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A Novel Image Highly Compression Technique With Spread Parameter

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Abstract - A novel image highly compressed technique has been introduced to reduce the artifacts in compressed JPEG images. In order to reduce the noise, non-linear filtering techniques are often employed than linear filters and don't degrade the edges. A new metric has been introduced to reduce the artifacts occurred in colored images along the sharp transitions using directional spread parameter. Simulations on compressed images show improvement in artifact reduction by using edge based directional fuzzy filter when compared to the non-linear filters.

Index Terms—Artifact reduction, Edge based Directional fuzzy filter.

1. INTRODUCTION

Blocking and ringing are two major artifacts in highly compressed images and videos coded by block-based discrete cosine transform. Many existing deblocking and deringing algorithms are computationally very expensive and/or cannot produce satisfactory results at very low bit rates[1].JPEG is a commonly used method of lossy compression. The JPEG images are suffering from different types of artifacts. . It uses 8x8 blocks, on which the discrete cosine transform (DCT) is performed[7]. The Discrete Cosine Transform (DCT) attempts to de correlate the image data. After de correlation each transform coefficient can be encoded independently without losing compression efficiency. Hence DCT is used to provide the necessary transform and the resultant data is then compressed using quantization and various coding techniques to offer lossless as well as lossy compression. the DCT-II, is often used in image processing, especially for lossy data compression, because it has a strong "energy compaction" property In this case, N is typically 8 and the DCT-II formula is applied to each row and column of the block. The result is an 8 × 8 transform coefficient array in which the (0,0) element (top-left) is the DC (zero-frequency) component and entries with increasing vertical and horizontal index values represent higher vertical and horizontal frequencies[8]. JPEG Compression can introduce ringing artifacts at sharp transitions; this is a due to loss of high frequency components, as in Step response ringing and the another is Blockiness in "busy" regions[6]. Various approaches have been proposed for compression techniques the methods have focused on "post-processing"[3] to reduce the effects of image. In this an adaptive 1-D linear filter is applied along the boundaries of all 8×8 blocks for deblocking. Then each block is classified into edge or non-edge block, and a 2-D fuzzy filter is applied to edge blocks only for deringing . The blocks with suspicious ringing are then replaced with the weighted average of itself and pixel-by-pixel shifted neighboring blocks.

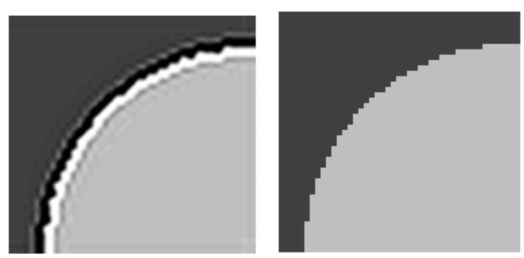


Fig (a) Fig (b)

Fig 1 (a): Image showing ringing artifacts. 3 levels on each side of transition: overshoot, first ring, and (faint) second ring.

Fig (b): without ringing artifacts.

To reduce the noise in the images non-linear Filters have been introduced the filter here used is the median filter[4]. All smoothing techniques are effective at removing noise in Smooth patches of a signal, but adversely affect edges. Often though, at the same time as reducing the Moderate levels of (Gaussian) noise, the median filter is demonstrably better than Gaussian blur at removing noise whilst preserving edges[9]. For block based artifact reduction a LPF was used that pass low-frequency signals but attenuates signals with frequencies higher than the cutoff frequency and it introduces blurring in images. Edge based fuzzy filter was introduced to reduce the ringing artifacts along the sharp transitions.

II. Fuzzy Filter

Fuzzy filter is a specific case of bilateral filter which is an edge-preserving and noise reducing smoothing filter[2]. The intensity value at each pixel in an image is replaced by a weighted average of intensity values from nearby pixelsThis weight is based on a Gaussian distribution .The conservative way to define fuzzy filter is the generalized spatial rank relation[5].

Assume that a filter K is applied to a set **Ω** of neighboring samples x [m+m', n+n'] around the input x[m,n] to form the output

Z[m,n]= ∑ (I[m+m',n+n'],I[m,n])

[m',n']ϵΩ X I[m+m',n+n'] equ(1)

In equ(1) K(I [m+m',n+n'] , I [m,n]) controls the contribution of input to the output. Here we are assuming two cases one is for linear k is fixed value and the another is for non-linear median filter.Due to the designing of LPF in compressed images blurring was introduced in that case the filter coefficients follow the constraints .

K (I [m+m',n+n'] , I [m,n]) =1; equ(2)

K (I [m+m',n+n'] , I [m,n]) =0; equ(3)

Here the fixed value is input independent for linear filters .The function K (I[m+m',n+n'] , I[m,n]) is a membership function that are many functions fulfill the requirements .

K(I[m+m',n+n'],I[m,n]) =exp(-(b-a)2 / 2σ^2) equ (4)

Where represents input of the spread parameter and controls the fuzzy filer, the value of 'b' in equ (4) indicates image neighboring samples, value 'a' is the center samples. The artifacts that are occurred in images are mostly directional and thus fuzzy filter should consider x[n] and is its surrounding samples.

III. COMPRESSION TECHNIQUE WITH SPREAD PARAMETER

When the image is highly compressed, the ringing artifacts are more along the sharp transitions .This ringing artifacts can be removed by using the Directional spread parameter.

(I [m+m', n+n'], I[m,n]) = k_y [m+m', n+n'] x

σ^m [m, n] equ (5)

The filter strength should be applied more along the directions of an image .If we observe the 3-D image it has two directions horizontal axis and vertical axis.Here σ^m is a position dependent amplitude of spread parameter σ and k_y is the scaling factor.

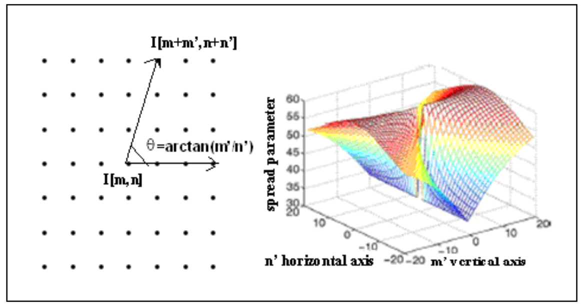


Fig 2 (a) Angle θ (b) spread parameter

For example, the filter should ideally apply stronger smoothing in the horizontal direction, where the ringing artifacts are likely to have no relation with the original value, and a weaker filtering in the vertical direction, which is the edge direction of the image. One general form of cosine-based spread parameter which satisfies this requirement is

$$\sigma(\theta) = \sigma_m (\alpha + \beta \cos^2(\theta)) \quad \text{equ (6)}$$

Where θ is the direction between the pixels of interest I [m, n] and its surrounding pixels I [m+m', n+n'] as shown in figure for an colored image two edges are considered on is horizontal and another is the vertical direction in this we are considering the minimum value applied in vertical direction and maximum value applied in Horizontal direction. The spread parameter can be plotted with σ_m=15, **α =0.5, β=3.5.**

$$\sigma_{min} = \alpha \, \sigma_m \quad \text{equ (7)}$$

$$\sigma_{max} = (\alpha+\beta) \, \sigma_m \quad \text{equ (8)}$$

IV EDGE BASED DIRECTIONAL FUZZY

The ringing artifacts are detected by finding the edge blocks since they usually occur around the image edges. All edge blocks are filtered by a fuzzy filter with fixed spread parameter. Another method to remove the artifacts is Edge based directional the strongest filtering is applied to the direction perpendicular to the edge .Here sobel operator is used with horizontal and vertical derivative approximation of the gradient G_x and G_y are two gradient matrices and these edges are detected by using gradient magnitude is G=$\sqrt{G_y^2 + G_x^2}$. Its direction is determined by $\theta_0 = \text{atan}\,(G_y/G_x)$.

G_x = [-1 0 1; -2 0 2; -1 0 1] x Image and

G_y = [1 2 1; 0 0 0; -1 -2 -1] x Image.

The spread function in this case is ($\theta - \theta_0$) instead Of θ.

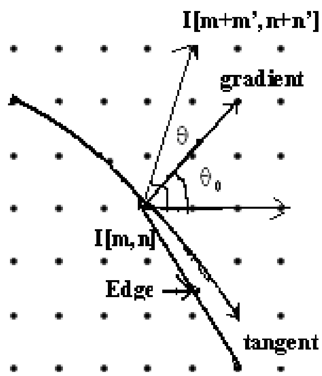


Fig 3: Angles θ and θ_0

The spread parameter should also be adaptive to different areas which have different activity levels such as smooth or detail areas. To control the central pixels amplitude of spread parameter σ_m in equ (6) we use the standard deviation *STD* (*I* (*m, n*))

$$\sigma_m[m,n] = \sigma_0\left((1-\gamma)\left(\frac{STD(I[m,n]) - STD\min}{STD\max - STD\min}\right) + \gamma\right) \quad \text{equ(9)}$$

Where STDmax and STDmin are respectively the maximum and minimum value of all STD (I (m, n)) values in the current frame. σm is scaled to [γσ0 σ0] so that the fuzzy filter is still applied with σm = γσ0 to the lowest activity areas. The proposed algorithm for the directional fuzzy filtering based on edge data.

Algorithm:

The proposed algorithm for edge based directional fuzzy filtering is used to reduce the artifacts in compressed images.

Step1: The pixels in input image are first classified into edge and non edge pixels.

Step 2: compare the gradient magnitude to an empirically threshold.

(a) If G>threshold it detects edge pixels

(b) If G<threshold it detects non-edge pixels

Edge pixels are not filtered because they are not ringing pixels. On edge pixels are ringing pixels.

Step3: If G<Threshold when it detects the non-edge pixels it checks for the edge pixels in the same block.

(a) If it finds the pixels in the same block it finds a particular direction using directional spread parameter

(b) If it finds the pixels in the same block it doesn't considered being any particular. Direction. and are filtered using isotropic fuzzy filter.

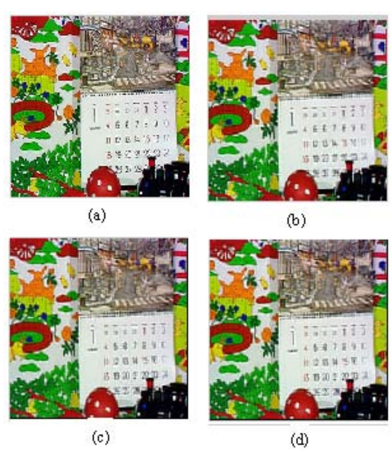
Step 4: Remaining Non-edge pixels spread parameter compression technique is controlled by deviation of centered pixels by all the activity levels.

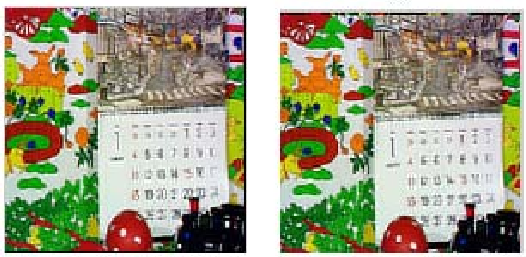
V. RESULTS:

Simulation results show that the qualities of different approaches are compared in terms of visual quality and PSNR in dB. Only the nonedge pixels that have G >210 are filtered to avoid destroying the real edges of the image. The test images are the frames taken from News, Silent, Foreman and Mobile

Table 1: PSNR values in dB

sequence	fuzzy	Directional Spread parameter	Proposed
News	27.65	27.64	29.52
Silent	27.34	27.33	29.78
Foreman	28.23	28.22	29.67
Mobile	21.26	21.25	22.42





(e) (f)

Fig 4: (a) Original image (b) Degraded image (c) Fuzzy filtered image (d) minimum direction fuzzy filter (e) maximum direction fuzzy filter (f) edge based fuzzy filter.

VI. CONCLUSION:

The Proposed algorithm for edge based fuzzy filter is introduced to reduce the artifacts in compressed images. This highly compression technique has been proved that it gives better results when compared to the non-linear filters. It has been proved that edge based fuzzy filter gives better visual quality and PSNR of compressed images.

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