization of pilot images that expend significant channel limit is kept away from however rather than that, the channel is evaluated by utilizing characteristic data in got signals and also in transmitted sign

Blind Estimation Technique

In general Blind Channel Estimation Technique are sensitive to the channel order over estimation and the required channel to be time-invariant in blind channel.

Semi-Blind Detection Technique

In case of Semi-Blind Channel Estimation Technique belongs to algorithm where superimposed periodic pilot sequences are used to estimate channel co-efficient based on the first and second order statistics of the channel. In contrast, the semi-blind channel estimation technique is the combination of training based estimation and blind channel estimation method. In this method the information about the known training symbols as well as inherent information in unknown received signal is used for the purpose of channel estimation technique.[5]

SIMULATION RESULTS

The above Figure 2 shows the input data 100 bits for IDMA. The above Figure 3 shows the Scrambled signal (encoded & spreaded) .with spreading length 90 bits. Scrambler is a device that manipulates data stream before transmitting. In convolution encoder, the message stream continously runs through the encoder .spreading codes are combined with the data stream that is to be transmitted.

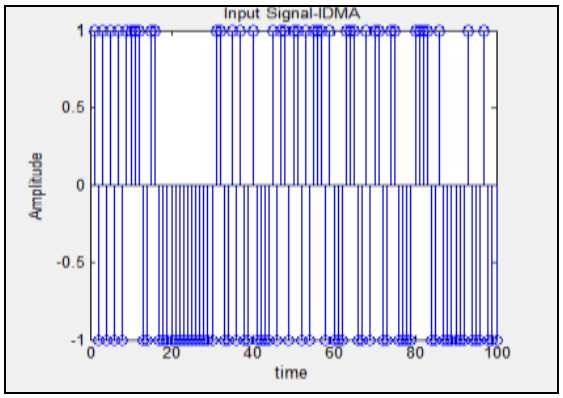

Fig. 2. *Input Signals.*

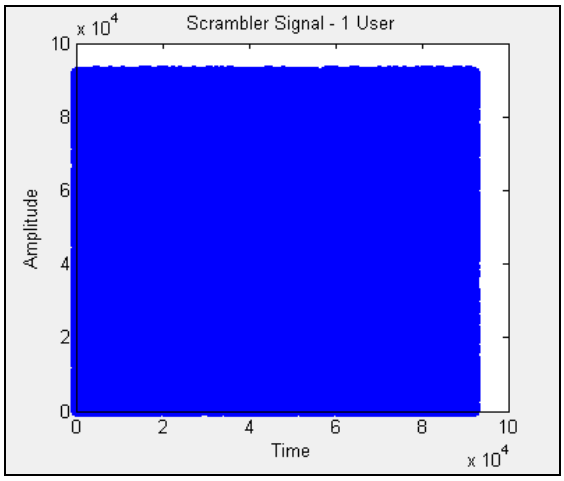

Fig. 3. *Scrambled Signal.*

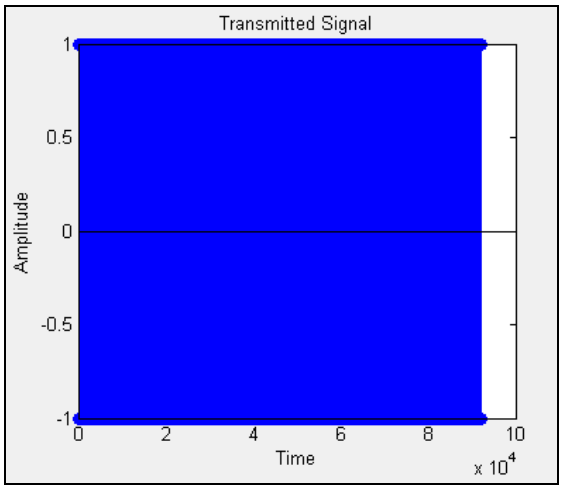

Fig. 4. *Transmitted Signal.*

The above Figure 4 shows the transmitted signal with 90 bits, after encoding and spreading.

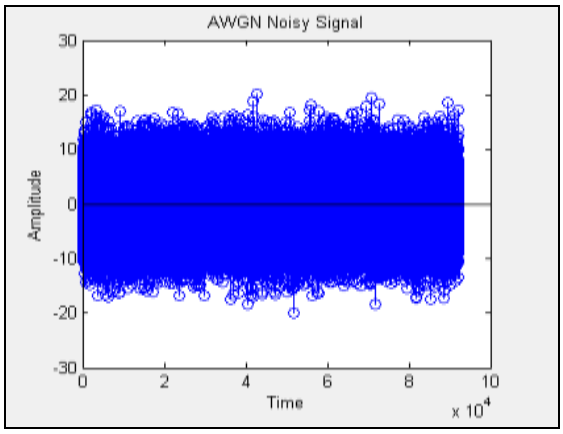

Fig. 5. *AWGN Channel.*

The above Figure 5 shows the AWGN signal for IDMA. It is widely used to achieve reliable communication over a noisy channel and to make the error probability as small as desired.

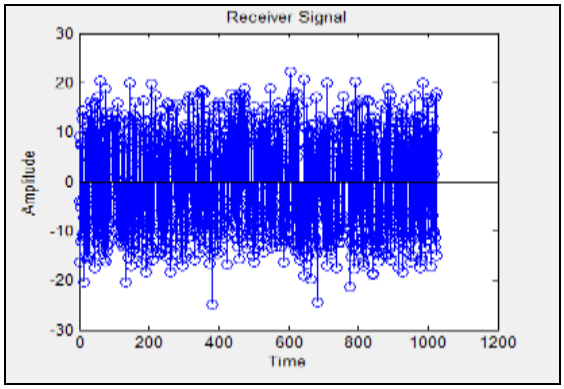

Fig. 6. *Received Signal.*

The above Figure 6 shows the received signal with 90 bits. after demodulating and despreading by using Semi-Blind detection technique.

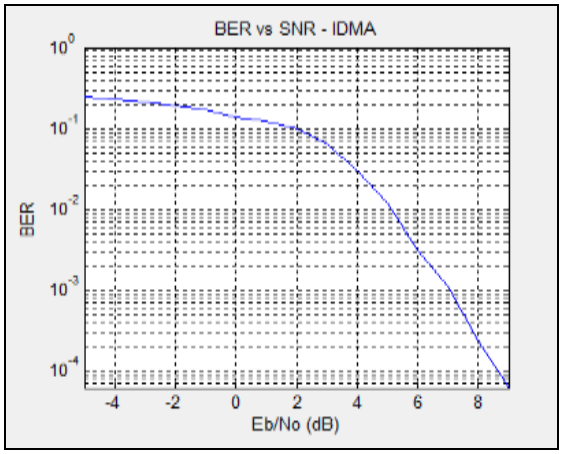

Fig. 7.*BER vs SNR.*

The above Figure 7 shows BER versus SNR graph for IDMA. Between -6 and 8dB of SNR. BER is ranging from 0.31622 to 0.00025. From 6 to 8 dB of SNR , BER ranging from 0.00158 to 0.00025.

IDMA based on the mentioned graphs which are the graphs of SNR versus BER graphs through which we can analyze that BER performance is reduced to a considerable amount and computational complexity is also decreases.

Table 1. *Parameters for IDMA.*

Parameters	**Value**
Modulation	BPSK
Interleaver	Prime
Noise	AWGN
No. of bits	90
Spreading length	90
Data Length	1024
No of users	16

CONCLUSION

We have outlined the basic principles of IDMA and the simulation results with the help of AWGN channel. Using IDMA, ISI can be overcome. IDMA can mitigate interference among users to a maximum extent and provides high data rates without compromising the required quality of service Hence it can be more suitable for future wireless communication systems. From the experimental results, the BER performance of IDMA is reduced. Hence we can conclude , the Computational complexity is also reduced and it performs better for large number of users and finally with the help of prime interleaver memory required is also reduced.

The research for the improvement in the IDMA is being carried out throughout the world. but still there are few provocative problems in this IDMA technique such as coding scheme , designing of Interleaver, behaviour of channel and optimum signalling scheme etc. Further data rate services can be increased; complexity can also be reduced using various efficient

diversity techniques in IDMA for superior performance. IDMA can be used for various applications such as MIMO, MANET, ADHOC, 4G-UPLINK, UWB & WLAN etc.

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