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Review On Image Blurriness reduction by Adaptive filters

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Abstract: **In this paper, we propose to use image blurriness to estimate the depth map for image enhancement. It is based on the observation that objects farther from the camera are more blurry for images. Adopting image blurriness with the image formation model (IFM), we can estimate the distance between scene points and the camera and thereby recover and enhance images. In this paper review of different methods of blurriness removal from images and type of filters**

Keywords:**Filter,Kernel,Deblurr**

I. INTRODUCTION

Image processing is an approach which converts an image into digital image and performs some operation on it to enhance its quality. Image processing is done to observe the hidden objects, to produce better quality image from degraded image and distinguish the object from the image. There are two types of image processing that are Analog and Digital image processing. Analog image processing is used for hard copies while digital image processing is used for manipulation of digital images.
There are some problems that occurred in the images like blurring, mixed pixel problem and degradation due to noise. In this paper, different types of deblurring methods are discussed in brief.

Deblurring approaches: these are the approaches that are used to solve the issue of blurring in the image. Deblurring is divided in two types that are:

1. Blind Deblurring
2. Non- Blind Deblurring

Fig 1 Blurred and de-blurred image [5]

A. Types of filters

"Filtering" the pixel value of the filtered images at a particular location is a function of the values of the input image in a small neighborhood of the same location (Tomasi and Manduchi, 1998).

a) **Linear Filter:** If the operation performed on the image pixels linearly, then the filter is called a linear filter. The output of a linear filter is the average of all the pixels contained in the neighborhood of that filter mask. These types of filters are also called averaging filters. In linear filters we replace the value of every image pixel by the average of the intensity levels in the neighborhood defined by filter mask, and linear filter reduced sharp transitions in intensities in an image. The linear filter is nothing but a simple sliding window spatial filter that replaces the center value in the window with the average of all the

neighboring pixel values including itself e.g. Arithmetic mean filter, Geometric mean filter etc.

b) Non-linear filter (order statistics) : Order statistics are non-liner filters whose response is based on ordering (ranking) the pixels contained in the image area encompassed by the filter, and then replace the center pixel value with the value obtained by ranking result (Gonzalez and woods, 2008). Non-linear filters have many applications, especially the median filter is used for reducing impulse noise but non-linear filters are harder to use and design than linear ones.

E.g. Median filter, Min filter, Max filter and Midpoint filter etc.

B. Filter based techniques: In filter based techniques we use following techniques for implementation.

Median filters: The median filter is a non-linear filtering technique, often used to suppress noise. Median filters are quite popular because it provides the excellent noise-reduction capabilities, while producing less blurring images than linear smoothing filters of similar size. Median filter replaces the value of pixel by the median of intensity values in the neighborhood of that pixel. The median filter is defined as follows (Gonzalez and Woods, 2008).

Median filter based on ordering the pixels in an image. It is based on sliding window principle. To perform the median filter first we take a window of 3*3 or 5*5 dimension and then sort the pixel value in the neighborhood to find its middle value for example if we take a 3*3 window size then the median is 5^{th} value or if we take the 5*5 window then median is 13^{th} value, then we assign the median value to the corresponding pixel in the restored image. For example, the median filter is widely used to remove spike noise i.e. very effective in removing impulsive noise. However, nonlinear filters are considerably harder to use and design than linear ones.

Bilateral filters: This filter is called bilateral filter because in this technique, both domain and range filters are combined. A bilateral filter is a non-linear filter, preserving edges of an image and also noise reducing smoothing filter for images. The concept used in the bilateral filtering is to do in the range of an image what traditional filters do in its domain. (Tomasi and Manduchi, 1998). The intensity value at each pixel in an image is replaced by a weighted average of intensity values from nearby pixels. In the two filters differ in the method by which weights are computed. The weights for the implementation of bilateral filters are computed by both radiometric (gray-level) proximity and geometric proximity between the pixels (protter et al., 2009)

*Non-local means filter***:** Non local means filter proposed by Buades in 2005. The Most efficient technique called non-local means (NLM) in which instead of using the single pixel intensity it uses the patch based similarity to preserve the edges and fine details of an image.

In this method for a given pixel, the restored pixel value of each pixel is obtained by the weighted average of gray values of all pixels in the image (Buades et al., 2005). It uses the concept of two window called search window and similarity window. In this algorithm, discrete noisy image g is given then the estimated value of NL (g) (i), for pixel I, is computed as (Guo et al., 2011).

III. PERFORMANCE EVALUATION OF DENOISING TECHNIQUES

For evaluating the performance of denoising technique we used the important evaluation factors called peak signal-to-noise ratio (PSNR) in decibels (dB) and mean squared error (MSE)

A. MSE (Mean Square Error): MSE represents the error between the original image and restored image. It is the sum of all squared value differences between the original and restored image divided by image size. The quality of denoised image is better if it has the lower MSE value.

B. PSNR (Peak Signal-to-noise ratio**):** The PSNR is the peak signal-to-noise ratio, in deciles, between two images. The PSNR ratio is used as a quality measurement between the original image and restored image. The quality of denoised image is better if it has the higher PSNR value.

II. LITERATURE REVIEW

Single image de-blurring method is proposed with reduced ringing effects using Bayesian estimation method. This approach is used to reduce the effects of shaking movement of the camera during image capturing. It reduced the ringing using cyclic boundaries and the image is restoring by using Richardson-Lucy algorithm. It reduces the noise and ringing effects [1]. Kernel grid regularization method is proposed for non-uniform motion de-blurring. This

method depends on the mapping flow of constraints which estimates the kernels. This method is used to detect and optimize the kernel which depends on earth mover's distance. Optimized region is expended by ink dot diffusion based model [2]. Plenoptic image motion de-blurring is proposed by using blind convolution formulation. In this author works on identification of blur point and latent sharp image. Iterative methods are used for effective GPU implementation. Regular energy minimization method is used to recover the high resolution scene texture and the camera motion. It also handles the non-uniform motion [3]. Introduces the space varying kernel for image blurring in total variation. Convex optimization method is used in this work for de-blurring. Fourier transformation method is used for solving linear equations. Richard algorithm is used for splitting and implementing with low-complexity [4]. Multi-image de-blurring is done by using complementary sets of fluttering patterns. This method recovers the sharp latent image preserves the spectrum bands of latent image. Results of the experiments show its effectiveness [5]. Image restoration is done in the presence of Gaussian noise. This approach is used to reduce the effects of shaking movement of the camera during image capturing [6]. Patch based prior is proposed using Gaussian mixture model which solve the inverse problem of two images. It works on image de-blurring and compressive imaging. Variable splitting algorithms are used that are able to decouple the handling of the observation [7]. An algorithm is proposed for exploration of reliable edges and removing outlier in latent images. In this work author discussed the effect of outliers on kernel and show the effective de-blurring method [8]. In this paper, the author described learning based approach for image de-convolution. It work in two stages, in first stage feature extraction and kernel estimation module is working. In second stage, latent images used for image estimation module [9]. Enhanced low rank prior is used for image deblurring. To enhance the effectiveness of the prior weighted nuclear minimization is performed. For better kernel estimation eliminate the fine texture edges and retain the dominant edges [10].

TABLE 1

INFERENCE FROM LITERATURE REVIEW

Author's Name	Year	Algorithm/ Technology used	Summary
Cao, Shan, et al.	2018	Bayesian Estimation	• It reduced the ringing using cyclic boundaries and the image is restoring by using Richardson-Lucy algorithm. • It reduces the noise and ringing effects.
Shen, Ziyi, et al.	2018	Kernel Grid Method	• This method depends on the mapping flow of constraints which estimates the kernels. This method is used to detect and optimize the kernel which depends on earth mover's distance. • Optimized region is expended by ink dot diffusion based model
Chandramouli, Paramanand, et al.	2018	Motion De-blurring algorithms	• Iterative methods are used for effective GPU implementation. Regular energy minimization method is

			used to recover the high resolution scene texture and the camera motion. It also handles the non-uniform motion
O'Connor, et al.	2017	Space-varying kernel	• Convex optimization method is used in this work for de-blurring. Fourier transformation method is used for solving linear equations.
Jeon, Hae-Gon, et al.	2017	Fluttering Patterns	• This method recovers the sharp latent image preserves the spectrum bands of latent image. Results of the experiments show its effectiveness.
Marnissi, Yosra, et al.	2017	Bayesian Estimation	•This approach is used to reduce the effects of shaking movement of the camera during image capturing.
Teodoro, et al.	2016	Image prior	• It works on image de-blurring and compressive imaging. Variable splitting algorithms are used that are able to decouple the handling of the observation
Pan, Jinshan, et al.	2016	Kernel estimation method.	• In this work author discussed the effect of outliers on kernel and show the effective de-blurring method
Schuler, Christian J., et al.	2016	Deep Learning method	•It work in two stages, in first stage feature extraction and kernel estimation module is working. In second stage, latent images used for image estimation module
Ren, Wenqi, et al.	2016	kernel estimation Methods	•To enhance the effectiveness of the prior weighted nuclear minimization is performed. For better kernel estimation

			eliminate the fine texture edges and retain the dominant edges

IV. CONCLUSION

In this paper, review use image blurriness to estimate the depth map for image enhancement. It is based on the observation that objects farther from the camera are more blurry for images. Adopting image blurriness with the image formation model (IFM), we can estimate the distance between scene points and the camera and thereby recover and enhance underwater images. Experimental results on enhancing such images in different lighting conditions demonstrate the proposed method performs better than other IFM-based enhancement methods

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