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Single Image Super Resolution Image Reconstruction

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Abstract

Super-Resolution (SR) image reconstruction is the process in which the perceptual quality of image is improved to a greater magnitude. In other words, it is used to improve the clarity of the low resolution image. In this paper, first image is scaled by gamma contrast. It relates to the pixel intensities of the image. The variable gamma specifies the shape of the curve describing the relationship between the values in I and J. If gamma is less than 1, the mapping is weighted toward higher (brighter) output values. If gamma is greater than 1, the mapping is weighted toward lower (darker) output values. The image is later transformed from RGB to YCbCr. The SR algorithm is then applied to the Y (intensity) channel. The Cb and Cr chromatic channels are only interpolated. The three portions are then combined to form our SR result.

1. Introduction

The goal of this paper is to attain an understanding of Super-Resolution (SR) image reconstruction and use that knowledge to improve the clarity of the low resolution image. The quality of images can be significantly affected by the situation when capturing. The super-resolution (SR) image reconstruction is to promote the space resolution of captured original image through software.

This paper is divided into four sections. Section 1 presents a review of the theory, development and implementations of SR image reconstruction. Section 2 employs the models of the first section to design an efficient SR image. Section 2 also provides an in-depth look into image registration, the relationship between colour image and YCbCr image. Section 3 submits four different benchmarks for measuring the quality of the output images of the algorithm. These are: peak signal-to-noise ratio (PSNR)[2,7], mean square error (MSE), for an input signal or image, X, and its approximation, XAPP. Section 4 reviews the effectiveness of the SR image reconstruction (based on the results of section 3), maintains the desirability of the design approach by comparing quality metrics of output high resolution image with output of image fusion method.

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2. Overview

2.1. Euclidean metric

The Euclidean distance or Euclidean metric is the "ordinary" distance between pairs of objects in *m*-by-*n* data matrix X. Rows of X correspond to observations, and columns correspond to variables. Older literature refers to the metric as Pythagorean metric. By using this metric formula as distance, Euclidean space (or even any inner product space) becomes a metric space. The associated norm is called the Euclidean norm. In Cartesian coordinates[5], if $p = (p_1, p_2,..., p_n)$ and $q = (q_1, q_2,..., q_n)$ are two points in Euclidean *n*-space, then the distance from p to q, or from q to p is given by

$$d(p,q) = d(q,p) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2} = \sqrt{\sum_{i=1}^{n} (q_i - p_i)^2}.$$

In the Euclidean plane, if $p = (p_1, p_2)$ and $q = (q_1, q_2)$ then the distance is given by

$$\mathrm{d}(\mathbf{p}, \mathbf{q}) = \sqrt{(p_1 - q_1)^2 + (p_2 - q_2)^2}.$$

2.2. Approach Pipeline

Our approach consists of two main stages. First, gamma scaling[3] of an image. It relates to the pixel intensities of the image. The variable gamma specifies the shape of the curve describing the relationship between the values in I and J. If gamma is less than 1, the mapping is weighted toward higher (brighter) output values. If gamma is greater than 1, the mapping is weighted toward lower (darker) output values. If you omit the argument, gamma defaults to 1 (linear mapping). Second, we propose a reference image quality assessment method which considers the effects of blurring and ringing to guide the choice of parameters in the regularization term. In this way it is possible to preserve the details of the image since the parameter significantly determines the smoothness of the resulting image.

3. Algorithm

3.1. PSF Regularization

In order to preserve the consistency among PSF of different channels while preventing overfitting between PSF estimation and noise in observed images, a generalized regularization term is utilized to constrain the extended PSF. And this method is utilized in blind restoration of single image.

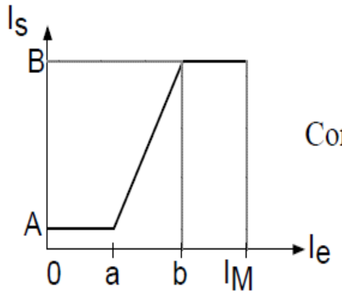
3.2. Colour image to YCbCr metric conversion

If the input is an RGB image, it can be of class uint8, uint16, single, or double. The output image I is of the same class as the input image. If the input is a colormap, the input and output colormaps are both of class double. rgb2gray[8] converts RGB values to grayscale values by forming a weighted sum of the R, G, and B components:

0.2989 * R + 0.5870 * G + 0.1140 * B

3.3. Contrast enhancement

The contrast enhancement improves the contrast of an image. It creates a new gray colormap that has an approximately equal intensity distribution. It enhances the contrast of the image by mapping the values of the input intensity image to new values such that, by default, 1% of the data is saturated at low and high intensities of the input data and by stretching the intensity values to fill the uint8 dynamic range.



Contrast enhancement

3.4. Sampling

Sampling for images is done in the spatial domain, and quantization is done for the brightness values. In the Sampling process, the domain of images is divided into N rows and M columns. The region of interaction of a row and a Coolum is known as pixel[8]. The value assigned to each pixel is the average brightness of the regions. The position of each pixel was described by a pair of coordinates (xi, xj). The resolution of a digital signal is the number of pixel is the number of pixel presented in the number of columns × number of rows. For example, an image with a resolution of 640×480 means that it display 640 pixels on each of the 480 rows. Some other common resolution used is 800×600 and 1024×728, among other.

3.5 Image sterilization (Normalization)

Image sterilization is the process of removing steganographic information embedded in digital images. This technique does not need to know how the information has been embedded inside the image. Steganography can be applied to a variety of multimedia contents like images, audio, video, text etc.Our objective in this project is to develop a function to intelligently destroy stego[1,4] information inside an image without affecting the image quality by reverting as many stego pixels of an image as possible to their original cover form. This method is referred as image sterilization.

The 24-bit color image consists of a number of pixels and each pixel contains three intensity levels (of 8 bits each), one for each of red, green and blue color components. One of the most popular steganography techniques is Least Significant Bit (LSB) insertion. Typically, there are thousands of pixels in an image. So if we change the LSB of some pixels, the resulting picture will probably be alike to the original image.

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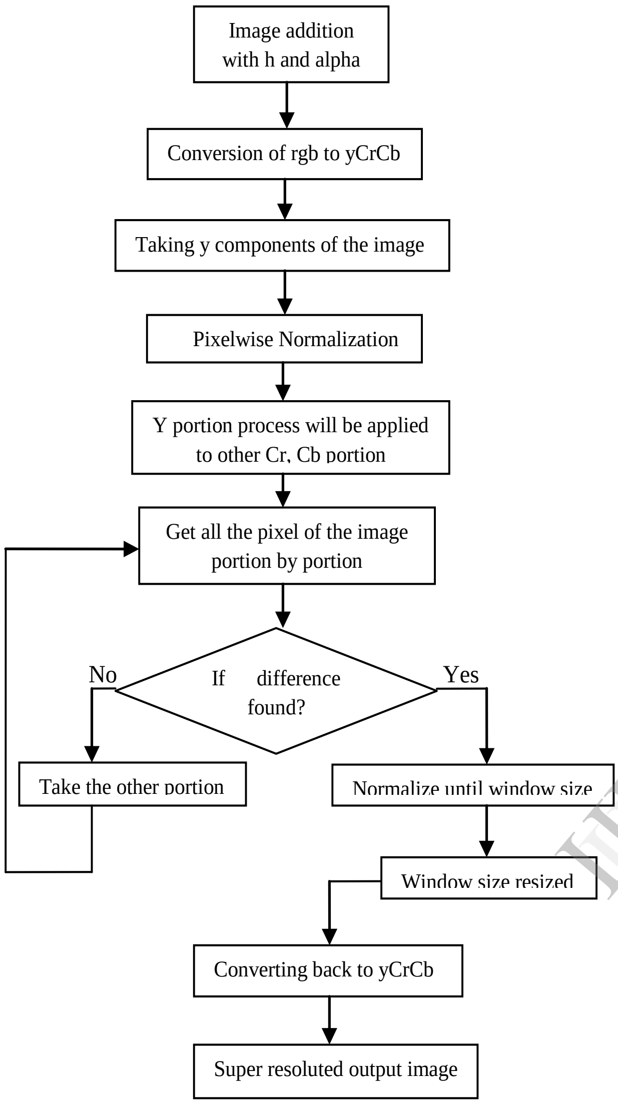
4. Flowchart



Input low resolution single image is taken as input. Image can be of any format (like jpg, png, tiff) and size (row x column).Image addition with smoothness parameter h and gamma contrast alpha. Conversion of rgb to yCrCb and taking initially all y components. It takes the highest pixel value from the image and normalizes to neighbouring pixels by Euclidian metric. Pixel to pixel i.e odd values are converted to even values by the command disk and flooring floating point values to integer value. Later process is continued by Cr and Cb and taking all the pixel values portion by portion. If found any difference in pixel values, image is normalized until window size is resized else take another portion. Image is converted back to yCrCb and final output is super resolution image.

5. Experiments and performance

Objective image quality measures play important roles in various image processing applications. Some of the image quality measures widely used are PSNR and MSE.

In the experiment with simulated images, we use original low resolution satellite image shown in Figure 1(a) to generate super resolution image as in Figure 1(b).

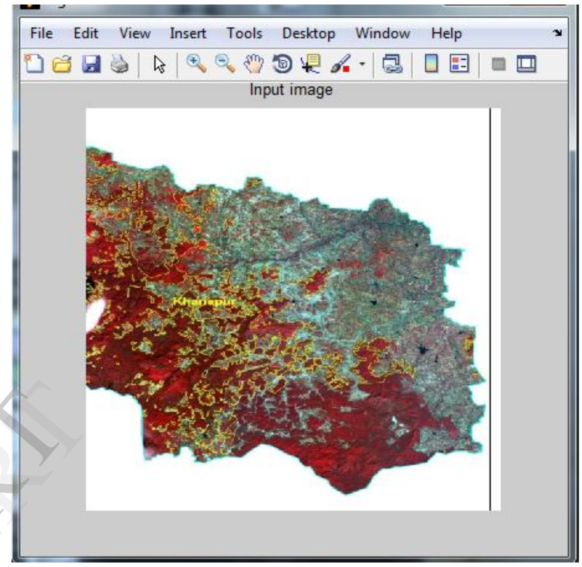


Figure 1(a). khanapur_forest.png (input image)

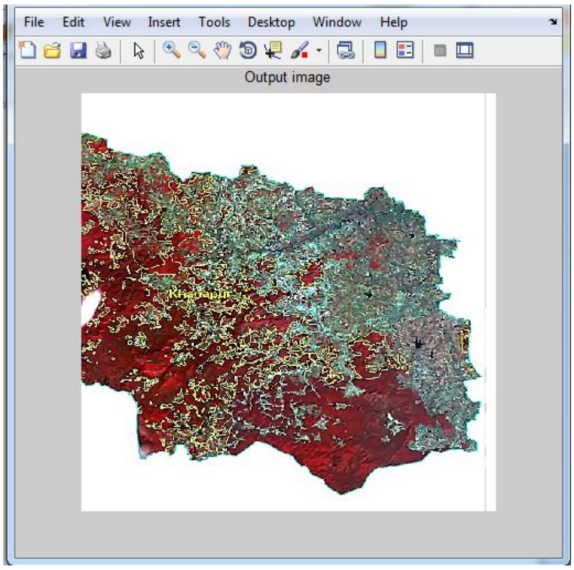


Figure 1(b). khanapur_forest.png (output image)

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With another non-satellite images, we use original low resolution natural image shown in Figure 2(a) to generate super resolution image as in Figure 2(b).

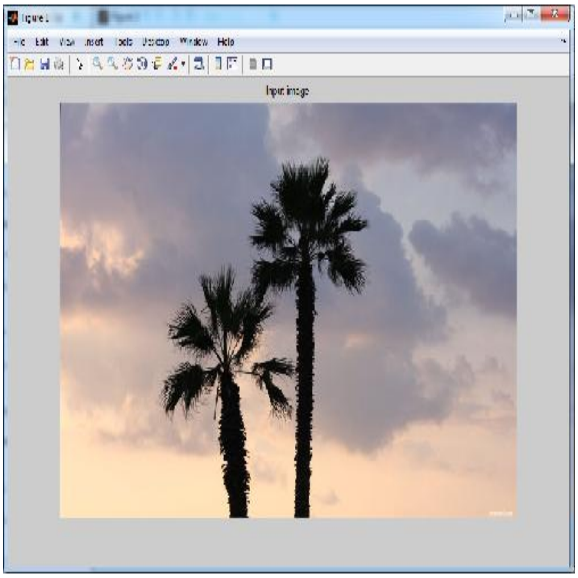

Figure 2(a). palm_tree.jpg (input image)

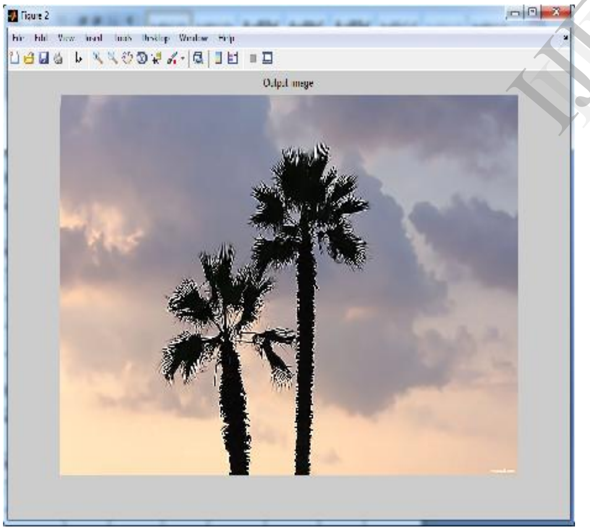

Figure 2(b). palm_tree.jpg (output image)

Table 1. Comparison of our approach and image fusion method

Performance comparison	Image name	PSNR	MSE
Our approach	Khanapur forest	**18.26**	**969.95**
	Palm_tree	**29.0129**	**81.6184**
Image Fusion method	Khanapur forest	17.60	1.128e+ 003
	Palm_tree	25.7701	172.213

When working with color images, the image is first transformed from RGB to YCbCr. The SR algorithm is then applied to the Y (intensity) channel. The Cb and Cr chromatic channels are only interpolated. The three portions are then combined to form our SR result.

The generated image through our approach is shown in Fig. 1(b) and Fig. 2(b). By comparing image quality measurements of our approach, the magnitude of output image is increased as compared with image fusion method.

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5. Conclusions and Discussions

In this paper, we propose a single frame based SR approach which can adaptively choose parameter of regularization terms while generating high space resolution image. To achieve self-adaptive parameter chosen, we also propose a robust reference image quality assessment which focuses on blurring and ringing effect to provide feedback to regularization terms. Our approach can effectively generate high resolution image from single input low resolution image by gamma contrast. However, there is still a need of further research to deal with scene containing moving objects. In the zoomed-up images, low-contrast details next to high-contrast edges can be lost because of the contrast normalization fixing on the level of the high-contrast edge.

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