A Review on Estimation of Defocus Blur from a Single Image

Jaya Tiwari
PG Scholar
Department of Electronics &
Communication Engineering
NRI Institute of Information
Science And Technology
Bhopal, India

Rajesh Kumar Rai
Associate Professor and Head
of the Department
Department of Electronics &
Communication Engineering
NRI Institute of Research and
Technology Bhopal, India

Brahmi Shrman
Assistant Professor
Department of Electronics &
Communication Engineering
NRI Institute of Information
Science and Technology
Bhopal, India

ABSTRACT

Defocus estimation is an important part in high quality image processing field, which mainly includes edge detection, image deblurring, and measuring image quality. Wrong lens setting or shallow depth of field which would produce defocus blur. Defocus blur is most of the times present in natural images. In this paper we have discussed some of the methods like local contrast prior, defocus magnification and spectrum contrast for estimating the defocus blur map.

Keywords

Defocus, deblurring, depth of field, defocus magnification.

1. INTRODUCTION

Defocus is the phenomenon in which image is out of focus and it reduces the sharpness and contrast of image. Signal processing is a field in electrical engineering and in mathematics that deals with examine and processing of signals that is analog and digital signal and also deals with operations like storing operation filtering operations on signals. These signals involves transmission, sound or voice , image signals .From these the field that deals with the type of signals in which the input is taken as image and the output is also also an image is done is image processing. As it suggests, it works with the processing on images. Image processing in which images are to be analyzed and acted upon by peoples. It can be further divided into analog image processing and digital image processing.

Figure 1: Types of Image Processing

Analog processing is basically done on analog signals. This includes processing on two dimensional analog signals. In this type of processing in which the images are changes by electrical means by varying the electrical signal. Example include is the TV image. Digital image processing has different impact over analog image processing with the passing of time due its wide range of applications. The digital image processing works with developing a digital system that performs operations on a digital image. Within the field of image processing it includes image restoration, image magnification and image compression. Most of the image processing technique involves the image as a two-dimensional signal. These are the method to convert an image into digital form and perform some process on it, so that we can get an intensified image or to obtain some useful information. This is a type of signal dispensation in which input is image, like video frame or photo and output may be image or characteristics related with that image. The process in which by applying degradation models restoration of image is done to its original form. Image restoration is the field in image processing used in the field of photography or where the image by some means is degraded but needs to be improved before it can be printed. Image enhancement is the field in image processing in which by taking the benefits of human visual systems response we take an image and improving its visually. One of the simplest enhancement techniques is to simply change the contrast of an image. Enhancement techniques lead to be problem specific. Moreover enhancement and restoration are similar in achieving goal, to make an image look much better. They differ in manner that how these methods reaches the problem. Goal of image restoration is to recover a degraded image by using some degradation model and of the original image formation; it is essentially a reverse problem. Image enhancement uses qualitative subjective to produce a more precise visually pleasing image and they do not depend on any physical model for the image formation. These types of approaches are commonly simpler and faster. Image compression is the field in image processing which involves reducing the typically large amount of data or information needed to represent an image by eliminating data that are not relevant and by considering the of the redundancy that is inherent in images. Image processing basically includes three steps importing the image with optical scanner or by digital photography. Examine and manipulating the image which involves data compression and image enhancement. Output is the last stage in which result can be altered image or report that is based on image analysis. The motives of image processing are Visualization that is Observe the objects that are not visible, Image sharpening and restoration means to create a better image. Image retrieval means Seek for the image of interest. Measurement of pattern that measures various objects in an image. Image recognition which distinguish the objects in an image. An image gives visual representation of a physical object. In an ideal case, each small point within the object will represented by a tiny small, well-defined point in the image. The image of each object point is spread, or blurred, within the image in reality. Image blur can be generally categorized into four groups: motion blur, lens blur, turbulence blur and post processing blur. Camera or object movement during the exposure period causes motion blur. This phenomenon is common especially for digital cameras. Wrong
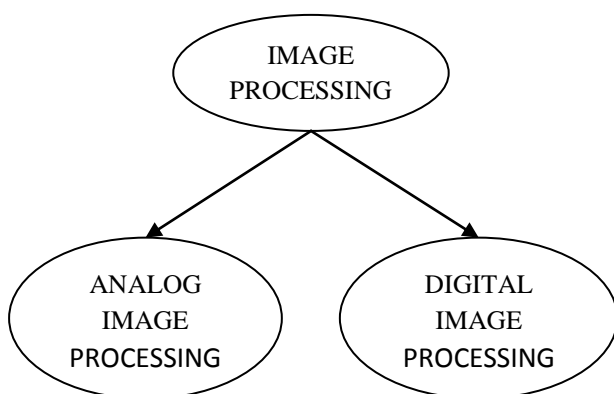
lens setting or shallow depth of field would produce defocus blur, which is an important kind of lens blur. Besides, even if the scene is perfectly in focus and no matter how well the lens is corrected, in most optical imaging systems there always exists a fundamental resolution limit .commonly used cameras add an anti-aliasing filter into the lens system to remove high-frequency components beyond the Nyquist limit of the digital camera sensor. Such kind of blur can actually improve the visual quality of captured images. For long-distance imaging systems (such as ground-based astronomical imaging systems) atmospheric instability, causes change in refractive index in the optical transmission path and which damages light wave front, can badly affect the image quality. Disturbance of other media also have similar kind of effects and which degrade the performance of related imaging systems. Generally disturbance in the transmission medium produces two major distortions: geometrical deformation and blur, where both are volatile and spatially varying. Removing such effects is significant for many applications and hence it is quite challenging. Post processing methods are denoising, deblurring, super-resolution can also introduce blur   mostly are used to intensify the image quality. Denoising filter is used to reduce noise level but it also produces blur as side effect while smoothing the input image. And if the filter is spatially invariant, like a Gaussian filter, then the blur is uniform.

2. LITERATURE REVIEW

Fergus et al. [1] proposed a method that Camera shakes during exposure May causes to objectionable image blur and damage photographs. Conventional blind deconvolution techniques rarely assume frequency-domain parameters on images for the motion path while camera shake. Real camera motions can follow up the convoluted way and spatial domain prior can better retains visually image properties. They introduced a method to remove the effects of camera shake from blurred images. This method assumes that a uniform camera blur over the image and also negligible in-plane camera rotation. In order to calculate the blur from the camera shake, the person must specify an image region without saturation effects. They showed results for a wide variety of digital photographs which are taken from personal photo collections.

 Bae and Durand[2] presented the image processing technique in which defocus magnification is used to perform blur estimation. To maximize defocus blur caused by lens aperture by taking a single image then estimate the size of blur kernel at edges and further they spread this technique to the whole image. In this approach multi scale edge detector is used and model fitting that obtain the size of bur propagate the blur measure by assuming that blurriness is smooth where intensity and color are approximately similar. Using defocus map, they enhance the existing blurriness, which means that blur the blurry regions and keeps the sharp regions sharp. In comparison to other methods more difficult issues arises such as depth from defocus, so this proposed method do not need precise depth estimation and do not need to disambiguate texture less regions. The method models changes in energy at all frequencies with blur and not just very high frequencies (edges).

Levin et al. [3] evaluate Blind deconvolution algorithm which is the restoration of a sharp version from a blurred image when the blur kernel is not known. Most algorithms have dramatic progress; still many aspects of the problem remain challenging and difficult to understand. The goal of this method is to analyze and evaluate blind deconvolution algorithms both theoretically as well as experimentally. They had also discussed the failure of the MAP approach.

Kee et al. [4], discussed that noticeable blur is generated due to the optical system of the camera, also with professional lenses. They introduce method to measure the blur kernel densely over the image and also across multiple aperture and zoom settings. It shown that the blur kernel can have a non-negligible spread, even with top-of-the-line equipment. the spatial changes are not gradually symmetric and not even left-right symmetric .In this method two models of the optical blur are developed and compared both having advantages respectively. It is shown that the model find accurate blur kernels that can be used to restore images. They demonstrated that they can produce images that are more uniformly sharp then those images which produced with spatially-invariant deblurring technique.

Tai and brown in [5] As Image defocus estimation is useful for several applications including deblurring, blur enlargement, measuring image quality, and depth of field segmentation. They proposed a simple effective approach for estimating a defocus blur map based on the relationship of the contrast to the image gradient in a local image region and call this relationship the local contrast prior. The advantage of this approach is that it does not need filter banks or frequency decomposition of the input image; infact it only needs to compare local gradient profiles with the local contrast. They discuss the idea behind the local contrast prior and shown its results on a variety of experiments. And it's found that for natural in-focus images, this distribution follows a similar pattern. They verified this distribution by plotting the distribution of the LC in images suffered from different type of degradation. This prior is useful in estimating defocus blur, in segmenting in focus regions from depth-of-field image and in ranking image quality.

Chakrabarti et al. [6] suggested a method for analyzing spatially changing blur. This method uses a sub-band decomposition to separate the "local frequency" components of an image, and an image model based on a Gaussian Scale Mixture to handle the variation in gradient statistics among local windows of a single image. These allow computing the particular window in an image being blurred by a candidate kernel, and this likelihood conveniently involves a preference for sharp edges without being badly affected by the natural variation in edge contrast that occurs in a typical image. Method proposed method used to determine the orientation and degree of motion in images with moving objects, and by combining them with color information, it shows that one can obtain reasonable segmentations of the objects also the proposed tools can be used to analyze motion blur, and this method is enough to handle any case of spatially-varying blur.

Kriener et al. [7] discussed that a shallow depth-of-field is rarely used in photos as a creative element. This comes at the high cost of expensive and massive camera equipment, such as fast lenses and large sensor DSLR bodies. In contradiction, Economical small-sensor cameras with fixed lenses normally show a larger depth-of-field than desire. In this case computational solution is suggesting, because a shallow depth-of-field cannot be achieved by optical means. One Possibility is to algorithmically enhance the defocus blur which is already present in the image. Though current algorithmic Solutions tackling this problem which suffer from bad off performance due to the ill-sadness of the problem the amount of defocus blur can be calculated at edges only uniform areas do not contain such kind of information. So, to magnify the defocus blur we need to know the amount of blur present at every pixel position in image. Calculating it requires solving an optimization problem with many unknowns. They proposed a faster method to propagate the amount of blur from edges to entire image by make out the optimization problem on a

small scale, follow up by edge-aware up sampling by using the original picture as a guide.

Chang Tang et al. [8] present spectrum contrast approach which is more appropriate method for estimating defocus map from a single image. This method is inspired by the observation that in an image defocusing mainly affects the spectrum amplitude at the object edge only. By creating the relation between the quantity of spatially varying defocus blur and spectrum contrast at edge Locations, they first find out the blur amount at the edge locations, then propagate the blur amount from edges to the entire image with a non homogeneous optimization procedure hence finding the blur map. The proposed method takes into consideration not only the affect of light refraction but also the blur texture of an image. Experimental results illustrate that our proposed method is much more reliable in defocus map estimation as compared to various methods.

Zhu et al.[9] proposed a new method for estimating PSF scale at each pixel in image. They presented an algorithm that estimating a defocus scale map from an image, which is used in conventional cameras. It also takes consideration in smoothness and color edge information to generate a coherent blur map that indicate the amount of blur at each pixel This estimation is based on local frequency component analysis. Smoothness parameters and image color edge information are also taken into consideration to generate a map that is smooth and meanwhile allows discontinuity in the boundary regions between objects. This algorithm does not depend on any specific PSFs model and is hence very commonly applicable. It is possible to implemented using any PSF model which is a function of a single parameter. It is capable of measuring the probability of local blur scale by analyzing the Gabor filtering spectrum.
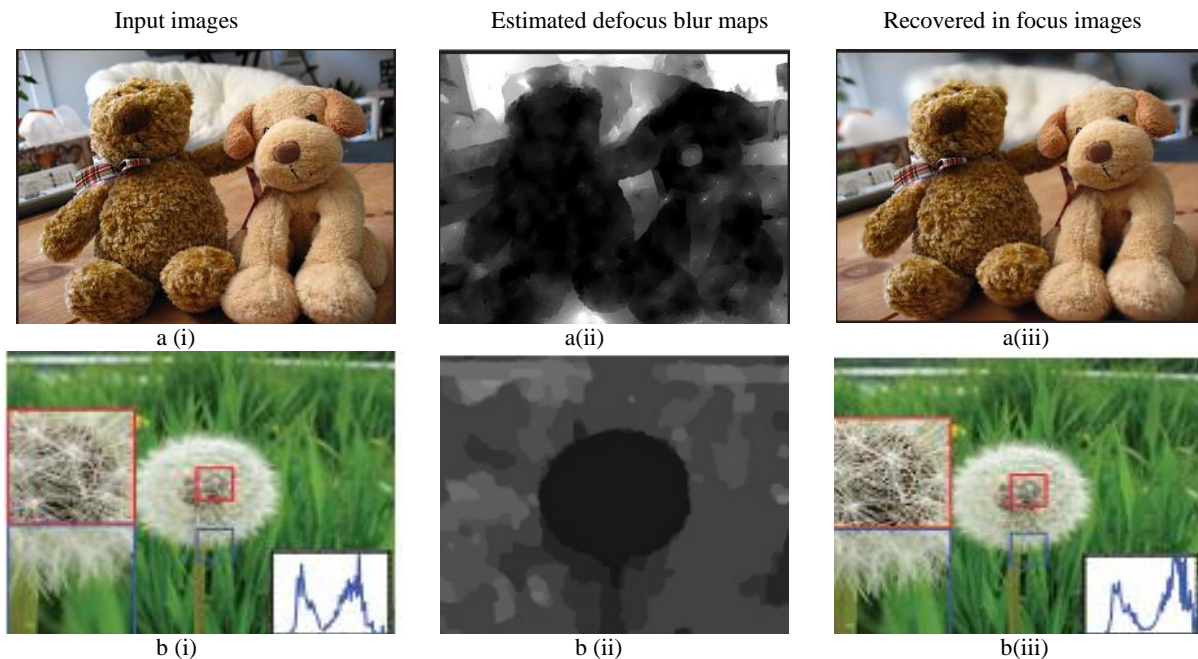
3. RESULT ANALYSIS

Figure 2: Comparison of blur techniques by two methods in 3(a) by using defocus magnification and 3(b) by using local contrast prior
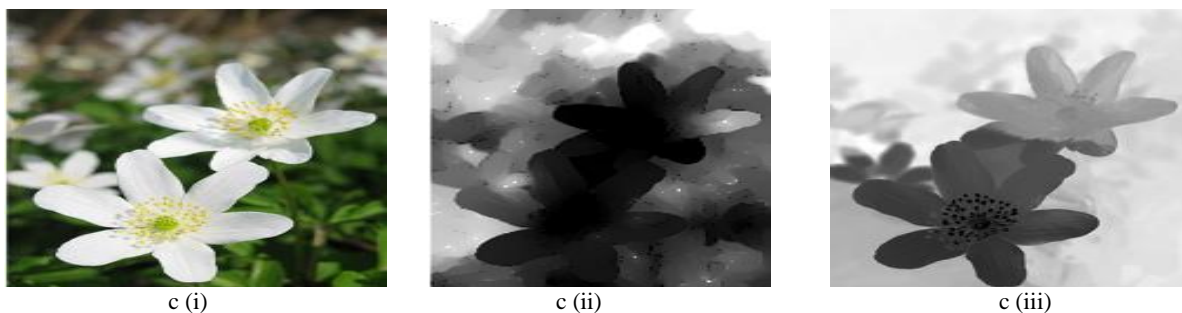

Figure 3: Here c (i) is taken as input image, c (ii) is the result obtained from defocus magnification and in c(iii) result obtained from spectrum contrast method

Here we have discussed some of the methods for estimating defocus map we have taken an input image then find out its blur map by various techniques and finally restores all in focus images. In Figure 3(a), S. Bae and F. Durand [2] shown the

results of using defocus map to magnify the current defocus effects in the original images. By seeing the result from resultant all in focus image which preserve the sharpness of

focused regions but in contrast it is enhancing the blurriness of the out-of-focus regions. Figure 3(b), Yu-Wing Tai, Michael S. Brown [5] show their results for estimating defocus maps. It used the estimated defocus map to improve the quality of the images through deconvolution. After enhancement it can be see that mean value of the edge pixels LC's is larger. And larger value indicates that image contain more sharp edges which

indicate higher quality of image. The results are much better than the previous methods can be seen. In Figure 3(c), Chang Tang, Chunping Hou, and Zhanjie [8] compare its blur map from Bae and Durand blur map c (ii) is the result of Bae and Durand and c (iii) is the result of Chang Tang, Chunping Hou, and Zhanjie and they considered the chromatic aberration caused due to wavelength-dependent variation of the index of refraction of lens to decrease the error of edge detection. Gaussian filter is used in order to remove high-frequency noise before calculating spectrum contrast. This defocus map is more accurate and reliable compared to the results of other methods.

4. CONCLUSIONS

In this paper we have discussed about the different methods for estimation of defocus blur from the image. By using different methods we have calculated and compared blur map. Future research will also focus on improving the statistical model for estimating the defocus blur. In one of the method currently latent image gradients are assumed to be Gaussian distributed. However, it has been found that for natural images "heavy-tailed" distribution models are better. Such distributions can be analyzed by using a Gaussian mixture model. Estimation accuracy may be enhanced by incorporating this model in future.

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