ISSN: 2454-4248
94 – 98

Super-Resolution on images: Directional Cubic ConvolutionInterpolation Approach

ShameeraShirineM^1,CharulathaAR^2
PG Student, Department of Computer Science, Stella Maris College, Chennai, India.[1]
Assistant Professor, Department of Computer Science, Stella Maris College, Chennai, India.[2]

Abstract: Super-resolution is the technique where grouping a set of low resolved (noisy) sequence of images can be used to construct a highly resolved image or image sequence.The original scene image in Super Resolution tries to be reconstructed with given set of observed images at low resolution to attain a highly resolved image. This paper discusses super-resolution (SR) system implemented on images. Images that are taken from different scenarios are subjected to our proposed filtering scheme where images that have noticeable presence of blur are rejected to escape exceptions from affecting the produced high-resolution (HR) image. This paper proposes edge gradient and directional cubic interpolation algorithm where sharp edges can be preserved and details are even better with high quality metrics, which makes its implementation on images more efficient than the previous methods. Whereas the previous methods use only single method which attain lower quality metrics. This also proves that in this testing there are significant changes from images captured using burst mode or any other sequence set of images that can be utilized by an SR algorithm to attain an highly resolved image.

Keyword:*Directional extraction, Local gradient, edge strength, Cubic Convolutional Interpolation.*

*****

I. INTRODUCTION

The super resolution (SR) is a system where the sum of observed lower resolved (LR) images used for producing a highly resolved (HR) image. The LR image is primarily up sampled to higher anticipated resolution, thereby giving more details about the original scene. These random sampling of LR images are usually done through interpolation methodology. This paper verifies the multiple-image SR technique on images by set of observed LR images that signify the same scene and proves that set of multiple images captured using the burst mode feature or any other significant set of lower resolved (LR) images can be utilized to create a super-resolved or higher resolved (HR) image.

The input image experiences the proposed edge sharpness measure test in order to remove observable presence of blur and to get a clear image. The remaining subset of images is segregated for the non-local de-noising of images corresponds to the same planar surface in respect of the reference low resolved LR image. Thus highly resolved (HR) image is produced by combining all the observed lower resolved (LR) images.

II. LITRETURE REVIEW

Super Resolution refers to denote the number of pixels in an image and it is measured in pixel Per Inch (PPI). The SR technique reduces the image's blurring and used in many image processing applications.

a. Image Interpolation and super resolution

The down sampling of images uses interpolation [1] as their major SR method to enhance images.Thenon-linear algorithms are used to scale two-dimensional images with a fixed ratio without constructing continuous image. Interpolated pixel values are calculated as a linear combination of nearest sampled values, but the main difference with the linear interpolation is the variability of coefficients which depend on surrounding pixel intensities. The main idea of gradient algorithmsis the fact that directed interpolation along edges results in better interpolation than non-directed linear interpolation. The direction and the intensity of an edge in a point are defined by the local gradient information.The new edge direction interpolation is the new non-linear algorithm which helps in more enhancement of the resolution of images. The NEDI uses self-similarity and provides good quality but this method of interpolation is complex, so it is executed only in small areas with strong edges while simpler algorithms process the rest of area.

This paper analyses super resolution applied to interpolation of a single image. The approximate choice of initialization the NEDI method prevents rough edges in image resolution. The gradient-directed interpolation used for up sampling of the difference image prevents rough edges occurring in the process of iterations.

b. Image super resolution by sparse representation

To generate a super resolution image using conventional approaches normally require input as low resolution images of the same scene which are aligned with sub-pixel accuracy. The single-image super-resolution problem given a low-resolution image, recover a higher resolution image of the same scene. Two constraints are modeled in this work to solve this ill-posed problem: 1) reconstruction constraint, which requires that the recovered X should be consistent with the input Y with respect to the image observation model; and 2) sparsity prior, which assumes that the high resolution patches can be sparsely represented in an appropriately chosen overcomplete dictionary, and that their sparse representations [2] can be recovered from the low resolution observation.This presents a unique approach using single image super resolution based on sparse representation. The compatibility among adjacent patches is enforced both locally and globally. Experiment results demonstrate the effectiveness of the sparsity as a prior for patch-based super resolution for images.

c. Adjusted anchored neighborhood regression

Single-image super-resolution (SR) is a branch of image reconstruction that concerns itself withthe problem of generating a plausible and visually pleasinghigh-resolution (HR) output image from a low resolution (LR) input image. SR is an ill-posed problem because each LR pixel has to be mapped onto many HR pixels, depending on the desired up sampling factor. Most popular single-image SR methods try to solve this problem by enforcing natural image priors based on either intuitive understanding statistical analysis of many natural images. Two recent neighbor embedding approaches, Anchored neighbor resolution and Simple functions, have been successful in reducing the time complexity of single-image super-resolution significantly without sacrificing the quality of the super resolved output image. We take these approaches (specifically ANR) as a starting point to introduce a novel SR method, which we have dubbed A+ [5] that, makes no sacrifices on the computational efficiency and achieves an improved quality of the results which surpasses current state-of-the-art methods.

d. Deep Convolution Network

The deep convolutional neural network that directly produce an end-to-end mapping between LR images and HR images. This method does not explicitly learn the dictionaries or manifolds for modeling the patch space. These are implicitly achieved by hidden layers. Furthermore, the patch extraction and aggregation are also formulated as convolutional [4] layers, so are involved in the optimization. In this method, the entire SR pipeline is fully obtained through learning, with little pre/post processing. The experiments show that the restoration quality of the network can be further improved when (i) larger and more diverse datasets are available, and (ii) a larger and deeper model is used. Furthermore, the proposed network can cope with three channels of color images simultaneously to achieve improved super-resolution performance.

The proposed approach, SR convolution neural network, learns an end-to-end mapping between low- and high-resolution images. With a lightweight structure, the SR convolution neural network has achieved superior performance than the state-of-the-art methods. We conjecture that additional performance can be further gained by exploring more filters and different training strategies. Besides, the proposed structure, with its advantages of simplicity and robustness, could be applied to other low-level vision problems, such as image de-blurring or simultaneous SR and de-noising.

e. Edge-directional interpolation using structure tensor

Regularization-based image interpolation algorithms pose the image interpolation as a functional minimization problem. The functional contains the data-fitting term and the stabilizer term. The data-fitting term restricts the high-resolution image to match the low-resolution image. High effectiveness on image shown by low complexity edge-directed image interpolation [6].Textured areas are a problem for edge-directed interpolation methods. Objects usually appear when edge-directed algorithm is applied to corners. Corners contain multiple directions and usually appear in textures areas. Using the structure tensor is an effective way to distinguish between edges, corners and at areas.The proposed fast and effective edge-directional algorithm based on structure tensor and individual interpolation kernels for each direction.

The main difference of the proposed algorithm with state-of-the-art algorithms is quantization of the direction vector into 6 directions and using optimal 4x4 kernels for each direction. The algorithm has shown great performance and quality in comparison to state-of-the-art image interpolation algorithms. The proposed algorithm does not introduce artifacts in textured areas. The algorithm has a great potential to be used for video interpolation and multi-frame super-resolution due to robustness of the directions obtained from the structure tensor to noise.

f. Super resolution an image warping approach

The image warping approach explores the multiple-image SR technique on a mobile device by utilizing a set (N = 10) of observed LR images, that denote the same scene. This proves that multiple images captured using the burst mode feature of mobile devices can be utilized to create a super-resolved image. These input images undergo our proposed sharpness measure test in order to remove images with observable presence of blur. The remaining subsets of image are subjected to non-local means de-noising and then image warping [7] such that the LR images correspond to the same planar surface in respect of the reference LR image. Afterwards, all the observed LR images are merged to generate the HR image. Merging the LR images to generate the HR images is performed using an L2-normSRminimization approach. This technique reverses the effects of aliasing and properly recovers the HR image. This is used to automatically identify the ground-truth from a given test image set, and for filtering unneeded images as input for the SR algorithm.

III. PROPOSED WORK

The proposed methodology discusses the implementation of the algorithm which applies edge gradient algorithm followed by direction cubic convolution approach. A random sample was established, which is capable of performing multiple set of image Super Resolution on images. These images can be set to capture

 ISSN: 2454-4248
94 – 98

photos in a set of series. Here in Edge Directional Cubic Convolutional Interpolation Approach we broadly categorize the missing pixels in the same direction and so non-horizontal or non-vertical edges are smoothened.

Primarily take images which are of Lower Resolved (LR) these images are placed one above the other and by using the Edge Directed CubicConvolutional Interpolation Algorithm we process these LR images. This paper uses the Mean Square Error (MSE) and Peak-Signal-Noise-Ratio (PSNR) to indicate a noticeable difference when compared to the first LR images and the processed HR images. This paper also checks for the sub-pixel directions of the given image to use the directional algorithm. This method first evaluates edge strength and direction through local gradient. The direction of the HR image are located in a matrix of (m rows and n columns) by computing the two orthogonal directional gradients using known pixels in the neighborhood of the image pixels giving us Highly Resolved images. Then we further move to given directional cubic algorithm to enhance the image into a quality HR image and calculate the quality measures.

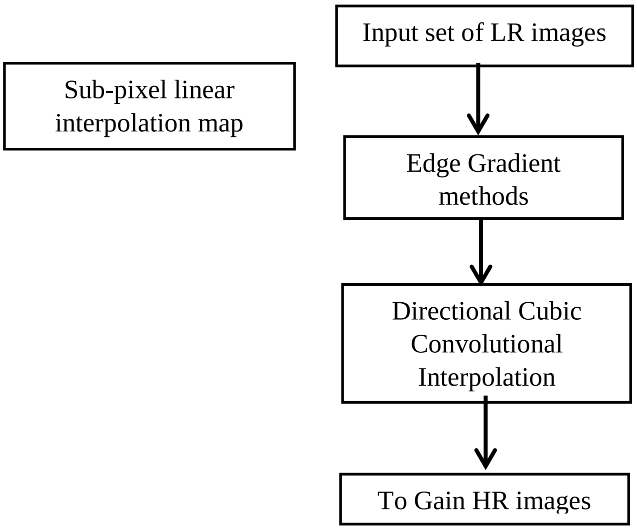

Fig.1Proposed Method Taxonomy.

IV. EXPERIMENTAL RESULTS

According to the given methodology this paper first takes the set of Lower Resolved input images. The size of the image is taken as $m \times n$ matrix they are taken pixel by pixel value of each direction of the matrices to be enhanced through the directional method.

.

Fig.2 Input image.

a. Sub-Pixel Graph

It also checks the Sub-Pixel through a graph plot this method is used to plot the pixel plot value of the given LR image we use a directed cubic convolution method as an enhancement method to gain a HR image.

ISSN: 2454-4248
94 – 98

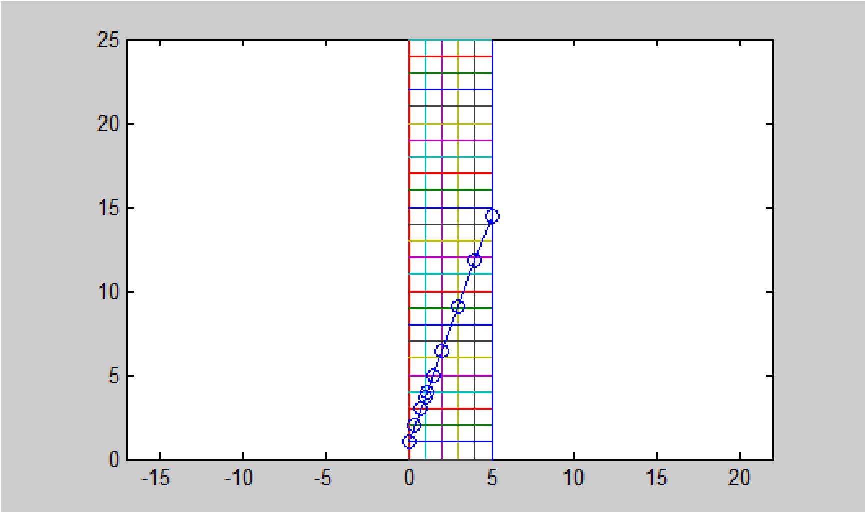

Fig.3 Sub-Pixel graph plot.

b. Edge Gradient Detection

Then we convert the image into a gray scale image to check the edge gradient by computing the two orthogonal directional gradients using known pixels in the neighborhood of the image pixels giving us the gradient images.

Fig.4 Edge Gradient Images

c. Directional Cubic Convolution Algorithm

The given algorithm is used further to enhance the Lower Resolved images by $m \times n$ matrix. This method induces that instead of giving the result as a gray scale image this paper gives a tinge of color pink of color map used in the coding just to enhance the details of the enhanced Highly resolved enhanced image.

Fig.5Enhanced HR image

V. PERFORMANCE ANALYSIS

This paper revolves around on how Super Resolution gets the input of Lower Resolved (LR) images to gain the Highly Resolved (HR) image by using Edge Gradient method to detect gradient edges and Directional Cubic Convolutional method taking the $m \times n$ matrix and calculating the pixel values to different directionsto gain the HR image, and check the quality of the enhanced

ISSN: 2454-4248
94 – 98

image. This paper proves that the given method gives more quality High resolution (HR) image than the former working methodology.

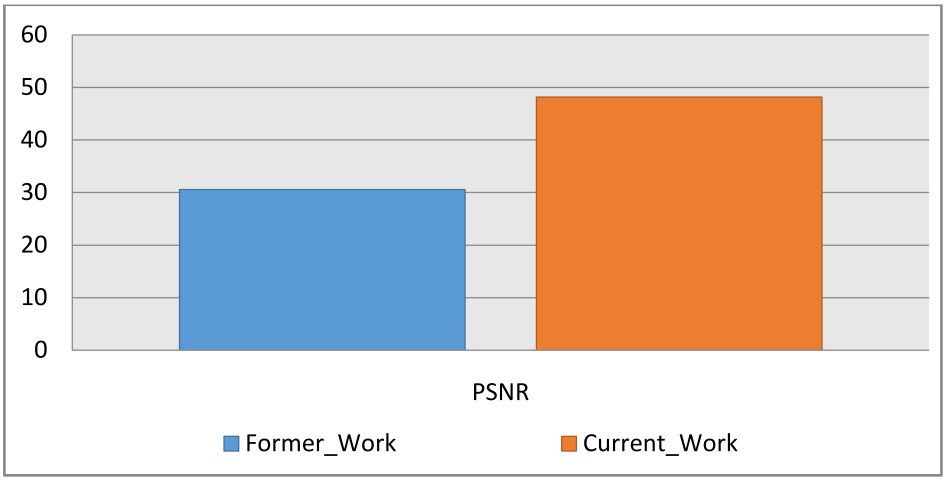

Fig.6 Comparison Graph

VI. CONCLUSION

Super Resolution method is used to enhance a Lower Resolved image into a Highly Resolved image through series of techniques and processes. This given method of Super Resolution Technique uses two methods and proves as an easy procedure to enhance an image and also gives the better quality and high quality metrics analysis using the given algorithm Directional Cubic Convolutional method. So this method proves to be a better method in enhancement of images in Super Resolution technique with good quality metrics.

REFERENCE

[1] [1] Review of Image Interpolation and Super-resolution Wan-Chi Siu and Kwok-Wai Hung The Hong Kong Polytechnic University, Hong Kong, China IEEE Trans. on Image Processing, vol. 20(2),pp. 433-445, 2011.

[2] [2] Image Interpolation by Super-Resolution Alexey Lukin, Andrey S. Krylov, Andrey Nasonov Moscow State University, Moscow, Russia International Conference Graphicon 2006, Novosibirsk Akademgorodok, Russia, http://www.graphicon.ru/

[3] [3] A Review of Some Image Pixel Interpolation Algorithms Don Lancaster Synergetics, Box 809, Thatcher, AZ 85552 copyright c2007 as GuruGram #32 http://www.tinaja.com.

[4] [4] Chao Dong, Chen Change Loy, Member, IEEE, Kaiming He, Member, IEEE and Xiaoou Tang, Fellow, IEEE "Image Super-Resolution Using Deep Convolutional Networks"arXiv:1501.00092v3 [cs.CV] 31 Jul 2015.

[5] [5] RaduTimofte, Vincent De Smet, Luc Van Gool A+: Adjusted Anchored Neighborhood Regression for Fast Super-Resolution CVL, D-ITET, ETH Z□urich, Switzerland VISICS, ESAT/PSI, KU Leuven, Belgium.

[6] [6] Andrey V. Nasonov1, Andrey S. Krylov1, Xenya Yu. Petrova2, Michael N. Rychagov2;Edge-directional interpolation algorithm using structure tensorLomonosov Moscow State University, Faculty of Computational Mathematics and Cybernetics, Laboratory of Mathematical Methods of Image Processing Samsung R&D Institute Russia, Algorithm Lab, 12, Dvintsev str., Moscow, Russia 127018.

[7] [7] EURASIP Journal on Image and Video Processing "Multiple-image super-resolution on mobile devices: an image warping approach"Neil Patrick Del Gallego* and Joel IlaoGallego and Ilao EURASIP Journal on Image and Video Processing (2017) 2017:8 DOI 10.1186/s13640-016-0156-z