



Image Compression based on Modified Block Truncation Code using Gray Scale Image

Usha Shukla

M Tech. Scholar

Dept. of Electrical & Electronics
NITTTR, Bhopal, India**Dr. Anjali Potnis**

Associate Professor

Dept. of Electrical & Electronics
NITTTR, Bhopal, India**Ravi Ranjan Kumar Singh**

M Tech. Scholar

Dept. of Electrical & Electronics
NITTTR, Bhopal, India

Abstract—In the present era of multimedia, the requirement of image/video storage and transmission for video conferencing, image and video retrieval, video playback, etc. are increasing exponentially. As a result, the need for better compression technology is always in demand. Modern applications, in addition to high compression ratio, also demand for efficient encoding and decoding processes, so that computational constraint of many real-time applications is satisfied. Since these method involves less number of simple computations, the time taken by this algorithm is also very less when compared with BTC. The given image is divided into non overlapping rectangular regions. For the sake of simplicity the blocks were let to be square regions of size $m \times m$. They differ in the way of selecting the quantization level in order to remove redundancy. Objectives measures were used to evaluate the image quality such as: Peak Signal to Noise Ratio (PSNR).

Keywords— BTC, PSNR, Block Size

I. INTRODUCTION

The rising multimedia technology and growth of GUI based software have made digital image data an inherent part of modern life. When a 2-D light intensity function is sampled and quantized to create a digital image, the amount of data generated may be large in volume that it results storage, processing and communication requirements. Therefore, the theory of data compression becomes more and more important for reducing the data redundancy to save more hardware space and transmission bandwidth.

Lossless compression ratio gives good quality of compressed images, but yields only less compression whereas the lossy compression techniques [2] lead to loss of data with higher compression ratio. JPEG [1] and Block Truncation Coding [3] are loss image compression techniques. Compression is useful as it helps to reduce the consumption of expensive resources such as hard disk space or transmission bandwidth [1] [2]. BTC is a simple and fast lossy compression technique for gray scale images. The basic idea of BTC [3] is to perform moment preserving quantization for blocks of pixels. The input image is divided into non-overlapping blocks of pixels of sizes 4×4 , 8×8 and so on. Mean and standard deviation of the blocks are calculated. Mean is considered as the threshold and reconstruction values are determined using mean and standard deviation.

Then a bitmap of the block is derived based on the value of the threshold which is the compressed or encoded image. Using the reconstruction values and the bitmap the reconstructed image is generated by the decoder. Thus in the encoding process, BTC produces a bitmap, mean and standard deviation for each block. It gives a compression ratio of 4 and bit rate of 2 bits per pixel when a 4×4 block is considered. This method provides a good compression without much degradation on the reconstructed image. But it shows some artifacts like staircase effects or raggedness near the edges. Due to its simplicity and easy implementation, BTC has gained wide interest in its further development and application for image compression.

To improve the quality of the reconstructed image and for the better compression efficiency several variants of BTC have been developed during the last many years. Absolute Moment Block Truncation Coding (AMBTC) [4] preserves the higher mean and lower mean of each block and use this quantity to quantize output. AMBTC provides better image quality than image compression using BTC. Moreover, the AMBTC is quite faster compared to BTC. The algorithm is computationally faster because it involves simple analytical formulae to compute the parameters of the edge feature in an image block. Reconstructed images are of good quality in accordance with human perceptual experience. The algorithm represents the image in terms of its binary edge map, mean information, and the intensity information on both sides of the edges.

II. LITERATURE SURVEY

Jing-Ming Guo et al. [1], Block truncation coding (BTC) has been considered a highly efficient compression technique for decades. However, its inherent artifacts, blocking effect and false contour, caused by low bit rate configuration are the key problems. To deal with these, an improved BTC, namely dot-diffused BTC (DDBTC), is

proposed in this paper. Moreover, this method can provide excellent processing efficiency by exploiting the nature parallelism advantage of the dot diffusion, and excellent image quality can also be offered through co-optimizing the class matrix and diffused matrix of the dot diffusion. According to the experimental results, the proposed DDBTC is superior to the former error-diffused BTC in terms of various objective image quality assessment methods as well as processing efficiency. In addition, the DDBTC also shows a significant image quality improvement comparing with that of the former ordered-dither BTC.

Jayamol Mathews et al. [2], with the emerging multimedia technology, image data has been generated at high volume. It is thus important to reduce the image file sizes for storage and effective communication. Block Truncation Coding (BTC) is a lossy image compression technique which uses moment preserving quantization method for compressing digital gray level images. Even though this method retains the visual quality of the reconstructed image with good compression ratio, it shows some artifacts like staircase effect, raggedness, etc. near the edges. A set of advanced BTC variants reported in literature were studied and it was found that though the compression efficiency is good, the quality of the image has to be improved. A modified Block Truncation Coding using max-min quantizer (MBTC) is proposed in this paper to overcome the above mentioned drawbacks. In the conventional BTC, quantization is done based on the mean and standard deviation of the pixel values in each block. In the proposed method, instead of using the mean and standard deviation, an average value of the maximum, minimum and mean of the blocks of pixels is taken as the threshold for quantization. Experimental analysis shows an improvement in the visual quality of the reconstructed image by reducing the mean square error between the original and the reconstructed image. Since this method involves less number of simple computations, the time taken by this algorithm is also very less when compared with BTC.

Seddeq E. Ghrare et al. [3], with the continuing growth of modern communication technologies, demand for image data compression is increasing rapidly. Techniques for achieving data compression can be divided into two basic approaches: spatial coding and Transform coding. This research paper presents a proposed method for the compression of digital images using hybrid compression method based on Block Truncation Coding (BTC) and Walsh Hadamard Transform (WHT). The objective of this hybrid approach is to achieve higher compression ratio by applying BTC and WHT. Several grayscale test images are used to evaluate the coding efficiency and performance of the hybrid method and compared with the BTC and WHT respectively. It is generally shown that the proposed method gives better results.

Ki-Won Oh et al. [4], this paper presents a parallel implementation of hybrid vector quantizer-based block truncation coding using Open Computing Language (OpenCL). Processing dependency in the conventional algorithm is removed by partitioning the input image and modifying neighboring reference pixel configuration. Experimental results show that the parallel implementation drastically reduce processing time by 6~7 times with significant visual quality improvement.

III. METHODOLOGY

- **BTC-PF Method**

The encoding method of VQ is time consuming, whereas its decoding method uses table look-up method and is very fast. This method results in higher compression ratio, though quality of the reconstructed image is usually not as good as BTC. BTC is a simple and fast method, which enables high quality reconstruction but bit-rate is also high. Comparatively, the encoder of BTC is faster than that of VQ, while its decoder is little slower. A compromise between these two methods gives a fast decoder, maintains good quality for reconstructed image with moderate bit-rate. Again, this hybrid method can also be used in image feature extraction. That means the compressed data due to this method can directly be used to compute image features like, edge [5-6].

The method of selection of the best fit pattern for an image block B of size $n \times n$ is as follows. For an image block B, let the pixels coordinates are x_1, x_2, \dots, x_{n^2} and the corresponding pixel intensities are $f(x_i)$. Available patterns are, say, P_1, P_2, \dots, P_M of size $n \times n$ and the levels present in a pattern are represented by t where $1 \leq t \leq Q$. Thus, any pattern is represented as

$$km_1 = k'(A - d) + (k - k')(A + d) \quad (1)$$

$$km_2 = k'(A - d)^2 + (k - k')(A + d)^2 \quad (2)$$

Solving for A and d we get

$$A = m_1 + \frac{\sigma(2k' - k)}{2\sqrt{k'(k - k')}} \quad (3)$$

$$d = m_1 + \frac{\sigma k}{2\sqrt{k'(k - k')}} \quad (4)$$

Hence, intensity $\hat{f}(x_i)$ of the pixels of the corresponding block in the reconstructed image is given by

$$\hat{f}(x_i) = \begin{cases} A + d & \text{if } x_i \in C_1 \\ A - d & \text{if } x_i \in C_2 \end{cases} \quad (5)$$

It is clear that $a = A - d$ and $b = A + d$, where a and b are the quantization levels for partition.

IV. EXPERIMENTAL ANALYSIS

Performance of the MBTC and BTC-PF has been evaluated for a set of standard test images, viz., ‘lena256’, ‘cameraman’, and ‘lena512’. The first two images are of size 256×256 and other image is of size 512×512. MBTC and BTC-PF is compared with conventional BTC. Table I shows the comparative performance results of BTC, MBTC and BTC-PF. The performance is measured based on three parameters PSNR and CR. From Table I, it is seen that performance of the method MBTC and BTC-PF is better than BTC algorithm on the basis of the two performance measures. For all the test images with 4×4, 8×8 and 16×16 blocks, though the compression ratio is same as that of BTC, PSNR and values are high when compared with BTC. It shows an enhancement in the visual quality of the reconstructed image.

In certain images where the edges are not very distinct because of the inherent blurriness of the pixel values due to the nature of the images, the edge positions may or may not be accurate.

Table I: Comparative Performance Results Of Btc, Mbtc And Btc-Pf Algorithms

Image	Method	Block Size 4		Block Size 8		Block Size 16	
		PSNR	CR	PSNR	CR	PSNR	CR
Lena (256×256)	BTC	26.1870	4	23.2611	6.4	21.2497	7.5294
	MBTC	31.0293	4	28.0011	6.4	25.7397	7.5294
	BTCPF	32.1578	4	31.2568	6.4	27.2653	7.5294
cameraman (256×256)	BTC	24.2787	4	22.0288	6.4	20.608	7.5294
	MBTC	29.7992	4	27.5040	6.4	25.3539	7.5294
	BTCPF	30.5689	4	28.2531	6.4	26.1245	7.5294
Lena (512×512)	BTC	29.0602	4	25.7395	6.4	23.1014	7.5294
	MBTC	33.6711	4	30.4800	6.4	27.8683	7.5294
	BTCPF	35.2517	4	35.6012	6.4	33.2578	7.5294



Figure 1: Original Image, Reconstructed images (4×4 block)

Figure 2: Reconstructed images (8×8 block), reconstructed images (16×16 block)

V. CONCLUSION

The objective of this paper is to develop an image compression method for which the decoder would be very efficient. Such method is suitable in situations where image or image is compressed once but decoded frequently. It is clear that the decoding time due to spatial domain based compression is much less than that of the sub-band compression techniques. Two widely used spatial domain compression techniques are block truncation coding (BTC) and vector quantization (VQ). BTC method results in good quality image with high bit-rate, while the VQ is well known for low bit-rate but produces poor quality image. This thesis proposes a hybrid compression method using the concept of BTC and VQ to achieve a good compromise between bit- rate and quality. The proposed compression method, namely the block truncation coding using pattern fitting (BTC-PF), inherits the advantages of both BTC and modified BTC methods.

REFERENCES

- [1] Jing-Ming Guo, Senior Member, IEEE, and Yun-Fu Liu, Member, IEEE, “Improved Block Truncation Coding Using Optimized Dot Diffusion”, IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 23, NO. 3, MARCH 2014.
- [2] Jayamol Mathews, Madhu S. Nair, “Modified BTC Algorithm for Gray Scale Images using max-min Quantizer”, 978-1-4673-5090-7/13/\$31.00 ©2013 IEEE.
- [3] Ki-Won Oh and Kang-Sun Choi, “Parallel Implementation of Hybrid Vector Quantizerbased Block Truncation Coding for Mobile Display Stream Compression”, IEEE ISCE 2014 1569954165.
- [4] Seddeq E. Ghrare and Ahmed R. Khobaiz, “Digital Image Compression using Block Truncation Coding and Walsh Hadamard Transform Hybrid Technique”, 2014 IEEE 2014 International Conference on

Computer, Communication, and Control Technology (I4CT 2014), September 2 - 4, 2014 - Langkawi, Kedah, Malaysia.

- [5] M. Brunig and W. Niehsen. Fast full search block matching. *IEEE Transactions on Circuits and Systems for Video Technology*, 11:241 – 247, 2001.
- [6] K. W. Chan and K. L. Chan. Optimisation of multi-level block truncation coding. *Signal Processing: Image Communication*, 16:445 – 459, 2001.
- [7] C. C. Chang and T. S. Chen. New tree-structured vector quantization with closed-coupled multipath searching method. *Optical Engineering*, 36:1713 – 1720, 1997.
- [8] C. C. Chang, H. C. Hsia, and T. S. Chen. A progressive image transmission scheme based on block truncation coding. In *LNCS Vol 2105*, pages 383–397, 2001.