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Bit Error Rate Evaluation for Wireless Image Transmission System

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***Abstract* – When transmitting signals one of the most important issue is to keep the transmission error as low as possible and to obtain reliable transmission link bit BER should be kept limit. If SNR is high BER should be low. In this paper, a method for wireless image transmission is proposed. Low Bit Error Rate Systems are more efficient for image transmission so this system focus on bit rates for efficient data transmission. Based on wavelet decomposition theory, an image source can be decomposed into different weight levels. Then, the bit streams with different weight are modulated by FH-OFDM system, which can give low frequency bits more protection with help of hop frequency graphic design in FH-OFDM. A joint system combined with source coding and adaptive modulation method is introduced to give the image bit streams with different subcarriers, which eliminate ISI in low frequency streams more effectively. Comparatively there is another method used for progressive image transmission over coded Orthogonal Frequency Division Multiplexing (OFDM) system with Low Density Parity Check Coding (LDPC). It is used to compansate the introduced error i.e. it improves the Low bit error rate, ability and transmission efficiency for progressive image transmission over Additive White Gaussian Noise (A WGN) channel. Therefore, a better reconstruction image can be obtained at receiver with low bit error rate. Simulation results indicate that, Low Bit Error Rate is more efficient for image transmission.**

***Keywords* – Image Transmission, FH-OFDM, Multimedia Communication, PAPR, SPIHT, LDPC, Discrete Cosine Transform**.

I. INTRODUCTION

The FH-OFDM modulator has ability to restrain the Doppler frequency shift caused by fast moving, and also has the ability to eliminate the ISI caused by Multipath effect, so, it is especially suitable to be applied in wireless channel [1] ,and an efficient LDPC coded OFDM system with trigonometric transforms supporting image Transmission using SPIHT compression technique is presented [2] and studied. The effectiveness of the proposed system is investigated through simulations over A WGN channel. It is found that the proposed system must be designed carefully in order to achieve a reduction in the PAPR without degrading the PSNR performance.

The transmission of the images coded using set partitioning in hierarchical trees (SPIHT) across noisy channels is an active research topic recently. For example, in [8], a concatenated channel coding scheme was applied to SPIHT coded image to achieve performance gains over previous coding systems for Memory less channels with known statistics. In [11] and [12], a optimal source and channel rate allocation scheme is proposed for channels with and without feedback channel. A packetization scheme in [13] was proposed that the output bit stream of zero trees encoder was reordered and packetized in such a way that complete trees of wavelet coefficients were contained within packets. This allows graceful degradation of an image in the presence of packet erasures, instead of loss of synchronization typically experienced with the error-sensitive zero tree encoder. In [7], a product channel code structure is used to make the system in [8] robust to fading channels. A combination of channel coding and packetization is proposed in [6], which can perform well on channels that can suffer packet losses as well as statistically varying bit errors. In this paper, a joint source-channel matching scheme for progressive image transmission over broadband wireless channels using OFDM systems with spatial diversity is proposed, Neither feedback channel nor CSI is available at transmitter. Multimedia transmission over asymmetric digital subscriber lines (ADSL) have been studied recently [5], [3], where the channel is assumed to be time-invariant. For high bit-rate wireless communications, OFDM [16] is an attractive technique.

To be used because of its simplicity in dealing with frequency-selective, time-dispersive wireless fading channels [14], [16]. Diversity techniques, including spatial, frequency, and time domain diversity, have been suggested to decrease the fading effect. Sufficiently spaced antennas are an attractive source of diversity.
Since they do not typically incur bandwidth expansion

As in frequency division diversity, and does not incur delay as in time diversity. Though spatial diversity can be available at both transmitter and receiver, most of past work has focused on exploiting receiver diversity since simple combining techniques, such as maximum ratio combining (MRC) or antenna selection, are available to obtain sufficient diversity gain [15]. Whereas OFDM modulation has been adopted by several wireless multimedia transmission standards, such as Digital Audio Broadcasting (DAB) and Digital Video Broadcasting (DVB-T), because it provides a high degree of immunity to multipath fading and impulsive noise.

High spectral efficiency and efficient modulation and demodulation by IFFT/FFT are also advantages of OFDM. In the frequency-selective radio transmission channel, all fading and Inter-Symbol Interference (lSI) result in severe losses of transmitted image quality. OFDM divides frequency-selective channel into several parallel non frequency selective narrow-band channels, and modulates signal into different frequencies. It can significantly improve the channel transmission performance without employing complex equalization schemes. It also has broad application prospect in wireless image and video communications [1, 2]. There are several developed techniques to reduce the PAPR in OFDM systems [3, 4] such as clipping [5], companding [6, 7], Partial Transmit

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Sequence (PTS) [8], Selected Mapping (SLM) [9][10] and coding [lO]. The clipping technique is the simplest one that can be used in OFDM systems, but it causes additional clipping noise, which degrades the system performance. An alternative technique to mitigate the PAPR problem is based on signal transformations. This technique involves a signal transformation prior to amplification, then an inverse transformation at the receiver prior to demodulation. In [11] trigonometric transforms were suggested as alternatives for the FFT to reduce the PAPR. The authors in [11] concluded that OFDM systems with trigonometric transforms provide higher P APR reduction than the standard FFT based system. However, they modified the OFDM symbols before transmission using the PTS. Their results reveal that without PTS, the distribution of P APR is the same for that conventional one such that the reduction depends on PTS, which makes redundancy in the system.

II. PROPOSED METHOD

The objective of this paper is to to (a) a new scheme for wireless image transmission is proposed. Firstly, based on wavelet decomposition theory, an image source can be decomposed into different weight levels. Then, the bit streams with different weight are modulated by FH-OFDM system.(b). To improving the performance of the OFDM systems and reducing the Peak to- Average Power Ratio (PAPR) of OFDM signal. (c) It improves the Bit error resilience ability and transmission efficiency for progressive image transmission over Additive White Gaussian Noise (AWGN) channel The Set Partitioning in Hierarchical Trees (SPIHT) algorithm is used for source coding of the images to be transmitted.

The present work implements an efficient system for the proposed scheme the transmit data sequence of the OFDM signal after Inverse Fast Fourier Transform (lFFT) is grouped into in-phase and in-quadrature components, then each component is transformed using either the Discrete Cosine Transform (DCT) or the Discrete Sine Transform (DST).The effectiveness of the proposed system is investigated through simulations over A WGN channel.

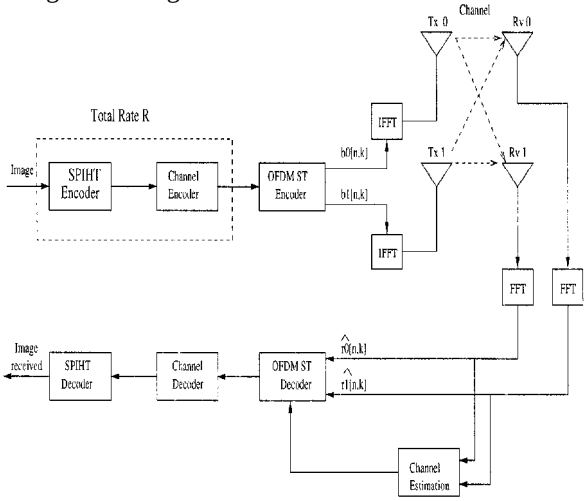


Fig.1. Image transmission over OFDM channels using multiple antennas.

It is found that the proposed system must be designed carefully in order to achieve a reduction in the PAPR without degrading the PSNR performance. For LDPC COFDM with rate (R=O.5) and rate of SPIRT rate (r = 1) the OFDM signal can be reduced by nearly 7Db or 7.25dB by adding the DCT or DST respectively. We also showed the PSNR for the received image at different rates. This work shows the performance of the system model using 256x256 grayscale images.

This paper concentrates on two targets reducing the PAPR of the OFDM signal and improving the quality of the reconstructed images. It considers the trigonometric transforms as a way for reducing the PAPR by using the character of the DCT/DST energy focused in the low component. The data of OFDM signal is modulated by IFFT then using DCTIDST, which can reduce the PAPR. Compared with the means of SLM-OFDM and PTS-OFDM, OFDM system modified by DCT/DST maintain the system orthogonal properties, which will not result in additional noise and need not transmit side information. At the same time, the proposed method reduces the PAPR greatly and the system has character of low complexity hardware. In this paper, a new scheme for wireless image transmission is proposed. Firstly, based on wavelet decomposition theory, an image source can be decomposed into different weight levels. Then, the bit streams with different weight are modulated by FH-OFDM system, which can give low Frequency bits more protection with help of hop frequency graphic design in FH-OFDM. A joint system combined with source coding and adaptive modulation method is introduced to give the image bit streams with different subcarriers, which eliminate ISI in low frequency streams more effectively. Therefore, a better reconstruction image can be obtained at receiver. Simulation results indicate that the scheme with joint source coding and adaptive modulation method can outperform the system without adaptive modulation in image quality. Under the same conditions, the proposed FH-OFDM system has better BER performance than traditional OFDM and better image quality than pseudorandom pattern FH-OFDM in the process of wireless image transmission.

2.1 Orthogonal frequency-division multiplexing (OFDM)

Orthogonal frequency-division multiplexing (OFDM) is a method of digital modulation in which a signal is split into several narrowband channels at different frequencies. In some respects, OFDM is similar to conventional frequency-division multiplexing (FDM). The difference lies in the way in which the signals are modulated and demodulated. Priority is given to minimizing the interference, or crosstalk, among the channels and symbols comprising the data stream. Less importance is placed on perfecting individual channels. OFDM is used in European digital audio broadcast services. The technology lends itself to digital television, and is being considered as a method of obtaining high-speed digital data transmission over conventional telephone lines. It is also used in wireless local area networks.

2.2 SPIHT Algorithm

New algorithms for image compression based on wavelets have been recently developed. These methods have resulted in practical advances such as: superior low-bit rate performance, continuous-tone and bit-level compression, lossless and lossy compression, progressive transmission by pixel accuracy and resolution, region-of-interest coding and others. One of the most efficient procedures that fulfill the above goals is the Set Partitioning in Hierarchical Trees (SPIHT) algorithm. This algorithm bases its efficiency in key concepts like: a) partial ordering of wavelet coefficients by magnitude, with transmission of order by a subset partitioning that is replicated at the decoder, b) ordered bit-plane transmission of refinement bits and c) exploitation of self-similarity of the image wavelet coefficients across different scales.

Most of the implementations known to date for the SPIHT algorithm have been done in C (or C++). This paper describes a MATLAB implementation of the SPIHT algorithm. MATLAB is widely used in the academic community as one of the teaching platforms for signal and image processing. It has a robust set of toolboxes, particularly the wavelets toolbox. The SPIHT algorithm creates a pyramid structure based on a wavelet decomposition of an image. It has been discussed that the wavelet coefficients at the top of the pyramid have a strong spatial relationship with their children. The SPIHT algorithm bases its efficiency by iteratively searching for significant pixels throughout the pyramid tree. Typically in C (or C++), there will be pointers (or arrays pointers) to perform a search in the tree. In MATLAB, one of its newest data structures (structure array) can be used for the same purpose. In addition, the SPIHT coder algorithm orders the wavelets coefficients according to a significance test and stores this information in three separate lists: list of insignificant sets (LIS), the list of insignificant pixels (LIP) and the list of significant pixels (LSP). These lists are also implemented using structure arrays. MATLAB also allows working efficiently at bit-level operations for bit-plane transmission of wavelet coefficients. Although the MATLAB implementation of the SPIHT algorithm is not as fast as its C (or C++) counterpart, the code can be easily modified by calling different wavelet routines in the wavelet toolbox

2.3 Low-density parity-check code

In information theory, a low-density parity-check (LDPC) code is a linear error correcting code, a method of transmitting a message over a noisy transmission channel, and is constructed using a sparse bipartite graph. LDPC codes are capacity-approaching codes, which means that practical constructions exist that allow the noise threshold to be set very close (or even arbitrarily close on the BEC) to the theoretical maximum (the Shannon limit) for a symmetric memory-less channel. The noise threshold defines an upper bound for the channel noise, up to which the probability of lost information can be made as small as desired. Using iterative belief propagation techniques, LDPC codes can be decoded in time linear to their block length. LDPC codes are finding increasing use in applications requiring reliable and highly efficient information transfer over bandwidth or return channel–constrained links in the presence of data-corrupting noise. Although implementation of LDPC codes has lagged behind that of other codes, notably turbo codes, the absence of encumbering software patents has made LDPC attractive to some. LDPC codes are also known as Gallager codes, in honor of Robert G. Gallager, who developed the LDPC concept in his doctoral dissertation at MIT in 1960.

II. RESULTS

OFDM technique would utilize the performance of wireless communication especially in multimedia transmission. There is implementation of a MATLAB program in order to transmit an image over AWGN and fading channels using OFDM. In the first part of this section, there is a comparision of the result of the RGB image transmission with various SNR with bit rate error, using BPSK as modulation technique and each subcarrier carries 2048 bits during the transmission. In the next step the results are compared with the theoretical performance of the OFDM transmission over AWGN channel. The graph is there to analyze the comparison of BER and SNR. And the Matlab simulation Graphs are shown in the fig 2.

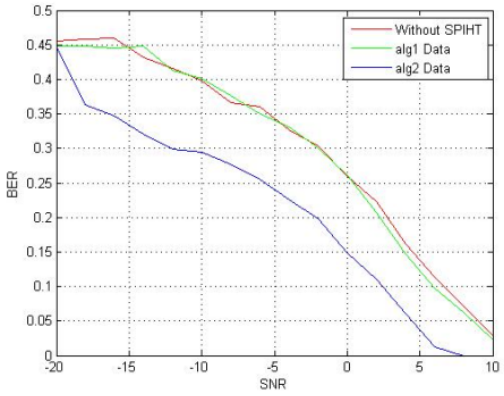
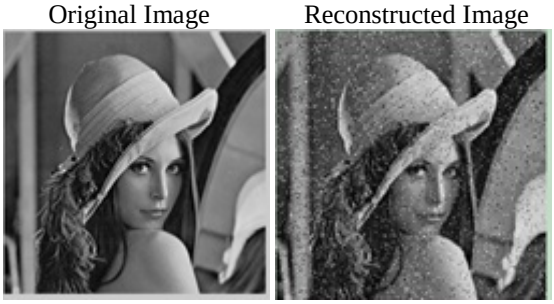


Fig.2. Comparison of SNR VS BER for both Algorithms discussed above.

Alg1.(BER).	Alg2.(BER).	SNR.
0.4604	0.4480	-20
0.4385	0.3634	-18
0.4412	0.3473	-16
0.4255	0.3216	-14
0.4011	0.2992	-12
0.3784	0.2943	-10
0.3728	0.2770	-08
0.3352	0.2547	-06
0.3191	0.2257	-04
0.2810	0.1979	-02
0.2583	0.1478	00
0.2114	0.1097	02
0.1631	0.0606	04
0.1013	0.0123	06
0.0576	0.0000	08
0.0217	0.0000	10

Original Image Reconstructed Image



Wavelet Decomposition Method (Algorithm 1)
Fig.3. SNR Vs BER

Original Image Reconstructed Image

DST Method (Algorithm 2)
Fig. 4: Lena Image

IV. Conclusion

This paper presents, wireless image transmission by DST and wavelet decomposition method and when there is a comparison between BER and SNR after going through the graphical analysis of the transmission methods it can be concluded that DST technique super seeds the wavelet decomposition.

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