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Implementation of Interleave Division Multiple Access (IDMA) and comparison of Rician Channel with MIMO Channel in Wireless Communication System

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Abstract: This paper provides a review on the IDMA (Interleave Division Multiple Access) technology inwirelesscommunication system based on Interleaver. In thispaper, IDMA technique is proposed in multipath rician fading channel and compared with MIMO. IDMA is a multi-users cheme in which chip Interleaversare the only means of user separation. The IDMA performance in term so bit error rate, error rate is discussed. Here comparison with different channel is done on the basis of error rate and various different parameters.

Keywords: Multipath rician fading channel, Interleave Division Multiple Access (IDMA), PSK, Kasami sequence generator, MIMO channel.

1. INTRODUCTION

From last several years, the broadband communicationservice in wireless grows rapidly. It gains extensive popularity inall over the world. Due to various parameters inwirelesscommunication systems, it also performs many personalor organizational requirements. It include mobility andcost effectiveness that need the transmission of high rate dataare highly reliable in order to fulfill the increasingservicesapplications such as high quality audio recording ,messaging services, and video chatting in next generation mobilesystem that is 4G generation. Existing wireless technologiesreliably cannot support high rates of data, because of these technology fading become very sensitive. For broadband wireless networks, the various Multiple Access technique (MA) has been proposed to support multi-service transmissions over the shared wireless link. Inwirelesscommunication system, the multiple access technique isone of the most efficient methods, particularly used incellular network by mobile phone communication system. Inrecent that is many years back, the availability in wirelessnetworkscan be exceeded by the use of bandwidth. It has been studied that, various techniques are used to make the efficiency of bandwidth utilization; is better more users can be allottedin thecell.Sothatitcanprovidesufficientspacewithineach cell. Previously existed multi- access techniques likeFDMA, TDMA and CDMA are used in 1G/2G/3G systemsare suitable for voice communication only but it is not suitable for burst data traffic and high data rate transmission whichwould bethedominantpartin4Gsystemfortrafficload.Forhigh mobility, the data rate is up to 100 Mega bits per second (Mbps) and for low mobility the data rate is up to 1 Gigabitsper sec (Gbps). But the 3rdgeneration systems allows the data rate of nearly 3.6 to 7.2 Mbps. usually if the systems fulfillall these requirements then it can be considered as fourth generation (4G) systems.

There are different types of multiple approachingtechniqueswhich are proposed for 4G systems follows CDMA, MC-CDMA, OFDMA and IDMA. In code division multiple access, every user assigned a single coded sequence and itisused to encode the significance of information signal.Thereceiver knows the sequence of the user code. Afterreception,itconvertsordecodesthereceivedsignalandretrievesthe sequence of data. Hence the spectrum of the coded sequence is selected to be larger than the informationsignal.

In Multi-carrier CDMA, it is also a multiple accesstechnique which is used in orthogonal frequency divisionmultiplexing based telecommunication system. It permits the system to hold multiple-users at identical time. MulticarrierCDMAsystem is highly complex in receiver andexceedingly necessary for changing the spreaded code at high data ratesin transmitter which build the systeminefficient.

One of the most multi-carrier techniques that are usedin modulation system that transmits the signal throughmultiple carriers is nothing but Orthogonal Frequency Division Multiplexing (OFDM). These sub carriers are orthogonalto eachotherandtheyhavedifferentfrequencies.Ontheother side, the orthogonal frequency division multiplexing isquickly detect or response the slight changes in carrieror offset frequency and phase noise than compared tosingle carrier systems. OFDM subcarriers result in the appearanceof inter-carrier interference (ICI) and common phase error(CPE) due to loss of orthogonality in OFDM. To maintain the condition of orthogonality and to eliminate the lossof collision

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between the Interleavers in the channel . InOFDM,the cyclic prefix needs to be greater than the timedelay increases in thechannel.
A basic fundamental of Interleave division multiple accessi.e. IDMA is differentiatedbytwousersinInterleaver.Amulti-user technique in which chip Interleaved are only meansof separating the users that is nothing but IDMA. Theiterative multi-user detection is done by receiver in chip-by-chipform. In this work, by combining the OFDM and IDMA, weproposeanewmethodreferredasamulti-usersysteminthe mobile radioenvironment.
All users can transmit their information in same time atsame frequency band in OFDM and IDMA method. Byusing Interleaving technique, the orthogonality can beobtained between the users. The choice of good Interleavermustdemonstrate that the inter leavers are weekly correlated, do not require large memory or large bandwidth tocommunicate between transmitter and receiver and easy togenerate.

2. IDMAMECHANISM

In wireless communication system, Interleaving canbereferred as a technique which is commonly used toovercome noise in the channel such as error burst or fading .In Interleaving process, the input data bits reorder itselfsuchthat consecutive bits of data are exchanged andsplitted amongvariousblocksinaknownpatternamongthem.Atreceiver , the Interleaved data is arranged back tooriginal sequenceofbitswiththehelpofde-interleaver.Asaresult, introducing the correlated noise in transmission channel seems to be statistically independent at the receiverin interleaving and thus allocate better errorcorrection.

In IDMA system, there exist several areas which are stillopen for the researchers. Many of them includes theoptimum design of integral parts of IDMA communication systemand hence future applications of IDMA mechanism in otherareasincluding satellite communication, LAN networking,opticalcommunications, power line communications, MIMOsystem and UWB technologies. In addition to this its horizon arestill open for investigation about optimum modulation, channel coding, spreading, interleaving, and detectiontechniques.

TheIDMAcanbeperformedintermsofbiterrorrateand compare its complexity with an Inter-symbolinterference cancellation technique for AWGN multipath channel. Thus,it promises a better performance that is compared withOFDMand IDMA when the existing information iscompletely evaluated. However we noticed that during iterativeprocessthe OFDM and IDMA out performs the IDMA withISICancellation when numbers of users are increased.Indeed, increasingthenumberofusersinMAIandISIiscarriedout in IDMA requires independentprocessing.

Interleavers in IDMAScheme

In [2], the Interleavers based on multi-access methodhasdiscussed earlier for large bandwidthefficiency, performance is improved and receiver complexity is low. Thismethoddependsoninterleavingastheonlymeanto differentiate the signal from particular users. Then it isnamedasinterleavedivisionmultipleaccess(IDMA).The user-specific Interleavers play a vital function inIDMAsystem. In case of turbo codes and decoding, thede- correlation between adjacent bit sequence is not possible.The correlation between the Interleavers should compute,the signals that get affected strongly from other user andthe decoding process of specific user also get effected [1].The transmitterand receiver doesn't store or communicate maximum bits inorder to agree with interleaving sequence. It might bedemonstrated that defining the correlation between the Interleavers .Itcan beusedtoproducethecollisioncriteria,wherezerocross-correlation implies that, it is not collided. In IDMAsystems, transmission is required for transfer the matrixInterleaver. Whereas in receiver , it consist of spreaded data alongwith the interleaving pattern and is related to the users . So thatlarger the size of the Interleavers, more bandwidthare consumed during transmission, more the orthogonalityisachieved among interleaver[1].

Schematic diagram ofIDMAScheme using different channel

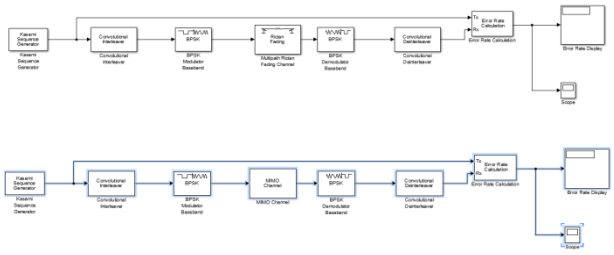

Fig 3 Schematic diagram of IDMA

In fig1.Kasami sequence generator is used as source. Convolutional interleaver are used then binary phase shift keying modulator then Ricianchannel is used.It is passed through BPSK demodulator and convolutional deinterleaver is used.

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Then error rate calculator calculates the error between transmitter and receiver. In fig2.Kasami sequence generator is used as source. Convolutional interleaver are used then binary phase shift keying modulator then MIMO channel is used.It is passed through BPSK demodulator and convolutional deinterleaver is used. Then error rate calculator calculates the error between transmitter and receiver.

Kasami Sequence Generator

Generate Kasami sequence from set of Kasami sequences.The Kasami Sequence Generator block generates a sequence from the set of Kasami sequences. The Kasami sequences are a set of sequences that have good cross-correlation properties.

MIMO is multiple input multiple output channel

Convolutional Interleaver
Permute input symbols using set of shift registers. The Convolutional Interleaver block permutes the symbols in the input signal. Internally, it uses a set of shift registers. The delay value of the kth shift register is (k-1) times the **Register length step** parameter. The number of shift registers is the value of the **Rows of shift registers** parameter.

PSK Modulator
Modulate using Phase frequency shift keying method. The PSK Modulator Baseband block modulates using the Phase frequency shift keying method. The output is a baseband representation of the modulated signal.

RICEAN FADING CHANNEL
The Ricean fading model is similar to the Rayleigh fading model, except that in Ricean fading, a strong dominant component is present. This dominant component is a stationary (non fading) signal and is commonly known as the LOS (Line of Sight Component. When there is a dominant, stationary (non-fading) signal component present such as LOS, which is usually possible when MS and BS are close to each other, the fading envelope is Ricean. The Ricean distribution degenerates to Rayeigh when the dominant component fades away.

PSK Demodulator
Demodulate PSK-modulated data. The PSK Demodulator Baseband block demodulates a signal that was modulated using the Phase frequency shift keying method. The input is a baseband representation of the modulated signal. The input and output for this block are discrete-time signals. The input can be either a scalar or a frame-based column vector of type single or double.

Convolutional Deinterleaver
Restore ordering of symbols that were permuted using shift registers. The Convolutional Deinterleaver block recovers a signal that was interleaved using the Convolutional Interleaver block. The parameters in the two blocks should have the same values.

Error Rate Calculator
Compute bit error rate or symbol error rate of input data. The Error Rate Calculation block compares input data from a transmitter with input data from a receiver. It calculates the error rate as a running statistic, by dividing the total number of unequal pairs of data elements by the total number of input data elements from one source.[12]

SIMULATION RESULTS

Parameter	Kasami sequence generator with convolutional interleaver for rician channel	kasami sequence generator with convolutional interleaver for MIMO channal
Target no. of errors	100	100
Max. no. of symbols	1e5	1e5
Error rate	0.5155	0.4505
Total no. of errors	100	100
The total no. of comparisons	222	198

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Parameters	
Kasami sequence generator	
Probability of zero	0.5
Initial seed	89
Data type	double
Sample time	1/1200
BER	
Probability of zero error	0.5
Initial speed	89
Data type	double
Convolutional Interleaver	
Sample time	1/1200
Row of shift register	6
Register length step	2
Initial condition	0
PSK modulator	
Phase offset	0
Data type	double
Awgn channel	
Initial seed	67
Eb/No(dB)	10
No. of bits per symbol	1
Signal power (watts)	1
Symbol period	1
PSK demodulation	
Phase offset	0
Decision type	Hard type
Convolutional deinterleaver	
Sample time	1/1200
Row of shift register	6
Register length step	2
Initial condition	0
Error rate display	
Computational delay	0
Receive delay	0
Display	
Format	short
decimation	1

CONCLUSION

We have outlined the basic principles of IDMA and the simulation results with the help of kasmi source. We have calculated the error rate by error rate calculator and found error rate of Kasami sequence generator with convolutional interleaver for MIMO channel is lower than kasmi sequence generator with convolutional interleaver for multipath rician fading channel.Based on the implementation of IDMA we found that Kasami sequence generator with convolutional interleaver for MIMO channel is better than gold sequence generator with convolutional interleaver for multipath rician fading channel.

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