A Comparative Study for Deblured Average Blurred Images

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Abstract-*This paper attempts to undertake the study of Restored Average Blurred Images. by using three types of techniques of deblurring image as Wiener filter, Regularized filter and Lucy Richardson deconvlutoin algorithm with an information of the Point Spread Function (PSF) corrupted blurred image with Different values of radius 10,15,20,25,30,35,40 and 45 and then corrupted by Gaussian noise. The same is applied to the remote sensing image and they are compared with one another so as to choose the base technique for restored or deblurring image. This paper also attempts to undertake the study of restored circular average blurred image or disk blurred with no any information about the Point Spread Function (PSF) by using blind deconvlution algorithm to execute the guess of the PSF, the number of iterations and the weight threshold of it to choose the base guesses for restored or deblurring image of this technique.*

Keywords: Point Spread Function/Blur Types /Deblurring Techniques.

I. INTRODUCTION

The restoration image is very important process in the image processing to restore the image by using the image processing techniques to easily understand this image without any artifacts errors. In this case, many studies are taken in that scope and this are some of these studies:

Image restoration methods can be considered as direct techniques when their results are produced in a simple one-step fashion. Equivalently, indirect techniques can be considered as those in which restoration results are obtained after a number of iterations. Known restoration techniques such as inverse filtering and Wiener Filtering can be considered as simple direct restoration techniques. The problem with such methods is that they require knowledge of the blur function [i.e., the point-spread function (PSF)], which is, unfortunately, usually not available when dealing with image blurring [1, 2, 3].The conventional Lucy-Richardson (LR) method is nonlinear and therefore its convergence is very slow. We present a novel method to accelerate the existing LR method by using an exponent on the correction ratio of LR; we present an adaptively accelerated Lucy-Richardson (AALR) method for the restoration of an image from its blurred and noisy version. That proposed AALR method shows better results in terms of low root mean square error (RMSE) and higher signal-to-noise ratio (SNR), in approximately 43% fewer iterations than those required for LR method [4].The most important technique for removal of blur in images due to linear motion or unfocussed optics blur is the Wiener filter. Weiner filters are far and away the most common deblurring technique used because it mathematically returns the best results. In practice Wiener filters are much more common. It should also be re-emphasized that Wiener filtering is in fact the underlying premise for restoration of other kinds of blur [5, 6, 7].

II. BLURRING

Blur is unsharp image area caused by camera or subject movement, inaccurate focusing, or the use of an aperture that gives shallow depth of field. The Blur effects are filters that smooth transitions and decrease contrast by averaging the pixels next to hard edges of defined lines and areas where there are significant color transition.

A. Blurring Types

In digital image there are 3 common types of Blur effects:

1) Average Blur

The Average blur is one of several tools you can use to remove noise and specks in an image. Use it when noise is present over the entire image.

This type of blurring can be distribution in horizontal and vertical direction and can be circular averaging by radius R which is evaluated by the formula:

$R = \sqrt{g^2 + f^2}$

Where: g is the horizontal size blurring direction and f is vertical blurring size direction and R is the radius size of the circular average blurring.

2) Gaussian Blur

The Gaussian Blur effect is a filter that blends a specific number of pixels incrementally, following a bell-shaped curve. The blurring is dense in the center and feathers at the edge. Apply Gaussian Blur to an image when you want more control over the Blur effect.

3) Motion Blur

The Motion Blur effect is a filter that makes the image appear to be moving by adding a blur in a specific direction. The motion can be controlled by angle or direction (0 to 360 degrees or –90 to +90) and/or by distance or intensity in pixels (0 to 999), based on the software used.

III. DEBLURRING

A. Deblurring Model

A blurred or degraded image can be approximately described by this equation:

$$g = PSF*f + N,$$

Where: g the blurred image, h the distortion operator called Point Spread Function (PSF), f the original true image and F Additive noise, introduced during image acquisition, that corrupts the image

1) Point Spread Function (PSF)

Point Spread Function (PSF) is the degree to which an optical system blurs (spreads) a point of light. The PSF is the inverse Fourier transform of Optical Transfer Function (OTF).in the frequency domain ,the OTF describes the response of a linear, position-invariant system to an impulse.OTF is the Fourier transfer of the point (PSF).

B. Deblurring Techniques

This paper applying four methods deblurring image:

2) Wiener Filter Deblurring Technique

Wiener filter is a method of restoring image in the presence of blur and noise.

The frequency-domain expression for the Wiener filter is:

$W(s) = H(s)/F^{+}(s)$, $H(s) = F_{x,s}(s)\, e^{as} / F^{-}_{x}(s)$

Where: F(s) is blurred image, $F^{+}(s)$ causal, $F^{-}_{x}(s)$ anti-causal

3) Regularized Filter Deblurring Technique

Regulated filter is the deblurring method to deblur an Image by using deconvlution function deconverge which is effective when the limited information is known about additive noise

4) Lucy-Richardson Algorithm Technique

The Richardson–Lucy algorithm, also known as Richardson–Lucy deconvolution, is an iterative procedure for recovering a latent image that has been the blurred by a known PSF.

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

Where

Is PSF at location i and j,u_j is the pixel value at location j in blurred image. Pij

C_i is the observed value at pixel location i.

Iteration process to calculate u_j given the observed c_i and known p_{ij}

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

Where

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

5) Blind Deconvolution Algorithm Technique

Definition of the blind deblurring method can be expressed by:

g(x, y) =PSF * f(x,y) + η(x,y)

Where: g (x, y) is the observed image, PSF is Point Spread Function, f (x,y) is the constructed image and η (x,y) is the additive noise term .

IV. EXPERIMENTS VERIFICATIONS

A. Testing Procedure

The deblurring was implemented using (MATLAB R2007a, 7.4a) and tested average blur type with different Radius: 10,15,20,25,30,35,40 and 45 with help of PSF function corrupted on the images illustrated in the Figure 1**.**

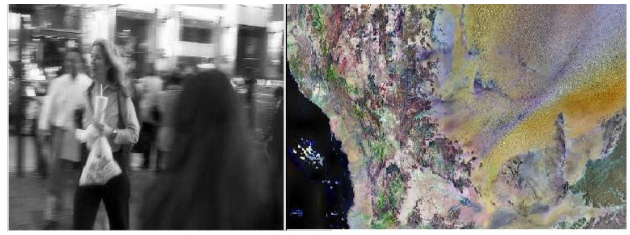


Figure 1- Originals Images

Three types of deblurring Techniques are implemented: Wiener Filter Deblurring Method, Regularized Filter Deblurring Method, and Lucy-Richardson Algorithm Method applying with information of PSF in the two cases: the first case without noise and second case with noise. The Blind Deconvolution Algorithm Method applied which doesn't have any information about PSF.

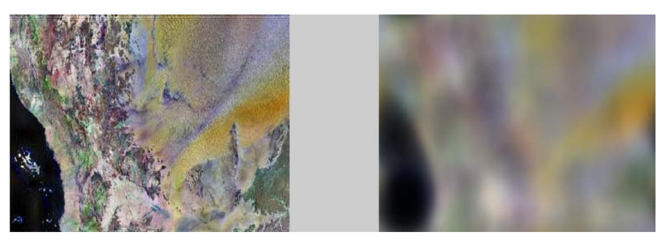
B) SIMULATION RESULTS

The performance results applied by two cases of the PSF function:

1) Deblurring with known PSF

The performance evaluations of the deblurring operation with known PSF can be implemented by two cases: the first case has a known amount of blur, but no noise, was added to an image, and second case is a known amount of blur and noise add to the image then the image was filtered to remove this known amount of blur and noise using Wiener, regularized and Lucy-Richardson deblurring methods. In the first case the regularized and Wiener techniques produced what appeared to be the best results but it was surprising that the Lucy-Richardson technique produced the worst results in this instance see this result in the figure2.

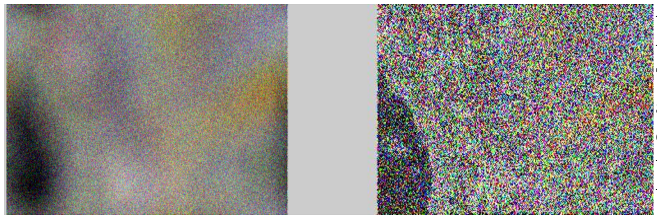
(a) Blurring image R=50 (b) Wiener Filter



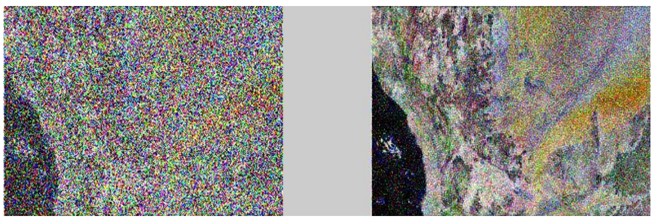
(c) Regularized Filter (d)Lucy Richardson

Figure 2-Deblurring image without adds noise when PSF Known

In second category when Gaussian noise was added to the image in addition to blur the Lucy-Richardson algorithm actually performed the best results from the Wiener and Regularized techniques. These results can be seen in the Figures 3.



(a) Blurring image with noise (b) Wiener Filter

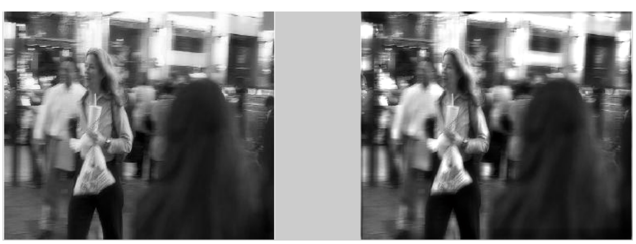


(c) Regularized Filter (d) Lucy Richardson

Figure3- Deblurring image with add noise when PSF Known

2) Deblurring with no PSF information

When no information about the original PSF the above techniques is not very useful techniques to Deblurring images. In this case applied another technique is called Blind deconvlution technique after execute the guess of the PSF, the number of iterations and the weight threshold of it. After much experimentation, it turned out that the weight threshold should be set between 0.10 and 0.25, the PSF matrix size should be set to 13x13, and the number of iterations should be any number more than 30.In this paper the best result is got when the PSF size is 13*13, iteration is 50 and weight threshold is 0.19 which is illustrated in the figure 4.



(a) Blurring original image (b) Deblurring with blind algorithm

Figure 4-Deblurring image with no information of PSF

CONCLUSION

Restoration or deblurring average blur from images is a very difficult problem to resolve. In this paper we describe a strategy that can be used for solving such problems. We describe how to restore images blurred by average blur in two cases: first case with information about PSF by using three technques, Wiener filter, Regularized filter and Lucy Richardson deconvlutoin algorithm. In the first case comparative studies are explained & experiments are carried out for different techniques Wiener filter, regularized filter is the best techniques to deblurring of remote sensing image when there is no noise in image see this in the Figure2. But when noise is presented with blur the Lucy-Richardson algorithmic technique is the best technique, see it in the Figure 3.

The second case unknown or doesn't have any information about point spread function (PSF).The comparative study is explained & experiments are carried out for different techniques blind deconveluation algorithmic technique is the best technique when the PSF size is 13*13, iteration is 50 and weigh threshold is 0.19 which is illustrated in the Figure 4.

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REFERENCES

[1] M. P. Ekstrom, ed., Digital Image Processing Techniques (Academic, Orlando, Fla., 1984).
[2] A. Rosenfeld, A.C.Kak.,"Digital Picture Processing", (Academic, New York, 1982),Vol. 2.
[3] H. Lim, K. C. Tan, B. T. G. Tan, ‘‘Edge errors in inverse and Wiener filter restorations of motion-blurred images and their windowing treatment,’’ CVGIP: Graph. Models Image Process. 53, PP.186–195 (1991).
[4] M.K.Singh, U.S.Tiwary, H.Kim,"adaptively Accelerated Lucy Richardson method for image deblur", EURASIP Journal on advances in Signal Processing,Vol.2008,No.18,Article,ID35021,10Pages,doi:10.155/2008/365021.
[5] Boyle, Richard, Milan Sonka, and Vaclav Hlavac, "Image Processing, Analysis, and Machine Vision", First Edition, University Press, Cambridge, 1993.
[6] Gaskill, Jack D., "Linear Systems, Fourier Transforms, and Optics", John Wiley and Sons, Inc., New York, 1978.
[7] Gonzales, Rafael C. and Paul Wintz, "Digital Image Processing", Second Edition, Addison-Wesley Publishing Co., Massachusetts, 1987.
[8] Hunt, B.R., "The Application of Constrained Least Squares Estimation to Image Restoration by Digital Computer", IEEE Transactions on Computers, Vol C-22, No. 9, September 1973.
[9] Pitas, Ioannis, "Digital Image Processing Algorithms", Prentice Hall International (UK) Ltd., Cambridge, 1993.