

Image Restoration using RBF Neural Network and Filling-In Technique

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Abstract— Image restoration is known as enhancement and recovery of images. Personal pictures captured by varied digital cameras will simply be manipulated by a range of dedicated image process algorithms. The aim of this paper is to implement a model of neural network with Filling-in technique to resolve the problem of image restoration, which is retrieving the original image degraded by invariant blur. The algorithm is proposed in this paper implements a general RBF neural network model with Probabilistic approach which differentiates the pixels of image according to their level of corruption and employees different ways to correct it. Less corrupted are corrected by remaining part of pixel using Filling-in technique, while others are corrected by using RBF neural network image restoration resulting in better signal to blur noise and better visual quality.

Keywords:- PSNR,ISBN,MSE,RBF and LAB etc.

I. INTRODUCTION

Image Restoration is the process which attempts to obtain the original image from a degraded one, given all or partially knowledge of the degrading phenomenon [1]. The occurring degradations include blur and noise. Blur can be caused when an object moves horizontally or vertically during an exposure or when the object is outside the camera's field, whereas noise is a random variation of brightness or color information.

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). Degradation comes in many forms such as motion blur, noise, and camera mis-focus. In cases like motion blur, it is possible to come up with a very good estimate of the actual blurring function and undo the blur to restore the original image. In cases where the image is corrupted by noise, the noise removal algorithms are performed [5]. Image Restoration Techniques are divided into two categories on the basis of knowledge about Point Spread Function [2]:

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]

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 Weiner Filter (DWF), Deconvolution using Regularized Filter (DRF) are Non Blind Algorithms.[2]

II RELATED WORK

Liwei Zhang Yaping Zhang[1] proposed a solution based on neural network only for finding solution for blurred images with networks such as LAB and RBF. The restoration quality of proposed solution is superior to the other restoration algorithm. The comparison is made between various image restoration techniques in terms of ISBN resulting higher ISBN than others

Fillali Ferhat,Maza Sofiane,Graini Abid[3] implement an optimal neural network model to resolve the problem of colour image restoration. In this paper, a general network of reduced and regularized neural networks is proposed to solve the problem of restoring noisy blurred images. The ideas presented are based on the works of Zhou, Paik and Katsaggelos and other researches in the domain of image restoration.

Experimentations results shows that restored images have much better visual quality, higher improved SNR much lowest MSE. The proposed algorithm which is inspired from the two previous algorithms, gives also good results in terms of spatial and temporal complexity

Priyanka Rajesh Gulhane, V. T. Gaikwad[4] Proposed a scheme is for reconstruction of the lost data from the image. The performance of this method is tested for various images and combinations of lost blocks. They assume that as long as the features in the image are not completely lost, they can be satisfactorily reconstructed using a combination of computationally efficient image in-painting and texture synthesis algorithms. This eliminates the need for retransmission of lost blocks. The image-dependent information, i.e. texture and structure, is used to enhance the performance of image.

III PROPOSED WORK

Restoration algorithm continuously appears with the development of the nonlinear technology. The nonlinear mapping characteristic of the neural network is the reason for the image processing of the nonlinear problem [1]. So A solution is proposed based on RBF neural network for finding solution for blurred images with Probabilistic enhancement method.

In Proposed Algorithm, First of all, Probabilistic approach is implemented which differentiates the pixels of image according to their level of corruption and employees different ways to correct it.

Less corrupted are corrected by remaining part of pixel, the main technique used here is fill-in the missing data with the information propagating from the surrounding pixels

While others are corrected by using neural network image restoration technique according to that, the RBF neural network is trained by the training sample and a corresponding relation is built between the blurred image and clear image, resulting the recovered image with improved signal to blur noise and better visual quality.

IV. EXPERIMENT RESULT & DISCUSSION

Experimental Results

A total of 50 images are taken as the experimental images.

The image restoration techniques considering three different image formats viz. .jpg, .png and .tif. but we have taken the “my_cat.jpg” image for this particular paper as experimental Image the size of this image is 100X100 as shown in Fig 1.



Fig1(a) Original my_cat Image

So First of all,the gray image is obtained from the original color image using LAB transformation. LAB is an image pattern with 24 bit color depth. It can also save the color information of image as

$$L=R*0.30+G*0.59+B*0.11-----[1]$$

where L is used as the gray level of each pixel and A and B are the respective color channels .the gray image is obtained after the transformation is shown in the following Figure Fig 2.

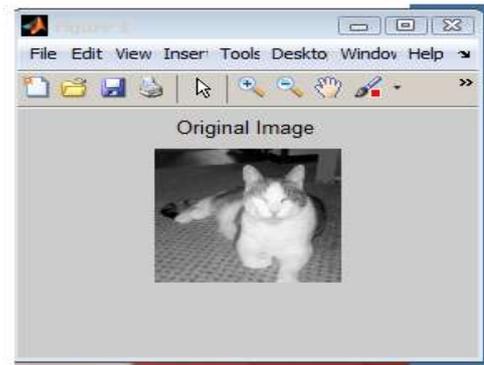


Fig 2 Gray my_cat Image

Now from this Gray image the blurred image is obtained by adding the motion blur into the image. Angle Θ (Theta)= 5 and L (Length)=15 is the horizontal motion blur parameters .The result of this operation is shown in following figure

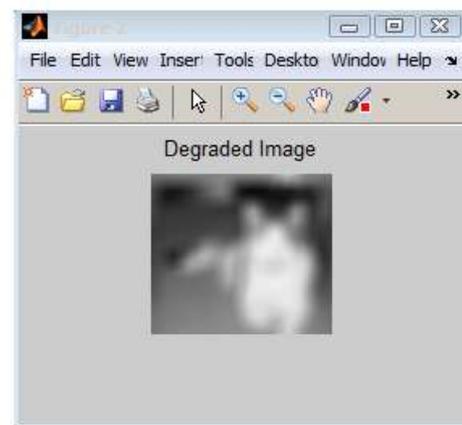


Fig 3: Degraded my_cat Image

Probabilistic Enhancement method will be now applied on degraded image to find the corrupted pixels and probability of enhancement on particular pixel. Now the pixels of image are differentiated according to their level of corruption and here we employees different ways to correct it.

Now for less corrupted pixels of the image, Image restoration is done by fill-in the missing data with the information propagating from the surrounding pixels .For this a window in the form of [3X3] matrix is used and average filtering technique is used which smoothes data by replacing each data point with the average of the neighboring data points defined within the span

The remaining pixels of image are recovered using training of RBF neural network and by establishing relation between clear image and degraded image. The neural network is trained with the similar type of image data of non-corrupted image. Basis function centers can be randomly sampled among the input instances. The output will be achieved according to the training data. Once the output is achieved using the RBF

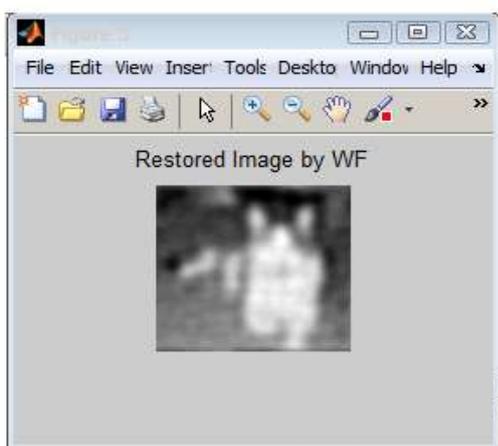
neural network the values would be copied to the respective positions.

The my_cat image is recovered by the proposed method and the experimental results shows that the recovered image has a high PSNR value i.e 50.53 a much lower RMSE i.e 0.76 and a higher ISBN i.e 16.28 if neural network is trained with original image and there is improvement in ISBN only if some other image data is used as training data .but in both cases the visual quality of image is better than images recovered from other methods and a higher ISBN.

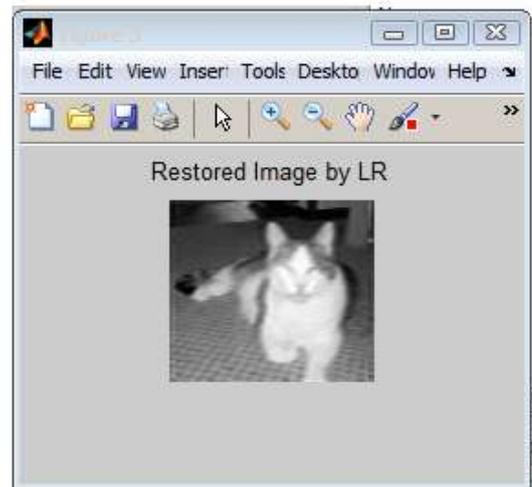
Now Comparison is made between the proposed algorithm and other traditional approaches in terms of PSNR, RMSE and ISBN and the results shown in Table I. Also the result of restoration is shown in Fig5(a),(b),(c),and (d). Among of them (a) Restoration Image by Inverse Filtering approach, (b) Restoration Image by wiener filter approach, (c) Restoration Image by Lucy Richardson approach,(d) Restoration Image by proposed algorithm.



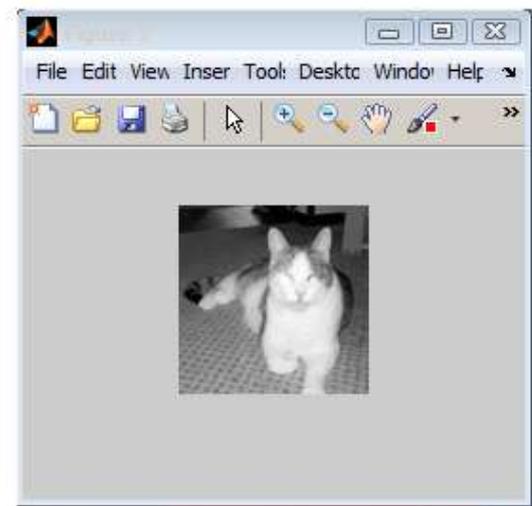
(a) Inverse Filtering Approach



(b) Wiener Filtering Approach



(c) Lucy Richardson Approach



(d) Restoration by Proposed Algorithm

Fig 5 Restoration Performance comparisons

It is clearly shown in above figure that restoration image details are clearer by using proposed algorithm as compared with other algorithm and also it is visually better.

B.Evaluation

Now we are comparing the different techniques of restoration in terms

$$ISBN = 10 \log_{10} \frac{\|g - f\|^2}{\|f - \hat{f}\|^2}$$

$$PSNR = 10 \log_{10} (MAX^2/MSE)$$

$$MSE = \frac{1}{m \cdot n} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} |f(i, j) - \hat{f}(i, j)|^2$$

Where f is a noise free (clear) $m \times n$ image, g is the blurred image and f^{\wedge} is the recovered image.

The results of all approaches are shown in tabular form in the following table.

TABLE 1
 COMPARISONS OF VARIOUS METHODS

Image "my_cat.jpg"	Method			
	Inverse Filter Approach	Lucy-Richardson Approach	Weiner Filter Approach	Proposed Algoritm
PSNR	42.4712	31.2715	24.27	50.5328
RMSE	1.9261	6.9931	15.6466	0.7614
ISBN	3.7684	1.0157	6.2931	16.2848

From the table I and the above figure, it is clearly observed that restoration results are improved in terms of ISBN and the restored image is also visually better as compared to other methods.

V. CONCLUSION

In this paper, a general network of RBF neural networks is proposed with Filling-In method to solve the problem of restoring the blurred images. Experimentations results show that the proposed algorithm converges to images that are more accurate. The restored images have much better visual quality and higher ISBN.

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