International Journal of Electrical and Electronics Engineers
Vol. No. 9, Issue No. 01, January-June 2017
ISSN (O) 2321-2055
ISSN (P) 2321-2045

IMAGE SUPER-RESOLUTION FOR DISTANCE AWARE

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ABSTRACT

A algorithm for high-definition displays to enlarge low-resolution images maintaining perceptual constancy (i.e., the same field-of-view regarding to distance, perceptual blur radius, and the retinal image size in viewers eyes)and model the relationship of a viewer and a display by considering two main facts of visual perception, i.e., scaling factor and perceptual blur radius.As long as enlarge an image while adjust its image blur levels on the display, and maintain viewers perceptual constancy.The scaling factor should be set in proportion to the viewer's distance towards display and the blur levels on display should be adjusted according to the focal length of a viewer.

Keywords: Highresolution(HR), Low-resolution(LR), Super-Resolution(SR),

I. INTRODUCTION

ThisSuper Resolution (SR) process generates a HR images from one or more Low Resolution (LR) images these LR images are may be aliased and they have got different information at sub-pixel level of the same scene. SR is an ill-posed problem which consists of denoising, Deblurring and enlarging processes.In most of imaging applications, images with High Resolution (HR) are desired and often required. HR means pixel density within an image is high and therefore an HR image can offer more details that may be critical in various applications. For example, HR medical images are very important for a doctor to take a correct diagnosis. It may be easy to distinguish an object from similar ones using HR satellite images, and the performance of pattern recognition in computer vision can be improved if an HR image is provided. The current resolution level and consumer price will not satisfy the future demand.[1] SR reconstruction can be carried out with single-frame or multi-frame. The zooming and magnification are given as example of single frame SRapplications. Single frame SR algorithms are implemented from only one observed LR image. But it is very high ill-posed problem. Registration and reconstruction steps are veryimportant in any SR process. We may classify SR methodswith frequency and spatial domain techniques. And represented a frequency domain registration method that is almost free of aliasing.[5] SR algorithms can be categorized according to the number of input images and output images involved in the process. When a single High-Resolution (HR) image is produced from a single degraded Low-Resolution (LR) image, we refer to Single-Image Single-Output (SISO) super-resolution. Possible applications of SISO super-resolution relate to the possibility of achieving resolution enhancements,e.g. to improve object recognition performance and enable zoom-in capabilities. Other SR algorithms deal with the integration of multiple LR frames to estimate a unique HR image: in this case we speak about Multiple-Input

Single-Output (MISO) super-resolution. An example application area is in license plate recognition from a video stream to increase the alphanumeric recognition rates. A recent focus on SR research relates to algorithms which aim at reconstructing a set of HR frames from an equivalent set of LR frames. This approach takes the name of multiple-input single-output (MIMO) super-resolution, also known as video-to-video SR. A typical application of these algorithms can be for example the quality enhancement of a video sequence captured by surveillance cameras.Many image display devices are have zooming that interpolate input images to adapt their size to high resolution screens. For example, high definition televisions include a spatial interpolator which increases the size of standard definition videos to match the high definition screen format and possibly improve the image quality.[2] Single-image super-resolution does task of makinga high-resolution of a single low-resolution image. This problem is ill-posed as they are generally multiple high-resolution images that can be reduced to the same low-resolution image for this problem, one has to on strong prior information. This information is available either in the explicit form of aenergyfunctional ordistribution defined on the image class, and/or in the implicit form of example images which leads to example based super-resolution.[3].

The primary task of the SR algorithms is not to improve recognition performance but to increase the visual quality of images.Another class of SR reconstruction methods to generate an HR image from a single LR image.these methods are called as 'example-based SR'.These methods are in generally based on natural image edge or gradient profile prior.[6] There is need of finding the desired solution to increasing the current resolution level. So, the most direct solution to increase spatial resolution is to reduce the pixel size by sensor manufacturing techniques where the spatial resolution is the pixel density in an image. As the pixel size decreases, the amount of light available also decreases.it generates shot noise that degrades the image quality severely. To reduce the pixel size without suffering effect of shot noise, therefore, there exists limitation of the pixel size reduction. Another approach for enhancing spatial resolution is to increase the chip size which is to an increase in capacitance. Since, the large capacitance makes difficult the speed up a charge transfer rate this is not considered effective. therefore, a new approach for increasing spatial resolution is required to overcome these disadvantages of sensors and optics manufacturing technology. The most promising approach is to use signal processing techniques to obtain HR image from set of LR images. Recently such a resolution enhancement technique has been involved in most of effective research areas, and it is called Super Resolution (SR) image reconstruction. The term Super in Super Resolution represents very well the characteristics of the technique that overcoming inherent resolution limitations of LR systems. The major advantage of signal processing technique is that requires less cost and existing LR imaging systems can be utilized.[1] Super resolution found in many applications areas, some ofthe first formulation areas are Satellite imaging,Video enhancement and restoration,Astronomical imaging, Video standards conversion, Digital mosaicing, Aperture displacement cameras,Confocal Microscopy, Medical computed tomo graphic imaging, Diffraction tomography, Video freeze frame and hard copy and Restoration of MPEG-coded video streams etc.,[4]

II. IMAGE SUPER-RESOLUTION:

SR algorithms can be categorized according to the number of input imagesand output images involved in the process. When a single high-resolution (HR) image is produced from a single degraded low-resolution (LR) image, we refer to single-image single-output (SISO) super-resolution. Possible applications of SISO super-resolution relate to the possibility of achieving resolution enhancements, e.g. to improve object recognition performance and enable zoom-in capabilities. Other SR algorithms deal with the integration of multiple LR frames to estimate a unique HR image: in this case we speak about multiple-input single-output (MISO) super-resolution. An example application area is in license plate recognition from a video stream to increase the alphanumeric recognition rates. A recent focus on SR research relates to algorithms which aim at remakinga set of HR frames from a similar set of LR frames. This approach takes the name of multiple-input single-output (MIMO) super-resolution, also known as video-to-video SR. A typical application of these algorithms can be for example the quality enhancement of a video sequence captured by surveillance cameras.[6]

Broadly speaking, multi-frame SR algorithms can be classified according to three main approaches followed:

1. Interpolation-based approach
2. Frequency-domain-based approach
3. Regularization-based approach

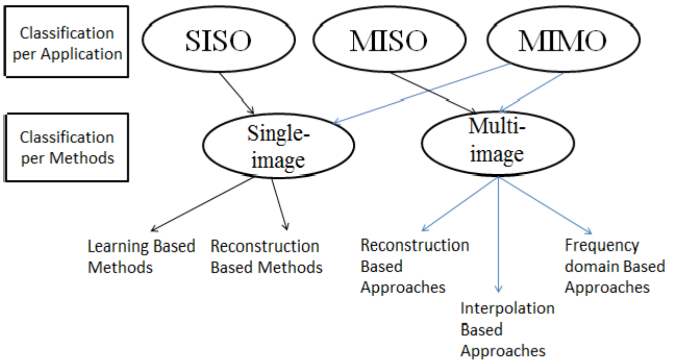

Fig.(1) Classification of Super Resolution as per Application and Methods.

Single-image SR aims at constructing the HR output image from as smaller as a single LR input image. The problem stated is an inherently ill-posed problem, as there can be several HR images generating the same LR image. Traditional interpolation methods (e.g. bicubic, cubic and linear spline interpolation) by computing the missing pixels in the HR grid as averages of known pixels, implicitly impose a smoothness prior. However, natural images often present strong discontinuities, such as corners and edges , and thus the smoothness prior results in producing ringing and blurring artifacts in the output image. [4]The goal of SR is thus to achieve better results, by using more sophisticated statistical priors.

III. VIEWERS DISPLAY AND DISTANCE:

In this the super-resolution problem for HD display can be formulated by considering both viewing distance and image formulation into account. The scaling factor and image blur are processed simultaneously to maintain distance between viewers and display.

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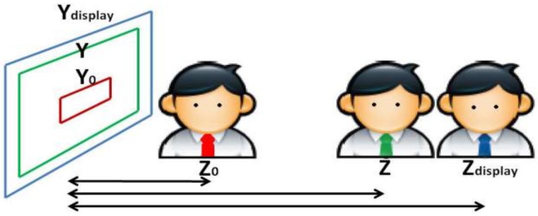

Fig(2) Relationship between viewing distance and enlarged image on the display.

When image seen on display the viewer must be consider the distance between display and viewer. From the above fig(2) the image Y is enlarged in proportion to the viewing distance Z from the viewer to the display with the following relationship;

$$\tan\frac{\theta}{2}=\frac{Yo}{2.Zo} \quad (1)$$

The field of view remains same to maintain perceptual constancy. So the relationship between arbitrary image size Y and corresponding viewing distance Z as;

$$Z=\frac{Y}{2.\tan\frac{\theta}{2}} \quad (2)$$

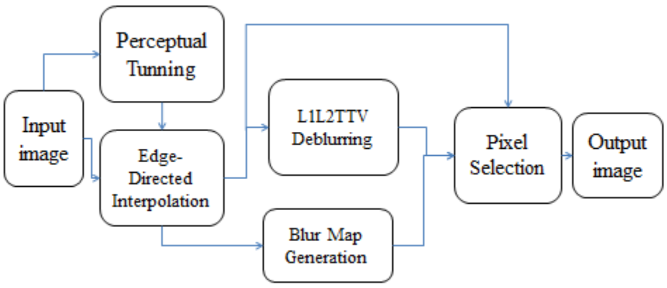

Fig.(3) Design flow

From the above fig(3) a median filter is used to remove noise so the blurry condition is maintained after that an edge directed interpolation is used for upsampling the desired image. Apart from this next estimate a spatially varying blur map generation for further blur adjustment. At last L1L2TTV Deblurring algorithm is used to reconstruct high quality desired image and maintain perceptual constancy.

IV. PROPOSED ALGORITHM:

4.1 Perceptual Constancy

SR problem for HD displays is formulated by taking both viewing distance and image formulation into account. The Scaling factor and image blur levels should be processed simultaneously in order to maintain perceptual constancy of a viewer. And for deciding image scale according to distance by;

$$Ydisplay=Zdisplay * (2 *\tan(\theta/2) \quad (3)$$

4.2 Edge Directed Interpolation

To ensure quality of an image when scale it upthe edge directed interpolation(EDI) is used for statistical sampling. The basic purpose of scaling to used on actual image data to interpolate to a new super resolution result as it is opposed to zooming term in an image.

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Algorithm for edge directed interpolation to upsample the image to desired size according to the scaling factor is as follows;

a. Image acquisition
b. Image Preprocessing
c. Separate three image planes R,G,B
d. Processing on single plane at a time
e. Apply sobel operator over row to detect edges
f. Apply sobel operator over columns to detect edges
g. Find gradient image
h. Convert gradient into binary by applying thresholds
i. Divide image into Non-overlapping blocks of 5x5
j. find orientation of each block based edges
k. Generate interpolation kernel according to orientation of block.
l. Interpolate block using interpolating kernel to get required size.
m. Repeat process j-l for each block
n. Repeat process e-m for each plane

4.3 L1L2TTV Deblurring

After the interpolation noise near to edges smooths so can use L1L2 normalization. Input blurred image passed to L1L2 to recovered original image.

To make deblurringoperation fast and accurate add the terms L1L2 deblurring. The normalization means L1L2 absolute summation of values present in that vector. The basic equation for L1L2 deblurring term is as follows;

$$x^{k+1} = X^k - \lambda_1 \|Y - H.X^k\|_1^1 - \lambda_2 \|Y - H.X^k\|_2^2 - \alpha_1^k \|f(X)^k\|_1^1 - \alpha_2^k \|f(X)^k\|_2^2 \quad (4)$$

When blur gets added to the image;

$$Y = H \times X + n \quad (5)$$

Where, Y- Observed image, H-shift invariant blur kernel(PSF), X-Desired image, n-Additive noise.

V. .EXPERIMENTAL RESULTS:

(a) Original Image

(b) Detected Edges

(c) Interpolated Image

Fig.(4) (a) Original image , (b) Detected image (c) Interpolation image

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Image after deblurring

Fig.(5) Image after deblurring

VI. CONCLUSION

The median filter is best for removing salt and pepper noise and edge directed interpolation to detect edges in desired image for better smoothness in image. And L1L2TTV norms are added for deblurring image which is used for making an image as a high super resolved.

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