International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869, Volume-2, Issue-3, March 2014

Comparative Study of Color Image Restoration Algorithms for Remote Farming Application

Khushbu Jain, Ira Joshi, Rakshita Chauhan

***Abstract*-- In this paper we study and compare various color image restoration algorithms for remote farming application. Here, we are mainly analyzing Wiener, Lucy Richardson and regularized deconvolution algorithms and then using PSNR and MSE value we can find which algorithm works better for remote farming application.**

***Index Terms* — Deconvolution algorithms, Fourier transform, Blur, Noise .**

I. INTRODUCTION

India is an agricultural country where 70% of population depends on agriculture. There is wide range of crops available and to monitor them by expert we use various remote techniques by which one can detect plant diseases and can suggest suitable pest control or other insecticides to farmers at remote places. All such highly used technical ways results in quality and optimum yield of crops. Image processing is one such technique. Here, in this paper we are discussing color image restoration which is one of the first step involve in image processing. By the use of color image restoration we can restore color images from degraded images. Images can be acquitted via various methods such as camera, microscope, telescope etc. The acquitted images are then represented in digital form in processors. Digital representation of an image means image represented in matrix form. During image acquisition process some noise and blur effects gets added due to sensor noise ,blur due to camera misfocus or due to relative object–camera motion, random atmospheric turbulence to the original image resulting in an degraded image[1],[2]. In order to obtain an approximate image of real image from a blurred and noisy one image restoration is use[1]. There are many deconvolution algorithms and filters for image restoration such as Wiener, Lucy-Richardson, Blind deconvolution etc. Here, in this paper we are mainly, discussing Wiener , Lucy-Ricardson and regularized deconvolution algorithm for color image restoration in frequency domain and then compare them. Here, we consider that we have knowledge of PSF. All the work has been done using MATLAB.

Manuscript received March 20, 2014.
Khushbu Jain, ECE Department, Jodhpur National University
Ira Joshi , ECE Department, Jodhpur National University
Rakshita Chauhan, ECE Department, Jodhpur National University

II. IMAGE DEGRADATION

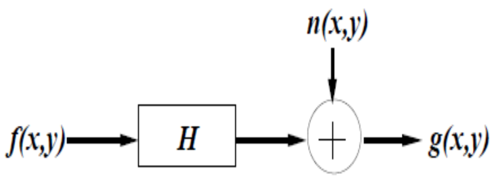


Fig. 1 Image Degradation Model[1]

Various form of degradation gets added to an image during acquisition process. There are various forms of degradations such as: additive noise, linear blurring, additive noise + linear blurring and complex noise + linear blurring. Here, in this paper we are using third form of degradation i.e. additive noise + linear blurring as shown[5]:

$$g(x,y)=f(x,y)*H(x,y)+ n(x,y) \qquad (1)$$

Here, "*" means convolution.
f(x,y) is the real image acquired by camera or any other acquisition device which then gets degraded by convolving with degradation filter H along that noise n(x,y) also gets added to it resulting in a degraded image g(x,y).

A. Noise:

Image noise is unwanted fluctuations. Noise can be added to images during image acquisition (faulty CCD elements), during image transmission (channel interference) or during image processing (compression).We normally assume that noise is an additive and not correlated with the image. The range and distribution of noise values can vary significantly from one image to the next. There are various types of image noises present in the image like Gaussian noise, salt & pepper noise, speckle noise, shot noise, white noise etc[4]. Here, we are comparing our results using Gaussian noise.

B. Blur:

The blurring of images is modeled as the convolution of an ideal image with a 2-D point-spread function (PSF).If the ideal image would consist of a single intensity point or point source, this point would be recorded as a spread-out intensity pattern , hence the name *point-spread* function. There are many blurring effects present such as linear motion blur, out of focus blur, atmospheric turbulence blur [4],[5]. In MATLAB blur effect can be added using fspecial filter.

There is various form of blur present in MATLAB such as average, disk, laplacian, motion etc.

III. IMAGE RESTORATION

A degraded image can be restored in order to get an approximate of real image. The image restoration can be done either in spatial domain or in frequency domain [5].

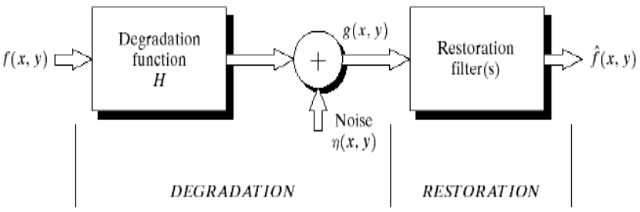


Fig.2 Image Restoration Model[1]

$\hat{f}$ (x,y) is the restored image using restoration filter.

Here, we are restoring a degraded image in frequency domain. In frequency domain the Equation 1 is represented as:

$$G(u,v)=F(u,v).H(u,v)+n(u,v) \quad (2)$$

In frequency transform convolution is replaced by product form [1].

A. Wiener Filter

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

The frequency-domain expression for the Wiener filter is:

$$W(s) = H(s)/F^{+}(s) , \quad (3)$$

$$H(s) = F_{x,s}(s)\, e^{as} / F^{-}_{x}(s) \quad (4)$$

Where,

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

B. Regularized Filter

Regularized filter is the deblurring method to deblur an image by using deconvolution function deconverge which is effective when the limited information is known about additive noise[11].

C. Lucy – Richardson

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[11].

$$C_i = \sum_j P_{ij} U_j \quad (5)$$

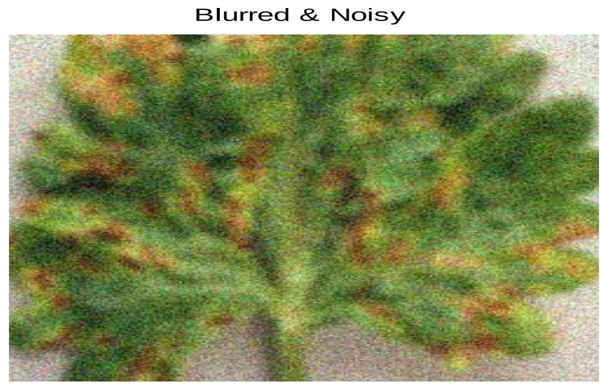
Where,

P_{ij} is PSF at location i and j, U_j is the pixel value at j in blurred image. C_i is the observed value at pixel location i.

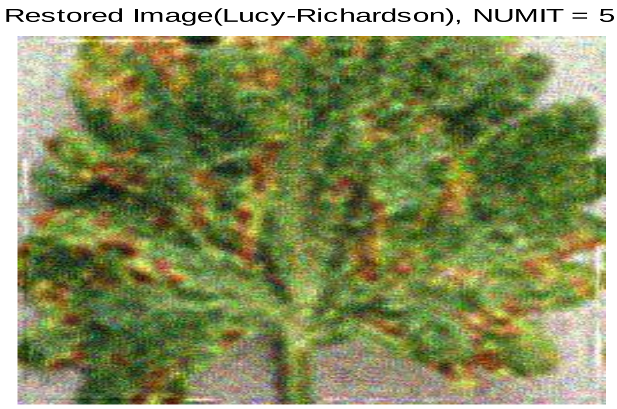
IV. SIMULATION

The color image restoration is implemented using MATLAB(R2009a) and tested for all algorithms. Here, we use a crop image 'leaf1.jpg' for testing purpose. The images used for simulation are taken from agricultural database. In figure 3(a) original image is present and in 3(b) degraded image 3(c), 3(d) and 3(e) contains restored image using wiener deconvolution, regularized and lucy-richardson method respectively. In this whole work we have assume that we have knowledge of only PSF.

(a)



(b)



(c)

(d)

Restored Image(Wiener)

(e)

Fig.3(a) Original Image ,(b) Blurred & Noisy Image, (c) Lucy-Richardson Deconvolution, (d) Regularized Deconvolution (e) Wiener Deconvolution.

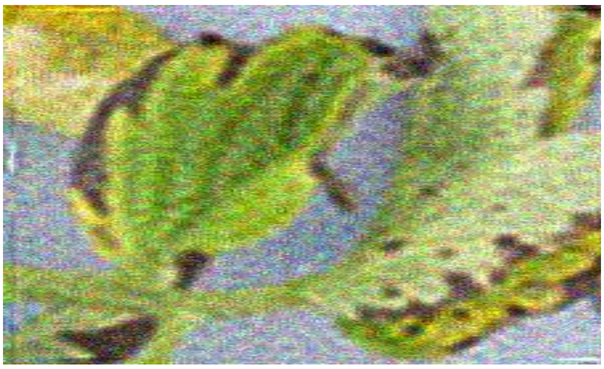
Original Image

a.

Blurred & Noisy

b.

Restored Image(Lucy-Richardson)

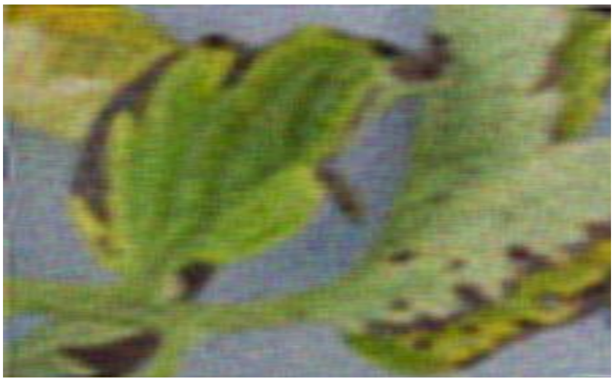


c.

Restored Image(Regularized)

d.

Restored Image(Wiener)



e.

Fig.4(a) Original Image ,(b) Blurred & Noisy Image, (c) Lucy-Richardson Deconvolution, (d) Regularized Deconvolution (e) Wiener Deconvolution.

TABLE I

Mean Square Error value and Peak Signal to Noise Ratio value for fig.3

Filter Type	MSE Value Fig. 1.	PSNR Value(dB) Fig. 2.
Wiener	0.0342	62.7364
Lucy- Richardson	0.0373	62.4127
Regularized	0.0113	67.5902

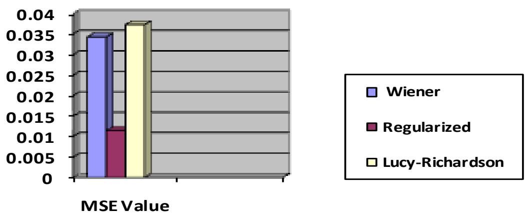


Fig.7 MSE value For all Deconvolution Algorithms.

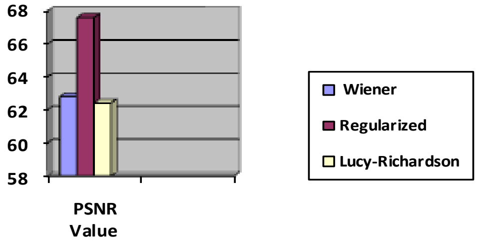


Fig.8 PSNR value For both types of Wiener Deconvolution using various Blur effects.

The experimental result shows that the approach using Regularized Deconvolution is better then other deconvolution algorithms. Here,we have knowledge of PSF only for the color images.

V. CONCLUSION

In this work we are restoring color image i.e. true RGB image by using various deconvolution algorithms in frequency domain. We assumed that we have only degraded image and knowledge of PSF.

The simulation results are compared by PSNR and MSE. And on simulation we found the results obtained by Regularized algorithm are better then other restoration algorithms for the testing image 'leaf1.jpg' for given application.

REFERENCES

[1] Rafel Gonzalez ,Richard E.Woods ,"*Digital Image Processing*" III edition,Published by Prentice Hall, ISBN No. 81-7758-168-6,2009.

[2] S.Jayaram,S.Esakkirajan,T.Veerakumar,"*Digital Image Processing*",III edition,published by TMH,2010.

[3] Lakshmi A,Rakshit S "*Noise Adaptive Image Restoration:A minimum meansquare error approach*".Third national conference,2011,pp.110-113.

[4] V.R.vijaykumar,P.T. Vanathy,P. Kanagasabapathy "*Fast and efficient algorithm to remove gaussian noise in digital images* ",IAENG International Journalof Computer Science,37:1,IJCS_37_1_09.

[5] Reginald L. Lagendijk,Jan Biemond "*Basic methods of image restoration and identification*",1999

[6] Hiroko Furuya,Shintaro Eda,Testuya Shimamura "*Image restorationvia wiener filtering in the frequency domain* ",ISSN:1790-5052 Issue 2,volume 5,2009.

[7] Zuaguan Wang,Yutian Fu "*Frequency domain regularized deconvolution for images with strip noise* " Image and graphics,2007.ICIG 2007.Fourth International Conference on Digital Object Identifier,pp.110-115.

[8] P.J.Shaw, D.J.Rawlins, "*The Point Spread function of a Confocal Microscope: Its Measurement and Use in Deconvolution of 3D-Data*", Journal of Microscopy 2011.

[9] K.R.Rao and R.Yip, "*Discrete Cosine Transform-Algorithm, Advantages and Applications*". Published by New York Academic Press, Edition 1990.

[10] Moacir P. Ponti-Jr, Nelson D.A.Mascarenhas, "Three-dimensional noisy image restoration using filtered extrapolation and deconvolution", Signal, Image and Video Processing , Volume 7,Issue I, pp1-10, Print ISSN1863-1703, 2013

[11] Salem, Dr. N.V.Kalyankar, "A Comparitive study for Deblurred average blurred Images". International Journal on Computer science and engg. Vol.02, No. 03,2010, 731-733, ISSN : 0975-3397.