Blur Estimation And Removal To Improve Quality In Image

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Abstract :Noise is major issue observed during the image processing in image processing applications. These noise levels have to be predicted and after estimation get it reduced to certain maximum declined level. We can't be completely structure noise free image but we can improve the quality of image by estimating those noise. The proposed approach is an innovative way to estimate and remove the noise which found through observation during the processing of image. Principal component analysis (PCA) approach is followed to remove the noise by estimating it, this can be done by following one of the statistical technique which is frequently used in signal processing for data dimension reduction or for the data correlation. In principal component analysis image blocks were rearranged into vector and compute the covariance matrix of this vector. Then by selecting the covariance matrix eigen values which corresponds only to noise. With the help the average of the eigen values we can be able to estimate the noise present in the image , for estimation of noise in image we just take a partial region of the image so that it will be convenient for us to reduce it by using the denoise function .

Keywords: Principal Component Analysis, Noise Estimation, Noise removal, Contour Based Segmentation.

I. INTRODUCTION

As noise in images during image processing deprecates its quality, to improve and to avoid it many algorithms were proposed and suggested which made a positive impact and performed an optimal functioning. Most of the algorithms suggestfor changing the neighboring pixel values through filters for which different types of filters were available which remove the noise from images. But most of these algorithms whether determine the actual differences in pixel values comprises of noise or detail of the real photograph and average out the former by attempting to preserve the latter. Noise in the Images has random variation that may be in terms of their information, color or brightness.Estimation of noise in single image is quite typical task and seems to be next to impossible; in that it is hard to find the cause of variation in image it may be due to brightness, texture or color due to noise or from itself. Most of the algorithms [01, 02, 03, and 04] have been proposed for gray level. Usually they are classified on the basis of filter based and segment based, or may be in combination of them.

In this paper an efficient approach for estimation and removal of noise from an image has been proposed which is based on contour based noise estimation algorithm using concept of Principal Component Analysis and novel strength metric to select the contour-based segmentation. This algorithm fulfill the number of objectives related to noise estimation and its removal such as

(I) Noise should be mostly removing from the affected regions ,

(II) there will be no loss in detail of texture.

(III) In denoised image there will not be presence of any artifacts. For estimation of noise from color image RGO model will be use.

II. PROBLEM STATEMENT

The proposed methods in prior research, it is found that their algorithm function on the basis of either by comparing the two image for the estimation of pixel density or to depict the noise or capable of either performing only estimation of noise or its removal. In those algorithm both estimation and reduction of noise is not performed simultaneously in single image.

3. Proposed Algorithm

For estimation and removal of noise from the image some basic algorithm were proposed such as

1. Contour based Segmentation

2. Functioning of PCA for Estimation and Removal of Noise

- Estimation of noise in image through PCA
- Removal of noise from Image through PCA

Contour based Segmentation:

During the analysis of an Image, partitioning of digital image is processed by segmentation into multiple regions which are certain set of pixels by following some homogeneity criterion [04].

The main function of the Pb contour detector is to compute the gradient oriented signal F(x: y; Θ) from intensity image I. This computation is performed by positioning a circular disc at axis (x ; y) which partition it into two half-disc from diameter at angle. For each part of half disc calculate the pixels values of I covered by it. The magnitude gradient F at location (x;y) is defined by the X2 distance between the two half-disc histogram g and h [05] :

$$X^2(x,y) = \frac{1}{2}\sum \frac{(g(t) - h(t))^2}{g(t) + h(t)}$$

Functioning of PCA for Estimation and Removal of Noise:

Principal Component Analysis (PCA): It is a statistical procedure which uses a concept of an orthogonal property to convert a set of observations of possibly correlated values into set of un-correlated values. The main objective of it is to remove the unnecessary disturbances which are considered as noise while retaining the maximum possible signal or image feature. In most cases the quality of particular image is identified and measure through the ratio of their peak signal to noise also abbreviation of PSNR [06]

III.ESTIMATION OF NOISE IN IMAGE THROUGH PCA

During the decomposition of image into segmentation, image model will be formed by an equation as

$$Y_i = P_b + N_i$$

Here $P_b$is an original image contour based block with i^{th} at its center written in vectorized format and Y_i is observed vectorized block corrupted by I, zero-mean Gaussian noise vector n_i . The objective of noise level estimation is to calculate standard deviation n of observed noisy image. The minimum variance direction is calculated using the PCA. The minimum variance direction is the eigen vector associated to the minimum eigen values of the covariance matrix defined as

$$\sum y = \frac{1}{2}\sum_{t=1}^{N}(y_t - \mu)(y_t - \mu)^T$$

Where N is the data number and μ is the average of the dataset $\{y_i\}$.

Removal of noise from Image through PCA

The variations observe in the data can be described by the following three components:

(Total variance) = (Specific variance) + (Common variance) + (error variance).

In matrix form, this can be formed as

$$\frac{1}{N}\mathbf{kb} = \lambda b \text{ , where } b = k\alpha$$

In this equation b represents the Eigen vector of K with Eigen value λ. Normalizing the solution $V_{k,}$ i,e. $(V_k . V_k)$ = 1 translates to $\lambda_k(b_k. b_k) = 1$. To extract non-linear principal component of a point, we compute projections onto the eigen vector by

$$B_k = (V^k, \varphi(x)) = \sum_{t=1}^{n}\alpha^k K(x_t, x)$$

Starting with the noisy image the proposed algorithm follows as

1. Select image and partition it on the basis of contour, then select contours based blocks, this can be done by selecting minimum value of the image blocks having same colour frequency, Contour Detection: $\min(Int(R\_1)) + \tau(R\_1); \; Int(R\_2) + \tau(R\_2)$
2. After selecting the contour based blocks select the blocks with high frequency pixels to estimate the noise present in it with minimum noise density

$$\lambda\_\min\left(\sum_y\right) = \lambda_{\min}\left(\sum_P\right) + \sigma_n^2$$

3. Estimate the noise variance through Principal component analysis (PCA)

$$\sigma_n^2 = \lambda_{\min}(\Sigma_y)$$

4. After estimating the noise variance ,Evaluate the quality of image blocks
(Total variance) = (common variance) + (specific variance) + (error variance)
5. If the quality of image block is acceptable then Evaluate quality of whole image

$$\frac{1}{N}Kb = \lambda b where b = K\alpha$$

6. Finally, after evaluating the quality of whole image then with the help of Principal Component Analysis remove the Noise present in it to maintain the quality of that image

$$\beta_K = (V^K, \varphi(x)) = \sum_{i=1}^{N}\alpha_i^K \, K(x_i, x)$$

7. After removing the noise present in that image now the image is blur free with better quality.

IV. RESULTS FROM EXPERIMENT:

On comparing the proposed method the following results were obtained having different scenes at different noise level.

Table 1 :PSNR value on the noise variance of the Gaussian (Berkeley Data Set) noise.

Level	Red pixel	Green pixel	Blue pixel	Calculation Time
σ = 5	4.96	5.06	5.07	3.29sec
σ = 10	9.87	9.95	9.88	1.49 sec
σ = 20	19.52	19.84	19.62	1.55 sec
σ = 40	39.12	39.07	39.34	1.79 sec

Figure 1: Experimental Image (Lena.Png)

Method	Wavelet denoising	K-SVD Denoising	Proposed
Cameraman	26.0(0.7806)	26.5(0.8048)	26.2(0.8201)
House	28.9(0.7708)	29.1(0.7771)	28.9(0.7891)
Lena	26.0(0.7466)	26.2(0.7504)	26.0(0.7678)
Tower (color)	27.9(0.7505)	27.9(0.7583)	27.8(0.7569)
Parrot (color)	27.5(0.7925)	27.4(0.7994)	27.4(0.8297)

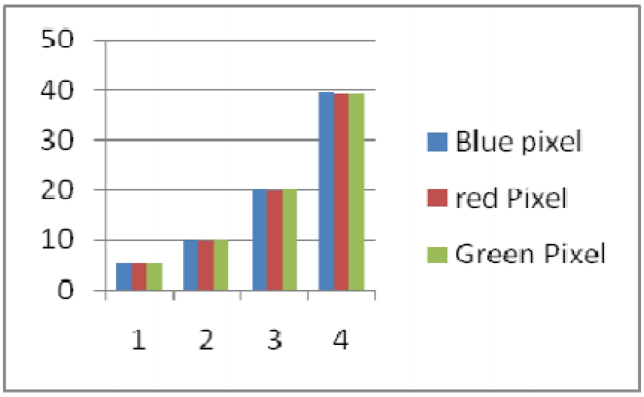

Figure 2: Experimental Result Noise Level Estimation Results of Lena.Png Image, where we are using the RGB Model for Noise Estimation

V. CONCLUSION

In this paper, an algorithm is suggested which is based on the approach that when an image is corrupted by Gaussian noise a contour based segmentation would be performed. For that we have followed the PCA technique which estimate and remove the level of noise based on the contour based segmented dataset. For that we use the maximum Eigen value from the covariance matrix of the image gradient as to improve strength of texture and discuss how it changes with different noise levels. As compare to prior proposed methods, the method proposed is more scene-independent and shows significant improvement in terms of both accuracy and stability for a range of noise levels in various scenes.

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