

A Performance Analysis of Different Techniques for Removing Blocking Artifacts

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Abstract

In different graphical images after compression there are certain problems arises like blocking artifacts, removal of information etc. Blocking artifacts degrades the images by making regular blocks in images. The image will not appear smooth. In this paper we are making performance analysis between different image processing techniques like spatial filtering, and localized. The performance is made on the basis of different parameters like mean square error, peak signal to noise ratio, bit error rate and the visibility of image. Out of these techniques localized technique shows good results. It smoothes the artifacts more in comparison to others.

Keywords

Block Discrete Cosine Transforms, Blocking Artifacts, PSNR, BER, MSE

I. Introduction

One of the most noticeable significant problems in DCT-Based image is Blocking Artifacts, which is the introduce distortion of image Quality. Compression artifact (or artefact) is a noticeable distortion of media (including images, audio, and video) caused by the application of lossy data compression. This noticeable degradation of blocking effect is "blocking artifact" which shows the regular pattern of visible block border. If the compressor could not reproduce enough data in the compressed version to reproduce the original, the result is a diminishing of quality, or introduction of artifacts. Transform from spatial domain to frequency domain is the basic operation. So, this will affect the judgment of an observer. There are the DCT coefficients are available in DCT- domain image/video processing methods, it would be advantageous to measure the quality of image/video in the DCT-domain. For this process there are many bit-streams processing algorithms which are applied directly to the DCT-domain have been developed to avoid the process of decompression and compression. In this paper, we have discussed a spatial, localized filtering method for reducing the blocking artifacts in transformed images. In order to reduce blocking artifacts, measurement of blocking artifacts is very necessary. To propose a blind but accurate measurement algorithm by taking into account that the change in pixel value cross block boundary is large as compared to adjacent pixels as we move away across block boundary. Our method takes advantage of the fact that some of the DCT coefficients of a step function (a sharp edge) have nonzero values [1].

II. DCT Process and Its Equation

Various methods are proposed to measure the blocking artifacts in compressed images. Some method can be implemented only in the pixel domain and therefore requires DCT/IDCT operations. Some general overviews of the graphical image process are:

1. Image is broken into 8×8 blocks of pixels.
2. Start working from left to right, top to bottom, the DCT is applied to each block.
3. Each block is compressed through quantization.
4. Array of compressed blocks that reduced amount of space.
5. Finally, the image is reconstructed through decompression called Inverse Discrete Cosine Transform (IDCT).

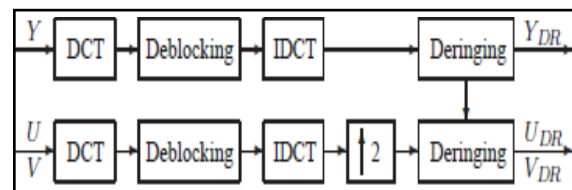


Fig. 1: Technique for Localized Filter

Fig. 1, shows the whole algorithm. First of all, entire components are transformed into DCT domain and with the help of localized non linear filters are deblocked. We use IDCT transform to convert back into pixel domain. Then the deblocked Y component is implemented to form the coefficients at the localized filter which is used for removing ringing effects. U and V components are unsampled to the same size of Y component then are deranged by the localized filter from luma [2].

A novel method to remove blocking artifacts is localized DCT-based filter. It considers the condition of similarity between adjacent blocks [2]. A localized filter is utilized to avoid blurry effect of linear filter and to overcome ringing effect.

$$F_b(u, v) = C_u C_v \sum_{k=0}^{N-1} \sum_{l=0}^{N-1} b(k, l) W_{DTC}(u, k) W_{DCT}(v, l) \quad (1)$$

Where, $b(k, l)$ is the intensity of the (k, l) pixel in b , u , v and $WDCT$ are given by [1].

III. Filtering for Removal of Blocking Artifact

For blocking effect reduction in decoded images, we employ an approach described in [4-6], Various parameters of post-filtering for removing of blocking artifacts in decoded images are there. The efficiency of the proposed method for test images compression is analyzed. Therefore, different filtering method is able to provide the quality of decoding images.

A. Spatial Filtering Methods

To cope with the blockiness problem, different types of post-filtering techniques are developed to reduce the high frequency components near the block boundaries. These methods can be classified as spatial filtering methods, DCT based filtering method or hybrid filtering methods [5].



(a). Horizontally Adjacent Blocks, (b). Vertically Adjacent Blocks

Fig. 2: Blocking Artifacts at the Block Boundaries [5]

This method include the range of smoothing the blockiness effects to those areas where blockiness is quite strong. Firstly we detect the regions having blocking artifacts with help of frequency coefficients. Then compare it with the neighboring pixels if the value of frequency is same we say it is a smooth region [5].

B. Localized Filtering Methods

Localized filters modify the value of each image pixel based on the value of pixels in its neighborhood. Localized filters are sometimes implemented as a convolution. Convolution filtering is a method for modifying the appearance of an image by convolving its pixel values with a transformation kernel. When the kernel is small it is more efficient to use the built-in operation `MatrixConvolve`. When the convolution kernel is relatively large it is more efficient to compute the convolution using the Fast Fourier Transform (FFT). A number of typical convolution kernels are implemented in the operation `MatrixFilter` which also contains a few localized (neighborhood) operators [2].

IV. Parameters Used

In this paper, I have used three parameters. First one is Mean Square Error, Second other is Peak Signal to Noise Ratio and third is Bit Error Rate.

A. Mean Square Error (MSE)

$$MSE = \frac{1}{MN} \sum_{j=1}^M \sum_{k=1}^N (x_{j,k} - x'_{j,k})^2 \quad (5)$$

Where, M and N are rows and columns, respectively of the image. $x_{j,k}$ is the original image and $x'_{j,k}$ is the corresponding output image. The MSE should be less, which means that the pixel intensity of the input and output image should be as close as possible.

B. Peak Signal to Noise Ratio (PSNR)

$$PSNR = 10 \log_{10} \frac{255^2}{MSE} \quad (6)$$

Peak Signal to Noise Ratio should be as large as possible which means that the content of signal in the output is large and the noise is less. Since it is peak signal to noise ratio that's why the value of the signal is considered as maximum which is 255 (for gray scale images the gray scale ranges from 0 – 255).

C. Bit Error Rate (BER)

$$BER = \frac{1}{PSNR} \quad (7)$$

- the number of bit errors is the number of received bits of a data stream over a communication channel that have been altered due to noise, interference, distortion or bit synchronization errors.

V. Results and Discussion

The spatial filter and localized filtering technique is applied on gray scale images.

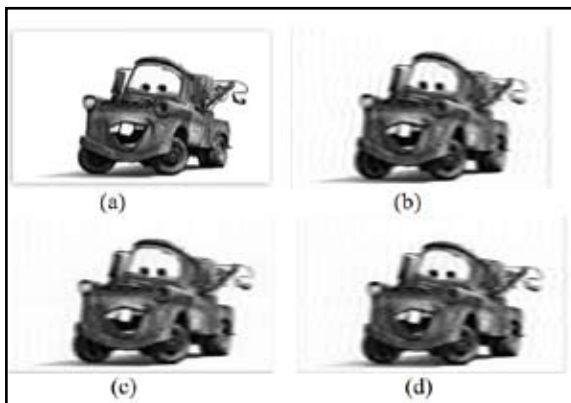


Fig. 3(a): Original Image, (b). Blocking-Artifact Image, (c). Spatial Filtered Image, (d). Localized Image

Table 1: Shows the Parameter Results of Spatial Filter Applied on Original Image

Spatial Filter	Quality factor	Spatial Filter		
	0	PSNR	MSE	BER
	50	2.620	13.67	0.38
	100	23.44	13.67	0.04
	150	29.06	13.67	0.03
	200	32.44	13.67	0.03
	250	34.87	13.67	0.02
	300	36.77	13.67	0.02

Table 2: Shows the Parameter Results of Localized Filter Applied on Original Image

Localized Filter	Quality factor	Localized Filter		
	0	PSNR	MSE	BER
	50	6.592	5.478	0.15
	100	27.42	5.478	0.03
	150	33.03	5.478	0.03
	200	36.41	5.478	0.02
	250	38.84	5.478	0.02
	300	40.74	5.478	0.02

The table shows that peak signal to noise ratio is maximum for Localized filter in comparison to spatial filter. Also as the quality factor increases the peak signal to noise ratio also increases which is again maximum for localized filter. The mean square error and bit error rate is also less for localized filter. The localized filter also removes blocking artifacts from the image in comparison to other filters.

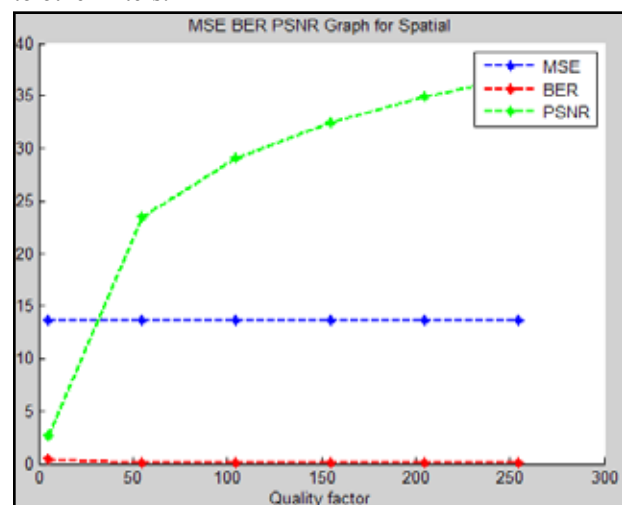


Fig. 4: Graph Shows the Performance Analysis of Spatial Filter Between Different Parameter MSE, BER & PSNR

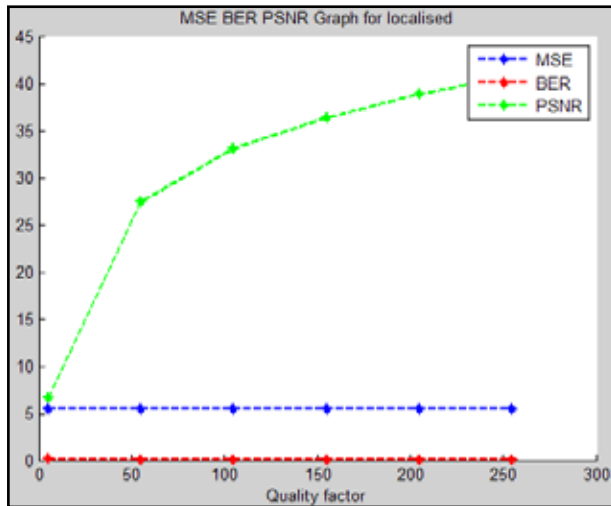


Fig. 5: Graph Shows the Performance Analysis of Localized Filter Between Different Parameter MSE, BER & PSNR

Again the graph shows that the peak signal to noise ratio is maximum while mean square error and bit error rate is minimum for localized filter.

VI. Conclusion

To objectively assess the degree of blocking artifacts in a compressed image, we applied different filters like spatial filtering and localised for measurement of blocking artifacts in DCT-Coded images. The experimental results have shown that our performance is made on the basis of different parameters like mean square error, peak signal to noise ratio, bit error rate and the visibility of image. So as measure to spatial and localised techniques the localized technique shows good results. It smoothes the artifact effectively and stable across different images. Experimental evaluation of the performance of the localized technique showed its ability to removed artifacts faster and also increases the PSNR value of the image. As it is clear from graph results that the artifacts are removed to some extent and it has increased the quality of the images. But the blocking artifacts are not removed totally. We can further apply new filter and then can compare their results on basis of psnr,ber,mse. That which filters is better.

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