Image Deblurring using Segmentation

Johar A.
Department of Electronics and Communication Engg
Lovely Professional University
Phagwara, India

Johar Aditi
Department of Electronics and Communication Engg
Lovely Professional University
Phagwara, India

Kalra GS
Department of Electronics and Communication Engg
Lovely Professional University
Phagwara, India

ABSTRACT
Motion deblurring is a vastly used technique in image processing and is an interesting task in this field .In this paper an algorithm is proposed for the performance of segmentation to create boundaries of the object under observation. Segmentation of the image is performed to separate the focused object from the blurred background. The image is uniformly blurred by performing kernel estimation of the background image and convoluting it with the focused part of the image. Finally deconvolution is performed on the image in order to obtain a clear image.

General Terms- Algorithm, Image Deblurring, robust

Keywords- Segmentation, Cepstrum, Inverse filtering

1. INTRODUCTION
Image Deblurring is a major factor responsible for the degradation of an image making it a poor quality image. When blurring of an image occurs a lot of information is lost from the image and the quality of the image is greatly effected, the information content of the image is lost so the restoration of the image becomes a great concern in image processing problems. Motion blur greatly effects object recognition feature of the image, and are caused by rapidly moving objects such as taking photographs of a fastly moving car. The result of this is that the image is blurry, unclear and unfit for use in further processing. A blurred image creates a bad view on the observer and looks bad and useless. The major disadvantage of this are feature extraction of the image is greatly effected which makes an image vague. The blur of the image should be removed efficiently and it is of great challenge in image processing. Blind convolution methods are are adopted in this paper that helps us to obtain a deblurred image by adopting the method of estimation of kernel from the blurred image. It is however impossible to estimate the kernel of the whole image because this requires the whole image to be uniformly blurred. This creates a problem known as spatially variant blur. The spatially variant blur problem occurs when deconvolution is performed on the whole image even on the that particular part of the image which is not blurred also, hence it creates undesirable effects on the part which is not blurred . It is therefore desirable we also define and implement suitable methods for the removal of this problem. The problem of spatially variant blur should be removed by the application of robust and reliable methods .In this paper we introduce a reliable methods of segmentation which solves our problem of spatially variant blur .Convolution is performed between the degradation function of the blurred image and the clear image are . The object is removed from the whole image by using the technique known as segmentation. The results obtained by our technique in this paper yields us with well defined borders of the object and has advantages of being inexpensive and also has high resolution. The image has two important parameters such as blur angle and blur length that should be known or should be estimated .The blur is corrected by using the technique of inverse filtering. In this paper we propose a method for image deblurring specially for images that have been degraded by motion blur in which the image background has been blurred but the front part is focused. As the important information content of the image is lost due to blurred background, we sometimes have to discard such images. We have worked out with a solution to this problem by segmenting the image to separate the background from the focused object. If segmentation was not performed on the image and uniform blur was not obtained then obtaining satisfactory results would had been a difficult task.Hough transform is performed on the image for the detection of edges .It is powerful and the one of the most global method for the detection of edges in an image. It is a global technique which can be used for detecting edges in the image. It is a feature extraction method which is used in various fields like digital image processing, computer vision etc. The goal of this method is to find objects in the group of certain shapes which are not perfect. It can be used to detect shapes such as circles, ellipses etc in a image. It can also be said that hough transform is the technique of finding parameters from the boundary. The input to the hough transform is a binary edge detected image The hough transform detects straight lines and also detects other types of curve in an image. The advantage that this Hough transform possesses is that it is unaffected by the image noise. It should be noted that the shapes like circle, ellipses can only be determined if the parametric equation for these shapes are known If for example we are considering straight lines in an image, we take a point (x,y) in the image, and the form of all the lines that pass that pass through that pixel is given as follows:

$$Y=mx+c \tag{1}$$

The deblurred image is modeled as

$$g(a,b) = h(a,b) \otimes i(a,b) \tag{2}$$

$$G(s,w) = h(s,w).I(s,w) \tag{3}$$

Where g(a,b) is the blurred image, i(a,b) is the original image and h(a,b) is the point spread function responsible for blurring of image. We know that convolution in time domain is equivalent to multiplication in frequency domain.

2. OUTLINE FOR THE PROPOSED ALGORITHM
The proposed method works suitably for the case where only the background is blurred and the front object is focused. Hence separation of the clear object is required from the background[1,11]]. Segmentation is done for the above. If segmentation was not performed and it creates the problem of spatially variant blur. Hence by segmentation uniform blurring of the whole image is obtained. It solves the problem

greatly. The results obtained are very improved than those obtained without segmentation. The proposed work is divided into four modules. The new model obtained can be given as follows:

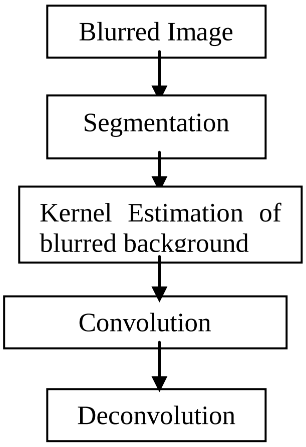

Fig1. Proposed Model for Image Deblurring

3. PROPOSED METHODS FOR ESTIMATING PARAMETERS

The important steps used in this paper for image deblurring have been discussed in the following section :

3.1 Segmentation

The next step is segmentation of image. Segmentation is the process of extracting objects of interest. This is a important step for obtaining a uniform blur. The focused object needs to be convoluted with the estimated point spread function of the background. For this separation of background from the foreground is desired. So segmentation need to be done on original image.The method used for segmentation of the image is the adaptive thresholding of image [3,9-11]. This step is done to separate the unblurred part of the image from the blurred part. Segmentation of the image is done by moving a fixed window over the original image which will result in multiple subimages. The threshold value for each subimage is computed. The threshold value is based on any statistical quantity like mean, variance etc. In our case the statistical quantity used is mean value. If the threshold value is less than the pixel value than it belongs to the background otherwise it belongs to the object. This will result in a binary image. As a result the unblurred part will be separated from the background. Another approach which can be used for separating the clear object from blurred background is based on connected components.

3.2 Kernel Estimation

The estimation of parameters such as blur angle and blur length by which the image has been blurred is the most important step in the point spread function estimation. It is one of the most important parameter for the practical image restoration .We have proposed methods in this paper for knowing these parameters. For motion blur images various PSF estimation parameters have been developed. If these parameters are unknown, then estimation of these parameters from the blurred Image is done and the image is finally deblurred by using these values. For blur angle and length Estimation the image is converted into cepstrum domain[4-9] .A cepstrum is the result of taking inverse fourier transform (IFT)of the logarithm of the estimated spectrum of a signal.The two types of cepstrum used are complex cepstrum and a real cepstrum.The formula for cepstrum is given below:

$$Cep_g(\mathrm{a,\ b}) = f^{-1}[\log|\mathrm{G}\ (s,w)|] \qquad (4)$$

Where G(μ,v) is the input blurred image and C_g(x,y) is the cepstrum of the image.Hough transform is used for finding blur angle which could be further used for calculating the blur length. The hough transform will provide us with the accumulator array from which the maximum value in the accumulator array will correspond to the blur direction. After calculating the blur angle the corresponding blur length is calculated .

3.3 Convolution and Deconvolution

Convolution of the segmented focused object is done with the estimated point spread function to obtain the resultant image that would exhibit uniform blur[4-9]. We use the method of Inverse filtering is used for obtaining the deconvolution of the resultant image. The image so obtained is devoid of noise .Hence the conversion of the clear image and the degraded function into frequency domain is done and inverse filtering techniques are applied for obtaining the clear image. The required formula for deconvolution is given as follows:

$$\mathrm{I}(s,w) = \frac{G(s,w)}{H(s,w)} \qquad (5)$$

where I(s,w) is the resultant deblurred image, G(s,w) is the original blurred image and H(s,w) is the estimated degradation function. The above results provides us with significant deblurring effects and the resultant image is free from artifacts and the problem of spatially variant blur is also removed.

4. EXPERIMENTAL RESULTS

Our research paper yields us with the following experimental results that were obtained by the application of our proposed algorithm.We used the method of frequency tuned saliency and estimation of point spread function for deblurring a blurred image.Hough transform has been proved to be an ideal method for the calculation of Blur angle and length.The following original image is taken on which motion deblurring is to be performed.

4.1 Segmentation

For appropriate results it is desired that the image is uniformly blurred, otherwise it gives rise to a problem known as spatially variant blur. This problem is greatly solved in our paper by using a suitable method for calculation of segmentation. Fig.2(a) shows the original image with focused foreground and blurred background. The results for segmentation are shown in fig.2(b).It is very clear from the results that the problem of spatially variant blur can be solved by using the segmentation method.The segmentation algorithm used has many applications in other image processing techniques that involves the separation of focused object from background.

Fig. 2(a) Original image

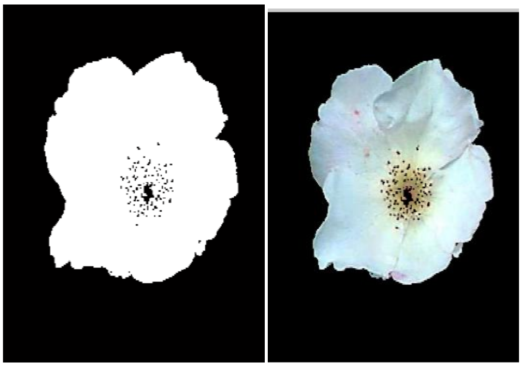

Fig. 2(c) **Fig. 2(d)**

Fig.2(c) Image segmentation,(d)colored image segmentation

4.2 Convolution

The result for convolution of the segmented image with the estimated point spread function is shown in fig.3

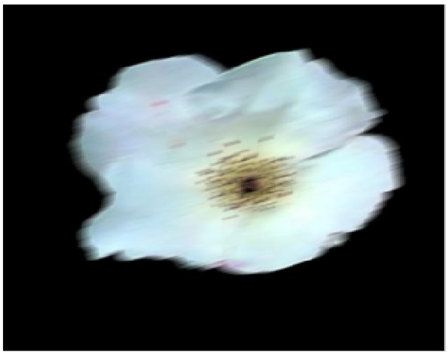

Fig3. Convolution of estimated PSF with segmented image.

The segmented convoluted image is combined to the background blurred image to obtain a blur which is uniform over the entire image. The result is as shown in figure 4.

Fig.4 Image with uniform blur

4.3 Deconvolution

This is the last step in our motion deblurring algorithm. The results of inverse filtering technique used is given in Fig.5.The results shown in the following figure show that a clear deblurred image is obtained using this algorithm.

Fig.5 Resultant image after deblurring

5. CONCLUSION AND FUTURE SCOPE

In this paper, an algorithm is proposed for motion deblurring. The image is assumed to be free from noise. In this paper we have used the technique of motion deblurring using segmentation. The problems of spatially variant blur can also be handled effectively. The results obtained prove the effectiveness of our proposed algorithm. A number of real-world problems from astronomy to consumer imaging find applications for image restoration algorithms. Plus, image restoration is an easily visualized example of a larger class of inverse problems that arise in all kinds of scientific, medical, industrial and theoretical problems. It can be used in astronomy, iris recognition etc.

6. ACKNOWLEDGEMENT

A special vote of thanks to my guide and co-guide who helped me to complete my research paper named “Image Deblurring Using Segmentation”.

7. REFERENCES

[1] Jun Xie1, Weiyao Lin1*, Hongxiang Li2, Kai Guo1, Bin Jin1, Yihao Zhang1, Donghua Liu3,” A New Algorithm for Improving Deblurring Effects and Addressing Spatially-variant Blur Problems for Image Motion Deblurring”, 2011 4th International Congress on Image and Signal Processing, pp. 651-655,2011.

[2] Qi Shan, Wei Xiong, and Jiaya Jia ,” Rotational Motion Deblurring of a Rigid Object from a Single Image”, IEEE transaction on image processing,2007.

[3] Ioannis M. Stephanakis and George C. Anastassopoulos,”Segmentation using adaptive thresholding on image histogram according to the incremental rates of the segment likelihood functions.”

[4] Deshpande, Ashwini M.; Patnaik, Suprava, "On improving accuracy of PSF estimation in spectral and cepstrum domain with morphological filtering," Emerging Technology Trends in Electronics, Communication and Networking (ET2ECN), 2012 1st International Conference on , vol., no., pp.1,6, 19-21 Dec. 2012.

[5] Jeong Ho Lee, Member, “Image Deblurring by Using The Estimation of PSF Parameters for Image Devices”, IEEE transaction on image processing,2010

[6] D. Kundur and D. Hatzinakos, "Blind image deconvolution," IEEE Signal Processing Magazine, pp. 61-63, 1996.

[7] Y. Yitzhaky and N. Kopeika, "Identification of blur parameters from motion blurred images," Graphical Models and Image Processing, vol. 59, no. 5, pp. 310-320, 1997.

[8] Cho, S., Lee, S,” Fast motion deblurring”, ACM transactions on Graphics, vol. 28, no. 5, 2009.

[9] 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.

[10] X. Jiang, "Adaptive local thresholding by verification-based multithresh-old probing with application to vessel detection in retinal images," IEEE Trans. on Pattern Anal. and Machine Intell, vol. 25, No. 1, pp. 131-137, Jan. 2003.

[11] F. Yan, H. Zhang, C. R. Kube, "A multistage adaptive thresholding method," Pattern Recognition Letters, vol. 26, pp. 1183-1191, 2005.

[12] Johar A., KalraGS.,”Image deblurring using saliency detection”, Proceedings of 2014 RAECS UIET Panjab University Chandigarh, pp.1-4, 2014