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REVIEW ARTICLE

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Blind and Non- blind Image Restoration Techniques

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Abstract: With the popularity of digital cameras, digital image processing is getting more and more important. One of the most common problems in digital photographing is motion blur. When taking a photograph, the shaking of camera is the reason causing blurred image. Images may be degraded for many reasons. Reducing the blur and the noises in images is known as image restoration. The survey involves restoring the blurred/degraded images using Blind Deconvolution algorithm, Lucy Richardson Algorithm, Weiner Filtering Image restoration Algorithm and Regularized Filtering Image Restoration Algorithm. The fundamental task of Image deblurring is to de-convolute the degraded image with the PSF that exactly describes the distortion. BID uses less information of the point spread function (PSF) to restore the degraded image. During the restoration of the degraded image, the first step is to identify the proper PSF model. The degraded image does not uniquely define the PSF. Nevertheless there are many applications where the degraded images have been blurred either by an unknown or a partially known PSF.

Keywords: Motion blur, Deconvolution, Point Spread Function, Degradation Model, Image restoration algorithms

I. INTRODUCTION

Image deblurring is an inverse problem which aspires to recover an image which has suffered from linear degradation [1]. Digital image recovery entails a process which is meant to recover the original image data by considering the degradation (noise in the acquisition, transmission problems, etc.) that this image has undergone [8]. The objective of image restoration is to reconstruct the original scene from a degraded observation which is commonly blurred by a point spread function (PSF) [2]. Distortion may arise from atmospheric turbulence, relative motion between an object and an out of focus camera. The blurring degradation can be space invariant or space-in variant [3]. The term noise in digital images refers to any pixel value of an image which does not match the reality.[8] Image deblurring methods can be divided into two classes: non-blind, in which the blurring operator is known. And blind, in which the blurring operator is unknown.[1][2][3] Blind Deconvolution Algorithm comes under blind deblurring techniques in which the degraded function is unknown and Lucy Richarson Algorithm,Weiner Filtering Algorithm,Regularized algorithm comes under non blind deblurring techniques in which degraded function is known. BID also takes a lot of attention in many different technical areas, for example photography, medical imaging, astronomical imaging, and so forth [8].

II. DEGRADTION MODEL

In degradation model, the image is blurred using filters and additive noise. Image can be degraded using Filter and Noise. The degraded image can be described by the following equation (1) [1].

$$g = H * f + n \quad (1)$$

In equation (1), g is degraded/blurred image, H is space invariant function (i.e.) blurring function, f is an original image, and n is additive noise. The following Fig.1 represents the structure of degradation model.

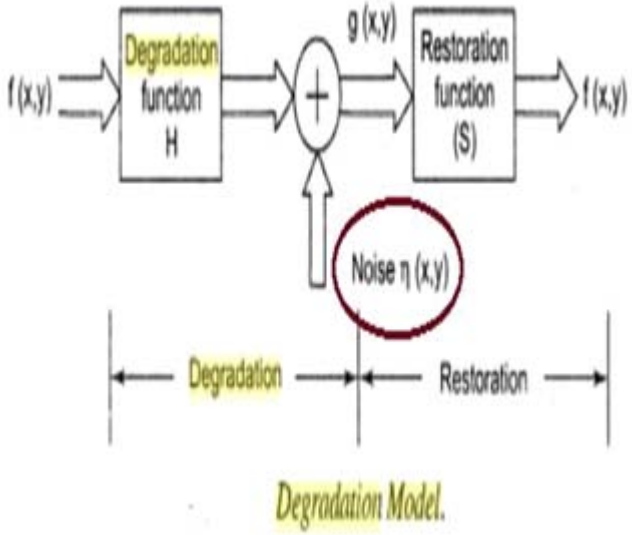

Figure: 1

BLIND DEBLURRING TECHNIQUES

A. Blind Deconvolution Algorithm:

Blind Deconvolution Algorithm can be used effectively when no information of distortion is known. It restores image and PSF simultaneously. This algorithm can be achieved based on Maximum Likelihood Estimation [1][10]. Blind Image Deconvolution is a more difficult image restoration where image recovery is performed with little or no prior knowledge of the degrading PSF. The advantages of Deconvolution are:

higher resolution and better quality. Generally, BID must consider three key issues: blur model, PSF estimation, and image restoration.[1][9][10]. Researchers have been studying blind deconvolution methods for several decades, and have approached the problem.

Blind image deconvolution is constantly receiving increasing attention from the academic as well the industrial world due to its theoretical and practical implications [2][11]. The field of blind image deconvolution has several applications in different areas such as image restoration, microscopy, medical imaging, biological imaging, remote sensing, astronomy, nondestructive testing, geophysical prospecting, and many others.

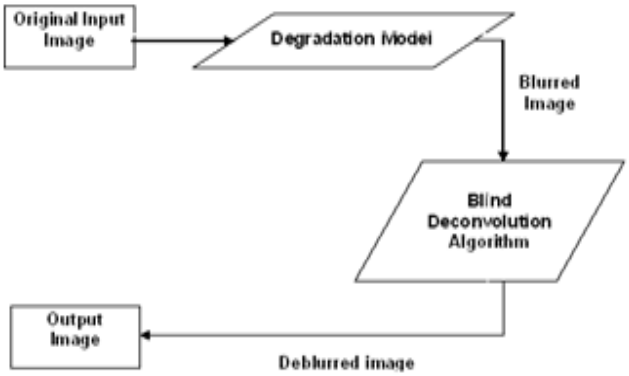

Figure. 2

IV. NON-BLIND DECOVOLUTION TECHNIQUES

A. Lucy-Richardson Algorithm:

Richardson-Lucy algorithm is a well-known image deconvolution algorithm which is an iteration algorithm. Its methods are effective and simple to implement. At beginning, the PSF of a blurred image is known, and then intermediate clear image is obtained, lastly to acquire the input blurred image. After several times deconvolution, the unblurred image is obtained. The blurred image is defined as follow [4][9].

$$I = L * k + n \quad (1)$$

Where I is blurred image, L is Latent unblurred image, k is point spread function, n is noise and * is convolution operator.

B. Weiner Filtering Algorithm:

It is important to note that the application of a low-pass filter like Weiner is an effective way to reduce Gaussian noise in an image[8]. Its purpose is to reduce the amount of noise present in a signal by comparison with an estimation of the desired noiseless signal. The discrete-time equivalent of Wiener's work was derived independently by Kolmogorov and published in 1941. Hence the theory is often called the Wiener-Kolmogorov filtering theory[11][9]. In case of the Gaussian noise, Weiner filter is used[8]. A Wiener filter is not an adaptive filter because the theory behind this filter assumes that the inputs are stationary. The goal of the Wiener filter is to filter out noise that has corrupted a signal. Wiener filters are characterized by the following. [9]

C. Regularized Restoration Algorithm:

- ***a. Assumption:*** Signal and (additive) noise are stationary linear stochastic processes with known spectral characteristics or known autocorrelation and cross-correlation
- ***b. Requirement:*** The filter must be physically realizable/casual (this requirement can be dropped, resulting in a non-causal solution)
- ***c. Performance criterion:*** minimum mean-square error (MMSE).[6][7][9]

V. CONCLUSION

Many solutions have been implemented to obtain the high resolution image by reducing the effect of noise and blur. Blind image deblurring method differs from most other existing methods by only imposing weak restrictions on the blurring filter, being able to recover images which have suffered a wide range of degradations. To aim for the higher quality in blind restoration algorithms we use PSO to explore the unknown PSF where as in Non Blind Debluring techniques, degraded function is known before deblurring of the image occurs .

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