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Image Restoration Technique to Solve Image Deblurring Problem

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Abstract: Image restoration is an important role in image processing from last 10 decades. The quality of image degraded due to lots of reason. There is a need to restore the quality of an image for further processing for many applications. Blur and noise are responsible to degrade the image. . The image restoration is the reconstruction process. This process is applied to the degraded images to perform restoration. The aim of the paper is to remove the blur from an image to gain its quality. The paper proposes local statistical and non local statistical method to perform image restoration.

Keywords: Image blurring, statistical methods, image deblurring etc

I. INTRODUCTION

To perform image restoration it's necessary to remove the noise from an image along with blur. There are various types of blur and noise are available in an image such as gaussian blur, uniform blur, salt and pepper noise, gaussian noise etc. In image acquisition process the optical signals get converted into electrical and then electrical signal gets converted in to digital signal. If there is fluctuation at the brightness then noise may get added in an image. So at each process of conversion from one form to another form noise gets added to the image. So finally noisy image is obtained. Noisy image is different from original image. The quality of image degraded due to blur and noise added in an image.

The sources of blur in digital images are takes place during image acquisition process or transmission process. Defocus of camera from scene causes blurred image and along with blur noise is also present in an image. The artifacts present in an image due to blurring. The convolution of point spread function with input image is blurring. It is imperative to remove such types of blur and noise from an image to obtain better quality of image for many application purposes. The image inverse problems are presents in variety of areas such as scientific, medical problem etc. The mathematical information about how the image was blurred is essential to achieve deblurring. In the paper, various deblurring and denoising techniques have been discussed.

II. RELATED WORK

There are various image deblurring algorithms such as shape-adaptive DCT method [2], and split augmented Lagrangian shrinkage method [7] are proposed. But these algorithms works on only on one image property i.e. local smoothness and achieve less sharp edges. The block matching and 3D filtering method [3], achieves self similarity of an image but it works only on non-local self similarity property. D. Dai [8] proposed "frame let-based approximation or sparsity deblurring algorithm". This algorithm removes mixed noise from an image but also remove some image details. Y. Wen [6] proposed "Fast image restoration methods for impulse and Gaussian noise removal". It removes noise from an image to better level but there some artifacts are generated in smooth area of an image. Therefore single image property for image restoration can't achieve high quality image restoration. So it is important to achieve both the two main properties of an image to achieve image restoration.

The paper proposes a method that performs image restoration through two statistical modeling methods which is called as joint statistical modeling method. It gets both image properties i.e. local smoothness and non-local self similarity.

III.PROPOSED WORK

The paper proposes two types of modeling methods to image restoration. The block diagram for restoration using modeling methods is given below in fig. 1

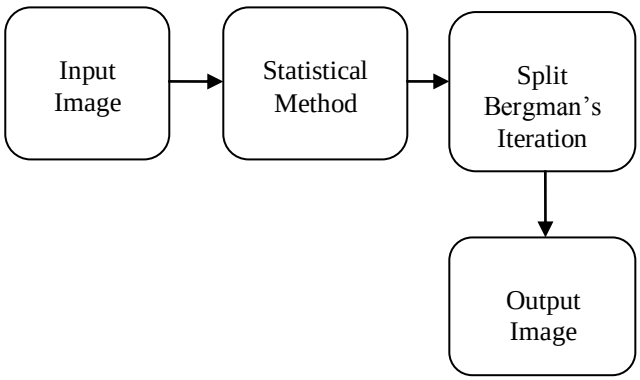

Fig. 1 Image Restoration Using Statistical Methods

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A. Local Statistical Model:
The aim of the local modeling method is to deblur the image by taking derivative of neighboring pixels. So the values of neighboring pixels are nearly similar. Local modeling method is used to achieve local smoothness. The equation is given as;

$$\Psi_{LSM}(u)[1] = \|D_v u\|_1 + \|D_h u\|_1 \qquad (1)$$

Where, u is original input image, D_h and D_v are difference operator in horizontal and in vertical direction.

B. Non local Statistical Model:
Both the modeling methods are necessary to obtain image restoration. This modeling method recovers the sharpness of an image. The local statistical modeling method is performed in space domain and non-local statistical modeling method is performed in transform domain. The description for non-local model in transform domain at block level is given as;

First divide the image into overlapping blocks. Consider two blocks one is target window and second is search window. Take any target block and find out the best match for it within the search window.

Apply this process to all target blocks to find best match for each. Take 3D transform of blocks to obtain NLSM at block level. In mathematical format the equation is written as;

$$\Psi_{NLSM}(u)[1] = \sum_{i=1}^{n} \| T^{3D}(Zu^i) \|_1 \qquad (2)$$

Take inverse transform to obtain original image and use interpolation. The joint modeling method is obtained by combining above two modeling methods to perform image restoration task. In mathematical format it can be written as;

$$\Psi_{JSM}(u)[1] = \tau . \Psi_{LSM}(u) + \lambda . \Psi_{NLSM}(u) \qquad (3)$$

IV. RESULTS

To know the prior knowledge about an image, firstly the input image is blurred by using different blur kernel and then using modeling methods deblurring is achieved. Result are obtained by using MATLAB is given below. Result for uniform blur is shown in figure 2 and for gaussian blur is shown in figure 3.

A. Performance Parameters:

1) Peak Signal to Noise Ratio:
To calculate superiority of image PSNR is used. The PSNR is calculated as;

$$PSNR = 10 \times Log_{10}^{\frac{255^2}{MSE}} \qquad (4)$$

Where, MSE is mean square of error

2) Feature Similarity Index Model for Image Quality Assessment:
FSIM is used to calculate approximately the visual quality of an image. The value of the FSIM lies in between 0 and 1. Higher value of the FSIM, better visual quality of an image is achieved.

B. Results for Deblurring:
For 9 × 9 uniform blur:

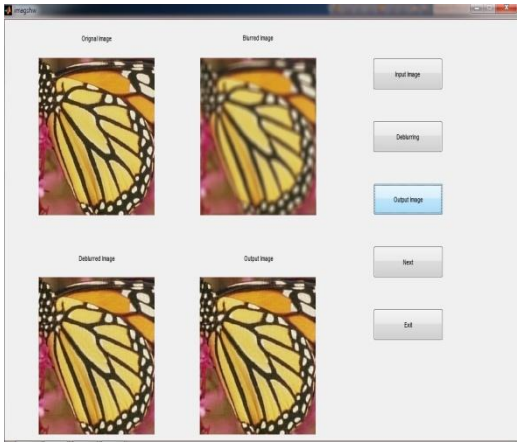

Fig. 2 Result using 9 × 9 uniform blur

For gaussian blur:

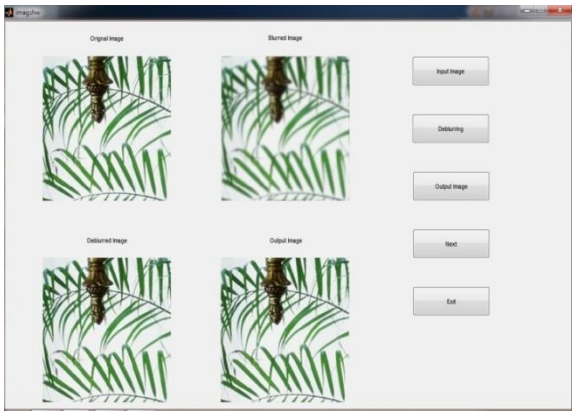

Fig. 3 Result using gaussian blur

TABLE I
COMPARISION OF PSNR AND FSIM VALUES USING
9 × 9 UNIFORM BLUR

Image	PSNR	FSIM
Butterfly	33.88	0.9641
Leaves	31.70	0.9580
Baboon	21.85	0.8627
Pepper	30.49	0.9392
Lena	28.90	0.9269

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TABLE II
COMPARISION OF PSNR AND FSIM VALUES FOR GAUSSIAN BLUR

Image	PSNR	FSIM
Butterfly	33.52	0.9708
Leaves	36.12	0.9855
Baboon	21.35	0.8507
Pepper	29.86	0.9407
Lena	29.02	0.9378

V. CONCLUSION

The method of image restoration by two statistical modeling is achieved. It achieves image deblurring in minimum 8 to 15 iterations. Experimental results are compared in the form of PSNR and FSIM. It achieves higher PSNR and FSIM values. For future work the Split Bregman's iteration algorithm will be used to resolve optimization problem and results will be obtain for image inpainting, image denoising etc.

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