Image Restoration Method for Motion Blurred Image

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Abstract: An art to enhance the eminence of image through estimating the amount of noises and blur involved in the image is Image restoration. Over the time, image gets dishonored due to different environmental conditions and atmospheric, hence it is vital to restore the original image using different image processing algorithms. There is a wide spread application of image restoration in today's world. Application area varies from restoration of old images in radar based image acquisition and restoration etc. In this paper we have proposed an image restoration technique using non-blind convolution based deblurring and compared the performance with TwIST.

Keywords: image restoration, image enhancement, image degradation, image denoising, motion blur, TwIST, PSNR.

I. Introduction

Image is a virtual or graphical representation of a person or object, such as a painting or photograph. But in terms of computers it called a digital image because computer understands everything in the form of digits that is 0 and 1. When we apply changes to digital image to increase or improve the quality then that is known as digital image processing. Blur is unsharp image area caused by various reasons. Capturing image while sports or games is going on or fast moving objects such as aircrafts or vehicles have blurness or get uncleared image. There are following ways to get a feeling of movement in your images – either your object move or your camera move or both. Motion blur occur due to missed focus, it means your camera is not focus on that particular area.

To make vision system more accurate and reliable, we remove the blurry and noisy effects from the image. Research on recovery of image from motion blurred image can be done by Image Restoration. Image restoration is recovering the original image and eliminate or reduce the effect of motion by some extent. People are trying to reduce the motion effects by applying the Motion Blur techniques which are in many in number and unfortunately these all methods doesn't produce good results. This paper describes the existing motion Blur Techniques that is TwIST in this each iterate depends on the two previous iterates, rather than only on the previous one, providing faster converge in ill-conditioned case but still having deblurring or noising problem. To handle this problem we apply proposed algorithm in which we firstly estimate the PSF, then normalize the image and secondly apply non blind deconvolution method ,then perform denormalization to restored the image. As a outcome, the proposed methods are very well suited for motion blurred images give better PSNR values than existing one. The resulting method contain iterative procedures which identify and restore a noisy blurred image. In Section II we will show the findings and limitations after analyzing many papers. To improve the performance of this identification algorithm, non blind deconvolution method will be described or mentioned in Section IV. After applying restoration methods comparision can be done and their result contain in Section V.

II. Literature Review

A lot of contribution already exists in this field. Some of the contributions by different authors were presented below

Salsabil A. El-Regaily, Haythem El-Messiry, Mohamed H. Abd El-Aziz, Mohamed I. Roushdy(2012) represent paper which proposes an algorithm for removing motion blur from a single input blurred image using Genetic Algorithm and finding a proper goal function for both cases, linear and non-linear motion blur. However, the algorithm works perfectly for small blur lengths. The fact that our GA doesn't depend on the input image size is an advantage to the algorithm, as it only works on a small selected patch not on the whole image.

In 2012, Meenal surveyed different traditional image denoising methods. Their suggested approach can provides a heterogeneous way of the challenging issue. The proposed method involved the combination of three different approaches, first is for blur, second is for noise and finally for blur and noise. A detailed survey shows that there is not a single method that can provide promising result.

Michal Dobes, Libor Machala, Tomás Fürst (2010) present a article on fast method for finding the direction and size of the blur automatically is presented. The method is based on computation of the power spectrum of the image gradient in the frequency domain. The method has achieved good results on both types of images: artificially blurred and naturally blurred. We found that if the direction of blur was close to the direction of the x-axis (or y-axis) the estimation of the blur-length is more reliable when it is computed from the power spectrum. The aim that is finding the length and direction of blur and therefore the reconstruction kernel was fulfilled.

Juwei Lu, Eunice Poon, K.N. Plataniotis presents the paper on Restoration of motion blurred images. This paper includes two contributions. First, we begin with a single image based deblurring approach in the case of linear constant motion. This approach is a wavelet-based method with a novel lp-norm regularization term. Secondly, the proposed framework is able to effectively take advantage of information contained in the multiple input images, even when they are blurred in the same direction. For future work we further developed a general multi-image based deblurring framework.

José M. Bioucas-Dias and Mário A. T. Figueiredo represents paper with a new TV-based algorithm for image deconvolution, under the assumptions of linear observations and additive white Gaussian noise. To compute the TV estimate, we propose a majorization-minimization approach, which consists in replacing a difficult optimization problem. The resulting algorithm for TV deblurring is related to iteratively reweighted least squares. Each iteration consists in minimizing a quadratic function, which is equivalent to solving a linear system. We note, however, that in the MM framework we do not need to minimize the so-called majorizer function, but only to assure that it decreases.

José M. Bioucas-Dias and Mário A. T. Figueiredo (2007) represents paper they introduce two-step IST methods, called TwIST, which have the form of two-step iterative shrinkage/thresholding (TwIST) algorithms. The update equation depends on the two previous estimates (thus, the term two-step), rather than only on the previous one. Experimental results have shown that TwIST can in fact be tuned to converge much faster than the original IST, specially in severely ill-conditioned problems, where the speed up can reach two orders of magnitude in a typical deblurring problem. It also introduced MTwIST, a monotonic variant of TwIST, conceived for noninvertible observation operators; the performance of MTwIST was illustrated on a problem of image restoration from missing samples.

III. Problem Identification

The following problems are identified after analyzing the literature survey.

- After study the paper,we have seen image deblurring problem which degrades the performance of TwIST.
- Need of reduction in motion blur which is present in image.
- Need to improve MSE and PSNR values.
- Need to enhance the blur image.
- Reconstruct the image in less iterations with enhanced quality.

IV. Methodology

In TwIST algorithm we have seen image deblurring problem which degrades the performance of TwIST. We have proposed an image restoration technique using non-blind convolution based deblurring by priori knowledge of noise level and performing perform deconvolution on the whole image.The proposed algorithm have several steps.

The Multi-channel restoration algorithm steps are as follows.

Step-1 Set Upper Bound of the Expected PSF

Step-2 Get the Size (Rectangular Support) of Blurs

Step-3 Find the Ground-Truth PSF (For Comparison)

Step-4 Normalize the Images

Step-5 Perform PSF Estimation

Step-6 Prepare for Multiscale Process

Step-7 Precalculate ROI (On which PSF Calculated) for Each Scale Level

Step-8 Initial PSF Size and Set them to Delta Functions

Step-9 Init PSF as Delta Impulse

Step-10 Main PSF Estimation

Step-11 Apply Non-Blind Deconvolution Algorithm

Step-12 Denormalize the Result

Step-13 Select Center Part of Image for PSF Estimation

Step-14 Normalize Images in G

Step-15 Normalize the Input Images so that Intensity Values Lie Between 0 and 1.

- PSF Estimation(G, iH)

//G is ROI

//iH Delta function

Step-1 Initialization of variables for min_U step, which do not change

//min_u and min_h are iterative with maximum of maxiter_u and maxiter_h

Step-2 hsize := [size(iH,1) size(iH,2)]

size := [size(G,1), size(G,2)]

usize := gsize

U:=zeros(usize)//array of zeros

H := iH

Step-3 FFT of u and initialize auxiliary variables for image gradient and blurs initialize to zeros.

Step-4 eG := edgetaper //reduce border effect

// blurs the edges of the input image I using the point spread function PSF. The size of the PSF cannot exceed half of the image size in any dimension. The output image eG is the weighted sum of the original image I and its blurred version.

- Non-Blind Deconvolution

Step-1 g = H*u + n,

Step-2 where g is a vector of blurred image

Step-3 H is a blur matrix, u is the reconstructed image and n is noise.

Step-4 Solving: min_u {gamma/2*|| g - H*u ||^2 + alpha*||grad(u)||_p^p},

/* where 0<=p<=1.

G ... input LR images in a cell array

h ... input blurs in a cell array, empty or PSF size

gamma ... weight of the fidelity term */

step-5 return gamma

V. Experimental Results

The experimental results with natural blurred images are shown in Fig. 1 and Fig. 2. Fig. 1 and 2 shows intermediate result which is the separation between foreground and background portion of blurred image of a giraffe.

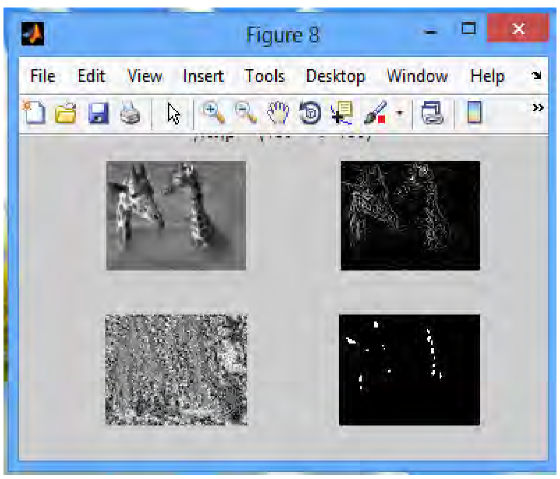


Fig. 1: Separation between foreground and background portion.

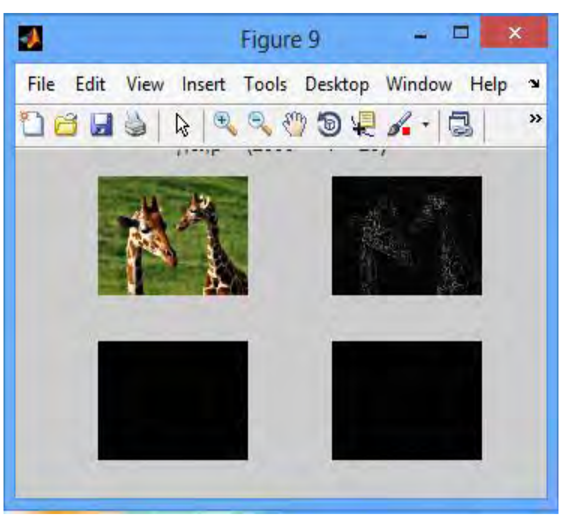


Fig. 2: Separation between foreground and background portion.

VI. Result

In our paper, we perform work on color images, we are applying this algorithm on colored input image which is blurred and degraded because of motion present in surroundings while taking photograph, to obtain a restored and clear image. Using a proposed methodology we are trying to get better PSNR value as compared to existing methodology.

a. PSNR

PSNR is using a term mean square error (MSE) in the denominator. So, low the error, high will be the PSNR. Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE) are used to comparing the squared error between the original image and the reconstructed image. There is an inverse relationship between PSNR and MSE. So a higher PSNR value indicates the higher quality of the image. If PSNR is high better for Compression and Stegnography but encryption concept PSNR very low is better.

$$
\begin{aligned}
PSNR &= 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right) \\
&= 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) \\
&= 20 \cdot \log_{10}(MAX_I) - 10 \cdot \log_{10}(MSE)
\end{aligned}
$$

Here, MAX_I **is the maximum possible pixel value of the image.**

b. MSE

The MSE is the cumulative squared error between the compressed and the original image, whereas PSNR is a measure of the peak error. The mathematical formulae for the MSE are

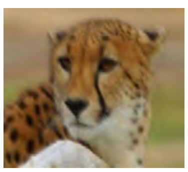
$$MSE = \frac{1}{MN}\sum_{y=1}^{M}\sum_{x=1}^{N}[I(x,y) - I'(x,y)]^2$$

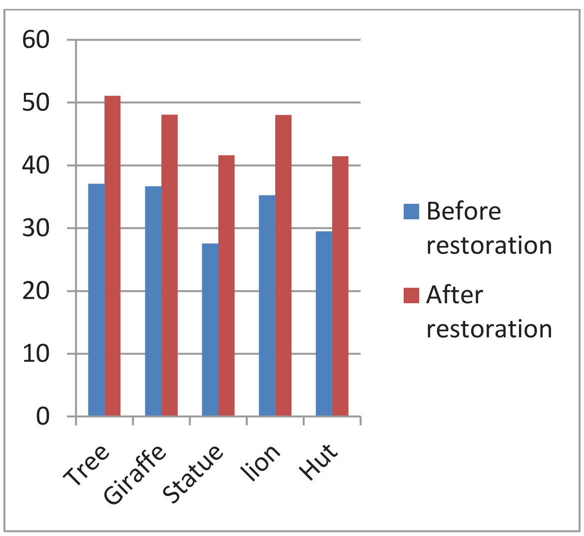
I(x,y) is coordinate of clear image and other one is the coordinate of same image after compression is added to it.

Table I: PSNR

S No	Image Name	PSNR	
		TwIST	Proposed Algorithm
1	Tree	37.11	51.11
2	Giraffe	36.69	48.07
3	Statue	27.56	41.64
4	lion	35.26	48.02
5	Hut	29.51	41.45

Table II: Images

S.No	Image Name	TwIST	Proposed Algorithm
1	Tree		
2	Giraffe		
3	Statue		
4	Lion		
5	Hut		



Graph 1: PSNR of original and restored image

Comparision results shows that the PSNR of Restored image is better than the motion blurred image to some extent, therefore resultant image or restored image is used for future work.

VII. Conclusion

In this paper, a new algorithm for deblurring is mentioned and also consist comparision with TwIST

Method, get quite better PSNR values by applying non blind deconvolution method, show effective because work on both gray scale and color images. The experimental results of this paper used a many motion degraded images of different place, but cannot apply in all large blurred images. The future Scope of this methodology is that the iterations will be reduce by applying advanced optimizing algorithm or some advanced technique like neural network, artificial intelligence, fuzzy logic .

References

[1] J. M. B. Dias, and M. A. T. Figueiredo, “A new TwIST: two-step iterative shrinkage/thresholding algorithms for image restoration,” *IEEE Transactions on Image Processing*, vol. 16, no. 12, December 2007.

[2] C. Khare, and K. K. Nagwanshi, “Implementation and analysis of image restoration techniques,” *International Journal of Computer Trends and Technology,* May to June 2011 .

[3] M. Jain, S. Sharma, and R. M. Sairam, “Effect of blur and noise on image denoising based on PDE,” *International Journal of Advanced Computer Research (IJACR)* vol. 3, no. 1, March 2013.

[4] J. Kaur, and M. Garg, “An improved weighted median filter for the image processing application,” *International Journal of Science and Research (IJSR),* vol. 2, no. 4, April 2013.

[5] K. Kaur, G. Singh, and A. Singla, “Research on spatial filters and homomorphic filtering methods,” *Journal of Global Research in Computer Science,* vol. 3, no. 11, Nov. 2012.

[6] S. S. A. Amri, and N. V. Kalyankar, “A comparative study for deblured average blurred images,” *International Journal on Computer Science and Engineering (IJCSE),* vol. 2, no. 3, pp. 731-733, 2010.

[7] M. Dobes, L. Machala, and T. Furst , “Blurred image restoration: A fast method of finding the motion length and angle,” *Digital Signal Processing*, vol. 20, pp. 1677-1686, 2010.

[8] R. L. Lagendijk, J. Biemond, and D. E. Boekee, “Identification and restoration of noisy blurred images using the expectation-maximization algorithm,” *IEEE Transactions on Acoustics Speech and Signal Processing*, vol. 38, no. 7, July 1990.

[9] M. Elad, and A. Feuer, “Restoration of a single superresolution image from several blurred, noisy, and under

sampled measured images," vol. 6, no. 12, December 1997.

[10] T. Chan, S. Esedoglu, F. Park, and A. Yip, "Recent developments in total variation image restoration," Springer Verlag, 2005.

[11] X. Pan, and J. Wang, "Identification of blur parameters of motion blurred image using fractional order derivative," *ISSPA,* May 26, 2012,

[12] J. Portilla, V. Strela, M. Wainwright, and E. Simoncelli, "Image denoising using scale mixtures of gaussians in the wavelet domain," vol. 12, no. 11, pp. 1338–1351, Nov. 2003.

[13] Y. Chen, and J. Hua, "Image restoration algorithm research on local motion-blur," *Information Engineering and Electronic Business*, vol. 3, no. 3, pp. 23-29, June 2011.

[14] J. Singh, and S. Singh, "Motion blur an introduction," *International Journal of Innovative Research in Science Engineering and Technology*, vol. 2, no. 1, January 2013.

[15] N. Joshi, R. Szeliski, and D. J. Kriegman, "PSF estimation using sharp edge prediction," *Computer Vision and Pattern Recognition, 2008. CVPR 2008. IEEE Conference on, 2008.*

[16] R. L. Lagendijk, and J. Biemond, "Iterative identification and restoration of images," Boston, M. A. Kluwer, 1991.

[17] F. Sroubek, J. Flusser, "Multichannel blind iterative image restoration," *IEEE Transactions on Image Processing,* vol. 12, no. 9, Sep. 2003.

[18] S. E. Regaily, H. E. Messiry, M. H. A. E. Aziz, and M. I. Roushdy, "Single image motion deblurring using genetic algorithms," *29th National Radio Science Conference*, 2012.

[19] S. Sharma, S. Sharma, and R. Mehra, "Image restoration using modified lucy richardson algorithm in the presence of gaussian and motion blur," *Advance in Electronic and Electric Engineering,* vol. 3, no. 8, pp. 1063-1070, 2013.

[20] www.google.com, last reference date 22 January 2015.

[21] Wikipedia.