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Enhancement of Image Quality in MATLAB Environment – Super-Resolution

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Abstract— *The Super-Resolution (SR) or High Resolution Image reconstructed from noisy, blurred and aliasing the low resolution image using techniques known as super-resolution reconstruction. This paper focuses on super resolution of images using different type of Enhancement of Image Quality in MATLAB Environment – Super-Resolution algorithms. The super-resolution have phases such as registration,interpolation,restoration,the low resolution is registration with to the reference images then to interpolation using the algorithm ,then after the restoration to from image to removing noise, blure. The super-resolution to generate high resolution image using the low resolution image and it is graphical interface to measure the parameters. In this paper the MATLAB based result to using the Super-resolution algorithms and also it graphical interface to measure parameters.*

Keywords—Registration, Sampling, Interpolation, Restoration, Super-resolution.

1. INTRODUCTION

The super-resolution reconstruction techniques to generate high resolution image from the low resolution images using noisy, blures, aliasing and shifting pixels in images. Today super-resolution techniques are used in lot fields. The some application areas are surveillance, forensic and satellite imaging, medical imaging application. Today 's image processing application mostly using in the areas are electronics and medical fields, in the medical field the high resolution image very useful for doctor to a correct diagnosis. The low resolution noisy image captured from common imaging system. It means that pixel density within an image is high, and therefore an high resolution image can offer more details that may be critical in various applications. In SR, the sub-pixel shifted in low resolution images can be obtained from one camera with several captures or multiple scene can be obtained from one camera with several captures located in different positions. Thus the recorded image usually suffers from blur, noise and aliasing effects, although the main concern of an SR algorithm is to reconstruct high resolution images from under sampled low resolution images.

2. OBSERVATION MODEL

For extensive analysis of SR image reconstruction problem, the required thing is to formulate, an observation model that relates the original HR image to the observed LR images. The first step to understand SR is to formulate an observation model to relate the low resolution (LR) images to the desired HR image. A scene with continuous intensity distribution $\underline{P}$ is seen to be warped at the camera lens because of the relative motion between the scene and camera. The images are blurred by atmospheric disorder and camera lens by continuous point expanded functions $H_k=H_k^{cam}H_k^{atm}$. Then, they will be discretized using CCD sensors systems which results in a digitized noisy frame $\underline{Q}$. We are represent forward model by equation (1). Fig.1 shows us to how the frame of real world scene gets runned due to several parameters of super resolution such as turbulence of atmospheric, camera lens of continuous point spread functions and noise of system. The following process can illustrated using the figure of the equation.

$$\underline{Q}_k = D_k F_k H_k \underline{P} + V_k \qquad k = 1, 2, \ldots, N \qquad (1)$$

Where the camera's point spread function (PSF), is modeled by the blur matrix H_k, and D_k represent the decimation operator. F_k is the geometric warp operator between the HR frame P, the k_{th} LR frame $\underline{Q}_k$ which are rearranged in lexicographic order (P and Q_k present their matrix from). V_k is the additive noise and N is number of available LR frames. Fig. 1 illustrates equation (1).
The estimation of motion information is registration and all the images are aligned in the same coordinate system. The multiple low resolution images can represent different view points of the same scene and image registration deals with mapping corresponding points in these images to the actual points in original scene and transforming data into one coordinate system. Several types of transformations could be required for registration of images like affine transformations could be required for registration of images like affine transformations.

The extremely so difficult, to estimating the completely arbitrary motion in frame of real world image scene, with no almost guarantees of estimator performance. On the overall super-resolution performance to estimates incorrect of motion have disastrous implications. The low resolution between the shifts are different from each other, to the generated high resolution image will not always match into a spaced high resolution grid uniformly. Hence the interpolation is needed.

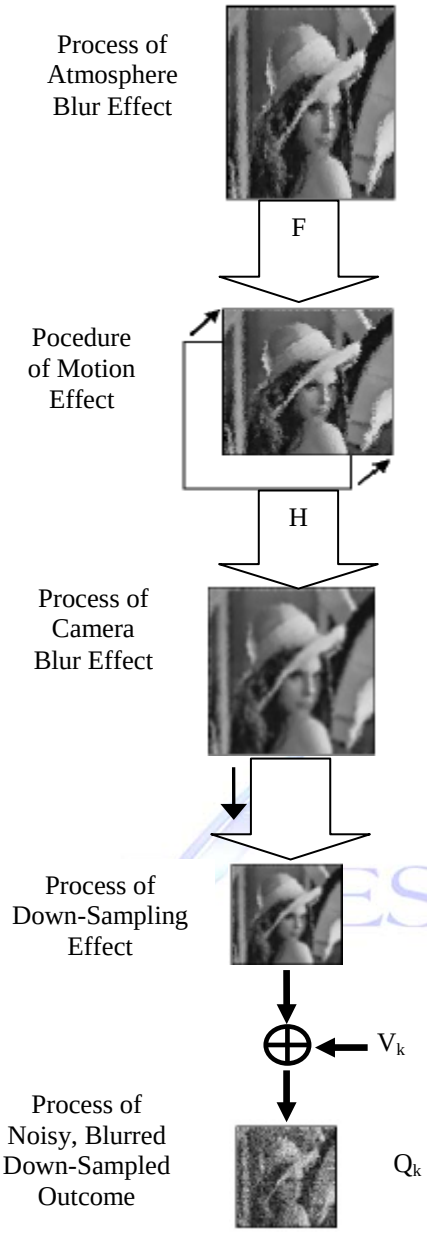


Fig.1. Block diagram representation, process to where P is the continuous intensity distribution of the scene, V_k is the additive noise, and Q_k is to resulting discrete low-quality image.

3. SUPER-RESOLUTION ALGORITHMS

A. Robust Super-Resolution Algorithm

The steps Robust super-resolution are motion estimation & image registration, data fusion and interpolation to high resolution grid. In the robust super-resolution method to estimation of an unknown high resolution image is not exclusively based on the low resolution measurements. The data fusion is blurred high-resolution image from the low-resolution is finding and estimation the deblurred image and estimating the deblurred image. In interpolation the adding a regularization term to calculating missing data. In robust regularization is a very useful in the square and determined cases ($p = r^2$ and $p > r^2$ respectively) and also reregularization very help the algorithm to remove artifacts from the final answer & improve the rate of convergence. In super resolution cases ($p < r^2$ in which p is the non-redundant low-resolution frames of number and r is enhancement resolution factor) and the pixel locations will not estimate at all. The following expression formulates our minimization criteria (2).

$$\underline{\hat{P}} = \underset{\underline{P}}{ArgMin} \left[\sum_{k=1}^{N} \left\| D_k H_k F_k \underline{P} - \underline{Q}_k \right\|_1 + \lambda l=0 Pm=0 Pam+l P-SxlSymP1 \right] \quad (2)$$

λ is a scalar to weighting the first term (likeness cost) against the second term (regularization cost). S_x^l is the operator to horizontal direction way shifting P by l pixels and S_y^m is operator to shifts P by m pixels in vertical direction way, presenting a few scales of derivatives. Scalar weight α, $0 < \alpha < 1$, spatially decaying effect to the summation of the regularization term is applied.

B. Fast & Robust Super-Resolution Algorithm

The steps Fast and Robust super-resolution are motion estimation & image registration, non-iterative of data fusion process and iterative debluring interpolation to high resolution grid. In the Fast & Robust SR method the function first computes an estimation of the blurred HR image, using the median and shift method. . It then uses the bilateral filter as a regulating term for the debluring and interpolation step. The fast & Robust SR method is load the low resolution image in the .mat format then it is registration the images with shifting of pixels using pyramidal LK optical flow process with resolution factor increase. The translational motion for each low resolution frame. The PSF function common to all frames and space inveriant.The property structure used to control the algorithm parameters then it estimated high resolution image. The following expression (3) use in it.

$$\underline{\hat{P}} = \underset{\underline{P}}{ArgMin} \left[\left\| H\underline{P} - \underline{\hat{R}} \right\|_1 + \lambda' \underbrace{\sum_{l=-P}^{P} \sum_{m=0}^{P}}_{l+m>=0} \alpha^{|m|+|l|} \left\| \underline{P} - S_x^l S_y^m \underline{P} \right\|_1 \right] \quad (3)$$

C. Cubic –Spline Super-Resolution Algorithm

The implements a simple cubic-spine interpolation of a single image .This is then deblured using the same method as in the Fast and Robust method.The Cubic-Spine Super-resolution algorithm process consists of basic three steps are motion estimation & image registarion using median operation, non-iterative of data fusion process and interpolation and deblurring process to high resolution grid. In addition with these steps one may use some post processing for more better results.

4. EXPERIMENTS

We have studied the performance of the resolution algorithms. Low resolution frames order created using one high resolution image as shown in Figure. First, in high

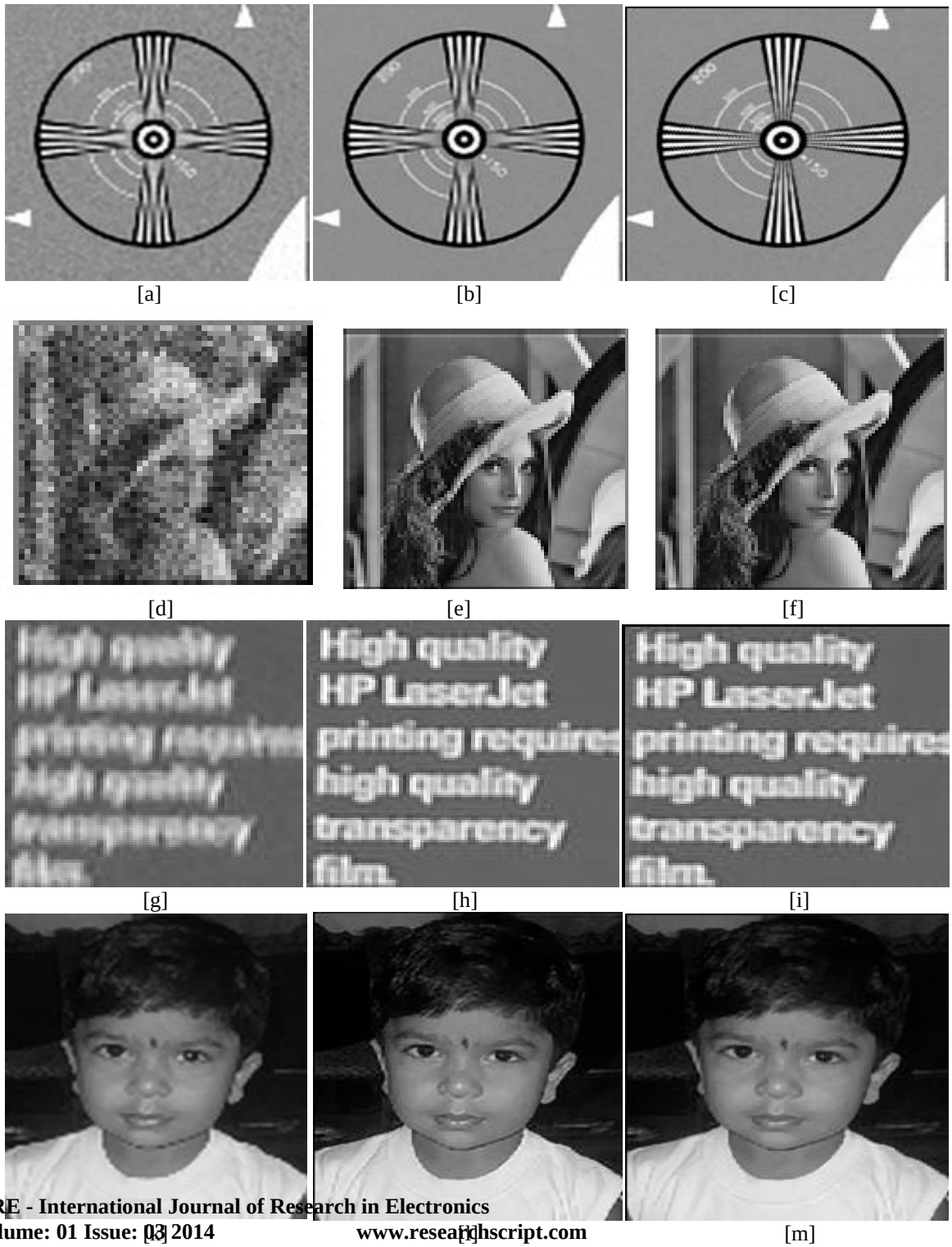
resolution image by a pixel shifted in the vertical direction. Then, after to simulate the camera PSF effect, convolved with a symmetric Gaussian low-pass filter of size 4X4 with standard divergence equal to one by shifted image. The resulting image was sub sampled by the factor. The same approach with different motion vectors (shifts) in vertical and horizontal directions was used to produce low resolution images from the original scene. The low resolution frames are shown in Figure. The sequence of low resolution frames is used for these three algorithms .The super-resolved images for Cubic Spline SR method is shown in Fig.2 (a,d,g,k), Robust SR method is shown in Fig.2 (b,e,h,l) and Fast & Robust SR method in Fig.2 (c,f,i,m). The results and study shows the improvement in resolution factor and quality in Fast &Robust SR method. The super resolution parameters resolution factor, PSF kernel size, PSF sigma, Alpha, Beta, Lambda and Iterations were also computed.

5. RESULTS

The results are shown below.

6. CONCLUSION

In this paper, the results shown are implemented in



[a] [b] [c]
[d] [e] [f]
[g] [h] [i]
[j] [k] [m]

Fig. 2. Super-Resolved images generated using Cubic Spline SR Method, Robust SR Method and Fast & Robust SR Method from set of LR Images.

MATLAB and GUI is developed for image Super-Resolution. The study shows the improvement in the quality of LR images by using the above mentioned three super-resolution algorithms and in it also graphical interface parameters are measured.

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