IMAGE RESTORATION USING BLIND DECONVOLUTION ALGORITHM

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Abstract: *Image restoration is the process of recovering the original image from the degraded image. Aspire of the project is to restore the blurred/degraded images using Blind Deconvolution algorithm. The fundamental task of Image deblurring is to de-convolute the degraded image with the PSF that exactly describe the distortion. Firstly, the original image is degraded using the Degradation Model. It can be done by Wiener filter which is a low-pass filter used to blur an image. In the edges of the blurred image, the ringing effect can be detected using Canny Edge Detection method and then it can be removed before restoration process. Blind Deconvolution algorithm is applied to the blurred image. It is possible to renovate the original image without having specific knowledge of degradation filter, additive noise and PSF. To get the effective results, the constrained least square restoration algorithm that uses a regularized filter Technique is used with our proposed Blind Deconvolution Algorithm.*

Key Words: *Image, PSF, Wiener Filter, Canny Edge, Regular filter.*

I. INTRODUCTION

The Blind Deconvolution[1] Algorithm can be used effectively when no information about the distortion (blurring and noise) is known. The algorithm restores the image and the point-spread function (PSF) simultaneously. Additional optical system (e.g. camera) characteristics can be used as input parameters that could help to improve the quality of the image restoration. PSF constraints can be passed in through a user-specified function.

Understanding Deblurring: This section provides some background on deblurring techniques. The section includes these topics:

- Causes of Blurring
- Deblurring Model

Causes of Blurring: The blurring, or degradation, of an image can be caused by many factors:

(i) Movement during the image capture process, by the camera or, when long exposure times are used, by the subject.
(ii) Out-of-focus optics, use of a wide-angle lens, atmospheric turbulence, or a short exposure time, which reduces the number of photons capture.
(iii) Scattered light distortion in confocal microscopy

Deblurring Model: A blurred or degraded image can be approximately described by the equation: $g=Hf+n$, where, g-The blurred image, H-The distortion operator, also called the Point Spread Function (PSF), f-The original true image, n-Additive noise.

II. POINT SPREAD FUNCTION (PSF)

The distortion operator, also called the point spread function (PSF)[1]. In the spatial domain, the PSF describes the degree to which an optical system blurs (spreads) a point of light. The PSF is the inverse Fourier transform of the optical transfer function (OTF)[2]. In the frequency domain, the OTF describes the response of a linear, position-invariant system to an impulse. The OTF is the Fourier transform of the point spread function (PSF). The distortion operator, when convolved with the image, creates the distortion. Distortion caused by a point spread function is just one type of distortion. Based on this model, the fundamental task of deblurring is to deconvolve the blurred image with the PSF that exactly describes the distortion. Deconvolution is the process of reversing the effect of convolution. The quality of the deblurred image is mainly determined by knowledge of the PSF.

The **fspecial** function to create a PSF that simulates a motion blur, specifying the length of the blur in pixels, (LEN=31), and the angle of the blur in degrees (THETA=11). Once the PSF is created, the example uses the **imfilter** function to convolve the PSF with the original image, to create the blurred image, Blurred. (To see how deblurring is the reverse of this process, using the same images, see "Deblurring with the Wiener Filter".

Deblurring functions:

deconvwnr :Implements deblurring using the Wiener filter. **deconvreg :**Implements deblurring using a regularized filter **deconvlucy:**Implements deblurring using the Lucy-Richardson algorithm **deconvblind:**Implements deblurring using the blind deconvolution algorithm.

III. WIENER FILTER

The most important technique for removal of blur in images due to linear motion or unfocussed optics is the Wiener filter [3]. From a signal processing standpoint, blurring due to linear motion in a photograph is the result of poor sampling. Each pixel in a digital representation of the photograph should represent the intensity of a single stationary point in front of the camera. Unfortunately, if the shutter speed is too slow and the camera is in motion, a given pixel will be an amalgram of intensities from points along the line of the camera's motion. This is a two-dimensional analogy to $G(u,v)=F(u,v).H(u,v)$ where F is the fourier transform of an "ideal" version of a given image, and H is the blurring function.

IV. DEBLURRING WITH THE BLIND DECONVOLUTION ALGORITHM

Use the deconvblind function to deblur an image using the blind deconvolution algorithm. The algorithm maximizes the likelihood that the resulting image, when convolved with the resulting PSF, is an instance of the blurred image, assuming Poisson noise statistics. The blind deconvolution algorithm can be used effectively when no information about the distortion (blurring and noise) is known. The deconvblind function restores the image and the PSF simultaneously, using an iterative process similar to the accelerated, damped Lucy-Richardson algorithm [4]. The deconvblind function, just like the deconvlucy function, implements several adaptations to the original Lucy-Richardson maximum likelihood algorithm that address complex image restoration tasks. Using these adaptations, you can

- Reduce the effect of noise on the restoration
- Account for nonuniform image quality (e.g., bad pixels)
- Handle camera read-out noise

Avoiding Ringing in Deblurred Images:

The discrete Fourier transform (DFT)[5], used by the deblurring functions, assumes that the frequency pattern of an image is periodic. This assumption creates a high-frequency drop-off at the edges of images. In the figure-1, the shaded area represents the actual extent of the image; the unshaded area represents the assumed periodicity.

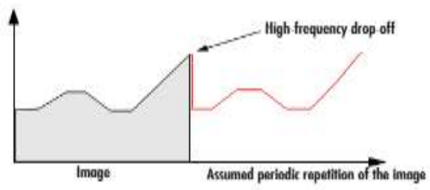

Figure-1: Frequency Analysis of captured image

This high-frequency drop-off[6] can create an effect called boundary related Ringing in deblurred images. In this figure-2, note the horizontal and vertical patterns in the image.

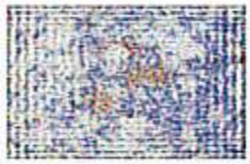

Figure-2: Patterns of an Image

To avoid ringing, use the **edgetaper** function to preprocess your images before passing them to the deblurring functions. The **edgetaper** function removes the high-frequency drop-off at the edge of an image by blurring the entire image and then replacing the center pixels of the blurred image with the original image. In this way, the edges of the image taper off to a lower frequency.

V. PROCEDURE

Step 1: Read Image

Step 2: Simulate a Blur

Step 3: Restore the Blurred Image Using PSFs of Various Sizes

Step 4: Analyzing the Restored PSF

Step 5: Improving the Restoration

Step 6: Using Additional Constraints on the PSF Restoration.

VI. RESULTS

Figure-3: Captured Image

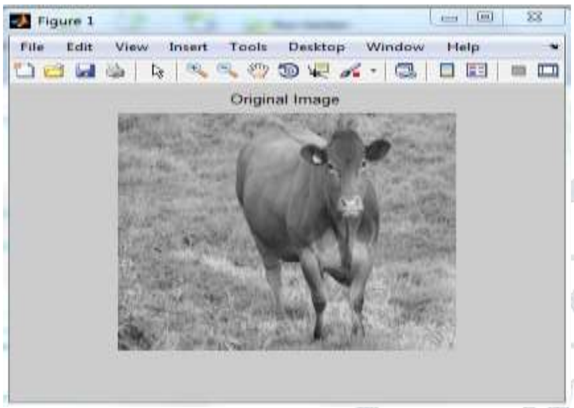

Figure-4: Gray scaled Image (256x256)

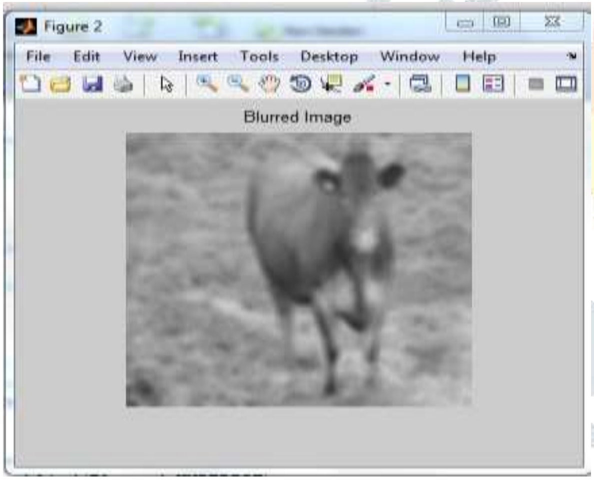

Figure-5: Blurred Image

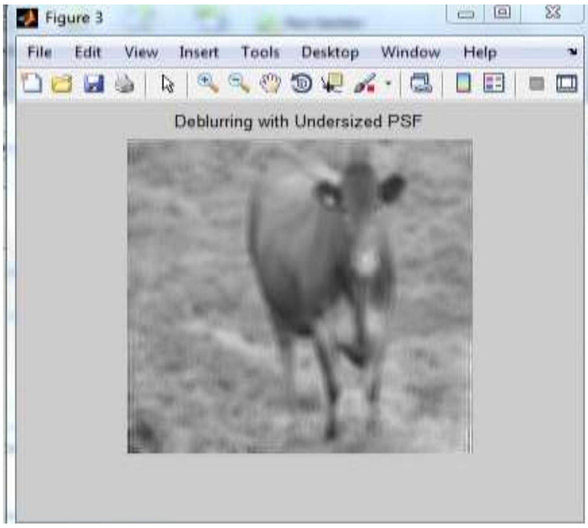

Figure-6: Deblurring with undersized PSF

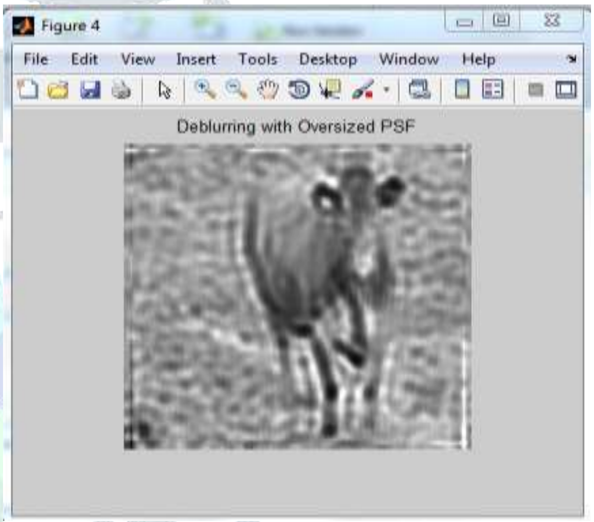

Figure-7: Deblurring with oversized PSF

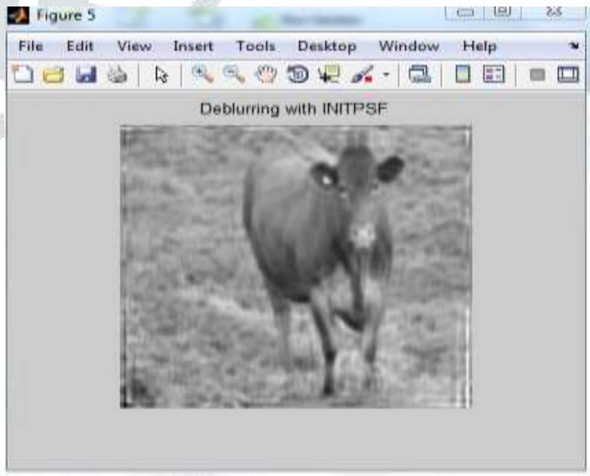

Figure-8: Deblurring with INITPSF

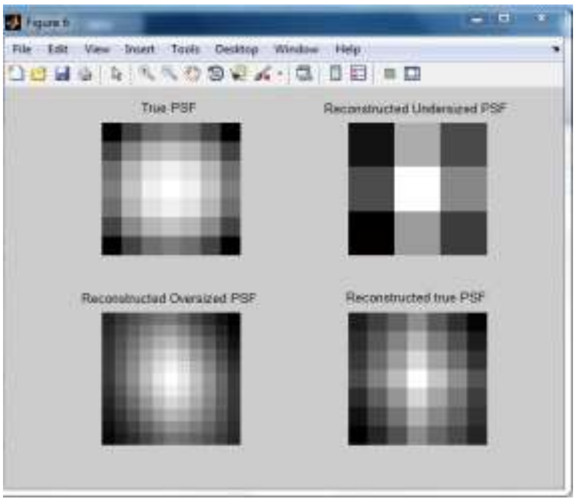

Figure-9: Point Spread Functions

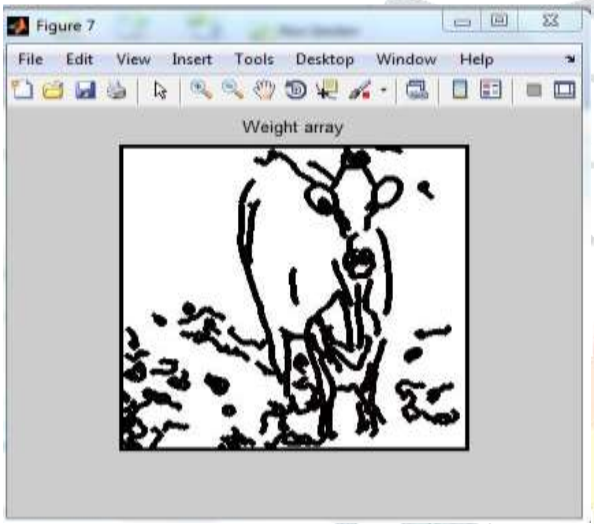

Figure-10: Weight Array

Figure-11: Deblurred Image

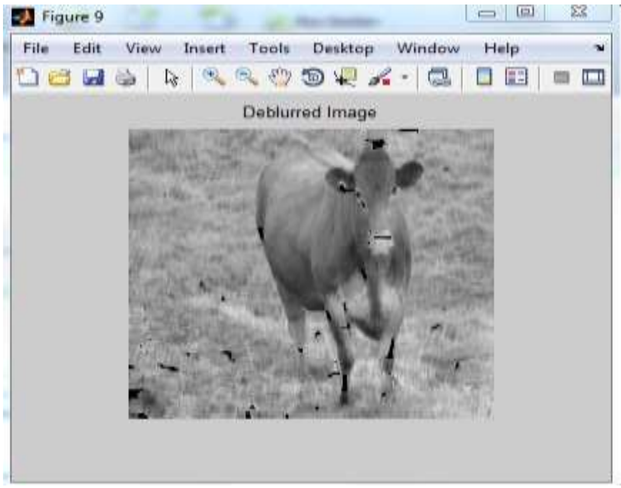

Figure-12: Deblurred Image

VII. CONCLUSION

In this paper, it is possible to restore our image without having specific knowledge of our degradation filter, additive noise, or image spectral density. However, not knowing our degradation filter **h** imposes the strictest limitations on our restoration capabilities. The methods we examined all required zero phase degradation filters. There are methods that estimate phase, but they are very tricky and were not attempted in this project. Finally, all of the homomorphic blind deconvolution techniques require iterations through either breaking up the degraded image or using multiple degraded images for estimation.

VIII. REFERENCES

[1]K. R. Castleman, *Digital Image Processing*, Prentice-Hall, 1996

[2] M. R. Banham and A. K. Katsaggelos, "Spatially Adaptive Wavelet-Based Multiscale Image Restoration," IEEE Trans. Image Processing, vol. 5, no. 4, pp. 619-634, April 1996.

[3] J. Biemond and A. K. Katsaggelos, ``A New Iterative Restoration Scheme for Noisy Blurred Images," Proc. Conf. on Math. Methods in Signal Processing, pp. 74-76, Aachen, W. Germany, September 1984.

[4] J. Biemond and A. K. Katsaggelos, ``Iterative Restoration of Noisy Blurred Images," Proc. 5th Inf. Theory Symposium in the Benelux, pp. 11-20, Aalten, The Netherlands, May 1984.

[5]A. K. Katsaggelos, ``A General Formulation of Adaptive Iterative Image Restoration Algorithms," Proc. 1986 Conf. Inf. Sciences and Systems, pp. 42-47, Princeton, NJ, March 1986.

[6] A. K. Katsaggelos, J. Biemond, R. M. Mersereau and R. W. Schafer, ``An Iterative Method for Restoring Noisy Blurred Images," Proc. 1984 Int. Conf. Acoust., Speech, Signal Processing, pp. 37.2.1-37.2.4, San Diego, CA, March 1984.

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