Restoration of Motion Blurred Image Using Spatial Domain

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Abstract- In image restoration, it is nearly always assumed that the point-spread function of the degrading system, as well as the variance of the observation noise and a model of the original image, is known a priori. Since these parameters are unknown for practical images of interest, they have to be estimated from the noisy blurred images themselves. This thesis presents a maximum likelihood approach to the motion blur identification problem, and proposes to employ the expectation-maximization algorithm to optimize the nonlinear likelihood function in an efficient way. In order to improve the performance of the identification algorithm, motion blur models are incorporated into the identification method. The resulting iterative technique simultaneously identifies and restores noisy motion blurred images.

Keywords – Motion Blurred, Restoration, PSF, PSNR

I. Introduction

Image restoration [2] is the process of recovering an image that has been degraded by using a priori knowledge of the degradation phenomenon. Restoration techniques involve modeling of the degradation function and applying the inverse process to recover the original image. This process is processed in two domains: spatial domain and frequency domain.

Restoration of digital images from their degraded measurement has always been a problem of great interest. A specific solution to the problem of image restoration is generally determined by the nature of degradation phenomena. So it is highly dependent on the nature of the noise present there. Given the noise function, one can use the Richardson-Lucy Algorithm to restore the degraded image. This algorithm was introduced by W.H. Richardson (1972) and L.B. Lucy (1974).In this paper we are using the modified Richardson-Lucy Algorithm.

A. Blur Type

In digital camera [1] there are four common types of blur effects:

i. Average Blur

The Average blur is one of several tools you can use to remove noise and specks in an image. Use it when noise is present over the entire image. This type of blurring can be distribution in horizontal and vertical direction and can be circular averaging by radius R which is evaluated by the formula:

$R = \sqrt{g2 + f2}$

Where: g is the horizontal size blurring direction and f is vertical blurring size direction and R is the radius size of the circular average blurring.

ii. Motion Blur

The Many types of motion blur can be distinguished all of which are due to relative motion between the recording device and the scene. This can be in the form of a translation, a rotation, a sudden change of scale, or some combinations of these. The Motion Blur effect is a filter that makes the image appear to be moving by adding blur in a specific direction. The motion can be controlled by angle or direction (0 to 360 degrees or –90 to +90) and/or by distance or intensity in pixels (0 to 999), based on the software used.

iii. Gaussian Blur

A Gaussian blur is the result of blurring of an image by Gaussian function. It is a widely used effect in graphics software, typically to reduce image noise and reduce detail. Gaussian blur is also used as a pre-processing stage m in computer vision algorithms in order to enhance image structures at different scales. The Gaussian Blur effect is a filter that blends a specific number of pixels incrementally, following a bell-shaped curve. The blurring is dense in the centre and feathers at the edge. Apply Gaussian Blur to an image when you want more control over the Blur effect.

iv. Out-of-focus Blur

When a camera images a 3-D scene onto a 2-D imaging plane, some parts of the scene are in focus while other parts are not. If the aperture of the camera is circular, the image of any point source is a small disk, known as the circle of confusion (COC). The degree of defocus (diameter of the COC) depends on the focal length and the aperture number of the lens, and the distance between camera and object. An accurate model not only describes the diameter of the COC, but also the intensity distribution within the COC.

II. LITERATURE REVIEW

G. Al-Bakkar et al. [4] studied in his paper that passive imaging in the millimetre wave region of the spectrum is attractive compared with imaging in the visible and infrared because of its better penetration through cloud and rain. However, the diffraction limited spatial resolution is far worse and computer restoration of millimetre wave images is necessary. The Richardson-Lucy algorithm is frequently used for image restoration because compared with linear algorithms it has reduced sensitivity to error in a priori knowledge, and fewer restoration artefacts. However, it requires much iteration to converge and is very slow compared with linear methods. This paper investigates modifications of the Richardson-Lucy algorithm which speed up the execution of the algorthm. Software techniques investigated include incorporating a speedup parameter, using dual point spread functions and implementation in the Fourier domain. A parallel implementation of the algorithm has also been investigated using a tree topology network of between 1 and 10 transputers. Finally an application of the transputer system to the de-blurring of a millimetre-wave image obtained from a mechanical scanning system is described in the paper.

Siba Prasad Tudu et al.[2] discussed that image restoration is the process of restoring degraded images which cannot be taken again or the process of obtaining the image again is costlier. We can restore the images by prior knowledge of the noise or the disturbance that causes the degradation in the image. Image restoration is done in two domains: spatial domain and frequency domain. In spatial domain the filtering action for restoring the images is done by directly operating on the pixels of the digital image. In frequency domain the filtering action is done by mapping the spatial domain into the frequency domain by taking fourier transform of the image function. By mapping the image into frequency domain an image can provide an insight for filtering operations. After the filtering, the image is remapped into spatial domain by inverse fourier transform to obtain the restored image. Different noise models were studied. Different filtering techniques in both spatial and frequency domains, were studied and improved algorithms were written and simulated using matlab. Restoration efficiency was checked by taking peak signal to noise ratio (psnr) and mean square error(mse) into considerations.

Y. Yitzhaky et al. [3] dealed with the problem of restoration of images blurred by relative motion between the camera and the object of interest. This problem is common when the imaging system is in moving vehicles or held by human hands, and in robot vision. For correct restoration of the degraded image, it is useful to know the point-spread function (PSF) of the blurring system. They proposed a straightforward method to restore motion-blurred images given only the blurred image itself. The method first identifies the PSF of the blur and then uses it to restore the blurred image. The blur identification here is based on the concept that image characteristics along the direction of motion are affected mostly by the blur and are different from the characteristics in other directions. By filtering the blurred image, we emphasize the PSF correlation properties at the expense of those of the original image. Experimental results for image restoration are presented for both synthetic and real motion blur.

Reginald L. Lagendijk et al. [5] discussed that in image restoration, it is nearly always assumed that the point-spread function of the degrading system, as well as the variance of the observation noise and a model of the original image, are known a priori. Since these parameters are unknown for practical images of interest, they have to be estimated from the noisy blurred images themselves. This paper presented a maximum likelihood approach to the blur identification problem, and proposes to employ the expectation-maximization algorithm to optimize the nonlinear likelihood function in an efficient way. In order to improve the performance of the identification algorithm, low-order parametric image and blur models are incorporated into the identification method. The resulting iterative technique simultaneously identifies and restores noisy blurred images.

III. RESULT

The figures from Figure 1 to Figure 5 are the images of the proposed work which shows the different images which consists of original images and output images.

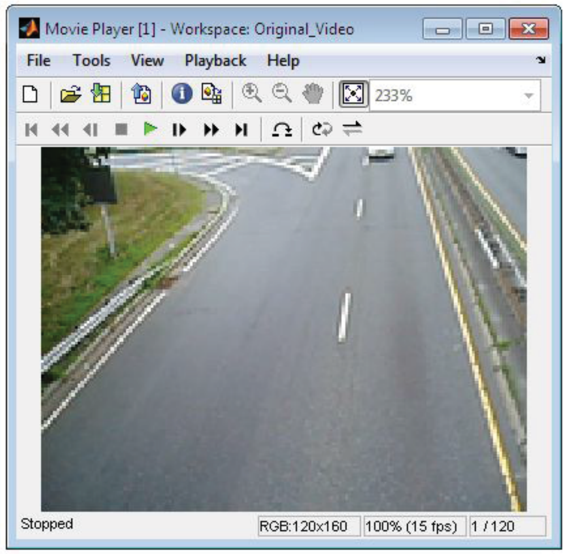

Figure 1. Original Car Video

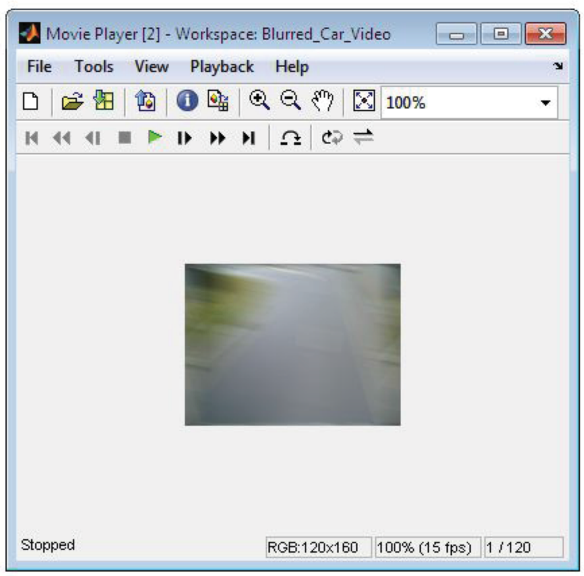

Figure 2. Motion Blurred Car Video

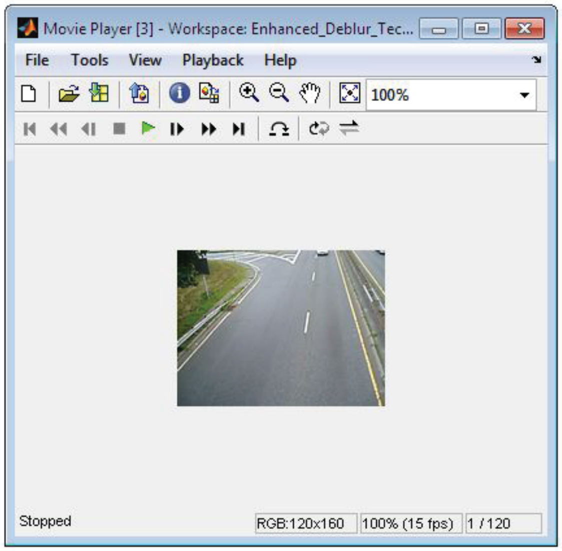

Figure 3. Restored motion blurred image using Enhanced Deblurring Technique

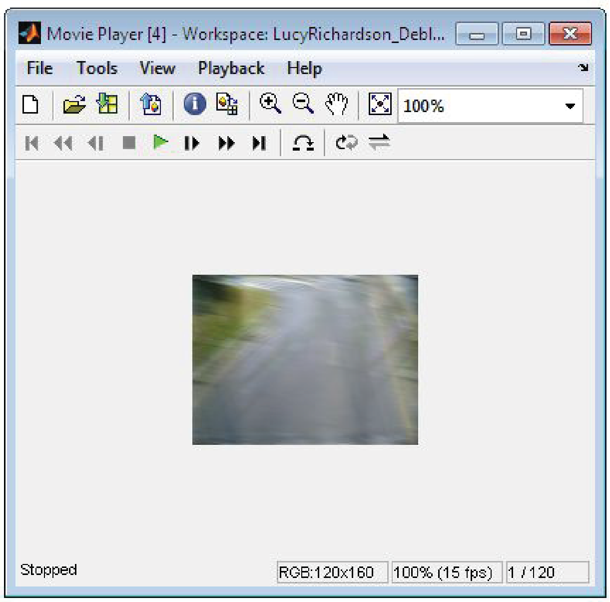

Figure 4. Restored motion blurred image using Lucy Richardson Deblurring Technique

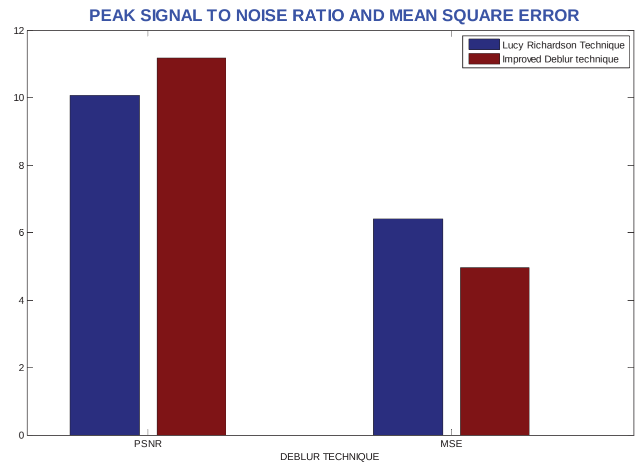

Figure 5. PSNR and MSE of Lucy Richardson and Improved Deblurring Technique

Figure 5 shows the PSNR(Peak Signal to Noise Ratio) and MSE(Mean Square Error) of Lucy Richardson and Improved Deblurring Technique. This figure shows that PSNR increases and MSE decreases in Improved Deblurring technique as compared to Lucy Richardson Deblurring Technique.

IV.CONCLUSION

Image restoration is the process of reconstruction or recovering an image that has been corrupted by some degradation phenomenon. Degradation may occur due to motion blur, Gaussian blur, noise and camera mismatch. In this thesis corrupted image have been recovered using Modified Lucy Richardson algorithm in the presence of motion blur. The performance of this algorithm has been compared with Lucy Richardson algorithm. The performance comparison done on the based on peak signal-to-noise ratio (PSNR) and MSE(Mean Square Error).The result shows that Modified Lucy Richardson method is better than Lucy Richardson algorithm.

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