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Performance Analysis of Wi-max IDMA Using Different Methodologies

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Abstract: ***Mobile communication in today's era requires high data rates with flawless connectivity and lower bit error rate. Traditional WIMAX system in use are unable to provide flawless data rates in conjunction with fewer bit error rates. Therefore keeping in view the era of 5G communication in research this thesis has proposed a novel radon transform based Wimax system. The system built compares the performance of DFT based WIMAX system , DWT based WIMAX and proposed radon transform based WIMAX system. From the simulation results the FRAT-WIMAX-IDMA system performs better as compared to DFT-WIMAX-IDMA and DWT-WIMAX-IDMA system in term of BER performance for next generation wireless communication system. The parameter taken for research in this project are no. of data points in the test signal, speed of transmission of test signal and finally the no of zero padding done in the WIMAX domain. The entire simulation model has been done in Matlab 2014 environment and the results have shown that at some selected parameters radon transform based WIMAX system outperforms DWT as well as DFT based WIMAX system.***

Keywords: OFDM, IDMA, FFT Wimax , DWT Wimax, FRAT Wimax

1. Introduction

Mobile voice communication is widely established throughout the world and has had a very rapid increase in the number of subscribers to the various cellular networks over the last few years. An extension of this technology is the ability to send and receive data across these cellular networks. This is the principle of mobile computing. Mobile data communication has become a very important and rapidly evolving technology as it allows users to transmit data from remote locations to other remote or fixed locations. This proves to be the solution to the biggest problem of business people on the move mobility [32].

Data Communications is the exchange of data using existing communication networks. The term data covers a wide range of applications including File Transfer (FT), interconnection between Wide-Area-Networks (WAN), facsimile (fax), electronic mail, access to the internet and the World Wide Web (WWW).

2. Radon Transform

The Radon Transform (RT) was first introduced by Johann Radon 1917. Finite Radon Transform (FRAT) was first studied Beylkin G [31]. RT is the underlying fundamental concept used for computerized tomography scanning, as well for a wide range of other disciplines, including radar imaging, geophysical imaging, nondestructive testing and medical imaging [6]. Recently FRAT was proposed as a mapping technique in WIMAX system [2].Conventional WIMAX/QAM systems are robust for multi-path channels due to the cyclically prefixed guard interval which is inserted between consequent symbols to cancel ISI. However, this guard interval decreases the spectral efficiency of the WIMAX system as the corresponding amount. Thus, there have been approaches of wavelet-based WIMAX which does not require the use of the guard inter. It is found that WIMAX based on Haar orthonormal wavelets DWT-WIMAX are capable of reducing the ISI and ICI, which are caused by the loss in orthogonality between the carriers [24].

It was found that as a result of applying FRAT, the Bit Error Rate (BER) performance was improved significantly, especially in the existence of multi-path fading channels. Also, it is found that Radon-based WIMAX structure is less sensitive to channel parameters variation, like maximum delay, path gain, and maximum Doppler shift in selective fading channels as compared with standard WIMAX structure [12].

Finite Radon Transform mapper has the ability to increase orthogonality of sub-carriers, it is non sensitive to channel parameters variations, and has a small constellation energy compared with conventional Fast Fourier Transform based orthogonal frequency division multiplexing. It is also able to work as a good interleaver which significantly reduces the bit error rate [10].

3. WiMax

Orthogonal frequency-division multiplexing (WIMAX) IS a technique of encryption (encoding) digital information on multiple carrier frequencies. WIMAX has developed into a well-liked theme for band data communication, utilized in applications like digital TV and audio broadcasting, telephone digital subscriber line (DSL), wireless networks and 4G mobile communications [1].

The mobile radio channel is characterized by multipath reception: the signal offered tothe receiver contains not solely an immediate line-of-sight (LOS) electromagnetic radiation, however conjointly an outsized variety of mirrored radio waves that make the receiver at completely different times. Delayed signals square measure the results of reflections from piece of land options like trees, hills, mountains, vehicles, or buildings [7].

4. IDMA

An interleaver-based multiple access scheme has also been studied in for high spectral efficiency, improved performance and low receiver complexity. This scheme relies on interleaving as the only means to distinguish the signals from different users, and hence it has been called interleave-division multiple-access (IDMA)[1].

The IDMA receiver principles for different modulation and channel conditions are outlined. A semi-analytical technique is developed based on the density evolution technique to estimate the bit-error-rate (BER) of the system. It provides a fast and relatively accurate method to predict the performance of the IDMA scheme. With simple convolution/repetition codes, overall throughputs of 3 bits/chip with one receive antenna and 6 bits/chip with two receive antennas are observed for IDMA systems involving as many as about 100 users[4].

5. Methodology

We have built a Graphical user interface using Graphical user interface development environment (GUIDE) of MATLAB version 13a. We Used MATLAB And Compare Fast Fourier Transform Frequency Orthogonal Division Multiplexing-Interleaver Division Multiple Access (FFT WIMAX-IDMA), Discrete Wavelet Transform WIMAX-IDMA And Finite Radon Transform Frequency WIMAX-IDMA In Terms Of BER. The GUI helps us in Getting Results for Various Configuration quickly.

The parameter Used in this project
1) No. of data point, rang of the data point is 16-256.
2) Speed of transmitted bit and the range is 64-2048 kbps.
3) No. of Zeros padded.

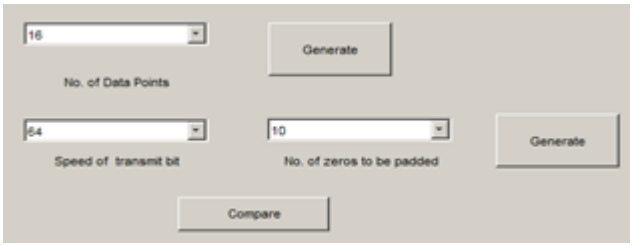

Figure 5.1: Complete Graphical User interface (GUI) of the project

6. Primary Components of the GUI

Below is a complete description of the various components used in the making of Graphical user interface.

6.1 Data Points Menu

This menu allows the user to select the preliminary data points for the analog signal. Then the generate button generates the waveforms for the selected data points for WIMAX-FFT, WIMAX-DWT and WIMAX-FRAT respectively. This allows the user to flexibly select any number of points for the analog value and thus keeping the interface as simple as possible.

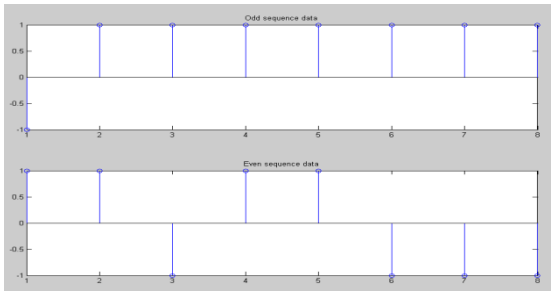

Figure 5.2: n=16 Sequence Of Odd and Even Data Points

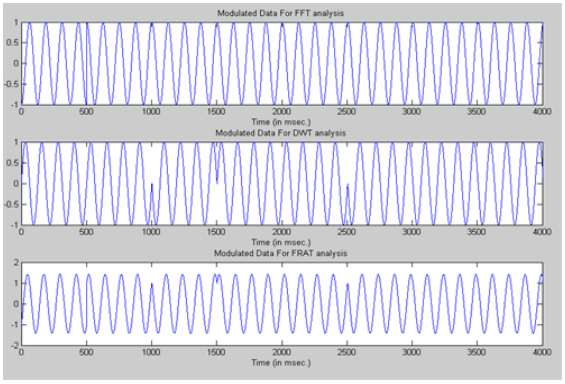

Figure 5.3: n=16 Various Waveforms

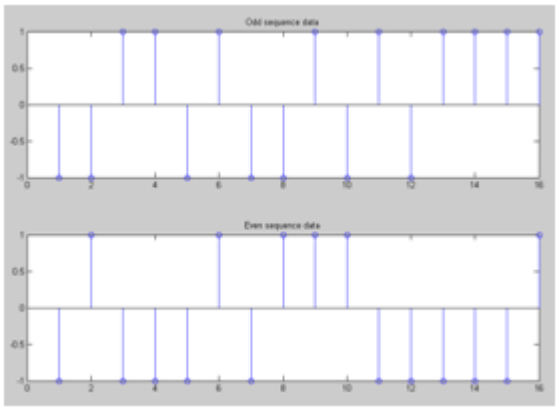

Figure 5.4: n=32 Sequence of Odd and Even Data Points

6.2 Speed of Transmitted Bit

This block helps the user to decide the no of digital bits to be transmitted through the channel. Hence this blocks helps the user in deciding the max data rate for the simulation , with the help of this block we can simulate WIMAX-IDMA for all the three cases at different bit rates. This block helps the user to decide the Speed of the transmit bit in kbps.

6.3 No. of zeros to be padded

Without zero padding it is not possible to create a WIMAX-IDMA system, hence this blocks allows the user to select the no of zeros for the system to be padded in the data stream.

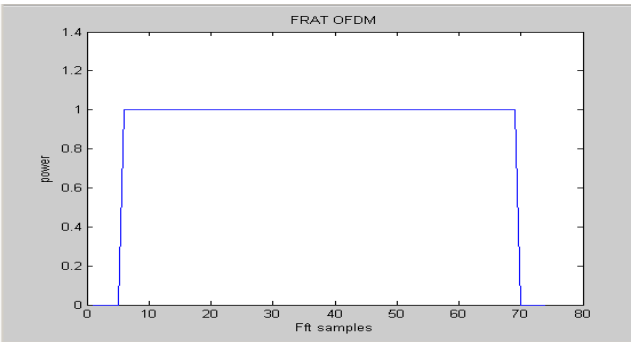

Figure 5.5: FRAT WIMAX power spectrum for N=64 ,Nz=10

6.4 Compare button

With the help of this button simulation and comparative analysis for bit error rate v/s SNR is carried out for all the three cases namely, WIMAX-IDMA with FFT, WIMAX-IDMA with DWT and WIMAX-IDMA with FRAT. The bit rate is selected in the menu given above the button.

6.6 Result shown in below following parameter

(i) No. of DATA Point 16**,** (ii) Speed of transmitted Bit 32**,** (iii) No. of zeros to be padded 20.

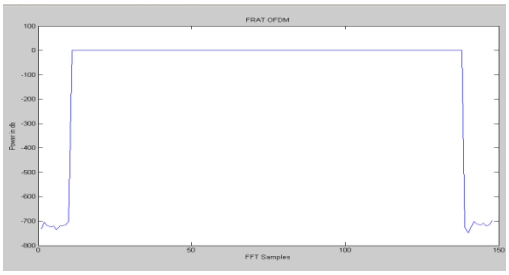

Figure 5.6.1: Graph of following parameter

(1) If the flat sample is 145 so power Is -709.7 db.
(2) If the flat sample is 3 so power Is -718.6 db.

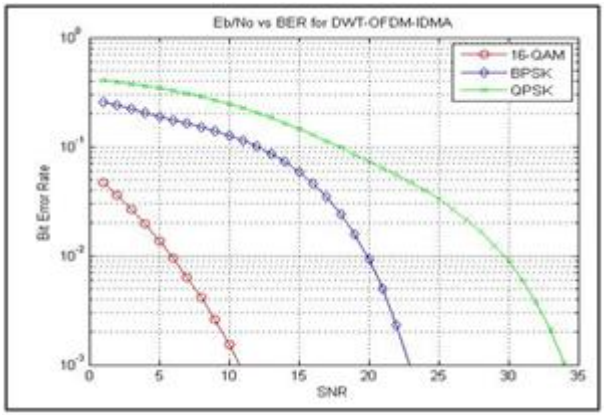

Figure 5.6.2: Comparision OF QPSK, BPSK And 16 QAM

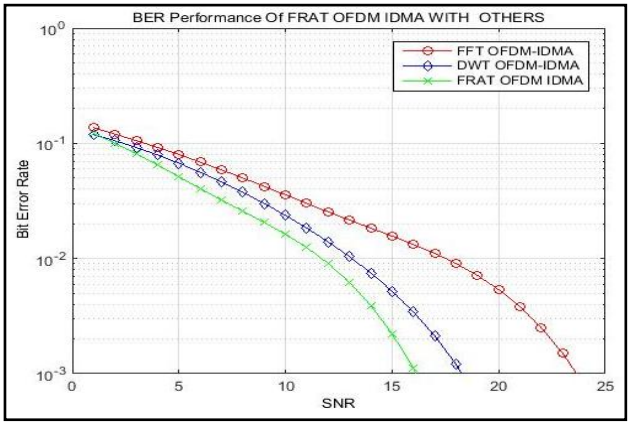

Figure 5.6.3: BER Performance of WIMAX IDMA with FFT, DWT and FRAT

Table 5.1: BER Comparission for No. of DATA Point16, Speed of transmitted Bit 32 and NO. of zeros to be padded 20

S.No	SNR in dB	BER		
		FFT WIMAX IDMA	DWT WIMAX IDMA	FRAT WIMAX IDMA
01	10	0.03566	0.02367	0.01626
02	15	0.01564	0.005202	0.002221

Explanation
As clearly seen from the Graph that FRTA WIMAX IDMA is having lees BER as compaird to other. So with these parameter FRTA WIMAX IDMA is better than others.

Result shown in below following parameter
(i) No. of DATA Point16**,** (ii) Speed of transmitted Bit 256**,** (iii) No. of zeros to be padded 30.

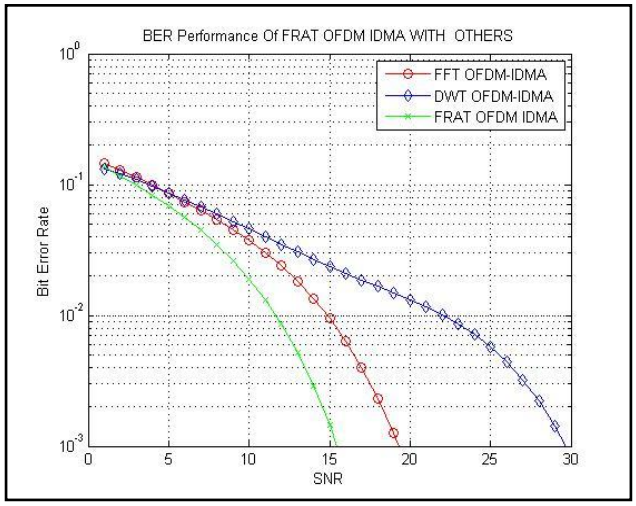

Figure 5.7: BER Performance of WIMAX IDMA with FFT, DWT and FRAT

Table 5.2: BER Comparission for No. of DATA Point16, Speed of transmitted Bit256 and NO. of zeros to be padded 30

S. NO.	SNR in dB	BER		
		FFT WIMAX IDMA	DWT WIMAX IDMA	FRAT WIMAX IDMA
01	10	0.03742	0.04556	0.01908
02	06	0.00397	0.025820	0.002792

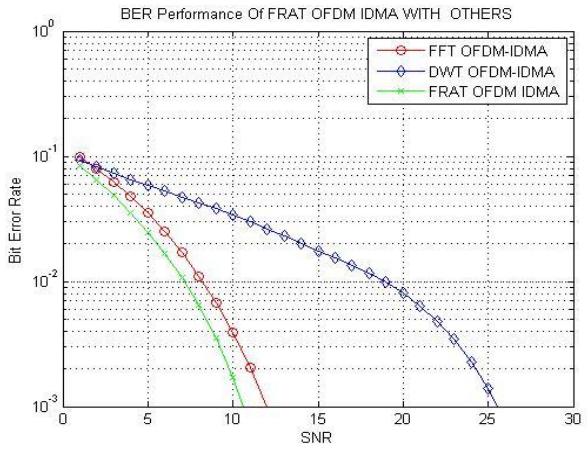

Figure 5.11: BER Performance of WIMAX IDMA with FFT, DWT and FRAT

ExExplanation

As clearly seen from the Graph that FRTA WIMAX IDMA is having lees BER as compaird to other. So with these parameter FRTA WIMAX IDMA is better than others.Thus as seen in the above figures that for majority of the test scenarios FRAT-IDMA is showing better performance than traditional IDAM as well as DWT-IDMA , although it is worth noting that such a system has not yet been realized physically and hence it is still a theoretical model and cannot be implemented till data.

7. Conclusion

As the demand for high data rate services grows in wireless networks, various challenging problems arise when the existing multiple access technologies are used. For orthogonal multiple access (MA) technologies such as TDMA, FDMA and WIMAXA, the major problems include their sensitivity to inter-cell interference and frame synchronization requirement for maintaining orthogonality. For non-orthogonal MA technologies such as random waveform CDMA, although it mitigates inter cell interference and supports asynchronous transmission, the challenge is to combat intra-cell interference. So, there is a new technique known as IDMA (Interleave Division Multiple Access) which seems to be the solution for these problems. The advantages of interleaving over scrambling seems very important for cell edge subscriber stations to receive broadcast services such as common signaling broadcasting because some advanced transmitting techniques for unit casting cannot be used for broadcasting. Interleave-division m multiple accesses (IDMA) can be considered as a special case of direct-sequence code division multiple access(DS-CDMA)The proposed system uses Radon-DWT mapping instead of QAM mapping which increases the orthogonality. The optimal ordering (best direction) in the Radon mapper can be considered as a good interleaver which serve in error spreading. In proposed system there is no need for using CP because of excellent orthogonality offered by FRAT and DWT, which in its order reduces the system complexity, increases the transmission rate, and increases spectral efficiency. Simulation results of proposed Radon-DWT based WIMAX show a very good SNR gain improvement and a BER performance as compared with DWT-WIMAX, FRAT-WIMAX, and FFT-WIMAX in an AWGN, a flat fading, and a selective fading channels. It offers more than 15 dB SNR improvement compared with FFT-WIMAX for selective Fading Channel at Doppler frequency 4Hz. From the simulation results, it can be seen that proposed Radon-DWT based WIMAX has the smallest sensitivity to variations of the channel parameters.

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