

# Detection of Noise in an Image using Blind Deconvolution Method

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## Abstract

Image Restoration is a field of Image Processing which deals with recovering an original and sharp image from a degraded image using a mathematical degradation and restoration model. This study focuses on restoration of degraded images which have been blurred by known or unknown degradation function. On the basis of knowledge of degradation function image restoration techniques can be divided into two categories: blind and non-blind techniques. Images are considered for analyzing the various image restoration techniques like Deconvolution using Lucy Richardson Algorithm (DLR), Deconvolution using Wiener Filter (DWF), Deconvolution using Regularized Filter (DRF) and Blind Image Deconvolution Algorithm (BID). The analysis is done on the basis of various performance metrics like PSNR (Peak Signal to Noise Ratio), MSE (Mean Square Error) and SSIM (Structural Similarity Index for Measuring Image

## Keywords

Lucy Richardson Algorithm, Wiener Filter, Regularized Filter, Blind Image Deconvolution, Gaussian Blur, Point Spread Function, PSNR, MSE, RMSE.

## I. Introduction

The main objective of Image Restoration is to recover the original image from a degraded image which is blurred by a degradation function, commonly by a Point Spread Function (PSF). Image Restoration Techniques are divided into two categories on the basis of knowledge about Point Spread Function (PSF).

### 1) Blind Image Restoration

This Technique allows the reconstruction of original images from degraded images even when we have very little or no knowledge about PSF. Blind Image Deconvolution (BID) is an algorithm of this type.

### 2) Non-Blind Restoration

This Technique helps in the reconstruction of original images from degraded images when we know that how image was degraded i.e. we have a

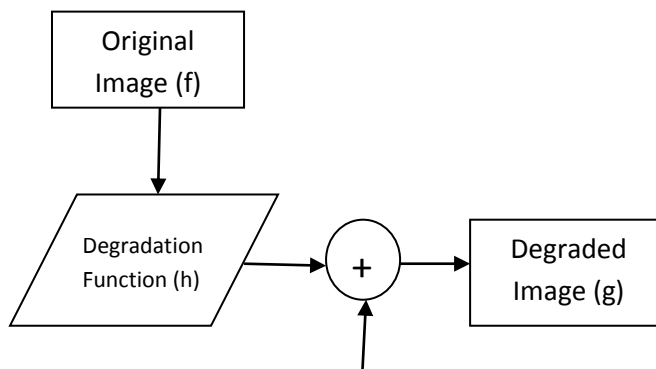
knowledge about PSF. Deconvolution using Lucy Richardson Algorithm (DLR), Deconvolution using Wiener Filter (DWF), Deconvolution using Regularized Filter (DRF) are Non Blind Algorithms.

## Degradation Model

In degradation model, the original image is blurred using degradation function and additive noise. The degraded image is described as follows:

$$g = h * f + n \dots\dots\dots (1)$$

In equation (1), g is the degraded image, h is the degradation function, f is an original image and n is the additive noise. The degradation Model is structured as follows:



Noise (n)

Fig. 1 Degradation Model

## Restoration Model

In Restoration model, the degraded image is reconstructed using restoration filters. It performs the inverse process of degradation by removing additive noise and blur factor. We get an estimate of the original image as a result of restoration. The closer the estimated image is to the original image the more efficient is our restoration filter.

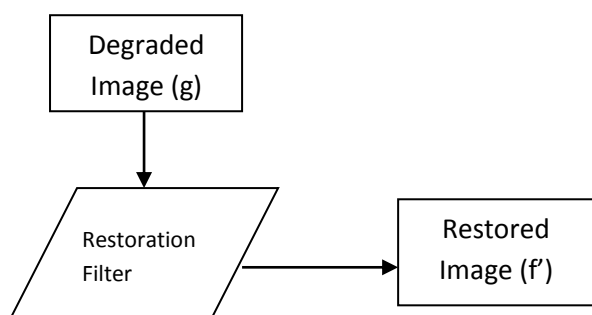


Fig. 2 Restoration Model

Section 2 consists of different algorithm. In Section 3 consists of simulation set up and the results. Conclusions are drawn in Section 4.

## II. Proposed Algorithm

This paper aims at studying , analyzing and comparing four different types of Image Restoration techniques viz. Deconvolution using Lucy Richardson Algorithm (DLR), Deconvolution using Wiener Filter (DWF), Deconvolution using Regularized Filter (DRF) and Blind Image Deconvolution Algorithm (BID). For making a comparison among all the above algorithms we will consider three image formats .jpg (Joint Photographic Experts Group), .png (Portable Network Graphics) and .tif (Tag Index File Format) . We will first degrade the original image using a Gaussian blur and then by using the above mentioned algorithms we will try to restore the original image from the degraded image.

### Deconvolution using Lucy Richardson Algorithm

DLR is a non blind technique of image restoration, used to restore a degraded image that has been blurred by a known PSF. It is an iterative procedure in which the pixels of the observed image are represented using the PSF and the latent image as follows:

$$d_i = \sum p_{ij} u_j \dots\dots\dots(2)$$

In equation (2),  $d_i$  is the observed value at pixel position “i”,  $p_{ij}$  is the PSF ,the fraction of light coming from true location „j” that is observed at position “i” ,  $u_j$  is the latent image pixel value at location “j”

### Deconvolution using Wiener Filter

Weiner Filtering is also a non blind technique for reconstructing the degraded image in the presence of known PSF. It removes the additive noise and inverts the blurring simultaneously. It not only performs the deconvolution by inverse filtering (high pass filtering) but also removes the noise with a compression operation (low pass filtering).It compares with an estimation of the desired noiseless image. The input to a wiener filter is a degraded image corrupted by additive noise. The output image is computed by means of a

filter using the following expression:

$$f'' = g * (f + n) \dots\dots\dots(3)$$

In equation (5),  $f$  is the original image,  $n$  is the noise,  $f''$  is the estimated image and  $g$  is the wiener filter’s response.

### Deconvolution using Regularized Filtering

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 chosen to be a discrete Laplacian. This filter can be understood as an approximation of a Wiener filter.

### Blind Image Deconvolution

As the name suggests, BID is a Blind technique of image restoration which restores the degraded image that is blurred by an unknown PSF. It is a

deconvolution technique that permits recovery of the target image from a single or set of blurred images in the presence of a poorly determined or unknown PSF.

In this technique firstly, we have to make an estimate of the blurring operator i.e. PSF and then using that estimate we have to deblur the image. This method can be performed iteratively as well as non-iteratively. In iterative approach, each iteration improves the estimation of the PSF and by using that estimated PSF we can improve the resultant image repeatedly by bringing it closer to the original image. In non-iterative approach one application of the algorithm based on exterior information extracts the PSF and this extracted PSF is used to restore the original image from the degraded one.

### III. Comparison & Simulation Result

In this paper, we take two images & apply different algorithm both images. Ist one Vegetables & IInd is Bottle Image. Comparison of different algorithm is given by Table 1 & Table 2. Table 1. Gives Comparison of different Algorithm for Cameraman Image while Table 2. Comparison of different Algorithm for Lena Image. Images are compared with three algorithms Lucy Richardson algorithm Deconvolution using Regularized Filter, Wiener filter and Blind deconvolution.

#### A. Vegetables

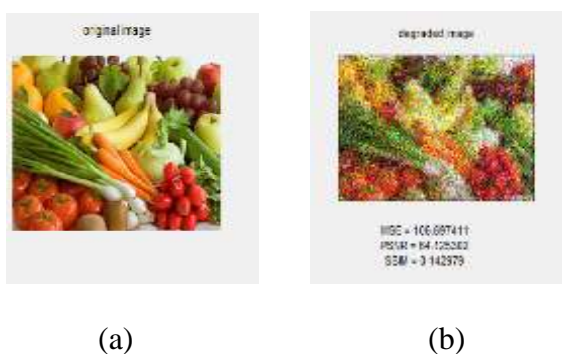


Fig 3. Vegetables Image a) Original Image b) Degraded Image



Fig 4. Restored Image (a) Lucy Richardson algorithm (b) Weiner Algorithm

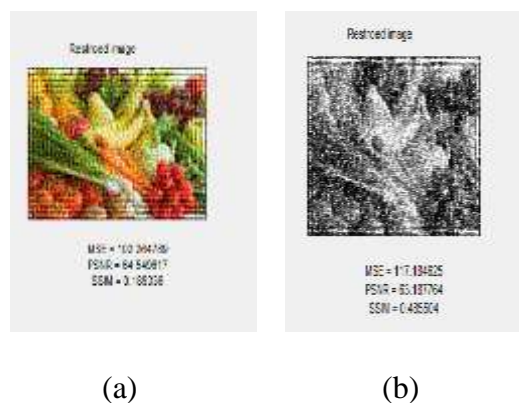


Fig 5. Restored Image (a) Deconvolution using Regularized Filter (b) Blind Deconvolution (EM Algorithm) (c) Blind Deconvolution (MAP Algorithm)

#### B. Bottle



(a)

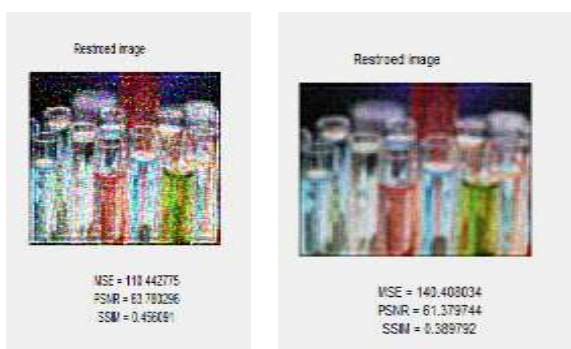
(b)

Fig 6. Vegetables Image a) Original Image b) Degraded Image



(c)

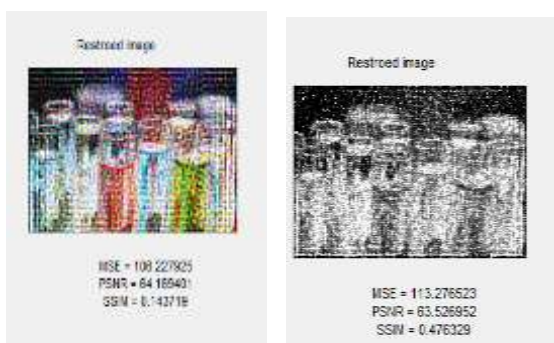
Fig 8. Restored Image (a) Deconvolution using Regularized Filter (b) Blind Deconvolution (EM Algorithm) (c) Blind Deconvolution (MAP Algorithm)



(a)

(b)

Fig 7. Restored Image (a) Lucy Richardson algorithm (b) Weiner Algorithm



(a)

(b)

Sr. No.	Algorithm	MSE	PSNR	SSIM	
1.	Degraded Image	106.6974	64.125302	0.142979	
2.	Lucy	109.2453	63.889313	0.469583	
3.	Weiner	128.1627	62.92265	0.302763	
4.	Regularized Filter	102.2647	64.549617	0.185336	
5.	Blind Deconvolution	EM	117.1846	63.187764	0.485504
6.		MAP	0.026639	56.277038	0.999720

Table 1. Comparison of different Algorithm for Vegetable Image

Sr. No.	Algorithm	MSE	PSNR	SSIM
1.	Degraded Image	110.9778	63.731966	0.127615
2.	Lucy	110.4427	63.780296	0.127615

3.	Weiner		140. 4080	61.379 744	0.389 792
4.	Regularized Filter		106. 2279	64.169 401	0.143 719
5.	Blind Deconv	EM	113. 2765	63.526 952	0.476 329
6.	olution	MAP	0.06 8916	55.954 994	0.996 712

Table 2. Comparison of different Algorithm for Bottle Image.

#### IV. Conclusion

We have discussed efficient noise detection algorithms for the detection of noise in the degraded image and to determine effective filtering technique required for removal of detected type of noise. This algorithm can be beneficial to enhance the quality of corrupted image. Blind deconvolution Method is best algorithm for detection of Noise.

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