Performance Evaluation and Comparison of Different Noise, apply on PNGImage Format used in Deconvolution Wiener filter (FFT) Algorithm

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ABSTRACT. Image Restoration is a field of Image Processing. This deals with recovering an original and sharp image from a degraded image using degradation & restoration function. This study focus on restoration of degraded images which have been blurred by known degradation function.PNG(Tag Index Format) are considered for analyzing the image restoration techniques deconvolution using wiener filter(FFT) algorithm with an information of the Point Spread Function (PSF) corrupted blurred image and then corrupted by Different noise. Performance analysis is done to measure the efficiency by which image is recovered. The analysis is done on the basis of various performance metrics like Peak Signal to Noise Ratio(PSNR),Mean Square Error(MSE), Root Mean Square Error(RMSE), Mean Absolute Error(MAE).

1. INTRODUCTION

Image restoration techniques can improve the apparent sharpness of image from the degraded image using degradation & restoration model. Image capture process Causes degradation of original image. There are several factors having contributions to the blur, two of them are the most important[1]:-Blur occur due to both object or camera motion is called motion blur.[2]out of focus optic caused by wide angle lens setting or atmospheric turbulence, being called out of focus blur. Degraded image is additionally corrupted by the noise. The noise is a consequence of imperfection of image sensor and acquisition part of camera. In Degradation model, the original image is blurred using degradation function and noise. Degradation image can be described by the formula:

$$g = f * h + n$$

Where:-g is degraded image is the degradation function is an original image and n is the noise. The ***Degradation model*** is structure as follows:
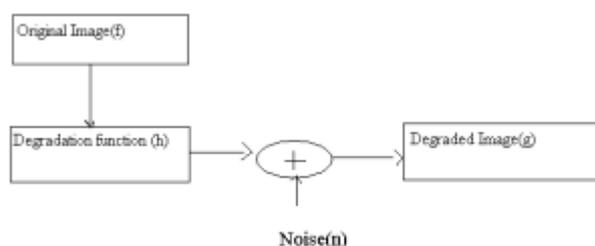

Fig.1 Degradation Model

Image deconvolution (sometimes known as image deblurring) is the process of reconstructing or estimating the true image from the degraded one. In ***Restoration Model***, the degraded image is regenerate using Deconvolution wiener filter (FFT) algorithm. It performs the inverse process of degradation by removing noise and blur factor. We get an estimate of the original image as a restoration result.
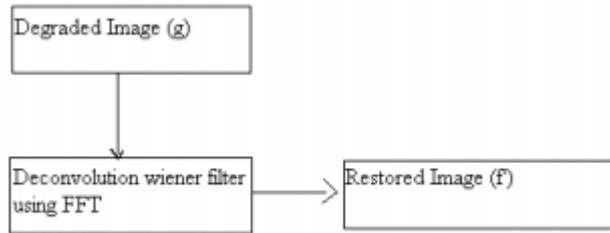
Fig.2 Restoration model

2. DECONVOLUTION USING WIENER FILTER (FFT TECHNIQUE)

The wiener filter is an image restoration technique for the deconvolution with a priori known PSF.The wiener filter is usually applied in the frequency domain. given a blurred image $g(x,y)$ .one takes the discrete Fourier transform (DFT)to obtain $G(u,v)$.the original image spectrum is estimated by taking the product of $G(u,v)$ with the wiener filter $W(u,v)$:

$$F (u, v) = G (u, v) w (u, v)$$

The inverse DFT is then used to obtain the original image from its spectrum. The Wiener filter can be stated as follows:

$$W (u, v) = H^*(u, v)/|H (u, v)|^2 +P$$

Where $H (u, v)$ denote Fourier Transform of the PSF .Since the $w (u, v)$ have the possibility to produce the pulse while the $|H (u, v)|^2$ approaches zero. Hence, in adopted P to prevent this situation.

Fig.3 Deconvolution using wiener filter (FFT technique)

a) Methodology
This paper aims at studying png image formats used in Deconvolution using wiener filter (FFT) Technique. We will first degraded the original image using a blur and different noise then by using the above mentioned algorithms we will try to restore the original image from the degraded image.

b) Basic Parameter
b1.) MSE (Mean square Error):-
MSE is defined as the some sort of average or sum (or integral) of square of the error between two image.

$$MSE=1/ (N*M)*sum\_ \{I, J (X\_ \{I, J\}-Y\_ \{I, J\}\})^2$$

Where: (I, J) is the original image
     Y (I, J) is the decompressed image
     M, N is the dimensions of the image

b2.) Peak Signal to Noise Ratio (PSNR):-
PSNR is defined as the ratio between signal variance and reconstruction error variance:-

$$PSNR= 20.\log_{10} (max_1)-10.\log_{10} (MSE)$$

Here: mean squared error (MSE)
Max$_1$ is the maximum possible pixel value of the image

b3.) RMSE (root mean square error):- RMSE is defined as the square root of mean square error.

$$RMSE = \sqrt{MSE}$$

b4.) MAE (maximum absolute error):- MAE is defined as the maximum absolute value, the difference between original image and degraded image

$$Max \ (abs \ (I1 \ (:) - I2 \ (:)))$$

3. EXPERIMENTS VERIFICATIONS

All the Implementation work in done in MATLAB 7.5.First of the entire original image is degraded using a degradation function. The degraded image is then deblurred using all of the above deconvolution wiener filter (FFT) techniques, following are tabular results obtained after the comparison:

Table 1. For Different Gaussian Noise Variance apply on PNG Image format

GAUSSIAN NOISE		DECONVOLUTION WIENER FILTER USING FFT			
IMAGE	NOISE VARIANCE	MSE	PSNR	RMSE	MAE
PNG	0.01	0.0019	75.3329	0.0438	0.6618
PNG	0.02	0.0020	75.2189	0.0444	0.6367
PNG	0.03	0.0021	74.9965	0.0455	0.6326
PNG	0.04	0.0022	74.6678	0.0473	0.6254

According to Table 1, this work makes a GAUSSIAN NOISE applied on PNG file format using Deconvolution Wiener filter (FFT) Algorithm. A Noise Variance comparison is done on the basis of various performance parameter like PSNR(Peak Signal to Noise Ratio),MSE(Mean Square Error),RMSE(Root Mean Square Error),MAE(Maximum Absolute Error).

Table 2. For Different Speckle Noise Variance apply on PNG Image format

SPECKLE NOISE			DECONVOLUTION WIENER FILTER USING FFT		
IMAGE	NOISE VARIANCE	MSE	PSNR	RMSE	MAE
PNG	0.01	0.0017	75.8904	0.0411	0.6030
PNG	0.02	0.0018	75.6713	0.0421	0.6288
PNG	0.03	0.0019	75.4905	0.0430	0.6426
PNG	0.04	0.0019	75.3267	0.0438	0.6732

According to Table 2, this work makes a SPECKLE NOISE applied on PNG file format using Deconvolution Wiener filter (FFT) Algorithm. A Noise Variance comparison is done on the basis of various performance parameter like PSNR(Peak Signal to Noise Ratio),MSE(Mean Square Error),RMSE(Root Mean Square Error),MAE(Maximum Absolute Error).

Table 3. For Different Salt & Pepper Noise Variance apply on PNG Image format

SALT & PEPPER NOISE			DECONVOLUTION WIENER FILTER USING FFT		
IMAGE	NOISE VARIANCE	MSE	PSNR	RMSE	MAE
PNG	0.01	0.0017	75.8477	0.0413	0.5833
PNG	0.02	0.0018	75.6029	0.0425	0.6064
PNG	0.03	0.0019	75.4145	0.0434	0.6131
PNG	0.04	0.0020	75.1916	0.0445	0.6561

According to Table 3, this work makes a SALT & PEPPER NOISE applied on PNG file format using Deconvolution Wiener filter (FFT) Algorithm. A Noise Variance comparison is done on the basis of various performance parameter like PSNR(Peak Signal to Noise Ratio),MSE(Mean Square Error),RMSE(Root Mean Square Error),MAE(Maximum Absolute Error).

Fig.4. IMAGE IN PNG USED GAUSSIAN NOISE

Original image   Blur image   Speckle noise

BlurredNoisy   Deblur image using FFT

Fig.5. IMAGE IN PNG USED SPECKLE NOISE

Original image   Blur image   salt & pepper noise

BlurredNoisy   Deblur image using FFT

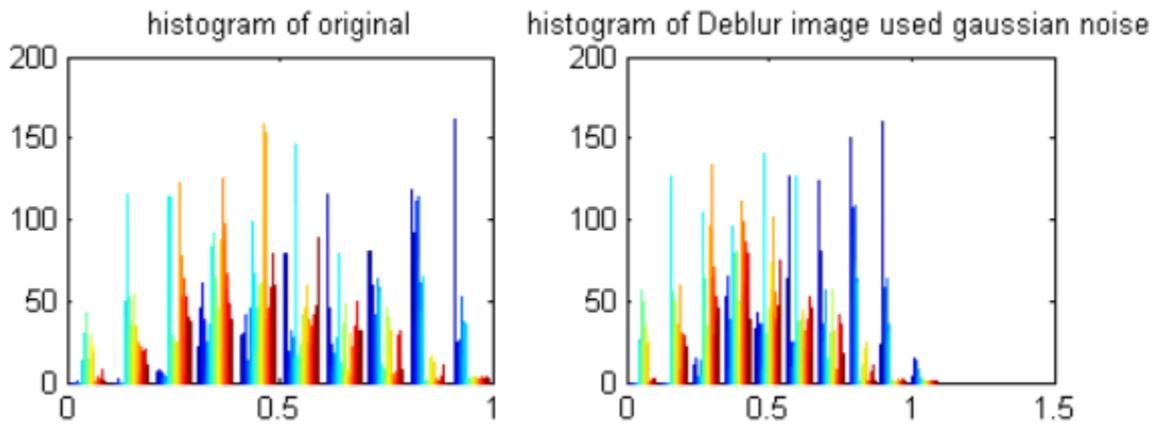**Fig.6. IMAGE IN PNG USED SALT & PEPPER NOISE**

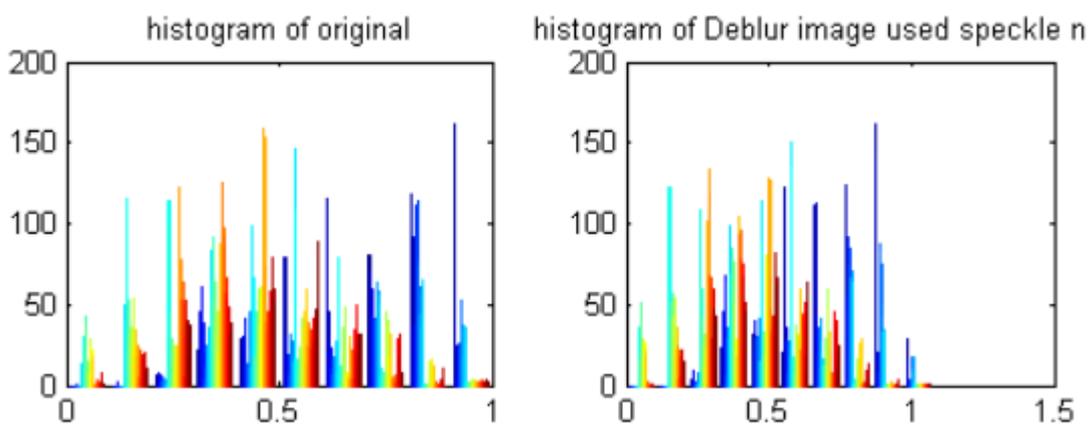**Fig.7. Histogram representation of PNG Image used Gaussian Noise**

Fig.8. Histogram representation of PNG Image used Speckle Noise
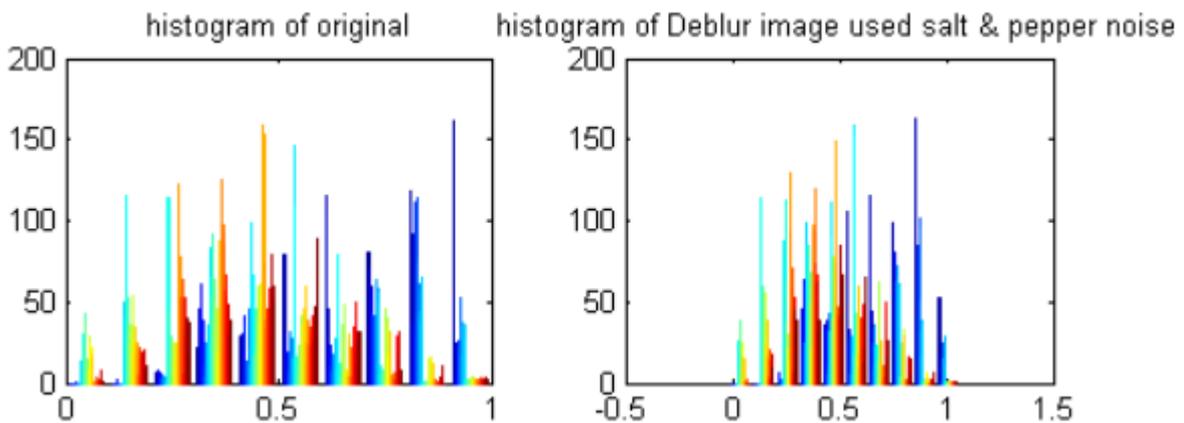

Fig.9. Histogram representation of PNG Image used Salt & Pepper Noise

The MSE value of GAUSSIAN NOISE is 0.0019,PSNR value of 75.3329 ,RMSE value of 0.0438,andMAE value of 0.6618.The MSE value of SPECKLE NOISE is 0.0017,PSNR value of 75.8904 ,RMSE value of 0.0411,andMAE value of 0.6030.The MSE value of SALT & PEPPER NOISE is 0.0017,PSNR value of 75.8477 ,RMSE value of 0.0413,and MAE value of 0.5833. Then MAE according to result "SALT & PEPPER NOISE" is give the better results of png image format.because MAE find the maximum absolute value, the difference between original image and degraded image. Wiener deconvolution is a fast deconvolution algorithm. It is an interesting deconvolution tool that can be very useful to process any kind of image with relatively high signal to noise ratio. Wiener deconvolution is particularly suitable for lunar and planetary imaging. Due to minor optical aberrations or slight tracking errors to quickly find and test PSF.

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