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Effect of Truncation Matrix on Compression Ratio in Block Truncation Coding Technique

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ABSTRACT: Biomedical images are important factor in health care for diagnosis of disease. As medical imaging facilities are moving towards film less imaging technology, digital image processing techniques plays an important role. Image compression technique is an important multimedia application to effectively store and transmit data at lower bandwidth. BTC based algorithm is designed to compress the biomedical x-ray image. A new application of block truncation coding (BTC) is presented to compress gray scale X-ray images with square and rectangular non-overlapping truncation matrix. The compressed image characteristics parameters such as signal to noise ratio (SNR), peak signal to noise ratio (PSNR), root mean square error (RMSE), and mean absolute error (MAE) with respect to original images are computed. Experimental results are presented which demonstrate that at lower value of truncation matrix, the compression rate is low with image characteristic parameters close to the original image values. As the size of truncation matrix is increased, higher compression of the x-ray image is obtained. Comparative analysis between square truncation matrix and rectangular matrix is also carried out.

KEYWORDS: BTC; Compression; Truncation; Image characteristics.

I. INTRODUCTION

Bio medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention. Bio medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treat disease. Bio medical imaging also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities. Although imaging of removed organs and tissues can be performed for medical reasons, such procedures are usually considered part of pathology instead of bio medical imaging. It includes the analysis, enhancement and display of images captured via x-ray, ultrasound, MRI, nuclear medicine and optical imaging technologies [1].

With the continuing growth of modern communication technology, demand for image transmission and storage is increasing rapidly. Advanced in computer technology for mass storage and digital processing have paved the way for implementing advanced data compression techniques to improve the efficiency of transmission and storage of images. Applications of data compression are primarily in transmission and storage of information [2]. Typically, a compressed image when decoded to reconstruct its original form will be accompanied by some distortion. The efficiency of a compression algorithm is measured by its data compression ability, the resulting distortion and as well by its implementation complexity. The complexity of data compression algorithms is a particularly important consideration in their hardware implementation image transmission application are in broadcast television, remote sensing via satellite, aircraft, radar, sonar, teleconferencing, computer communication, facsimile Transmission.....etc. image storage is required most commonly for education, and business document, medical image used in-patient monitoring system....etc. because of their wide application, data compression and coding schemes have been of great importance in digital image processing application of data compression is also possible in the development of fast algorithms where the number of operation required to implement an algorithm is reduced by working with the compressed data [3-5].

Fig. 1. Image compression model.

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Block Truncation Coding is a lossy image compression techniques .It is a simple technique which involves less computational complexity. BTC is a recent technique used for compression of monochrome image data. It is one-bit adaptive moment-preserving quantizer that preserves certain statistical moments of small blocks of the input image in the quantized output. The original algorithm of BTC preserves the standard mean and the standard deviation [6-9]. The statistical overheads Mean and the Standard deviation are to be coded as part of the block. The truncated block of the BTC is the one-bit output of the quantizer for every pixel in the block .Block Truncation Coding is a well-known compression scheme proposed in 1979 for the grayscale images. It was also called the moment-preserving block truncation because it preserves the first and second moments of each image block. Various parameters that can be used for measure the quality of images are: SNR, PSNR, RMSE and MAE [10-11].

II. METHODOLOGY

In order to proceed with the research work image processing toolbox is used. The work is divided into two major parts. The main goal of image compression is to reduce redundancy in the image as much as possible. Block Truncation Coding (BTC) is one of the simple and easy to implement image compression algorithms. The basic steps of BTC algorithm is shown in Fig. 2. The first section of the research work is divided into two sub divisions with square and rectangular truncation matrix. The size of truncation matrices ranging from 8 bit to 256 bit with step size of 8 bits. Similarly, in case of rectangular truncation matrices of size $n \times 8 + n$. Figure 3 shows the image used in research work.

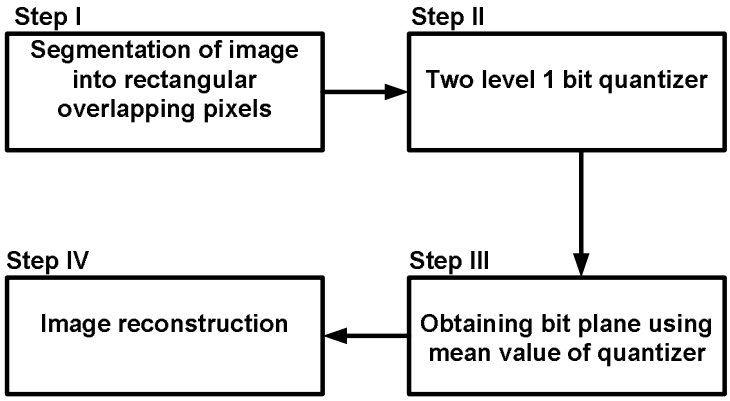

Fig. 2 Steps involve in BTC coding.

Fig. 3 X-ray image used in the research work.

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III. RESULTS

BTC based x-ray image compression is carried out to estimate the compression ratio and image quality parameters. The research work is divided into two parts. In the first part square truncation matrix are used ranging from 8bit to 1024 bits. In the second part, rectangular truncation matrices having size $n \times 8+n$ and range of 4bit to 512 bit are taken. The capability of BTC based compression depends upon the complete coverage of image by truncation matrix. Various iteration of truncation matrix such as 8x8, 16x16, 24x24…..., and 1024x1024 are taken and compressed output images are obtained. Table 1 and Table 2 shows the size of compressed image size with respect to truncation matrix size. Compression of x-ray image using square and rectangular truncation matrix in BTC algorithm provides low size image with good quality information. The graphical representation of size of compressed image with increasing order of truncation matrices are shown in Fig. 4. It can be observed that as the size of matrix is increased size of the compressed image decreases. The compression of image provided by rectangular truncation matrix is lower than square matrix.

Table 1 Size of compressed image w.r.t square truncation matrix in BTC.

Truncation Matrix		O/P Image Size Kb	Truncation Matrix		O/P Image Size Kb
M	N		M	N	
8	8	2,526	144	144	2,147
16	16	2,540	152	152	2,139
24	24	2,477	160	160	2,154
32	32	2,450	168	168	2,099
40	40	2,411	176	176	2,114
48	48	2,362	184	184	2,078
56	56	2,342	192	192	2,086
64	64	2,311	200	200	2,062
72	72	2,289	208	208	2,086
80	80	2,282	216	216	2,065
88	88	2,249	224	224	2,077
96	96	2,231	232	232	2,058
104	104	2,213	240	240	2,062
112	112	2,230	248	248	2,068
120	120	2,181	256	256	2,022
128	128	2,170	512	512	1,806
136	136	2,174	1024	1024	1,584

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Table 1 Size of compressed image w.r.t rectangular truncation matrix in BTC.

Truncation Matrix		O/P Image Size Kb	Truncation Matrix		O/P Image Size Kb
M	N		M	N	
4	8	2,580	136	144	2,158
8	16	2,559	144	152	2,130
16	24	2,490	152	160	2,159
24	32	2,455	160	168	2,114
32	40	2,427	168	176	2,102
40	48	2,373	176	184	2,106
48	56	2,344	184	192	2,083
56	64	2,327	192	200	2,058
64	72	2,294	200	208	2,070
72	80	2,294	208	216	2,092
80	88	2,247	216	224	2,065
88	96	2,243	224	232	2,095
96	104	2,212	232	240	2,059
104	112	2,213	240	248	2,050
112	120	2,208	248	256	2,055
120	128	2,176	256	512	1,869
128	136	2,171	512	1024	1,687

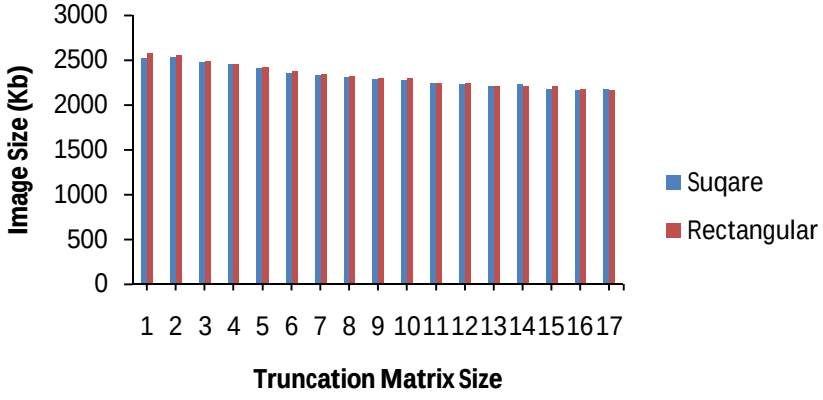

Fig. 4.10 Compressed image size w.r.t truncation matrix size ranging from 8 bit to 136 bits.

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IV. CONCLUSION AND FUTURE WORK

Block Truncation Coding (BTC) is an apparently elegant and efficient time-domain compression technique. BTC is attractive in many applications that require low complexity and moderate data rates. It was observed from the results that the compression of image using rectangular truncation matrix is lower as compared to square truncation matrix. With lower truncation matrix i.e. 8x8 and 4x8 the size of compressed images are 2,526 Kb and 2,580 Kb respectively. Similarly for higher value of truncation matrix 1024 x 1024 and 512 x 1024 the size of compressed images are 1,584 Kb and 1,687 Kb respectively.

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