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# Energy Efficient Image Compression Using SPIHT and Huffman Encoding Based On DWT over Transmitting OFDM Channel

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***Abstract: - In this paper we present an energy saving approach to transmission of discrete wavelet transformation based compressed image frames over the OFDM channels. Based on one-bit channel state information at the transmitter, the descriptions in order of descending priority are assigned to the currently good channels used in Huffman and SPHIT Encoding. Analytical evaluation of the system in terms of probability of error is carried out in a diffused wireless channel. As a conclusion, the proposed system shows promising results for a high speed wireless channel and we demonstrate the usefulness of our proposed scheme in terms of system energy saving without compromising the received quality in terms of peak signal to noise ratio. Despite using more number of carriers instead subset of carriers is usable for successful data transmission and permitting the retransmission of lost packets. The improvements that can be realized in various performance parameters in a digital Communication system using wavelets. Parameters like Spectral efficiency, Mean square error, Peak signal to noise ratio (PSNR) and bit error rate are found to improve with the help of wavelets.***
***Keywords: DWT; IMAGE; HUFFMAN; SPIHT; OFDM.***

## I. INTRODUCTION

OrthogonalFDM could be a multi-carrier modulation scheme having glorious performance that permits overlapping in frequency domain. In OFDM, individual sub channels area unit suffering from flat weakening, so for an amount of your time, condition of the sub channels may be smart, or they may be deeply pale. The packets that area unit transmitted through these pale sub channels area unit extremely vulnerable to be lost at the receiver attributable to non-acceptable errors. OFDM system provides a chance to use the diversity in frequency domain by providing a number of subcarriers, which might work as multiple channels for applications having multiple bit streams. One simple overloaded transmission solution to upgrade existing OFDM based broadcast multicast traffic channel. With this scheme, legacy mobiles can seamlessly operate in the upgraded network without additional change. The control overhead signal part is same. The pilot part is reused. Only the traffic channel part is upgraded. The new traffic channel part is layer-modulated and transmitted with an additional pre-coded OFDM modulated enhancement layer, where the s-symbols are pre-coded with Walsh-Handmaid matrix before OFDM. In an additive white Gaussian channel, this scheme has the superposition pre-coding (SPC) gain since it essentially is an implementation of SPC. However, the interference from the enhancement layer is randomized due to additional Walsh-Handmaid spreading. In the fading channel, additional multi-layer diversity gain is achievable, since the base layer and the enhancement layer are operating in different signal spaces.

## II. PROPOSED METHOD

In the earlier method we have transmitted DWT compressed image over OFDM channel. During this process we have achieved efficiency of 60% and a PSNR of 38dB.In the proposed system HUFFMAN and SPHIT encoding techniques are used showing better performance in terms of efficiency and the PSNR of in a high speed wireless OFDM channel.

### *A. Image*

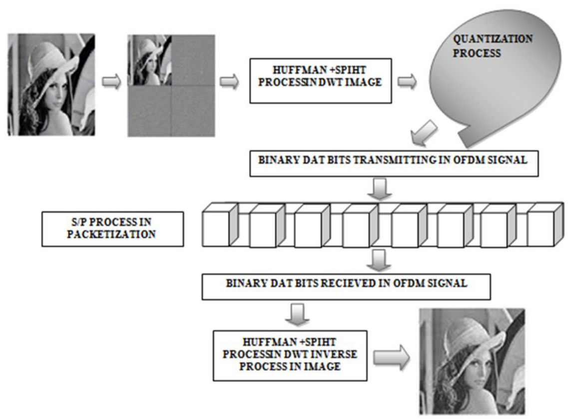
The Digital image is outlined as a 2 dimensional operate f(x, y), wherever x and y square measure special (plane) coordinates, and therefore the amplitude of f at any try of coordinates (x, y) is termed intensity or gray level of the image at that time. The digital image consists of a finite range of components, every of that includes a specific location and price. {The components the weather} square measure stated as image elements, image components, pixels, and pixels. Pixel is that the term most generally used. Digital compression addresses the matter of reducing the quantity of knowledge needed to represent a digital image. The underlying basis of the reduction method is removal of redundant information. An image compressed using a lossless method is guaranteed to be identical to the original image when uncompressed.

### *B. Compreesion Process*

Lossy schemes, on the other hand, throw useless data away during encoding. This is, in fact, how lossy schemes manage to obtain superior compression ratios over most lossless schemes. JPEG was designed specifically to discard information that the human eye cannot easily see. Slight changes in color are not perceived well by the human eye, while slight changes in intensity (light and dark) are. Therefore JPEG's lossy encoding tends to be more frugal with the gray-scale part of an image and to be more frivolous with the color.

JPEG was designed to compress color or gray-scale continuous-tone images of real-world subjects: photographs, video stills, or any complex graphics that resemble natural subjects. Animations, ray tracing, line art, black-and-white documents, and typical vector graphics don't compress very well under JPEG and shouldn't be expected to. And, although JPEG is now used to provide motion video compression, the standard makes no special provision for such an application.

The fact that JPEG is lossy and works only on a select type of image data might make you ask, "Why bother to use it?" It depends upon your needs. JPEG is an excellent way to store 24-bit photographic images, such as those used in imaging and multimedia applications. JPEG 24-bit (16 million color) images are superior in appearance to 8-bit (256 color) images on a VGA display and are at their most spectacular when using 24-bit display hardware (which is now quite inexpensive).




BLOCK DIAGRAM: DWT+HUFFMAN+SPIHT-OFDM SYSTEM

The amount of compression achieved depends upon the content of the image data. A typical photographic-quality image may be compressed from 20:1 to 25:1 without experiencing any noticeable degradation in quality. Higher compression ratios will result in image files that differ noticeably from the original image but still have an overall good image quality. And achieving a 20:1 or better compression ratio in many cases not only saves disk space, but also reduces transmission time across data networks and phone lines.

### *C. DWT Process*

In case of lossless compression, the best performances in compression were obtained by JPEG-LS, except in the case of computer generated images or texts, for which PNG grants, better results.

JPEG2000 is versatile and efficient with any kind of images and offers results similar to the other standards (less flexible).

In the case of lossy compression, progressive or not, JPEG2000 with not reversible Daubechies 9,7 filters is better than all the other standards in terms of PSNR on the average MSE, whatever the bit rate is: by increasing the compression ratio, the quality of JPEG2000 increases in comparison with the other ones.

In terms of visual quality, JPEG2000 was compared with JPEG only. The result shows that, visual quality being equal, JPEG needs a larger bit rate (from 13% to 112% depending on the number of bits) and the differences increase if the compression increases.

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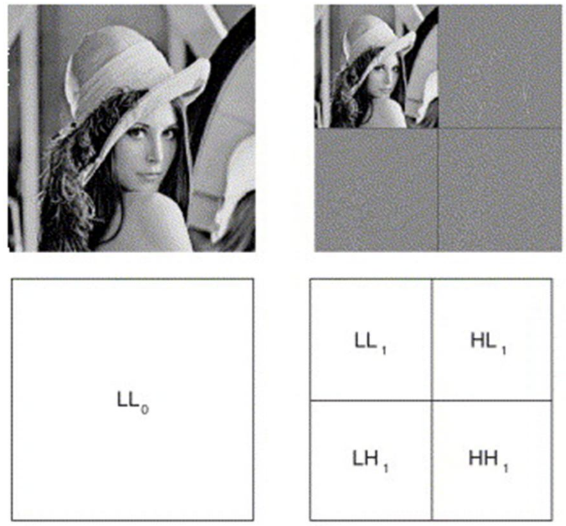



### D. *Huffman Process*

Huffman coding uses a specific method for choosing the representation for each symbol, resulting in a prefix code (sometimes called "prefix-free codes", that is, the bit string representing some particular symbol is never a prefix of the bit string representing any other symbol) that expresses the most common source symbols using shorter strings of bits than are used for less common source symbols. Huffman was able to design the most efficient compression method *of this type*: no other mapping of individual source symbols to unique strings of bits will produce a smaller average output size when the actual symbol frequencies agree with those used to create the code.

It is a statistical coding. It is allocated all significant coefficients with the same space.

For example:

212 coefficient = 1 byte

In encoder, Create binary tree nodes with character and frequency of each character then the Place nodes in a priority queue. Significant coefficient and convert to bit stream. In decoder, once receiver has treed it scans incoming bit stream and to saves the lot of bits.

Here a concrete example to analyze the output binary stream of SPIHT encoding. The following is 3 level wavelet decomposition coefficients of SPIHT encoding;

### E. *SPIHT Process*

It is an image compression algorithm based on three concepts:

1. Partial ordering of the transformed image elements by magnitude and transmission of this ordering information.

2. Ordered bit plane transmission.

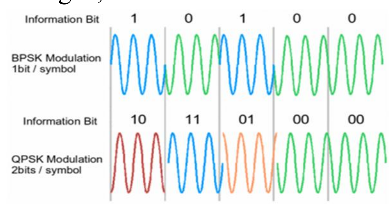
3. Application of similarity between coefficients from different wavelet levels which describe the same origin

In the SPIHT algorithm, compression is realized in two ways. First of all, because the transformed image elements are partially ordered by magnitude, the leading ‘0’ bits and the first ‘1’ of any coefficient do not need to be transmitted, since they can be derived from the ordering information. Secondly, the SPIHT-algorithm produces an embedded bit stream. In an embedded bit stream the encoding can be stopped at any time and still the image can be decoded and reconstructed. Moreover, if the transformed image is fully encoded and decoded, the reconstruction of the image is lossless.

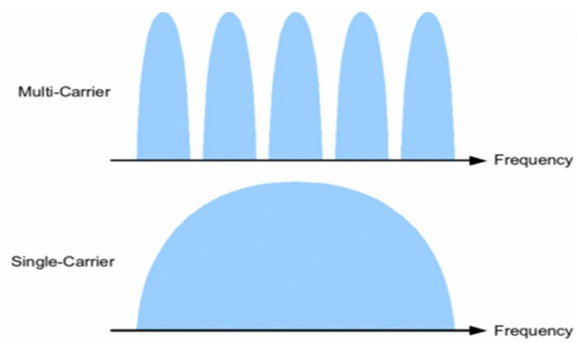
*F. OFDM Process*

Orthogonal frequency division multiplexing is a digital modulation method. In digital modulation the signal is split into many narrow band channels. And they have different frequencies. Orthogonal frequency division multiplexing is special type of multi carrier modulation method. Orthogonal frequency division multiplexing is suitable for dispersive channel transmission.

Each carrier is modulated with digital data. Using many carriers with error correction techniques improves the reliability of the communication link. If a few of the carriers get damaged, the link still works.



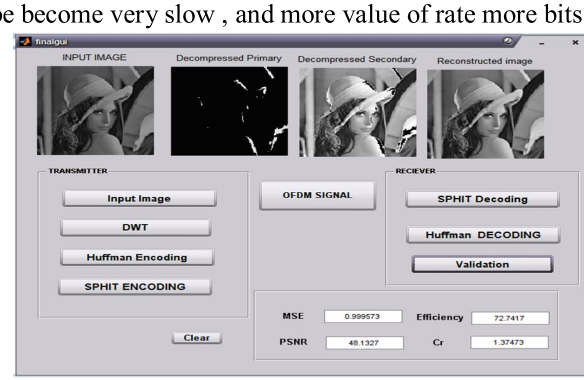

A MIMO wireless system consists of N transmit antennas and M receive antennas. However, unlike phased array systems where a single information stream, say x (t), is transmitted on all transmitters and then received at the receiver antennas, MIMO systems transmit different information streams, say x (t), y (t), z (t), on each transmit antenna. These are independent information streams being sent simultaneously and in the same frequency band. At first glance, one might say that the transmitted signals interfere with one another. In reality, however, the signal arriving at each receiver antenna will be a linear combination of the N transmitted signals.




## III. RESULT ANALYSIS

*A. BER Process*

From the experimental results, we can see that values of $L$ are less than 3, so we can achieve the compression effect. For each image in the same rate always the probability of each symbol appear flat, and only small fluctuations, so saving the number of bits are also pretty much the same thing. With the rate increase word code length in average( $L$ ) will be an increasing trend, but after the rate greater than 0.3bpp the trending will be become very slow , and more value of rate more bits will be save.



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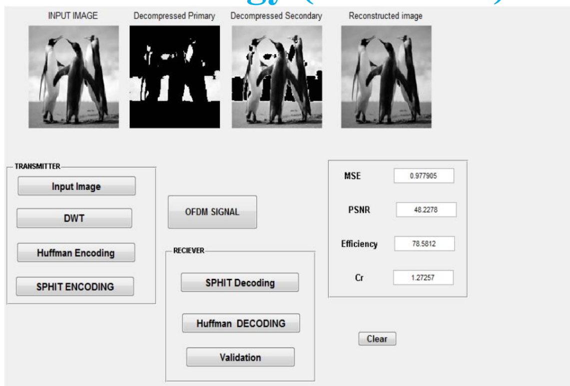
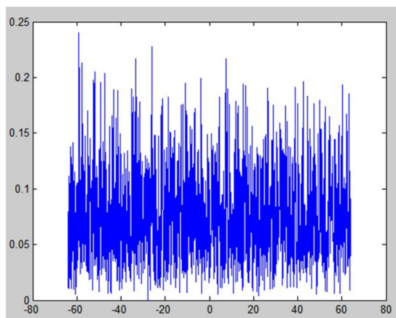
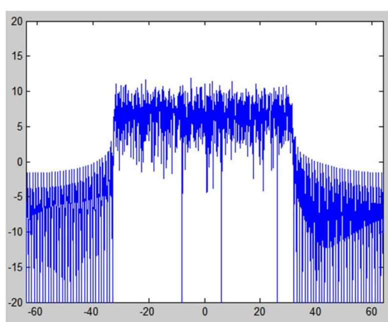



As an example, assume this transmitted bit sequence:
0 1 1 0 0 0 1 0 1 1,
And the following received bit sequence:
0 0 1 0 1 0 1 0 0 1,



The number of bit errors (the underlined bits) is in this case 3. The BER is 3 incorrect bits divided by 10 transferred bits, resulting in a BER of 0.3 or 30%.



### *B. Mean Square Error (MSE)*

It is defined as the square of error between original image and the compress image. The distortion in the image can be measured using MSE.

$$MSE = \frac{\sum\sum [A(i,j) - B(i,j)]^2}{N \times N}$$

Here, A (e.g.) = Original image.

B(i.j)= Compress image.

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N X N=row and column of image intensity of pixel vales (255 255) image size.

### C. Peak Signal to Noise Ratio

It is the ratio of the maximum signal to noise in the compress image

PSNR=20log10 {(255X255) / (MSE)}

### D. Efficiency Calculation

It is defined as the ratio between compressed file size and input file size.
Eff = (Comp_filesize / input_filesize)*100;

## IV. CONCLUSION

We Proposing an easy and effective technique combined with Huffman coding for additional compression during this paper that saves plenty of Log bits within the image information transmission. There's terribly big selection of sensible price for these days that contains a sizable amount of image data's to be transmitted. We have a tendency to propose a energy saving approach, wherever the compressed coefficients ar organized in down order of priority and mapped over the channels beginning with the great ones. The coefficients with lower importance level, that ar probably mapped over the dangerous channels, ar discarded at the transmitter to avoid wasting power while not vital loss of reception quality. Our analytic observations on reception quality and energy saving performance ar valid by intensive MATLAB simulations.

### A. SCOPE of the longer term WORK

In the future, this work will more be optimized to hold out all the phases on Verilog HDL. The Verilog HDL code is often optimized to attain the required leads to lesser time and fewer storage parts. Also, the newer FPGA families being introduced within the market provide higher performance and additional storage parts to reinforce performance and yield higher results.

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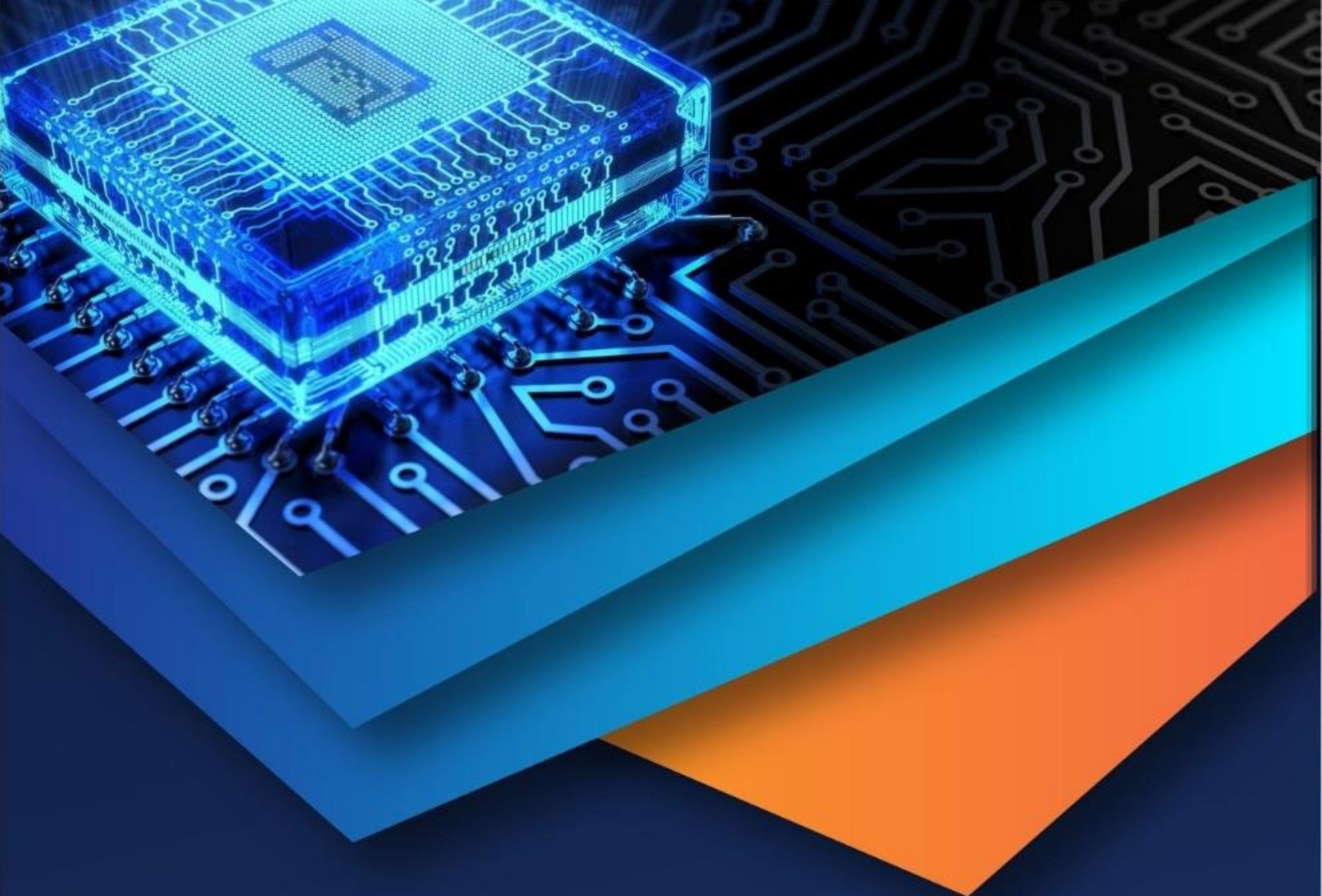


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