

“Result Analysis using CROI with JPEG & WAVELET on Natural Images”Sejal Thakkar¹¹*IT Department, G.H Patel College of Engineering and Technology*

Abstract—Aim of ROI based compression for Natural image is to enhance the compression efficiency for transmission and storage [2]. Some times from the whole image we need only some part. Image compression addresses the issues of larger storage and faster transmission requirements. ROI compression of Natural images aims at compressing the important region, region of interest (ROI), of an image with supreme quality as compared to rather unimportant area i.e. the background. Thus, the ROI area is compressed with less compression ratio and the background with the highest possible compression ratio in order to get better overall compression performance.

As a part of ROI compression technique CROI [1] with JPEG & WAVELET compression algorithm have been implemented on Image Cameraman.bmp using MATLAB. A detailed analysis on the basis of parameters like CR, MSE, PSNR and COC has been carried out to evaluate these algorithms. With the use of CROI approach with JPEG algorithm, we get PSNR of 34.74 for image and CROI with WAVELET gives PSNR of 35.13 db with extremely good quality of image area.

Keywords: DCT, JPEG, ROI, Region of Interest, US, Ultra sound, WAVELET

I. INTRODUCTION

In conventional compression model, an entire image is compressed equally, i.e. equal or same level of compression is applied to the useful area as well as to the redundant area of an image. But sometimes, in Natural image compression in particular, it is desired to preserve the quality of a particular portion of an image more as compared to the rest of the image. The disadvantage of a conventional compression system is that it will compress the entire image with same compression ratio. Hence we can not get a good overall compression performance in case of a conventional compression algorithm.

And that is where a newer concept of compression, called the ROI Compression, arises where the important and unimportant areas of an image are compressed with different compression ratios.

Now, natural images comprise of important areas-Region of Interest (ROI), that used for the diagnosis and unimportant area-Background region, which comprises the information and is redundant. The background area in an Ultrasound image is quite large, and we can compress it with quite a large compression ratio as it contains the redundant information. Again we cannot compress the diagnostically important area (ROI) beyond certain CR, in order to retain quality of the reconstructed image. Hence, the Contextual compression aims at compressing the ROI with the best quality (and least CR) and compressing the background with poor quality (and highest CR) to attain an overall better compression performance.

The evolution of performance is based on the following parameters [3].

$$CoC = \frac{\sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x, y) \hat{f}(x, y)}{\sqrt{\sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x, y)^2} \sqrt{\sum_{x=0}^{M-1} \sum_{y=0}^{N-1} \hat{f}(x, y)^2}} \quad (1)$$

1) *Correlation-coefficient*

It suggests how closely the reconstructed image is correlated with an original image, on a scale of 0-1. The nearer the value of CoC to 1 the higher the correlation of a compressed image to an Original image is there and vice versa.

2) *Mean Square Error*

$$MSE = \frac{1}{NM} \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} \left[\left| f(x, y) - \hat{f}(x, y) \right|^2 \right] \quad (2)$$

Where, $f(x, y)$ is the original pixel value and $\hat{f}(x, y)$ is the compressed pixel value, for an NxM input image.

$$PSNR = 10 \log \left[\frac{(255)^2}{MSE} \right] \quad (3)$$

3) *Peak Signal to Noise Ratio*

peak signal-to-noise ratio, the ratio between the maximum possible power of a signal and the power of corrupting noise. Higher PSNR would normally indicate that the reconstruction is of higher quality noise is the error introduced by compression.

4) *Compression Ratio*

$$CR = \frac{\text{size of original image in bits}}{\text{size of compressed image in bits}} \quad (4)$$

II. THE ROI CODING SCHEMES

Using conventional compression methods could hardly achieve the CR of 40 percent for natural images and that too with much degradation and poor visibility of compressed image. But with contextual compression scheme CR of even 65 percent are quite achievable with superior quality and extremely little degradation of ROI. Some of the ROI coding methods are available [2] here we have analyzed results of various methods and used CROI method with JPEG & WAVELETE compression algorithms.

A. General Scaling Based Method

The general scaling based method places ROI associated bits in the higher bit planes by scaling the bitplanes of ROI coefficients up, so that ROI coefficients can be coded first in the embedded bit plane coding.

This method allows the The general scaling based method place ROI associated bits in the higher bit planes by scaling the bit planes of ROI coefficients up, so that ROI coefficients can be coded firstly in the embedded bit plane coding. This method allows the use of arbitrary scaling value and allows fine control on the relative importance between ROI and BG

First, it needs to encode and transmit the shape information of the ROI. This rapidly increases the algorithm complexity. Second, if arbitrary ROI sharps are desired, the shape coding will consume a large number of bits, which significantly decreases the overall coding efficiency.

B. Maxshift method

In the Maxshift method, prior to bit-plane coding, bit planes of the ROI coefficients are scaled up by the desired amount so that coefficients associated with the ROI are placed in higher bit planes. The scaling factor is selected to ensure there is no overlap between background and ROI bit planes. When the entropy coder encodes the code block containing ROI coefficients, the encoded ROI bits appear before the background bits. Then rate control builds a layer progressive bit stream in which information pertaining to ROI precedes that of the background.

The main strength of Maxshift is its fast ROI reconstruction. It also lifts the restriction on ROI shape.

Weakness of the Maxshift method include the increase in coding time and background is received only after full ROI reconstruction

C. Implicit ROI Coding

The implicit ROI encoding operates as follows. When given a spatial ROI, the relevant code blocks are identified and their contributions are sequenced into the embedded bit stream in a manner that effectively augments the priority of the ROI. Since EBCOT allocates the code block contributions in terms of the overall distortion minimization, the implicit ROI encoding allocates code block contributions in accordance with distortion reduction and the region of interest

The main advantage of the implicit ROI encoding is its low Complexity. The method itself is straightforward and easy to implement. More than that, no bit plane scaling is involved at either the encoding or the decoding side.

Weakness is slow ROI reconstruction. This is because the priority arrangement is made on a block-by-block basis and some ROI code blocks may contain a large amount of BG information.

The performance parameters have been discussed in detail by many Authors. The output performance parameters have been analyzed quantitatively and plotted which clearly show the superiority of the proposed method at high compression rates in comparison to the methods.

D. CROI Method

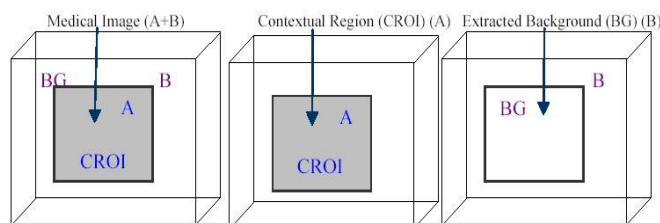


Fig 1.CROI method[1]

Following procedure is performed in the CROI compression method [1].

- Preprocess an input image
- Separate out CROI and background
- Apply compression algorithms on CROI and Background
- Merge compressed CROI and background
- Calculate CR and MSE, PSNR and COC of compressed image

This is iterative approach here we have to take iterations until we get the satisfactory Results.

III. IMPLEMENTATION PROCEDURE FOR NATURAL IMAGE (CAMERAMAN.BMP)

A. CROI WITH JPEG Algorithm steps for compression of Natural image

- Step:- Initialize the image parameters and load the original image to be compressed selectively. Using function like IMREAD.
- 2) Step:- The pre-processing and filtering is performed to rectify the noise if any.



Fig 2. Load original ultrasound image of Cameraman.bmp

- 3) Step:- Activate the ROI mask to get the selection of ROI. Using ROIPOLY() to select a polygonal region of interest within an image. ROIPOLY returns a Binary image that you can use as a mask for masked filtering. Binary image with 0's outside the region of interest and 1's inside.
- 4) Step:- After the ROI mask is activated, the priority adjustment is done to prioritize the encoding of Contextual region (ROI), so the ROI encoding can be done first and BG encoding later
- 5) Step: - Now selection of the Contextual region i.e. the ROI is done based on the ROI mask.



Fig 3. Activated Roi mass.bmp

6) Step: - The contextual region (ROI) is separated from the image as per the requirement and set high priority of encoding Using IMMULTIPLY ().



Fig 4. Separated Roi .bmp

7) Step:- Separate the BG form the image and assign low priority for encoding.



Fig 5. Separated Background.bmp

8) Step:- Encoding of the ROI region is performed selectively with the JPEG algorithm [5] using dct and Haffman coding method [5] with low CR

9) Step: - Encoding of the BG is performed with the JPEG Haffman coding technique with a very high CR

10) Step: - Now activate the encoded ROI for merging with BG & encoded BG for merging with the ROI.

11) Step: - Now, Merge the BG and the ROI.

12) Step: - After merging of the ROI and the BG, get the compressed image encoded.



Fig 6. Resualt.jpg

13) Step: - compressed image may be stored as per the requirement. The reconstruction of the image is done after decoding the compressed image encoded data.

14) Step:- After reconstruction, the image is correlated with original one Decide on the basis of MSE, PSNR and CoC

B. Performance Measuring Parameters of CROIJPEG

TABLE I-ROI AND ENTIRE IMAGE PARAMETERS: CR,MSE,PSNR & COC

CROI JPEG PERFORMANCE MESURING PARAMETERS FOR US MEDICAL IMAGE KIDNEY							
CR	bpp	MSE		PSNR, dB		CoC	
		ROI	ENTIRE IMAGE	ROI	ENTIRE IMAGE	ROI	ENTIRE IMAGE
20.01	0.40	21.92	57.65	34.75	29.17	0.9986	0.9969
32.01	0.25	39.47	109.17	32.19	27.78	0.9977	0.9942
40.02	0.20	45.79	184.69	31.54	25.49	0.9975	0.9914
44.36	0.18	56.38	206.44	30.65	24.99	0.9966	0.9905
51.06	0.15	68.28	289.77	29.70	23.56	0.9959	0.9876

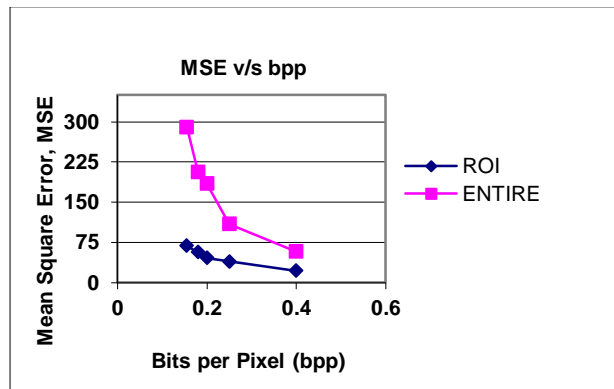


Fig 7. Graphical Representation: Bpp Vs MSE

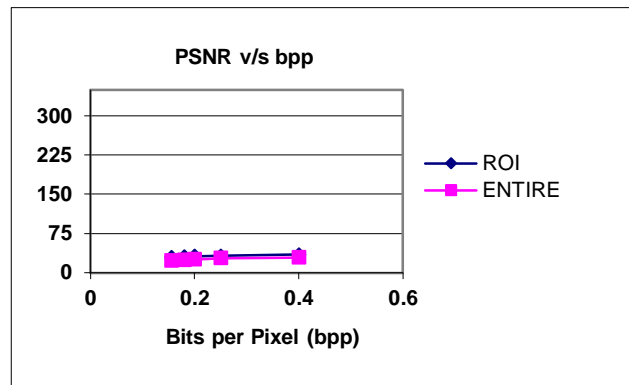


Fig 8. Graphical Representation: Bpp Vs PSNR

C. CROI WITH WAVELET Algorithm Steps For Compression Of Natural Image Cameraman.bmp

1) Step:- Initialize the image parameters and load the Image CAMERAMAN.bmp to be compressed selectively. Using function like IMREAD.

2) Step: - The pre-processing and filtering is performed to rectify the noise if any.



Fig 9. Cameraman.bmp

3) Step: - Activate the ROI mask to get the selection of ROI.

4) Step:- After the ROI mask is activated, the priority adjustment is done to prioritize the encoding of Contextual region (ROI), so the ROI encoding can be done first and BG encoding later

5) Step: - Now selection of the Contextual region i.e. the ROI is done based on the ROI mask. Using ROIPOLY to select a polygonal region of interest within an image. ROIPOLY returns a binary image that you can use as a mask for masked filtering. binary image with 0's outside the region of interest and 1's inside



Fig 10. Activated Roi mass.bmp

6) Step:- The contextual region (ROI) is separated from the image as per the requirement and set high priority of encoding. Using IMMULTIPLY.



Fig 11. Separated Roi .bmp

7) Step:- Separate the BG form the image and assign low priority for encoding.



Fig 12. Separated Background.bmp

8) Step:-Select the compression methodology for CROI and BG respectively.

9) Step:- Calculate the wavelet coefficients of CROI & BG separately for priority encoding of the test image . Obtain the bit allocation for each CROI and BG regions. here we have used 'bio 6.8' wavelet up to Third level decomposition.

10) Step:-Quantize the wavelet coefficients for each subband of each region (CROI & BG) and send the quantized coefficients to entropy encoder progressively.

11) Step:-Compress the CROI region with very low CR (high bit rate) lossy or near lossless by quantization.

Compress the BG region with very high CR (low bpp) and lossy by quantization

12) Step:- Get the compressed bit stream of test image for CROI & BG separately

13) Step:-Merge the CROI and the BG regions to get decoded image

14)Step:-Calculate performance parameters of CROI,BG & Image. Check the Image quality by the HVS and the Correlation.

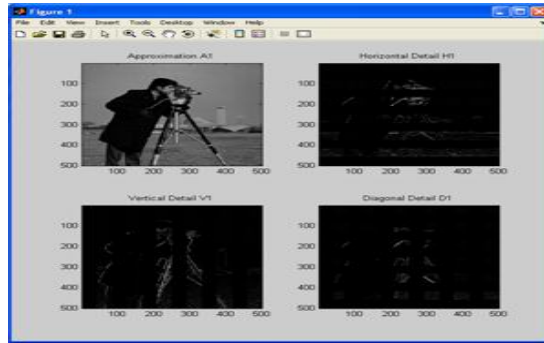


Fig 13.level 1 Decomposition

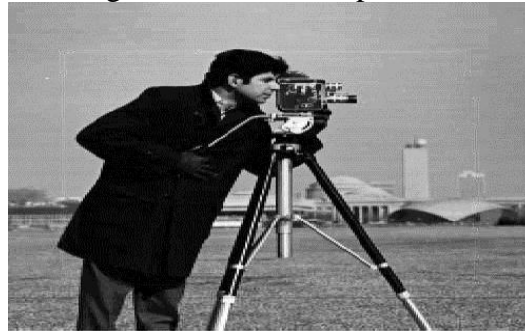


Fig 14.Result.jpg

D. Performance Mesuring Parameters CROI WAVELET

TABLE II-ROI and ENTIRE IMAGE Parameters: CR,MSE,PSNR & COC

CROI WAVELET PERFORMANCE MESURING PARAMETERS FOR US MEDICAL IMAGE KIDENY							
CR	bpp	MSE		PSNR, dB		CoC	
		ROI	Entire Image	ROI	Entire Image	ROI	Entire Image
20.01	0.40	20.03	78.55	35.12	30.17	0.9987	0.9959
32.01	0.25	24.05	96.04	34.33	28.31	0.9986	0.9949
40.02	0.20	29.71	125.87	33.42	27.14	0.9982	0.9936
44.36	0.18	40.48	128.93	32.06	27.04	0.9973	0.9933
51.06	0.15	45.83	131.94	31.56	26.71	0.9964	0.9925

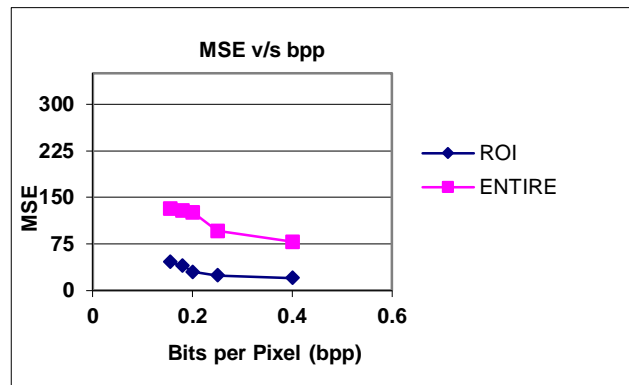


Fig 15. Graphical Representation: Bpp Vs MSE

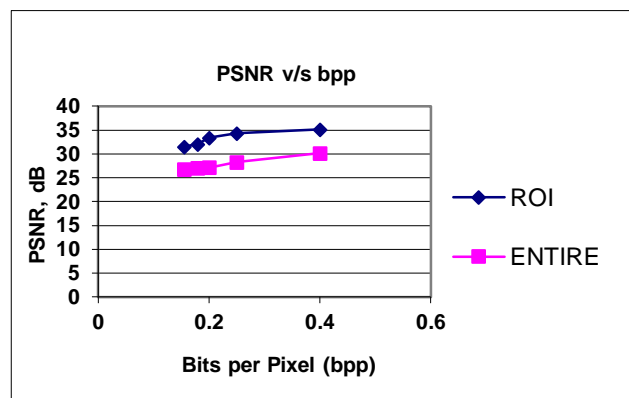


Fig 16. Graphical Representation: Bpp Vs PSNR

E. Comparative Analysis of CROI JPEG & WAVELET

TABLE III-PSNR Comparison of JPEG & WAVELET

Sr.No	CR	PSNR(dB)	
		JPEG	WAVELET
1	20.01	34.75	35.12
2	32.01	32.19	34.33
3	40.02	31.54	33.42
4	44.36	30.65	32.06
5	51.06	29.70	31.56

TABLE IV-MSE COMPARISON OF JPEG & WAVELET

Sr.No	CR	MSE	
		JPEG	WAVELET
1	20.01	21.92	20.03
2	32.01	39.47	24.05
3	40.02	45.79	29.71
4	44.36	56.38	40.48
5	51.06	68.28	45.83

TABLE V-CoC Comparison of JPEG & WAVELET

Sr.No	CR	CoC	
		JPEG	WAVELET
1	20.01	0.9986	0.9987
2	32.01	0.9977	0.9986
3	40.02	0.9975	0.9982
4	44.36	0.9966	0.9973
5	51.06	0.9959	0.9964

IV. RESULTS AND DISCUSSION

Using conventional compression we get maximum CR up to 40 for natural Images but using CROI with JPEG & WAVELET method we get entire CR up to 51 with good visual quality of ROI. With the use of CROI with WAVELET we get higher PSNR less MSE and nearer CoC than JPEG. ROI is compressed with better quality than background for so .we get the good visual quality of image area (ROI).

V. CONCLUSION & FUTURE WORK

WAVELET with CROI is a powerful tool for compressing an image than JPEG. We can also implement CROI method with other compression algorithms.

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