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Image Deblurring Using a Neural Network Approach

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Abstract*— This paper presents the restoration of blurred image which is degraded using blind disconsolation algorithm. There are many researches done using this algorithm [6], but no one conceived it from parallel computing procedure. In this work, we consider the problem of restoring a blurred image degraded by blur and high impulsive noise levels. Deblurring and denoising are probably two of the most studied problems in image processing. We present a novel algorithm for blind image deblurring from a single image using parallel computation. The blur point spread function (PSF) is assumed uniform. We divide the image and exert the algorithm on each part parallelly. Before applying the blind image deconvolution algorithm in blurred image we train the network using back propagation algorithm, for number of iterations used in deblurring process to finding the true PS.

***Index Terms*— Blind Image Deconvolution, Degradation, Point Spread Function (PSF).**

I. INTRODUCTION

Image restoration is the problem of finding an estimate of an ideal image from its blurred and noisy rendition. In many cases these degradations cannot be avoided, and the data must be recovered from the post processing. However, most of current digital image processing techniques are always assumed that all the information which is required to restore image is known a priori [7][8]. Image restoration is to improve the quality of the degraded image. It is used to recover an image from distortions to its original image. It is an objective process which removes the effects of sensing environment. It is the process of recovering the original scene image from a degraded or observed image using knowledge about its nature. 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 [4]. This paper is structured as follows: Section 2 represents restoration using a neural network. Section3 Quantization of an image. Section 4 describes the degradation model for blurring an image. Section 5 describes the blurring concept algorithm and. Section 6 overall architecture of this paper. Section 7 describes the sample results for deblurred images using our proposed algorithm. Section 8 describes the conclusion, comparison and future work.

II. RESTORATION USING A NEURAL NETWORK

Consider the single layer perceptron in figure **1** Single Layer Perceptron.

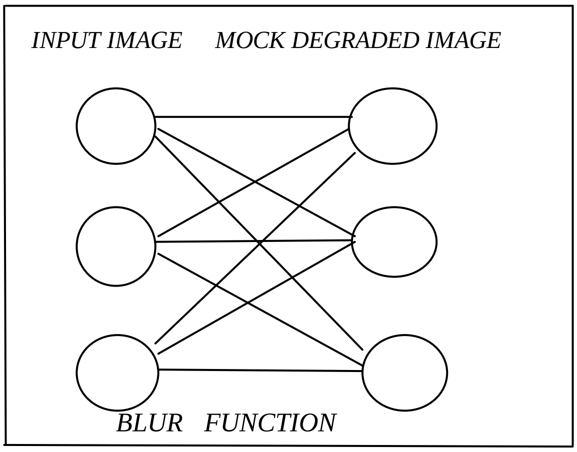

Fig 1. Single Layer Perceptron

If the input layer represents an input image, then by appropriately assigning weights to mimic the local interactions between neighboring pixels, the output would be a blurred version of the input image. We shall refer to this as the mock degraded image. Thus the mock image should closely resemble the given degraded image if the input were the true original image (just how close is subject to noise), and any deviation of the input trial image from the original will manifest itself in the error between the mock and the actual, observed degraded image. The current trial input can therefore be improved by back propagating the error signal through the network using the following modified delta rule

$$\Delta f_i^n = -\eta\,(dE/df_i^{n-1}) + \alpha\Delta\, f_i^{n-1} \qquad (1)$$

Where *E* is the error signal (or more conventionally referred to as the energy function), and the upper index represents the number of iteration [9]

A. Quantization

The image is partitioned into smaller frames. The whole image will contain same information so this part will make algorithm computationally efficient and suitable for parallel computation [6]. Image Model for kernel assessment assuming uniform blur distribution avoiding non linearity.

a. $G(x, y) = k(x, y)*f(x, y) + n(x, y) \qquad (2)$

B.Discrete Fourier transform can be used to yield frequency domain model

$G(m,n) = K(m,n)*F(m,n)+N(m,n) \qquad (3)$

Where m and n discrete horizontal and vertical frequency variable.

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c. Inverse procedure will compute

$G(m,n)K\text{-}1(m,n)=F(m,n)+N(m,n)k\text{-}1(m,n)$ (4)

The following model, after partition holds approximately:

$G_i(x,y)=K(x,y)F_i(x,y)+N_i(x,y);_i = 1,2,3\ldots n_p$ (5)

Where n_p is the total number of partitioned subsections.

A) Algorithm for Image Quantization[6]

Input:
Load an input image 'I'.
Initialize row value.
Initialize column value.
Procedure – I
Load an input image I
Partition the input image I
$G_i(x,y) = K(x,y) F_i(x,y) + N_i(x,y);_i = 1,2,3\ldots\ldots n_p$
Go to Procedure – II
End Procedure – I

B.Degradation Model

In the model of image degradation [5] fig. 1, the blurred image can be characterized by its degradation function, the noise function and by original image.

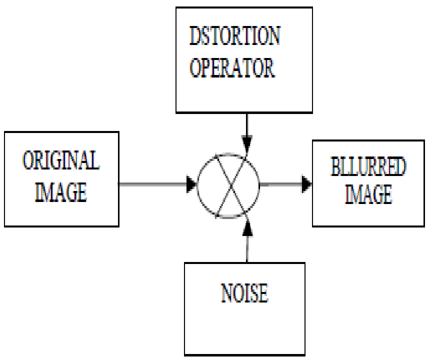

Fig. 2: Image Degradation Model

B) *Algorithm for Degradation Model*

Input:
Load an input image 'I'
Initialize blur length 'l'
Initialize blur angle 'theta'
Assign the type of noise 'n'
PSF (Point Spread Function), 'F'
Procedure – II
h=create (I, l, theta) %Creation of PSF
Blurred image (B) = I*F + n
B= filter (I, f, n,"convolution")
Go to Procedure – III
End Procedure – II

C. Blurring

Blur is unsharp image area caused by camera or subject movement, inaccurate focusing, or the use of an aperture that gives shallow depth of field. The Blur effects are filters that smooth transitions and decrease contrast by averaging the pixels next to hard edges of defined lines and areas where there are significant color transition.

A. Blurring Types

In digital image there are 3 common types of Blur effects:
1) Average Blur.
2) Gaussian Blur.
3) Motion Blur.

III. OVERALL ARCHITECTURE

The following Fig. 2 represents the overall architecture of this paper .The original image is degraded or blurred using degradation model to produce the blurred image. The blurred image should be an input to the deblurring algorithm. Various algorithms are available for deblurring. In this paper, we are going to use blind deconvolution algorithm. The result of this algorithm produces the deblurring image which can be compared with our original image.

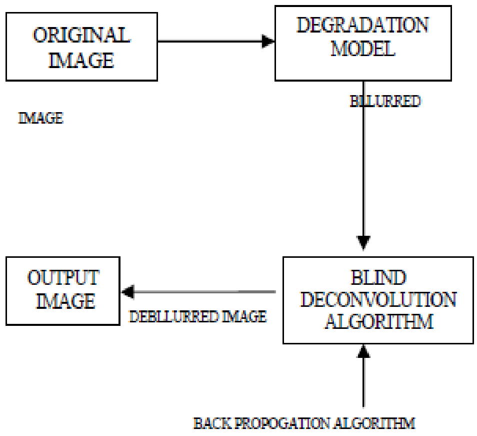

Fig. 3 Overall Architecture

1) Blind Deconvolution Algorithm:

Blind Deconvolution Algorithm can be used effectively when no information of distortion is known. It restores image and PSF simultaneously. Definition of the blind deblurring method can be expressed by:

$G(x, y) = h(x, y)*f(x, y) + n(x, y)$ (6)

Where: g (x, y) is the observed image, f(x,y) is Point Spread Function, h(x,y) is the constructed image and η (x,y) is the additive noise term .

C) Algorithm for Deblurring each frame:

Input:
Back propagation Algorithm'BA'
Blurred image 'B'
Initialize number of iterations 'j'
Initial PSF 'F'
Procedure – III
If PSF is not known then
Guess initial value of PSF
Else
Specify the PSF of degraded image
Apply back propagation algorithm BA,
Restored Image I'= Deconvolution (B, F, j,$G_i(x,y)$)
Combine all the restored images
End Procedure – III

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IV. SAMPLE RESULTS

The, Fig 4(a) the original image.We break the original Image and apply different PSF on every part named A,B,C,D as shown in Fig 5 (a)(b)(c)(d). Fig 6 (a)(b)(c)(d) is depicted as blurred images for all parts A,B,C,D. We apply the neural network approach , back propagation algorithm for each iteration of PSF. Fig 7 shows the trained output of first iteration using back propagation, and Fig 8 shows Trained output after final iteration using back propagation algorithm The sample image after applying the proposed algorithm will be shown in Fig. 9. The result of our algorithm is quite promising from parallel computation view. We can compute the each part independent from each other and final result will be combination of all divided images.

Fig 4 (a) Original Image

Fig 5. (a)(b)(c)(d) Four divided Original Image

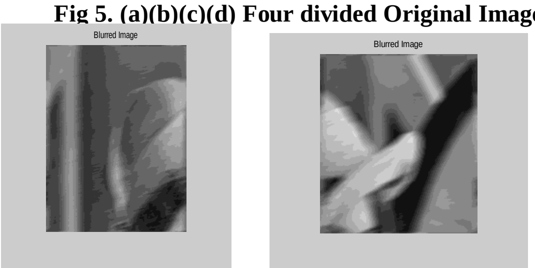

Fig 6(A) (B) (C) (D) Four Divided Blurred Image

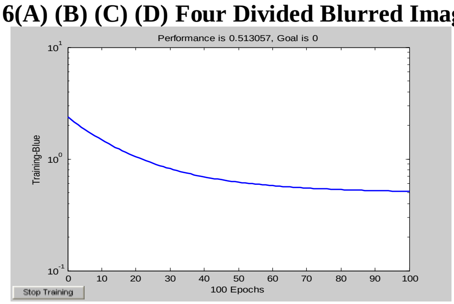

Fig 7 Trained Output First Iteration Using Back Propagation Algorithm

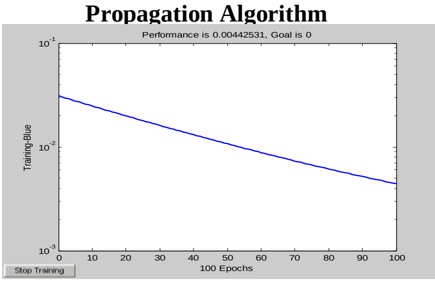

Fig 8 Trained Output after Final Iteration Using Back Propagation Algorithm

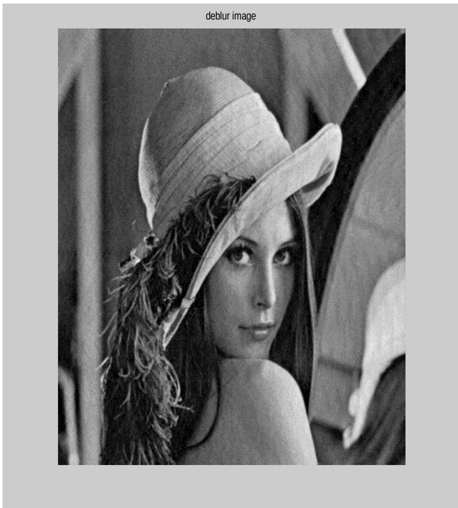

Fig 9 Final Image Computed From Our Algorithm

VI. CONCLUSION AND FUTURE WORK

This paper addresses the blind image restoration problem, on single image using unknown PSF, one wants to restore the original image. A new model is proposed for this restoration, the image is divided into different frames and the algorithm is applied to each frame parallelly also neural network approach i.e back propagation algorithm is used for iterations of different PSF. The restoration problem at hand in each of these approaches reduces to the problem of solving a multiple independent set of images on which algorithm is applied parallel. The future work of this paper is to increase the speed of the deblurring process that is reducing the number of iteration using for deblurring the image for achieving better quality image and by training the network it will take an advantage of to detect an appropriate image.

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