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RADON TRANSFORM BASED OFDM-IDMA SYSTEM WITH AWGN CHANNEL

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ABSTRACT

This paper presents a model which is Finite Radon Transform based Orthogonal Frequency Division Multiplexing-Interleaver Division Multiple Access (OFDM-IDMA) system for next generation wireless communication system. FRAT 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. Recently Finite Radon Transform (FRAT) was proposed as a mapping technique in OFDM system Conventional OFDM/QAM systems are robust for multi-path channels due to the cyclically prefixed guard interval which is inserted between consequent symbols to Remove ISI. An interleaver-based multiple access schemes have 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). From the simulation results the FRAT-OFDM-IDMA system performs better as compared to DFT-OFDM-IDMA and DWT-OFDM-IDMA system in term of BER performance for next generation wireless communication system. OFDM is a digital modulation scheme in which a wideband signal is split into a number of narrowband signals. Because the symbol duration of a narrowband signal will be large than that of a wideband signal, the amount of time dispersion caused by multipath delay spread is reduced.

Keyword- Finite Radon Transform, DWT, Interleaver Division Multiple Access (IDMA), Orthogonal Frequency Division multiplexing (OFDM)

INTRODUCTION

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 OFDMA, the major problems include their sensitivity to inter-cell interference and frame synchronization requirement for maintaining orthogonality[1]. For non-orthogonal CDMA 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)[1-2] 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 multiple accesses (IDMA) can be considered as a special case of direct-sequence code division multiple accesses (DS-CDMA)[3].

INTRODUCTION TO OFDM

With the increase of communications technology, the demand for higher data rate services such as multimedia, voice, and data over both wired and wireless links is also increased. New modulation schemes are required to transfer the large amount of data which existing techniques cannot support[4]. These techniques must be able to provide high data rate, allowable Bit Error Rate (BER), and maximum delay. Orthogonal Frequency Division Multiplexing (OFDM) is one of them. OFDM has been used for Digital Audio Broadcasting (DAB) and Digital Video Broadcasting (DVB) in Europe, and for Asymmetric Digital Subscriber Line (ADSL) high data rate wired links. OFDM has also been standardized as the physical layer for the wireless networking standard „HIPERLAN2 in Europe and as the IEEE 802.11a, g standard in the US, promising raw data rates of between 6 and 54Mbps[5].

Orthogonal Frequency Division Multiplexing (OFDM) is a digital transmission Method developed to meet the increasing demand for higher data rates in communications which can be used in both wired and wireless environments.

Orthogonal frequency division multiplexing (OFDM) is a widely used modulation and multiplexing technology, which has become the basis of many telecommunications standards including wireless local area networks (LANs), digital terrestrial television (DTT) and digital radio broadcasting in much of the world. In the past, as well as in the present, the OFDM is referred in the literature as Multi-carrier, Multi-tone and Fourier Transform. The OFDM concept is based on spreading the data to be transmitted over a large number of carriers, each being modulated at a low rate. The carriers are made orthogonal to each other by appropriately choosing the frequency spacing between them[9].

A multicarrier system, such as FDM divides the total available bandwidth in the spectrum into sub-bands for multiple carriers to transmit in parallel. It combines a large number of low data rate carriers to construct a composite high data rate communication system. Orthogonality gives the carriers a valid reason to be closely spaced with overlapping without ICI[10].

INTRODUCTIONTO OFDM-IDMA

The OFDM-CDMA scheme often employs mutual orthogonal codes to distinguish users, and one major problem with the OFDM-CDMA scheme in frequency selective channel is the distortion of orthogonality among users (especially in uplink transmission scenario), which leads to serious MAI problem. MUD is a promising technique for the MAI problem, but the complexity related to MUD has been a major concern for its practical application. The maximum a posteriori (MAP) multiuser detector has exponential complexity with the number of users K . Other linear multiuser detectors for conventional OFDM-CDMA system, e.g., the linear MMSE detector and the decorrelator, usually have quadratic complexity with the number of users K . The quadratic complexity is mainly due to the operations involved in resolving the correlation between spreading sequences. When K is large, the it is computationally prohibitive for practical implementation[1].

In OFDM-CDMA systems, spreading sequences are employed to distinguish signals from different users. From a coding theory point of view, it is not a wise choice to use spreading sequences for user separation, since the spreading operation results in band-width expansion without coding gain. The theoretical analysis shows that the capacity of multiple access channel can only be approached, when entire bandwidth expansion is devoted to FEC coding. The idea of a hybrid communication scheme combining OFDM and IDMA has recently been proposed and studied in [1,13]. The OFDM-IDMA scheme, which employs IDMA instead of CDMA in OFDM-CDMA inherits many attractive features of well-studied OFDM-CDMA scheme, such as the simple treatment of ISI and effective mitigation of cross-cell interference. Furthermore, the adoption of IDMA introduces additional benefits. In particular, IDMA allows a simple and effective turbo-type iterative MUD algorithm applicable to system with large number of users, which is crucial for system achieving high throughput. The CBC detection algorithm has linear complexity with the number of users K . Since random interleavers are employed to distinguish signals from different users, the spreading operation can be avoided in the OFDM-IDMA scheme. In this situation, the OFDM-IDMA scheme devotes entire bandwidth expansion to FEC coding and obtains additional coding gain.

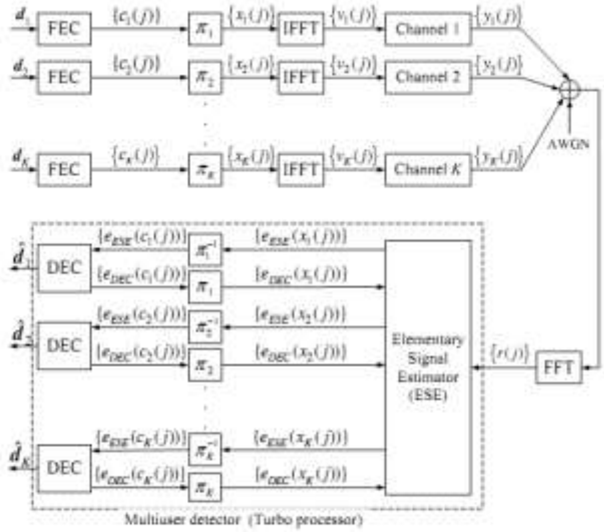

Figure 1: Transmitter and receiver structures of the OFDM-IDMA scheme with K simultaneous users

FINITE RADON TRANSFORM

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. Due to its good orthogonality, discrete wavelet transform is used for orthogonal frequency division multiplexing systems which reduces inter symbol interference and inter carrier interference. This eliminates the need for cyclic prefix and increases the spectral efficiency of the design[7,8,9].

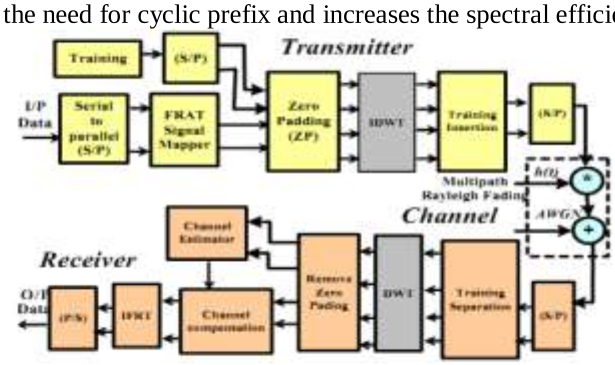

Figure 2: Block diagram of FRAT-DWT based OFDM system.

Due to good Orthogonality of both DWT and FRAT which reduce ISI and ICI, in proposed system there is no need of using Cyclic Prefix (CP). The block diagram of the proposed Radon-wavelet based OFDM system is depicted in Figure 2. The processes of Serial to Parallel (S/P) converter, signal demapper, and the insertion of training sequence are the same as in the system of FFT-OFDM. Also the zeros are added as in the FFT based case and for the same reasons. After that the IDWT is applied to the signal. The main and important difference between FFT based OFDM and DWT based OFDM is that in wavelet based OFDM cyclic prefix is not added to OFDM symbols. Therefore the data rates in wavelet based OFDM is higher than those of the FFT based OFDM. At the receiver, the zeros padded at the transmitter are removed, and the other operations of channel estimation, channel compensation, signal demapping and Parallel to Serial (P/S) are performed in the same manner as in FFT based OFDM. In conventional OFDM system, the length of input data frame is 60 symbols, and after (S/P) conversion and QAM mapping the length becomes 30 symbols. Zero padding operation makes the length 64 symbols which are the input to IFFT (sub-

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carrier modulation)[10]. After adding CP (usually 40% of the length of the frame), the frame length becomes 90 symbols. Since OFDM operations applied to training symbols are the same as those applied to transmitted data (except the mapping operation), the length of training symbols is also 90 symbols. The training and data frames are transmitted as one frame starting with training, so the length of transmitted frame is 180 symbols. In proposed system, the length of the input data frame must be (pxp), where P is a prime number. The closest number to 60 is 7x7, which makes the frame length 49symbols. This is because the input of FRAT must be a two dimensional matrix with size (pxp).

EXPERIMENTAL RESULTS

The performance evaluation and power allocation techniques for the FRAT-OFDM-IDMA system with different system configurations and channel conditions are experimented. FRAT-OFDM-IDMA is experimented for different models like QAM, BPSK, & QPSK. Firstly all the Performance is tested for different Eb/No (dB) values then compared with existing standard of OFDM system.

Bit Error Rate analysis of different modulations

The proposed model is designed 144 samples per frame for 16 QAM & BPSK, QPSK using a rate convolution code generator with AWGN channel and observed better BER for different Eb/No (dB).

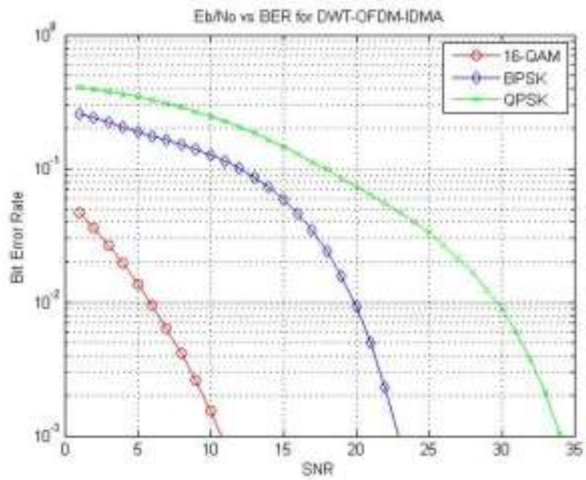

Fig.-3. Plot for BER -vs- Eb/No with AWGN channel.

In This Fig Show The 16 QAM Better Perform As Compare To Other In Terms Of BER.

Comparison of FRAT-OFDM-IDMA, DWT-OFDM-IDMA and DFT-OFDMIDMA system

From the simulation results the FRAT-OFDM-IDMA system performs better as compared to DFT-OFDM-IDMA and DWT-OFDM-IDMA system in term of BER performance for next generation wireless communication system.
The parameter Used in this project No. of data point, rang of the data point is 16-256. Another parameter is No. of bits to be Transmitted By this parameter We Select the how many bits we wants to transmit The range of this parameter is 64-2048, and the last is No. of Zero to be padded By this parameter we add the no of zeros in the transmitted side by this we reduce the ISI Noise. In This Project We Use The Software MATLAB Version R2014a**.**

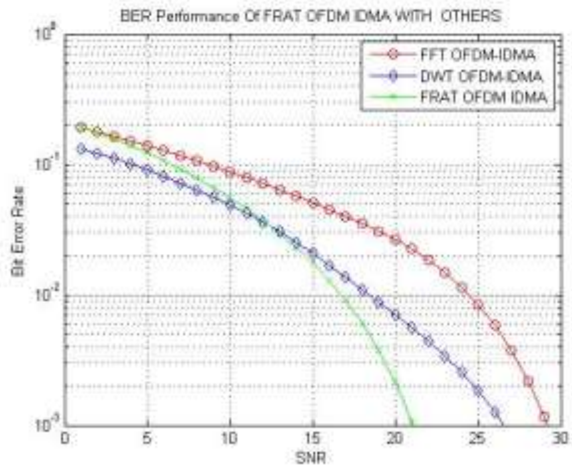

Fig.-4. Plot for BER -vs- Eb/No From Different Wavelets Families

ADVANTAGES OF OFDM

OFDM is highly immune to multipath delay spread that causes inter-symbol interference in wireless channels. Since the symbol duration is made larger (by converting a high data rate signal into N,,low rate signals), the effect of delay spread is reduced by the same factor. Also by introducing the concepts of guard time and cyclic extension, the effects of inter-symbol interference (ISI) and inter-carrier interference (ICI) can be removed completely.

CONCLUSION

A novel FRAT (Finite Radon Transform) based model which enables the communication media to scrutiny the noise and also Use for Remove Inter symbol interference. Due to good Orthogonality of both DWT and FRAT which reduce ISI and ICI, in proposed system there is no need of using Cyclic Prefix (CP). The proposed system uses Radon-DWT mapping instead of QAM mapping which increases the orthogonality. The FRAT Best Perform As compare To other In Terms OF BER.

REFERENCES

[1] Hemlata D. Marne, & Prachi Mukherji "Comparative study of Multiuser Detection techniques in OFDM-IDMA systems" IEEE, pp. 1-4 ,Jan 2015.
[2] Necmi taspinar "Channel estimation techniques in OFDM-IDMA systems" IEEE pp. 10-14, Sep 2014.
[3] Raghu Kalyana and S. Anuradha "Performance analysis of Modified Random Based Interleaver for OFDM-IDMA system" IEEE , pp. 896-900, May2014.
[4] Min Chen, and Alister G. Burr, "Low-Complexity Iterative Interference Cancellation Multiuser Detection for Overloaded MIMO OFDM IDMA System" IEEE Communication, pp. 1-4, March 2013.
[5] Litwin, Louis and Pugel, Michael. "The Principles of OFDM" 2001.
[6] Proakis G., Digital Communications, McGraw Hill, 2011.
[7] Upena Dalal .,Wireless Communications, Oxford University Press, Fourth Addition 2011.
[8] Al-Jawhar W., Kattoush A., Abbas S., and Shaheen A., "A High SpeedHigh Performance Parallel Radon Based OFDM Transceiver Designand Simulation," Computer Journal of DigitalSignal Processing, vol. 18, no. 11, pp. 907-918,2008.
[9] Vijay Kumar Kol and Agya Mishra "Discrete Wavelet Transform based OFDM-IDMA System with AWGN Channel" IEEE May2013.
[10] Al-Jawhar W., Kattoush A., Abbas S., and Shaheen A., "A High SpeedHigh Performance Parallel Radon Based OFDM Transceiver Designand Simulation," Computer Journal of DigitalSignal Processing, vol. 18, no. 11, pp. 907-918,2008.

[11] SeungWon K. and KyungHi C., "A Novel Channel Estimation Scheme for OFDM/OQAM-IOTA System," Computer Journal of Electronics and Telecommunications Research Institute, vol. 29, no. 4, pp. 430-436, 2007.
[12] Abbas Kattoush "A Novel Radon-Wavelet Based OFDM System Design and Performance Under Different Channel Conditions" The International Arab Journal of Information Technology, Vol. 7, No. 4, October 2010.
[13] Min Chen, AlisterG.Burr,"Low-Complexity Iterative Interference Cancellation Multiuser Detection for Overloaded MIMO OFDM IDMA System VDE pp. 1-5, March 2013.
[14] D. Meenakshi, S. Prabha And N. R. Raajan "VALUATION OF BER FOR VARIOUS FADING CHANNEL IN DWT BASED MIMO-OFDM SYSTEM," International Journal of Engineering and Technology (IJET), pp. 1067-1076, Vol 5 No 2 Apr-May 2013.
[15] Li Ping "Interleave-Division Multiple-Access," IEEE TRANSACTIONS ON WIRELESS COMM., VOL. 5, NO. 4, APRIL 2006.
[16] F. N. Brannstrom, T. M. Aulin, and L. K. Rasmussen, "Iterative decoders for trellis code multiple-access," IEEE Trans. Commun., vol. 50, pp. 1478–1485, Sept. 2002.

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