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Image Restoration Techniques Using Fusion to Remove Motion Blur

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***Abstract*—**Restoration techniques are oriented towards modelling the degradation and applying inverse process to recover the original image. The image gets blurred due to relative motion between object and detector (*Motion Blur*), and/or improperly focused image capturing device. This work presents a comparison of different image restoration process where, different filtering method are used with RL-Deconvolutionfor different applications. The proposed approach combines two different restoration method by using DWT.

Keywords: *Lucy Richardson method, wiener filter, image fusion,DWT (Discrete wavelet Transform)*

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I. INTRODUCTION

Image restoration is the process of recovering an image that has been degraded by using a priori knowledge of the degradation phenomenon. Restoration techniques involves modelling of the degradation function and applying the inverse process to recover the original image. [1]

Digital image Restoration techniques falls into digital image processing. In digital Image restoration degraded, noisy or/and Blurred images consider as an Input and put effort to estimate the original and de-noised image. image may have got corrupted by any unknown phenomenon or external interference like, when the image of source is captured/ taken on a detector or couple charged device (CCD) and there will be relative motion between them,then during the exposure the point sources of real image got shift/ drift in captured image, which depends upon the relative motion between them (This phenomenon is known as motion Blur).

Motion blur is an undesired effect on an image due to camera shake during exposure, a long aperture time, atmospheric turbulence, wrong focusing of lens, relative motion between Photographic device and original scene. In image processing system, it is Important to regain the original image from degraded image which is blurred by a degradation Function[2][3][4].The degradation producing ill-effect of blur is termed as the *point spread function* (PSF). Any type of blur is characterized by the PSF. The electromagnetic radiation or other imaging wave's propagated from a point source or point object is known as the PSF. The quality of any imaging system depends on the degree of spreading (blurring) of the point object. The PSFdefines the impulse response of a point source[3].

II. IMAGE RESTORATION

A. Wiener filter[5]

Wiener filter is used to yield an estimated image of desired or targeted arbitrary process by using linear Time-Invariant(LTI) processing of recognized noise, basically wiener filter minimizes the mean square error of estimated pixel value and the desired pixel value.

The main objective of wiener filter is to figure out statistical estimate of an anonymous signal employing an associated signal as an input and filtering the acknowledge signal to yield estimated output

Weiner Filtering is also a non-blind technique for reconstructing the degraded image in the occurrence of known PSF. It removes the additive noise and inverts the blurring at the same time. It not only performs the deconvolution by inverse filtering (high pass filtering) but in addition removes the noise by means of a firmness operation (low pass filtering). It evaluates through an estimation of the desired noiseless image. The input to a wiener filter is a degraded image corrupted through additive noise. The output image is computed by means of a filter through means of the subsequent expression

$$f'' = g * (f + n)$$

f is the new image, n is the noise, f'' is the estimated image and g is the wiener filters response.

B. Lucy-Richardson Deconvolution Method[6]

When an image is captured on a detector such as photographic film or a charge coupled device (CCD), it will get slightly blurred, with an ideal point source not appearing as a point but being spread out, that is known as the point spread function. Non-point sources are generally the sum of many individual point sources, and pixels in a recorded image can be

represented in terms of the point spread function and the latent image as

$$d_i = \sum_j p_{ij}\, u_j$$

Where,

p_{ij} is PSF (Point Spread Function),
j and i are; true image and recorded image,
u_j is value at location j,
d_i is observed value at location i,

The calculations are performed using Poisson Distribution

$$u_j^{(t-1)} = u_j^{(t)} \sum_i \frac{d_i}{c_i} p_{ij}$$

Where,

$$c_i = \sum_j p_{ij}\, u_j^{(t)}$$

C. **Regularized Filter[7]**

Regularized filtering is used effectively when constraints like smoothness are applied on the recovered image and limited information is known about the additive noise. The blurred and noisy image is restored by a constrained least square restoration algorithm that uses a regularized filter. Regularized restoration provides similar results as the wiener filtering but it has a very different viewpoint. In regularized filtering less prior information is required to apply restoration. The regularization filter is often chosento be a discrete Laplacian. ThisFilter can be understood as an approximation of a Wiener filter.

$$y(m,n) = h(m,n) * x(m,n) + u(m,n)$$

Where,

$*$ is 2D-Convolution,

$h(m,n)$ is Point Spread Function (PSF),

$x(m,n)$ is original image,

$u(m,n)$ *is additive noise*.

Regularization deconvolution concentrates mainly on two desirable goals.

1. The closeness of model fit.
2. The closeness of the model behavior

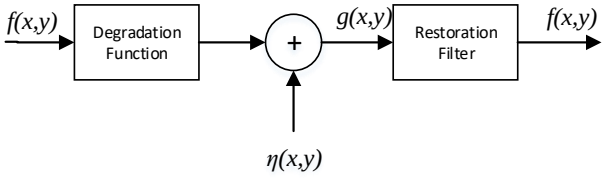
The model which will closely fulfills the model requirement are,

$$\sum_{m,n} [y(m,n) - h(m,n) * x(m,n)]^2$$

D. **Model of degradation**

A Model of image degradation and restoration process the basic unit of an image is called a pixel or image element i.e. the image is divided into very small blocks called pixels. An image can be defined as a two dimensional function I [2]

$$I = f(x,y)$$



Where x and y are spatial coordinates.(x,y) represents a pixel. I is the intensity or grey level value which is the amplitude of f at any point (x,y). If the values of the coordinates (spatial coordinates) and the amplitude are finite and discrete, then it is called digital image .the degraded images $g(x,y)$can Be represented as

$$g(x,y) = h(x,y) * f(x,y) + \eta(x,y)$$

observed image are represented using the PSF an image undeniably is to avoid the need for restoring the image. Furthermore, proposed work presents comparative analysis of different non-blind image restoration techniques based on Wiener and Lucy-Richardson algorithm for different types of image layouts. [8]

- Lucy Richardson fused with Wiener restoration

III. Lucy Richardson fused with regularized filter

IV. LITERATURE SURVEY

Li Yang et.al in 2016[3] proposed a Method to the relative motion between the camera and the object scene produce defect in recorded image which is termed as Motion Blur. The degraded image, which is degraded by the relative motion and, the image Must have Motion Blur with blur direction are crucial for image restoration. After image recognition and image analysis, the author developed an approach which is based on the fractional directional derivative operator with a non-casual solution to restore an image from Motion blurred image a partial Derivative operator is summarized on fractional derivative

Real and synthesized motion Blurred images are evaluated quantitatively and qualitatively performance evaluated. Noise is the crucial aspect of authored method. The experiments are established on a non-casual fractional partial derivative mask, which ensures That the method will provide better immunity to noise in comparison and accuracy of analyzing motion Blur than the method based on integer order differentiation.

Haiying Liu et.al in 2016[4] proposed a Total Variation Regulization Algorithm.Image taken / captured from unfavorable conditions are more tend to got blurred by unknown kernels and may corrupted by measurement noise. The authored paper such as a new total variation (TV) minimization based method for blindly deburredthose images. The proposed method is dissimilar to the alternative optimization based algorithm, by adopting a joint estimation strategy that removes the unknownblurringkernel and unknown image by iterative manner. In each iteration two separate image de-noisingsub problems / sub process are performed that provides fast implementation. In authored paper experiment perform on gray-scale test images as well as colored images. The proposed new method deburredimage with considerably fast than conventional algorithm technique.

	[13] + [9]	Proposed Method
SSIM	0.7595→0.9125	**0.7595→0.9739**
PSNR (dB)	21.4131→25.6472	**21.4131→31.4932**
Identified kernel L2 error	0.0090	**0.0033**
Eclipsed Time (sec)	77.9242	**48.9063**

Table 1 : Performance comparison for grey image

Tomio goto et.al[1]is proposed a blind method that rapidly restores blurred images implying local patches. Author's proposed method a little section of test image (blurred image) is used for PSF (Point spread function) calculation (estimation). Author's experiment results presents that the proposed method generates accurate de-blurred images, and processing time is significantly lower than that of the conventional de-blurring method.

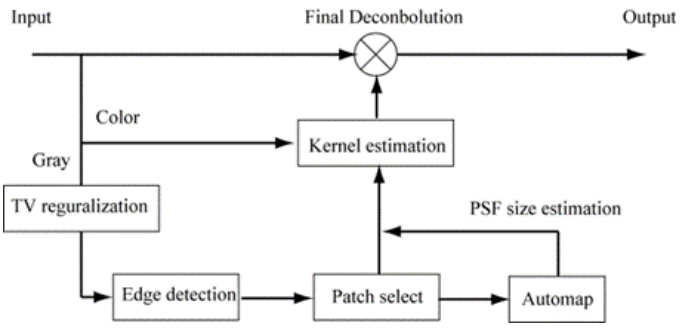


Figure 1 : Block Diagram of Restoration through Local Patched

Experimental Images	Image Size	Conventional method	Authored Method
Article	482 X 482	17.0	7.5
Parrots	753 X 502	25.4	8.5
Street	1024 X 683	52.8	10.4
Big Ben	1920 X 1080	141.9	16.8

Table 2: Processing Time [sec]

K. Panfilova et.al [8]proposedmethod to solved the problem of linear blur (Linear Blur Compensation). To restored image, authors usedLucy-Richardson iterative deconvolution and its sub variants. The main disadvantage of conventional Lucy-Richardson iterative deconvolution are edge artifacts that forms during deconvolution process and less information of optimal numbers of algorithm iteration. To lessen the issue of those problems authors proposed to extend the test subjected image beyond to its original border reducing its brightness to zero at newly created borders and used an empirical benchmark to define the point where the iterative Lucy-Richardson procedure should end. The limit of iterations is based on some analysis of the changes in the image at each iteration. The proposed changes (method) resulted in decrease of image distortion by more than 50% (in RMS). This study makes possible to easily estimate the required numbers of iterations for better performance of algorithms.

Jian-Jiun Ding et.al in 2014[2]proposed a Pyramid-Based Richardson-Lucy Algorithm.In image deburring, it is important to reconstruct images with small error, high perception quality, and less computational time. In this paper, a blurred image reconstruction algorithm, which is a combination of the Richardson-Lucy (RL) deconvolution approach and a pyramid structure, is proposed. The RL approach has good performance in image reconstruction. However, it requires an iterative process, which costs a lot of computation time, and the reconstructed image may suffer from a ringing effect. In the proposed algorithm, we decompose a blurred image from a coarse scale to a fine scale and progressively utilize the RL approach with different number of iterations for each scale. Since the number of iterations is smaller for the large scale part, the computation time can be reduced and the ringing effect caused from details can be avoided. Simulation results show that our proposed algorithm requires less computation time and has good performance in blurred image reconstruction.

Year Proposed	Title and Author	Methodology	Conclusion
Oct. 1997	O. Rockinger, " Image sequence fusion using a shift-invariant wavelet transform", IEEE, 26-29 Oct. 1997[5]	Wiener filter and Blind Deconvolution	Result based on the Wavelet image Fusion with Wiener filter provided the better results that iterative Blind Deconvolution
May 2002	I.W. Selesnick, "The design of approximate Hilbert transform pairs of wavelet bases", IEEE, 2016[9]	Wiener Filter, Blind Deconvolution algorithm and Wavelet Transform	Winer filter with Image Fusion with better acceptable restoration results Image Restoration
July 2016	K.Jaya Priya, Dr. R.S. Rajesh, "Dual Tree Complex Wavelet Transform based Face Recognition with Single View", Ubiquitous Computing communication Journal, July 2016[10]	Wiener Filter, Lucy-Richardson deconvolution algorithm & Neural Network approach	Better Restoration based on neural network with PSNR=30.1135 as compare to Lucy-Richardson, Inverse filter and Wiener filter
Feb. 2015	Paul Hill, Nishan Canagarajah and Dave Bull, "Image Fusion Using Complex Wavelets", BMVS, pp. 487-496, 2015[6]	Wiener Filter, Lucy-Richardson algorithm, Regularized filter & Blind deconvolution algorithm	Wiener filter, Regularized filter is the best techniques when no noise in image. If noise is presented with blur the Lucy-Richardson Algorithm is the best techniques
Oct. 2012	R.J. Sapkal, S.M. Kulkarni, "Image Fusion based on Wavelet Transform for Medical Application"[11]	Wavelet Transform	It integrates complementary information to give a better visual picture of a scenario suitable for processing

V. PROPOSED CONCEPT

Restoration techniques are located against base of degradation and applying the inverse process in order to recover the original image. There will be present several kind of degradation that need to be consider to restore degraded image. Such kind of degrading are blurring, noise and color imperfections. This study focus on approach to take measure PSF (Point Spread Function) parameters from blurred and noisy images and presents relative analysis of different restoration techniques. Methodology used will maintain the requiredinformation from both images

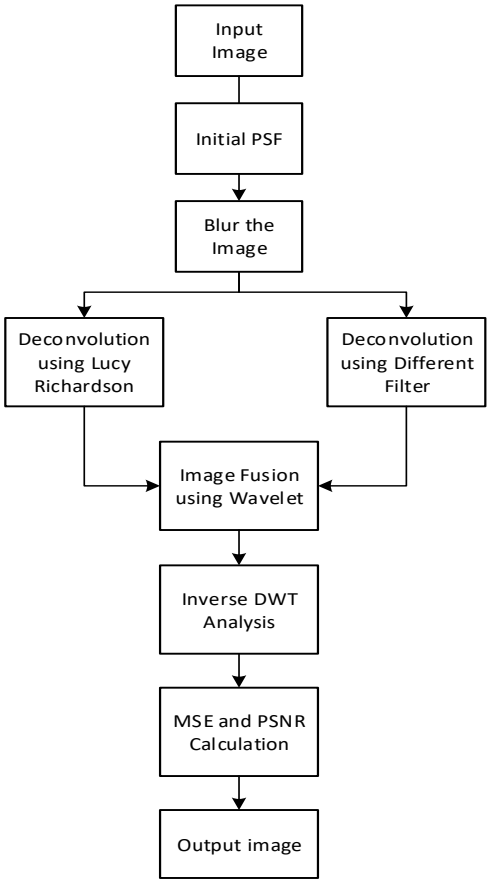


Figure 2: Process flow

Figure 2shows sequence of procedure to be taken. First a test subjected image is distorted and degraded in such ways that, I'll look similar to actual distorted image by assuming initial PSF and, then applying blur to it using assumed PSF as criteria. Then the blur simulated image will get passed into two different image restoration method, in our case RL-deconvolution and different filter (Wiener Filter, Blind Deconvolution and Regularized Filter). After the deconvolution process, resulted images then fused together by using Wavelet Fusion technique. For final end result, Inverse DWT Analysis carried out to calculate SNR and MSE.

VI. CONCLUSION

Image restoration is an active research area and various researchers work to get better the efficiency by applying different method. Primarily image restoration is done by using numerus restoration techniquesuch as Weiner filter, Richardson-Lucy Blind Deconvolution algorithm, Inverse filter. The proposed procedure focus to consider PSF as constrain since image are distorted and degraded. Moreover, it will improve the objectivity of the image and removes the noise and blurry content in the image. This work is present a relative study of different non-blind image restoration procedure will support on Wiener filter,Regularized Filterand Lucy-Richardson method. The performances of these techniques will evaluated and compared.

REFERENCES

[1]. T. Goto, H. Senshiki, S. Hirano and M. Sakurai, "Fast blind restoration of blurred images based on local patches," 2016 International Conference on Electronics, Information, and Communications (ICEIC), 2016.

[2]. D. Jian-Jiun, C. Wei-De, C. Yu, F. Szu-Wei, C. Chir-Weei and C. Chuan-Chung, "Image deblurring using a pyramid-based Richardson-Lucy algorithm," 19th International Conference on Digital Signal Processing, 2014.

[3]. Y. Li , "Image Restoration from a Single Blurred Photograph," 3rd International Conference on Information Science and Control Engineering (ICISCE), 2016.

[4]. H. Liu, J. Gu, M. Q. -H. Meng and W.-S. Lu, "Fast Weighted Total Variation Regularization Algorithm for Blur Identification and Image Restoration," IEEE Access, 2016.

[5]. O. Rockinger, "Image sequence fusion using a shift-invariant wavelet transform," Proceedings of International Conference on Image Processing, Santa Barbara, vol. 3, pp. 288-291, 1997.

[6]. P. hill, N. Canagarajah and d. Bull, "Image Fusion Using Complex Wavelets," BMVS, pp. 487-496, 2015.

[7]. S. Eddins, "Image deblurring using regularization," 21 july 2008. [Online]. Available: http://blogs.mathworks.com/steve/2008/07/21/image-deblurring-using-regularization/.

[8]. K. Panfilova and S. Umnyashkin, "Linear blur compensation in digital images using Lucy-Richardson method," IEEE, 2016.

[9]. I. W. SELESNICK, "The design of approximate Hilbert transform pairs of wavelet bases," IEEE Transactions on Signal Processing, vol. 50, pp. 1144-1152, 2002.

[10]. P. Jaya and R. RENGAN SIVAGURUNATHAN, "Dual Tree Complex Wavelet Transform based Face Recognition with Single View," Ubiquitous Computing communication Journal, 2016.

[11]. R. Sapkal and S. Kulkarni, "Image Fusion based on Wavelet Transform for Medical," International Journal of Engineering Research and Applications, vol. 2, no. 5, pp. 624-627, 2012.