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# Effect of Compression Level on the Performance of Image Transmission & Compression System under AWGN Channel

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***Abstract: -*** *Data compression is "process of reducing the amount of data required to represent a given quantity of information". Therefore, data and information are not having the same meaning as is often mentioned. Instead, Data is to convey information in their vehicle. Because the same information can be carried across the channel by varying the amount of data, This unnecessary data, which do not have actual information, is commonly referred to as redundant. Data redundancy is the core concept of image compression. Image compression encodes the actual data in few bits. Here we are analyzing the effect of compression level on different performance assets like PSNR (Peak Signal to noise ratio), MSE (Mean Squared Error), BER (Bit Error Rate) in the image transmission and compression system under AWGN Channel. We are using DCT (Discrete Cosine Transform) coding for the image compression. DCT is similar to DFT (Discrete Fourier Transform) rather deals only with the real values, So the computation complexity of the system decreases.*

***Keywords****- AWGN, BER, DCT, PSNR, MSE, Transform Coding, QPSK.*

## I. INTRODUCTION

Information is that part of data, which must be retained, permanently in its actual form to correctly interpret the meaning or the purpose of the data [1]. Redundancy is part of the data, which can be rejected when it is not needed and can be reinserted in order to interpret the exact data when needed. Data compression is the method to reduce the redundancies in data to decrease data storage requirements and communication costs. The Conventional image compression method is JPEG & JPEG 2000, these methods have excellent credit, in multi-resolution image compression performance of their representation. However, because of this flexibility, JPEG 2000 encoder requires complex and computing requirements. JPEG good in, high compression performance and low computational complexity and storage, make it into a The image compression method naturally appealing But, when we go to a lower bit rate, the compression algorithm introduces disturbing artifacts. Compression ratio is defined as ratio of storage bits of original image and storage bits of compressed image [2].
Low bit-rate encoding, i.e., when the compression ratio increases, causes the pixels to reduce the quality of each bit of the coded picture suffers serious deterioration.

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Under these conditions, the standard solutions obtained from these shortcomings introduce significant bits represent the coding artifacts**.** "Ringing artifacts generated JPEG 2000, expressed as fuzzy, image edge near the ring, while JPEG blackness and ringing, due to its 8*8 block". These effects are highly undesirable. Because Of high spatial correlation region most images contain, necessary information can retrieve from the sparse pixel data (after the elimination of redundant information obtained). Compression of the image is to be done before sampling. The image can be restored by interpolation from the rest of pixels.

In order to take advantage of existing high spatial correlation of most images, the visual content of the signal can be a powerful argument. "According to this signal, the corresponding down sampling ratio, down-sampling of the direction and the optimum quantization step, local visual sense, can decide.

## II. TYPES OF DATA REDUNDANCY

Image compression reduces the storage space of image and also maintains the quality of image [1]. We can achieve compression by removing of one or more of three basic data redundancies [4]:

1. Spatial Redundancy or correlation between neighboring pixel.
2. Correlation between different color planes or spectral bands.
3. Due to properties of the human visual system, the Psycho-visual redundancy is founded.

There are three possible kinds of data redundancy

- ***Coding Redundancy***- In coding redundancy, each message is represented by a set of code symbols. Minimum numbers of bits are used to describe the code information in order to reduce redundancy.

- ***Inter pixel Redundancy*** - Redundancy refers to correlation exists between inter-pixel of image. The concept of information included in a claim that the majority can be predicted from the pixel values of its neighboring pixels, and therefore it is mostly superfluous.

- ***Psycho visual Redundancy*** – It refers not visually significant information in an image, it cannot be perceived if not the human visual system. Remove extra coding and inter-frame pixel ensure lossless compression, mental visual redundancy resulting the elimination of quantitative information, so lost, resulting in lossy compression. Lost data, in this case, cannot be retrieved. This type of data reduction, more commonly referred to quantify a wide range of input sample map a very narrow number of the output value.

Numerous compression techniques are using in these days to compress multimedia data for storage and transmission [5]. some of them are efficient techniques that proved to be the better one in terms of performance. One of these techniques is technique using forward & inverse transforms.

***Transform Coding***- Transform coding uses quantization is one of such lossy compression technique. Quantization aims at reducing most of the less important high frequency DCT coefficients to zero, the more zeros the better the image will compress [4]. If we take small value for quantization then we get the better quality or less MSE (Mean Square Error) but less compression ratio [2].

Its general work can be shown through a simple block diagram. As shown in fig. 2.1 & 2.2 after converting the image in to N*N blocks apply transform on each block and thereafter quantization process will take place . at receiver side inverse process will take place.

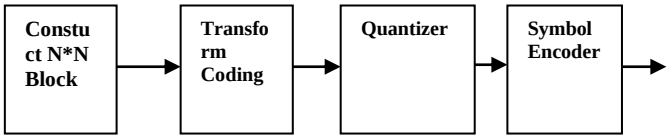


**Fig. 2.1: Block Diagram of a Forward Transform Encoding Technique**

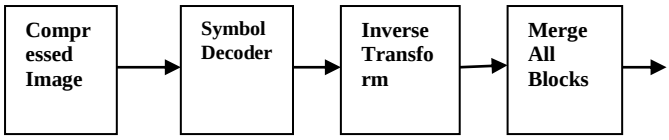


**Fig.2.2: Block Diagram of an Inverse Transform Decoding Technique**

The simplest way to describe DCT to transform N real numbers Yo,…..,$Y_{N-1}$ into N real numbers $Y_0$,....., $Y_{N-1}$ is

$$Y_k = \sum_{n=0}^{N-1} Y_n \cos\left[\frac{\pi}{N}(n+\frac{1}{2})(k)\right], k = 1,\ldots\ldots,N-1 \quad \ldots\ldots(1)$$

In DCT, based OFDM System Image is modulated by suitable modulation scheme. Here I am Using QPSK Modulation scheme. After converting the bit stream from serial to parallel, apply DCT transform method to each block of image. After that, transfer it through the AWGN (Additive White Gaussian Noise) Channel. In addition, at receiver side apply inverse DCT at each block of Image followed by parallel to serial converter and demodulation scheme. Finally, we receive compressed image.

## III. SIMULATION AND RESULTS

Here we are using MATLAB 2013 R for our simulation work. We are analysing Image Transmission and Compression system performance on different performance asset like PSNR (Peak Signal to Noise Ratio), MSE (Mean Squared Error) and BER (Bit Error Rate) at different SNR ( Signal to Noise Ratio) by varying the compression level .

**Peak Signal to Noise Ratio (PSNR)** ratio describes the discrimination in quality between the original image and the compressed one [3]. Higher the PSNR value is, the better the quality of the compressed image.

**Mean Square Error (MSE)** between reconstructed image and original image computes loss of information. If MSE of the reconstructed image to original image having extreme value, than the loss of information is more , Because the increasing number of coefficients decreases the quality of the image whereas compression ratio continues to increase [6].

**Bit Error Rate** (**BER**) is the number of bit errors per unit time. Bit error ratio can be considered as an approximate estimation of the bit error probability.

- **Compression level**

1. 50% coefficient retained
2. 10% coefficient retained

- ***50 %* coefficient *Retained***

Firstly We are selecting compression level, when 50 % coefficients would remain. We are taking lord.jpg as our source image. Plots of PSNR, MSE, and BER of this image, when transmitted through AWGN Channel, are given below. Curves numerical values are given in Table 3.1 at different SNR Values.


**Fig. 3.1 Source Image**


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**Fig: 3.2 Compressed Image when 50% Coefficient Retained**

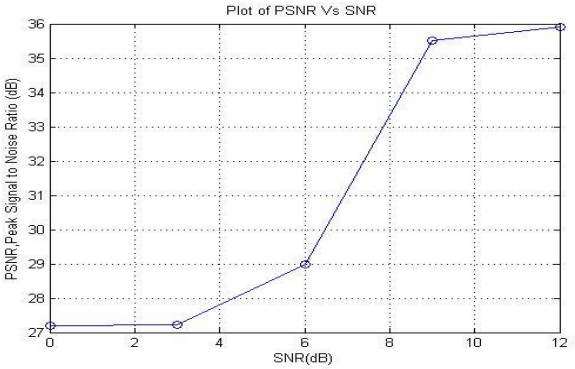


**Fig: 3.3 Plot Of PSNR Vs SNR when 50 % Coefficient Retained**

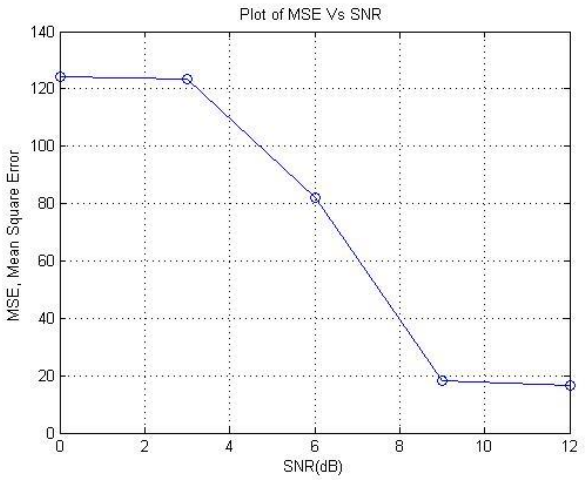


**Fig: 3.4 Plot Of MSE Vs SNR when 50 % Coefficient Retained**

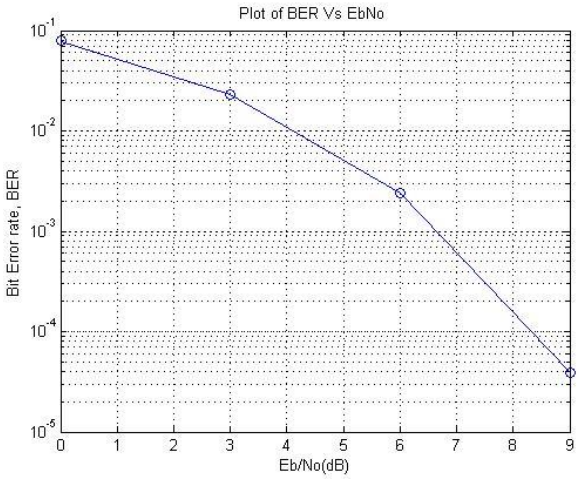


**Fig: 3.5 Plot Of BER Vs SNR when 50 % Coefficient Retained**

**Table: 3.1 Values of PSNR, MSE, BER when 50 % Coefficient Retained**

| SNR (dB) | BER | MSE | PSNR(dB) |
|---|---|---|---|
| 0 | 0.0784 | 123.9903 | 27.1969 |
| 3 | 0.0229 | 123.8456 | 27.2020 |
| 6 | 0.0024 | 79.0047 | 29.1543 |
| 9 | $2.769\ e^{-5}$ | 17.8699 | 35.6096 |
| 12 | 0 | 16.6502 | 35.9166 |

- ***10% coefficient Retained***

Now we are selecting compression level, when 10 % coefficients would remain. We are taking lord.jpg as our source image. Plots of PSNR, MSE, and BER of this image, when transmitted through AWGN Channel, are given below. Curves numerical values are given in Table 3.2 at different SNR Values.

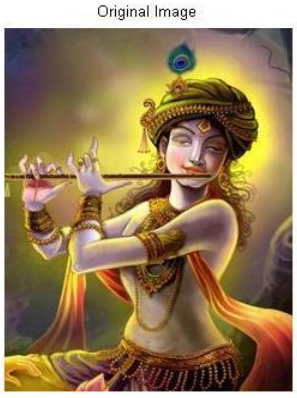


**Fig. 3.6 Source Image**


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**Fig: 3.7 Compressed Image when 10% Coefficient Retained**

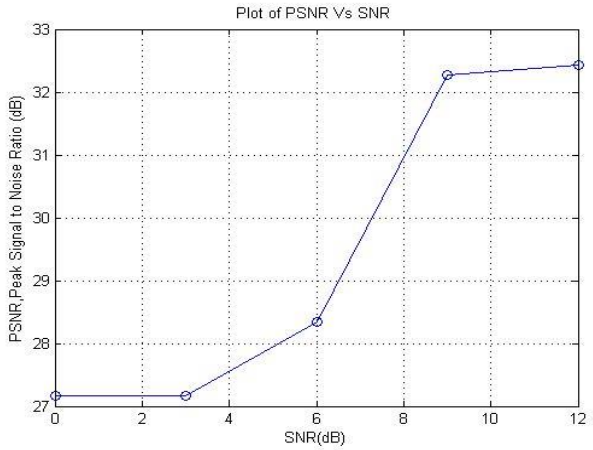


**Fig: 3.8 Plot Of PSNR Vs SNR when 10 % Coefficient Retained**

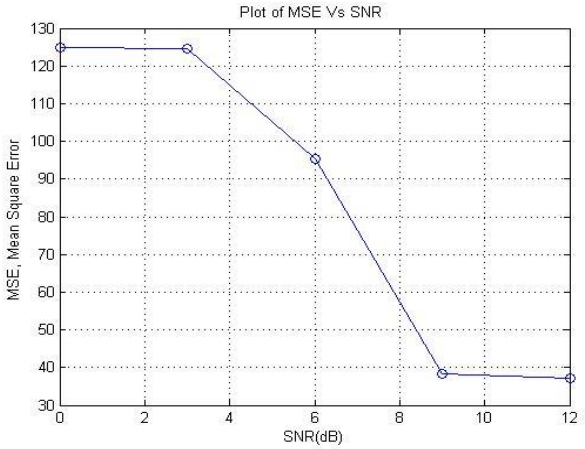


**Fig: 3.9 Plot Of MSE Vs SNR when 10 % Coefficient Retained**

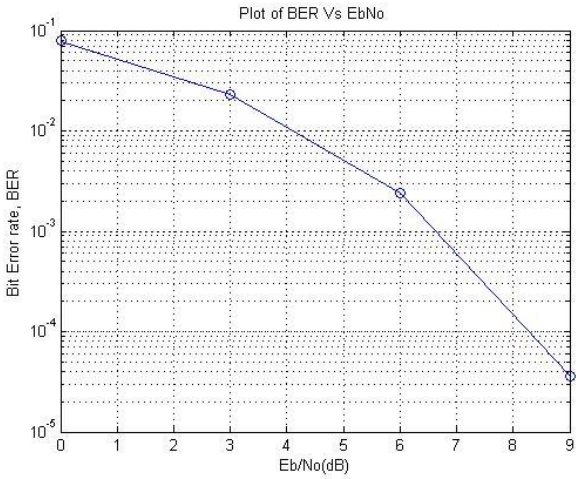


**Fig: 3.10 Plot Of BER Vs SNR when 10 % Coefficient Retained**

**Table: 3.2 Values of PSNR, MSE, BER when 10 % Coefficient Retained**

| SNR (dB) | BER | MSE | PSNR(dB) |
|---|---|---|---|
| 0 | 0.0786 | 124.8788 | 27.1659 |
| 3 | 0.0231 | 124.3909 | 27.1769 |
| 6 | 0.0024 | 95.3909 | 28.3357 |
| 9 | $3.2e^{-5}$ | 38.4765 | 32.2788 |
| 12 | 0 | 37.1353 | 32.43 |

## IV.CONCLUSION

In this research work initially we are analyzing the effect of compression level on the performance of image transmission and compression system at different compression level. As we can see at lower SNR compression level does not affect the performance assets like PSNR( Peak Signal to Noise Ratio), MSE(Mean Squared Error) , BER (Bit Error Rate). But as the SNR level increases comression level disturbes the assets . Having more compression values results gives poor performances as you can see in the tables 3.1 & 3.2.

## REFERENCES

1. Nikita Bansal, Sanjay Kumar Dubey , "Image Compression using Hybrid Transform Technique" , Journal of Global Research in Computer Science, Vol. 4 No.1 Jan 2013.
2. A.K. Katharotiya, S. Patel and M. Goyani, "Comparative Analysis between DCT & DWT Techniques of Image Compression", Journal of Information Engineering and Applications, Vol 1, No.2, 2011.
3. Oussama Ghorbel , Walid Ayedi , Mohamed Wasim Jmal and Mohamed Abid , "DCT & DWT Images Compression Algorithms in Wireless Sensors Networks: Comparative Study and Performance analysis" International Journal of Wireless & Mobile Networks (IJWMN) Vol. 4, No. 6, December 2012


*Published By:*
*Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)*

4. A.M.Raid, W.M.Khedr, M. A. El-dosuky and Wesam Ahmed, "Jpeg Image Compression Using Discrete Cosine Transform - A Survey" , International Journal of Computer Science & Engineering Survey (IJCSES) Vol.5, No.2, April 2014, DOI : 10.5121/ijcses.2014.5204
5. Priyanka Dixit, Mayanka Dixit, "Study of JPEG Image Compression Technique Using Discrete Cosine Transformation", International Journal of Interdisciplinary Research and Innovations (IJIRI), Vol. 1, Issue 1, pp: (32-35), Month: October-December 2013.
6. S. Anitha, "Image Compression Using Discrete Cosine Transform & Discrete Wavelet Transform", International Journal of Scientific & Engineering Research, Vol. 2, No. 8, 2011.