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Pixel Based Quality Improvement of Black & White Noisy Images

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Abstract: Resolution is designated as significant holding for images. Resolution is an underlined expression of any image. Gratifying quality images are required almost in every field. For this we propose new modified algorithm having the extension in scaling and the algorithm is applied on image mingled with text for producing the pleasing quality of image. This research explains resolution method for enhancing digital gray images. The proposed enhancement technique is based on the interpolation of the high frequency sub-bands.

Keywords: DWT, SWT, IDWT, WZP, CWT

1. INTRODUCTION

Resolution of an image is an important consideration in all image and video processing applications like satellite image resolution enhancement, video resolution enhancement and feature extraction. Satellite images are used in many applications like astronomy, geo scientific studies and geographical information systems. Resolution enhancement of images is a pre-process that is to be used for many satellite image processing applications such as vehicle recognition, building recognition, and bridge recognition. Image resolution enhancement methods can be categorized into two major classes namely.

1.1 Spatial domain

The term spatial domain refers to the image plane itself and approaches in this category are based on direct manipulation of pixels in an image. Spatial domain techniques lag in extraction and preservation of high frequency components of an image. This suggests that some other technique not involving spatial domain is to be used. So the image needs to be converted to some other Domain, processed and then converted back to spatial domain. The domain can be Fourier domain, wavelet domain or any other. Fourier domain is more suitable for spectral filtering. [1]

1.2 Frequency-domain

Frequency domain processing techniques use many transformations such as to achieve a high resolution image. Resolution images have also been increased. This is also impacted by the limited size of the digital image sensor. Though widespread commercial cameras provide very high resolution images, most of the scientific cameras still have the resolution of only 512 X 512. Resolution enhancement is always being associated with the interpolation techniques. Research suggests that interpolation methods increase the intensity of low frequency components. This means interpolated image will have less number of sharp intensity transactions per pixel. image. Wavelet domain separates components of an image in to individual matrices. These matrices then can be processed separately and combined together to get the desired result. Fast algorithms for implementation of discrete wavelet transform have enhanced the use of wavelet domain for image resolution improvement. Various image processing algorithms can be implemented with discrete wavelet transform DWT decomposes image into four sub bands. These sub bands are low-low (LL), low-high (LH), high-low (HL) and high-high (HH). These sub bands are of half the dimensions of that of image under consideration. Stationary wavelet transform (SWT) is also being used for the image resolution enhancement SWT also has four sub bands similar to DWT but sub bands in SWT are of same size of that of the image. Here we have proposed a new method for image resolution enhancement which is based on combination of DWT and SWT components and interpolation. Also we have proved that our proposed technique is better compared to previously available techniques for resolution improvements corrected interpolated high frequency sub bands and interpolated input image are combined by using inverse DWT (IDWT) to achieve a high resolution output image. The proposed technique has been compared with conventional and state-of-art image resolution enhancement techniques. The conventional techniques used are the following:

- Interpolation techniques: Bilinear interpolation and Bi cubic interpolation
- Wavelet zero padding (WZP).

The state-of-art techniques used for comparison purposes are
the following:

- regularity-preserving image interpolation

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- new edge-directed interpolation
- hidden Markov model (HMM)
- HMM-based image super resolution (HMM SR)
- WZP and cycle-spinning (WZP-CS)
- WZP, CS, and edge rectification (WZP-CS-ER)
- DWT based super resolution (DWT SR)
- complex wavelet transform based super resolution (CWT SR)

1.3 Interpolation

Interpolation is the process of defining a function that takes on specified values at specified points. There are two closely related interpolants: the piecewise cubic spline and the shape-preserving piecewise cubic named pchip. Interpolation is the process of estimating the values of a continuous function from discrete samples. Image processing applications of interpolation include image magnification or reduction, subpixel image registration, to correct spatial distortions, and image decompression, as well as others. Of the many image interpolation techniques available, nearest neighbour, bilinear and cubic convolution are the most common, and will be talked about here. Since Interpolation does not give good results within an image processing environment, since image data is generally acquired at a much lower sampling rate. The mapping between the unknown high-resolution image and the low-resolution image is not invertible, and thus a unique solution to the inverse problem cannot be computed. One of the essential aspects of interpolation is efficiency since the amount of data associated with digital images is large [2].

1.4 Resolution Enhancement Types

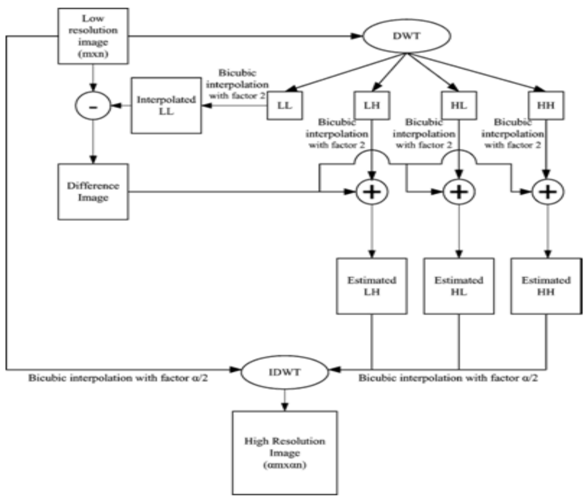

Figure 1 Block Diagram for types of Resolution Enhancement Algorithms

1.5 Histogram Equalization

Histogram Equalization method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values. The method is useful in images with backgrounds and foregrounds that are both bright or both dark. In particular, the method can lead to better views of bone structure in x-ray images, and to better detail in photographs that are over or under-exposed. A key advantage of the method is that it is a fairly straightforward technique and an invertible operator. So in theory, if the histogram equalization function is known, then the original histogram can be recovered. The calculation is not computationally intensive. In scientific imaging where spatial correlation is more important than intensity of signal (such as separating DNA fragments of quantized length), the small signal to noise ratio usually hampers visual detection. Histogram equalization often produces unrealistic effects in photographs; however it is very useful for scientific images like thermal, satellite or x-ray images, often the same class of images to which one would apply false-color. Also histogram equalization can produce undesirable effects (like visible image gradient) when applied to images with low color depth. For example, if applied to 8-bit image displayed with 8-bit gray-scale palette it will further reduce color depth (number of unique shades of gray) of the image.

1.6 WAVELET-BASED IMAGE RESOLUTION ENHANCEMENT

There are several methods which have been used for satellite image resolution enhancement. In this we used two state-of-art techniques for comparison purposes. The first one is WZP and CS, and the second one is the previously introduced CWT-based image resolution enhancement.

1.6.1 CS –Based Image Resolution Enhancement

This method adopts the CS methodology in the wavelet domain. The algorithm consists of two main steps as follows:

a. An initial approximation to the unknown high resolution image is generated using wavelet domain zero padding (WZP).
b. The cycle-spinning methodology is adopted to operate the following tasks:

- A number of low resolution images are generated from the obtained estimated high resolution image in part by spatial shifting, wavelet transforming, and discarding the high frequency sub-bands.
- The WZP processing is applied to all those low resolution images yielding N high resolution images.
- These intermediated high resolution images are re-aligned and averaged to give the final high resolution reconstructed image.

1.6.2 CWT-Based Image Resolution Enhancement

In this technique, dual-tree CWT (DT-CWT) is used to decompose an input image into different sub band images.

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DT- CWT is used to decompose an input low-resolution image into different sub bands. Then, the high-frequency sub band images and the input image are interpolated, followed by combining all these images to generate a new high-resolution image by using inverse DT-CWT. The resolution enhancement is achieved by using directional selectivity provided by the CWT, where the high-frequency sub bands in six different directions contribute to the sharpness of the high-frequency details, such as edges., where the enlargement factor through the resolution enhancement is α.

1.7 Noisy Images

"Image noise" is the digital equivalent of film grain for analogue cameras. Alternatively, one can think of it as analogous to the subtle background hiss you may hear from your audio system at full volume. For digital images, this noise appears as random speckles on an otherwise smooth surface and can significantly degrade image quality. Although noise often detracts from an image, it is sometimes desirable since it can add an old-fashioned, grainy look which is reminiscent of early film. Some noise can also increase the apparent sharpness of an image. Noise increases with the sensitivity setting in the camera, length of the exposure, temperature, and even varies amongst different camera models.

Figure 2: Noisy Image

1.8 DWT- BASED IMAGE RESOLUTION ENHANCEMENT

As it was mentioned before, resolution is an important feature in satellite imaging, which makes the resolution enhancement of such images to be of vital importance as increasing the resolution of these images will directly affect the performance of the system using these images as input. The main loss of an image after being resolution enhanced by applying interpolation is on its high-frequency components, which is due to the smoothing caused by interpolation. Hence, in order to increase the quality of the enhanced image, preserving the edges is essential. In this paper, DWT has been employed in order to preserve the high-frequency components of the image. DWT separates the image into different sub band images, namely, LL, LH, HL, and HH. High frequency sub bands contain the high-frequency component of the image. The interpolation can be applied to these four sub band images.

In the wavelet domain, the low-resolution image is obtained by low-pass filtering of the high-resolution image. The low-resolution image (LL sub band), without quantization (i.e., with double-precision pixel values) is used as the input for the proposed resolution enhancement process. In other words, low-frequency sub band images are the low resolution of the original image. Therefore, instead of using low-frequency sub band images, which contains less information than the original input image, we are using this input image through the interpolation process. Hence, the input low-resolution image is interpolated with the half of the interpolation factor, α/2, used to interpolate the high-frequency sub bands,. In order to preserve more edge information, i.e., obtaining a sharper enhanced image, we have proposed an intermediate stage in high-frequency sub band interpolation process. [2]

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