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Video Frame De-Blurring for Fast Moving Object Video Stabilization

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Abstract: - To stabilize the video frames, a variety of strategies have already been put forth, that may be differentiated by techniques they employ at certain phases. Because small handheld cameras user generally lack training, hand operated camera recordings frequently include unwanted motions and therefore are unsteady and causes blurry frames, the paper formulated the video frame de blurring model. Consequently this paper aims to demonstrate the impact off blur on motion estimation and stabilization process.in second pass the blind and non-blind video frame de-blurring methods are tested over the fast moving object highway videos required video stabilization. The four de blurring approaches are considered and presented for the real-time scenario.

***Keywords:*-Video Stabilization, Video De Blurring, Motion Estimation, Blind De-convolution, Wiener Filter, Fast Moving Object.**

I. INTRODUCTION

To stabilize the video sequences, a variety of algorithms have been put forth, which can be differentiated by the techniques they employ at certain phases. Untrained consumers of handheld cameras produce videos that are typically shaky (or jittery) as well as suffered from unwanted motions, such as tracking, boom, as well as pan, all through the scene-capturing process. In order to increase the quality of hand held videos, video stabilization technologies are therefore needed to eliminate blur and unwanted camera motions.

While the latter is generally brought forward by occlusion, shadowing, as well as autonomously movable objects, image former is mostly produced by sensor noises, air disturbance, and compression. Videos may have blurry frames due to the severe vibration. As a result, this study presents the pre-video frames de blurring prior to frame stabilization. Investigated is how the blur affects motion estimation as well as stability.

The effectiveness of several video frame deblurring filters, encompassing blind and non-blind techniques, is thus compared in this paper. For the investigation, the blind De convolution as well as Luky recursion blind methods as well as the wiener filter methodology are taken into consideration. The effectiveness of de-blurring techniques would then be assessed in the subsequent portion by taking into account the fuzzy video frames. The video only with quickly moving object I'm evaluating.

II. VIDEO FRAME DE-BLURRING

The acquired video sequence has already been compromised by motion blur if a frame rate at the time of scene capturing is inversely proportional towards the object motion. The point spreading function (PSF), another name for the blurring function used to model blur, is typically used (or PSF). There are multiple kinds of blur, although for our research, they have just taken into account motion blur. Due to the poor performance from both the optical and electrical systems, motion blur arises in numerous image production systems. Since frames are not uniformly blurred in video sequences, thus in the presence of linear motion blur with additive noise the relation between the observed current frame $g(x,y,t)$ and its uncorrupted version $f\,(x,y,t)$ can be shown by equation (7) below;

$$g(x,y,t) = f(x,y,t) * h(x,y,t) + n(x,y,t). \quad (1)$$

Where $h(x,y)$ is the blurring function (or point spread function (PSF)), that has been convolved with the original frame $f(x,y)$ and $n(x,y)$ is the additive noise function The convolution in spatial domain and multiplication in the frequency domain constitute a Fourier transform pair thus the eq. (1) in frequency domain may be modified as;

$$G\,(u,v) = F(u,v) * H(u,v) + N(u,v) \quad (2)$$

The degradation function $H(u,v)$ is sometimes are also called the optical transfer function (OTF), a term derived from the Fourier analysis of the optical system. The OTF and PSF are the Fourier transform pairs.

A. Effect of blur on Motion Estimation/ Optical flow

As clear from the eq. (1) that in the presence of the motion blur the original frame brightness is changed due to point spread function. In this section the effect of the blur on the motion estimation is discussed. In the absence of the blur, the efficiency of the global motion estimation is usually high except few accumulation errors. But in the presence of motion blur the motion between two consecutive frames $f(x,y,t)$ and $f(x,y,t-1)$ may be modelled using affine transform as; $f(x,y,t) = [f(\mathrm{m}_1\mathrm{x} + \mathrm{m}_2\mathrm{y} + \mathrm{m}_5\,,\ \mathrm{m}_3\mathrm{x} + \mathrm{m}_4\mathrm{y} + \mathrm{m}_6\,, t-1)] * h(x,y,t-1)$ (3)

Where m_1, m_2, m_3, m_4, m_5 and m_6 are defined as m the affine parameters and $h(x,y,t-1)$ is the blurring function. To estimate the affine parameters following sum of square difference quadratic error function has to be minimized; $E(m) = \sum_{x,y\in\Omega} [f(\mathrm{x},\mathrm{y},\mathrm{t}) - f(U(\mathrm{x},\mathrm{y}),V(x,y),t-1) * h(x,y,t-1)]^2$ (4)

Let term $f - f * h(x,y,t-1)$ is defined as $\Delta(t)$ and the term $(f_t - (U(\mathrm{x},\mathrm{y}) - \mathrm{x})f_x + (\mathrm{V}(\mathrm{x},\mathrm{y}) - \mathrm{y})f_y)$ is represented by $F(t)$, then by expanding the square

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function;

$$E(m) = \sum_{x,y \in \Omega} \Delta^2(t) + F^2(t) * h^2(x,y,t-1) + 2 * \Delta(t) * F(t) * h(x,y,t-1) \quad (5)$$

The aforementioned error function was contrasted with reference to m, minimized, and equals zero in order to discover the affine coefficients. It is obvious that term 2 (t) will be ignored because it will kept stable with m. Thus, it is evident that the existence of blur will result in a complex higher - level error function hence incorrect motion parameter tuning. The scenario will become more challenging if there is significant additive Gaussian noise present. As a result, de-blurring is suggested to be done preceding motion estimation with in method under consideration.

III. VIDEO DE-BLURRING

Various image/video rehabilitation techniques have been developed to eliminate motion blur. Blind de-convolution is really the de blurring technique that is most frequently utilized. Since motion blur may be thought of as a single uniformity blur, it uses regularized iteration to recover the deteriorated image and examines a single segment which covers a uniform moving regions. But somehow it necessitates highly complicated computing methods.

Due to the fact that the Wiener filter is really a minimum mean square errors filter, current work suggests its application in order to decrease the computational complexity and provide better, acceptable restorations outcomes. An reverse filter that uses a linear DE convolution technique is really the Weiner filter. The output f(x,y) of a linear de convolution is just a concatenation of a input. We assume that a transfer function I(x,y) has an inverse Fourier transform using an inverse filter as;

$$f(x,y) = I(X,Y) \otimes \mathrm{G}(\mathrm{x,y}) \qquad (6)$$

But since Weiner filter is just a linear filter, it requires less computing but performs worse when noise is present. Non-linear filtering with better quality, like the Lucy-Richardson, is available.

However, the main issue with successful de-blurring was that occasionally, ringing would occur on the de-blurred image. The discrete Fourier transformations utilized by de convolution functions, which presume a periodic frequency pattern in an image, are what create the high frequency drop-off that results in this ringing appearance. Consequently, where edges are there is a large frequency drop-off.

The goal of the method is to find an estimate of the uncorrupted image f where the mean square error among them is kept to a minimum [5]. The method is based on the idea that pictures and noise are both random processes. This measure of inaccuracy is provided by

$$e^2 = E\{(f - f^{\wedge})^2\} \qquad (7)$$

Where $E\{\,\}$ is the expected mean error function.

IV. WIENER FILTER DESIGN

It is presummated that there is no correlation between the noise and indeed the images, that either one or the other has zero mean, as well as the estimate's grey levels are a linear function of values in the damaged image. The formula in the spectral domain provides the minimum of the error function in Eq. (7) under these circumstances.

$$\hat{F}(-u,v) = \left[\frac{H^*(u,v)S_f(u,v)}{S_f(u,v)[H(u,v)]^2 + S_\eta(u,v)}\right]G(u,v) \quad (8)$$

$$= \left[\frac{H^*(u,v)}{[H(u,v)]^2 + S_\eta(u,v)/S_f(u,v)}\right]G(u,v)$$
$$= \left[\frac{1}{H(u,v)}\frac{|H(u,v)|^2}{[H(u,v)]^2 + S_\eta(u,v)/S_f(u,v)}\right]G(u,v) \quad (9)$$

Where we applied the principle that now the complex quantity's squared magnitude is equivalent to the product of the multidimensional quantity and its conjugate. The filter, which is made up of the terms on the inside of the parenthesis, is also known as the least square error filter or the minimum mean squared error filter.

Where $H(u,v) =$ is degradation function

$H^*(u,v) =$ is the complex conjugate of $H(u,v)$

$|H(u,v)|^2 = H^*(u,v)H(u,v)$

$G(u,v)$ is the transform of the degraded image \

$S\eta(u,v) = |N(u,v)|^2 =$ Power spectrum of the noise

$S_f(u,v) = |F(u,v)|^2 =$ Power spectrum of an image

Where the definition of a ratio estimation component is

$$\propto = \frac{mean\ S\eta(u,v)}{mean\ S_f(u,v)} \qquad (10)$$

The inverse Fourier transformation of frequency-domain estimation yields the restored image with in spatial domain.

But occasionally, de blurring might result in ringing on the de blurred image. Since the de-convolution algorithms employ discrete Fourier transforms (DFT), which presume that an image seems to have a periodic frequency sequence, this ringing appearance is brought by the high frequency drop-off. As a result, where edges are, there is a high frequency drop-off. That issue can be resolved using a function known as EDGETAPER. Before performing the de-convolution, edge-taper was applied, this significantly blurred the margins of the original input image. The ringing effect was lessened because the edges became then less sharp.

V. QUALITATIVE EVALUATION

The outcomes of the video de blurring were shown in this part. Figure 2 displays the qualitative assessment of the different video de blurring techniques. For the 24 th

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frame of the highway footage of quickly moving objects. A 10 and 7 degree long blur is introduced to the previous frame. For the 10 titrations, the outcome of the video frame de blurring utilizing the blind de convolution method is displayed.

a) Original image b) additionally introduced Blurry frame cb) deblur using blind Deconvolution(n=10)

d) deblur bsingy wenior filter e) with the blind Deconvolution and Edge tappering f) final stabilized Frame

Fig. 2 Results of De-blurring techniques for replicated fast moving object highway video frames are compared.

Wiener filter surpasses other filters and generates loosest match to a video frame. The VS process in this work does not prefer using edge tapering as it could be sensitive to changes in motion features. Functional evaluations make use of PSNR and MSE.

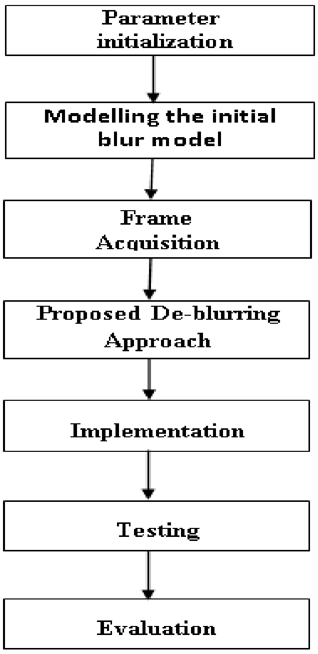

Fig.3. Proposed Deblurring methodology

The systematic design methodology for the recent research is presented in the Figure 3. The blur model is formulated for the evaluation of de blurring methods.

VI. PARAMETERS FOR EVALUATION

The peak signals to noise ratios (PSNR) as well as the index for structural similarity measure are typically used to measure invisibility (SSIM). The formula for PSNR is

$$\mathrm{PSNR}(C, C^*) = 10\lg\frac{C_{\max}^2}{\mathrm{MSE}}, \quad \textbf{(11)}$$

$$\mathrm{MSE} = \frac{1}{M^2}\sum_{i=1}^{M}\sum_{j=1}^{M}(C_{i,j} - C_{i,j}^*)^2, \quad (12)$$

Where

These parameters are frequently used for the performance evaluations.

VII. CONCLUSION AND FUTURE SCOPE

Several methods for stabilizing the video frames are already proposed, which can be distinguished by the approaches they use at different phases. The research developed a video frames de blurring framework since small and portable camera users typically lacking expertise, manually crank camera recordings commonly incorporate unwanted movements and are thus unsteady and generate blurry frames.

Therefore, the purpose of this study is to illustrate how blur affects the motion estimation and stabilizing process.

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paper presented blind as well as non-blind video de-blurring techniques are placed to the evaluate over the highway recordings that needed video stabilization due to fast moving objects during the second pass. For the real-time scenario, the four de blurring methodologies are taken into consideration and displayed. It is concluded that wiener filter out performs over the other approaches and is faster too.

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